Sabaragamuwa University Journal

Volume 1 Number 1 February 1998

ISSN 1391-3166

Sabaragamuwa University Journal

The Sabaragamuwa University of Sri Lanka is pleased to present the inaugural issue of the Sabaragamuwa University Journal on the occasion of the 50th anniversary of the independence of Sri Lanka. The journal provides a forum for Sri Lankan and international scholars to publish high quality articles on original academic research as well as on innovative teaching practice. It is a refereed journal and accepts articles from all academic disciplines. Contributions are reviewed by a panel of Sri Lankan and international referees. Senior scholars from the various faculties of Sabaragamuwa University comprise the journal's Editorial Board. The Sabaragamuwa University Journal will be published twice a year.

CONTRIBUTIONS

The Sabaragamuwa University Journal invites scholars from all academic disciplines to contribute articles for publication. Please refer to the 'Information for Contributors' at the end of this issue for the journal's editorial format.

SUBSCRIPTIONS

Interested individuals or institutions may receive the Sabaragamuwa University Journal either via the regular Subscription Service or through an Exchange Agreement. Please refer to the 'Subscription Form' at the end of this issue for detailed information.

PO Box 02, Belihuloya, Sri Lanka

published by **Sabaragamuwa University Press**

printed by Tharanjee Prints

ISSN 1391-3166

Sabaragamuwa University Journal

Volume 1 Number 1 February 1998

Message from the Vice Chancellor

Dayananda Somasundara

It is with pleasure that I send this message to the first issue of the Sabaragamuwa University Journal. It marks the fulfilment of yet another objective that we set ourselves at the inception of the Sabaragamuwa University of Sri Lanka. The fact that we have been able to achieve this within a short period of time, when the university is yet in its formative stages, gives us much satisfaction and pride. It is also significant that the journal is making its debut on the day Sri Lanka celebrates its golden jubilee of independence.

One of the primary responsibilities of a university is to seek, create and expand knowledge through scientific investigation and research with a view to improving and enriching human life and culture. The knowledge thus created has to be disseminated and preserved for posterity. The twentieth century is one of the greatest periods in which human civilization has witnessed advancement and development. This has been possible, because our ancestors have preserved and passed down to us their knowledge in various ways, such as inscriptions, manuscripts and books. Man constantly seeks knowledge and information to improve his life, and these should be freely and easily available.

The university is one of the most liberal and democratic institutions in any country in which there is freedom of thought and expression. One of the fundamental aims of university education is to encourage its community, consisting of both academics and students, to think independently and rationally, and to express their views freely and fearlessly within civilized norms. As part of society, and in fact supported by it, we also have a duty to focus on social, economic, political and environmental issues, and to promote and invite discussion and debate on these. Indeed, the community expects the universities to provide leadership in such matters.

I have no doubt that the journal we are launching today will fulfil the aims of providing a vehicle for the dissemination of the results of research undertaken by the academic community in the country, and of promoting open discussion of issues of current interest. It is also hoped that the journal will be a useful medium to develop the skills of the university community to communicate clearly and effectively .

In conclusion, I wish to extend my sincere thanks to the Co-ordinating Editor, Dr R. Starkloff, as well as the other editors and the authors for their invaluable contribution in making the Sabaragamuwa University Journal a reality.

I wish the journal success and a long life.

Prof Dayananda Somasundara
Vice Chancellor

4 February 1998

Ancient Iron and Steel Production at Samanalawewa

Gill Juleff, Samanalawewa Archaeological Project

Introduction

It is sometimes said that the countryside that lies between the road running through Belihuloya and the *Kaltota* escarpment has 'developed' with the coming of the *Samanalawewa* Hydro-Electric Scheme. Discoveries made by the *Samanalawewa* Archaeological Project[1] have however shown that, far from being a rural backwater, this area was, in the first millennium AD, the seat of technological innovations unparalleled in the ancient world. In brief, the invention of a unique wind-powered iron smelting furnace capable of producing high-quality steel sustained a large-scale industry that supplied the Islamic world with steel for sword-making. The dramatic findings of this project, described in more detail below, were recently presented to an international audience of archaeo-metallurgists at the British Museum in London with the result that *Samanalawewa* and Sri Lanka is now at the forefront of research in early steel-making.

Survey

Fieldwork began in late 1988 with a three month surface survey. The aim of this was to locate and identify evidence of past human activity in and around the proposed (now impounded) reservoir of the new dam. While the main of the objective of the project was to research the archaeo-metallurgical record of the area, the survey recorded all categories of archaeological evidence. An area of approximately 60 km^2, centred on the reservoir, was chosen for investigations. Given the often thick vegetation cover and the steepness of the terrain, the survey strategy adopted can best be described as 'selective', with areas of likely archaeological activity, open hilltops and valley bottoms, being explored in preference to less accessible areas. A temporary camp was established in the jungle close to the *Kinchigune* temple. From here, daily reconnaissance trips of up to 15 km were made on foot. Local villagers guided the survey team along unmarked footpaths and contributed valuable local knowledge of place names, oral traditions and likely informants on aspects of iron-working practices. At each location where evidence was identified notes were made to record the precise position of the site, using the 1' topographic map (in this case the *Haputale* sheet) and large-scale aerial photographs, its extent and the nature of the visible evidence, i.e. whether structural or artefactual. At the end of each day notes were collated and transferred into permanent field notebooks and each site was assigned a site number with the prefix SM, e.g. SM1, SM2 etc.

The 252 sites identified comprise 79 small prehistoric campsites, generally situated on open hilltops and identified by the presence of stone tools, 34 small historic and modern-period settlements, situated in valleys and identified by the presence of pottery shards, and 139 iron-working sites, located both on hilltops and in valleys close to settlements and identified by the presence of discarded slag waste. The iron-working sites span from the 3rd century BC to the present day and encompass two chronologically and technologically distinct traditions: a post-12th century AD to early 20th century iron smelting and crucible-steel manufacturing tradition which accords with the eye-witness descriptions given by *Ananda Coomaraswamy* (1956), and the pre-12th century wind-powered smelting technology described in this report. The 12th century watershed used here to demarcate the two groups is not well defined in the archaeological record as it is based on broad pottery classifications only. However, it

© 1998 Sabaragamuwa University Journal, vol. 1, no. 1, pp. 3-9

is clear that the two groups of sites are separated by a hiatus of an, as yet, unresolved duration.

The 77 sites, which make up the group now known as the west-facing iron smelting sites, are all situated on the extreme western edges of hilltops and ridges that have uninterrupted aspects in that direction, hence their name. Two important observations regarding these sites were made during survey work. First, their consistent locational characteristics including the coincidence of major concentrations of slag waste at the point, on west-facing hill-slopes, of maximum incident wind during the southwest monsoon months of June, July and August. The high-velocity winds which blow across the *Samanalawewa* are at this time of the year dry, having dropped their rain further to the west in the Wet Zone, and are constant in terms of both direction and time. The mean wind speed recorded in 1994 for the 3 month period of the monsoon was 30 km/h. These observations gave the first clue that the technology represented by the sites exploited the wind.

Second, the morphology of the slag found at the sites was quite unlike any previously recorded. The most generally accepted design for a successful iron smelting furnace is based on a circular-plan chimney or 'shaft'. In such a shaft furnace, which is most often bellows-driven, height is greater than diameter, and the slag that form and solidify at the base of such a structure are typically in the form of circular 'cakes', either complete or fragmentary. In the case of the west-facing sites the slag are elongated and sub-rectangular in form, and appear to have solidified against a straight wall or barrier. The furnace design indicated by these slag was unlike any previously recorded.

Excavation

On the basis of the evidence collected during survey it was decided that the west-facing sites were worthy of further investigation. A large site (SM88), located on the edge of the proposed reservoir, was selected and in 1990 a six-month excavation program was initiated. The site covered some 3000 m^2 and comprised a smelting area on the western brow of the ridge and deposits of slag extending downslope from the smelting area. Excavations concentrated on the smelting area and investigated approximately 20% of the site volume. The aims of the excavation were to examine and record the spatial layout of the site and any furnace structures which could be identified, and to resolve the stratigraphic sequence, and thus the chronology, of the site. A number of strategies were adopted including open-area excavation, localized trenching and quantitative sampling of waste deposits to allow calculation of production and output levels.

Forty-one furnaces were revealed by excavation, all critically positioned on the western brow of the ridge and forming a near-continuos north-south line. The furnaces conform to a basic two-component design comprising a semi-permanent rear wall, terraced into the hillside or the accumulated debris of earlier smelting, aligned north-south and curving westwards at either end to form an elongated, open-fronted 'stall', and a temporary, single-smelt, straight wall across the (western) front of the 'stall' (see Figure 1). This front wall is constructed on a foundation of re-used tapering tuyeres (clay pipes) which are telescoped one into another and laid horizontally to form a line. A further row of tuyeres, set higher in the wall, act in the conventional manner, allowing air to flow into the furnace. Furnace lengths, form north to south, range from 1.2 to 2.0 m, while depth-in-plan, the east-west dimension, is c. 0.35 m and furnace height is no more than 0.5 m. Immediately, we can see that this design

does not conform with the shaft furnace model described above; in fact, it represents a major departure in furnace geometry.

A series of eight charcoal samples collected during excavation have been dated by radiocarbon and place the use of the site between the 7th and early 11th centuries AD. Excavations carried out at another site within the *Samanalawewa* survey area revealed a similar but smaller smelting furnace, which has been dated by radiocarbon to the 3rd century BC. Thus the technology appears to have a long history of development. After the 11th century the technology disappeared completely from the archaeological record and no continuity can be detected between it and the later, village-based, bellows-driven smelting technology as described by *Coomaraswamy* (1956) and identified on the ground by the project. Estimates, based on archaeological and experimental data, give a minimum production from the known west-facing sites of 3,500 tonnes of metal. This is a conservative estimate and the reality may have been as high as three or four times this figure. The estimated number of furnaces at SM88 alone is 200. This level of production suggests a successful, well organized (possibly centrally controlled) and profitable industry with long-distance trade contacts.

Despite the wealth of archaeological evidence, the unconventional furnace design and use of wind remained problematic aspects of data and it was decided that a test of the furnace would be necessary to gain a full understanding of the way in which it operated.

Replication Smelting Trials

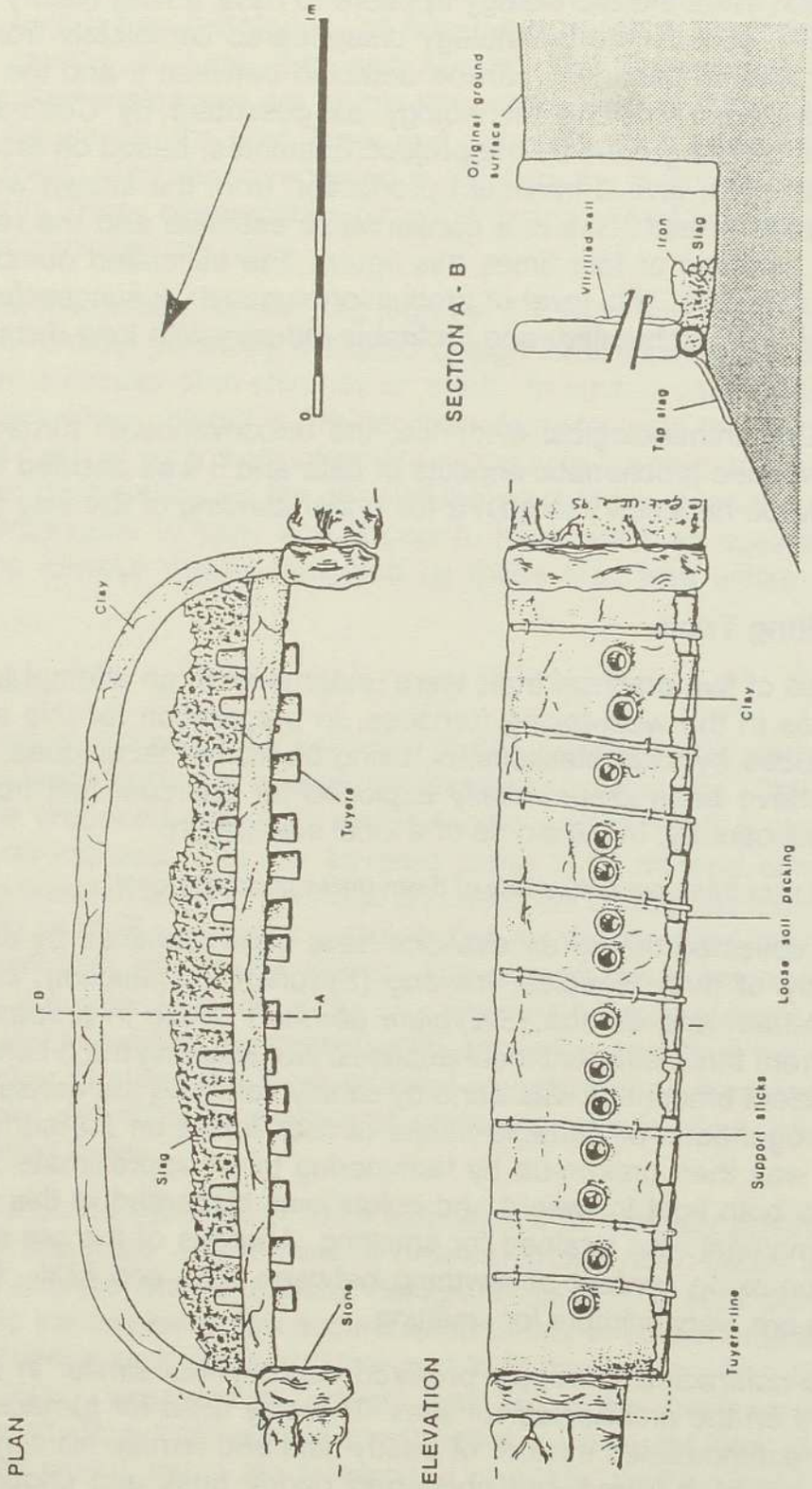
In July 1994 a series of five practical trials were undertaken in an attempt to recreate the smelting process in the west-facing furnaces. In preparation for this a tonne of charcoal was produced by local blacksmiths, using traditional techniques, form tree species known to have been preferentially exploited for charcoal fuel from the 3rd century BC up to this century. In the words of a local blacksmith:

> The jungle may be full of trees but only a few of them make good charcoal.

Charcoal samples collected during excavations have been identified by analysis as being predominantly of three species; *marang* (*Syzgium Zeylanicum*), *path beriya* (*Syzygium spathulatum*) and *damba* (*Syzygium gardner)* . Also in preparation, iron ore was collected from three different local deposits. Not knowing the criteria used for ore selection in ancient times, this was done by simply selecting the densest and apparently most homogeneous of portable lumps of rock found on the surface at the deposits. The ore was then broken-up by hammering to an approximate 3 cm size. Material which was both light in weight and colour was discarded at this stage and only the heaviest material was retained for smelting. Analysis of the ore shows it to have a variable iron-oxide content of anything between 79% and 87%. This represents a high-grade ore, very suitable for smelting.

A local potter was contracted to supply pre-fired clay tuyeres similar in shape and size to those found on the archaeological sites. The clay used for furnace construction was a locally recommended mixture of paddy-field and termite-hill clay with river sand and coarse gravel, charred and uncharred paddy husk and chopped paddy straw.

Figure 1: Furnace Used in Smelting Trials



(Reconstructed from archaeological data)

A known west-facing site was chosen for the experiments and two new furnace structures were built. In the first instance the furnace was constructed using the original position of an ancient furnace on the site. This guaranteed the correct orientation of the furnace, relative to the incident wind, for that site. It had been observed from the archaeological evidence that the precise positioning of furnaces varied by several degrees from site to site. Wind direction measurements taken from the sites revealed that the immediate local topography had a considerable influence on the direction of incident winds at different locations, at some sites being predominantly west-northwest, at other being west or west-southwest. The furnaces were constructed according to the archaeological evidence and attention was paid in recreating the exact size and shape of the furnace.

Of the five trials conducted only the last three, trials 3, 4 and 5 were full smelts. The first two trials were designed to test the durability of different clay mixtures and to gain experience in lighting and controlling a fire in high winds. Throughout each smelt wind speeds were recorded at 15 minute intervals and during the last trials, trial 5, temperature readings were taken every hour using an optical pyrometer and by sighting down the tuyeres into the hottest part of the furnace. So that the trails could be compared one against the other the same operational procedure was followed throughout and variation from trial to trial was restricted to changes in wind speed, which was beyond control, and progressive intentional changes in ore to charcoal ratios.

On the day of the trial the base of the furnace was first lined with a layer of paddy husk followed by a layer of paddy straw, in accordance with the archaeological evidence. A layer of charcoal was then added and the fire lit. Once the fire was established more charcoal was added until the furnace was full to the rim. The furnace was maintained in this way, with charcoal only, for two hours. This both heated the structure of the furnace and created a deep bed of burning charcoal. Smelting begins with the addition of the first of four pre-weighed ore/charcoal 'charges' to the top of the furnace. These were added by first spreading the ore on top of the burning charcoal and then adding charcoal in stages as the material in the furnace burned down. In all three trials, molten tap slag began to flow out of the bottom of the furnace within an hour of charging the first ore. With the appearance of the slag, a silica-rich mixture of waste products from the ore with a melting point of approximately 1200° C, it was apparent that temperature and gas conditions inside the furnace were within the correct range for successful smelting, i.e. that the charcoal was burning to produce excess carbon monoxide which was then reacting with the ore to reduce the iron oxide to iron metal. Throughout, the level of the material within the furnace was maintained to the rim and in each trial the charging of the ore and charcoal was completed within approximately four hours. The furnace was then allowed to burn with charcoal only for another one-and-a-half hours after which no more charcoal was added. After a further hour or so, the level within the furnace had burnt down to half the furnace height and at this point the furnace was opened by pushing the front wall inwards using long wooden poles. The contents of the furnace, hot charcoal, slag and metal, were then dragged out of the furnace, again using wooden poles and the lumps of metal were separated out.

All three trials produced metal in increasing amounts. About 100 kg of ore had been charged into the furnace and final metal products were 2.0, 8.7 and 17 kg for the three trials respectively. This percentage yield is considered good for early iron smelting. Subsequent examination and analysis has shown that, while approximately half the metal produced is the typical low-carbon wrought or 'bloomery' iron mixed, with considerable amounts of slag, expected of pre-modem bloomery smelting, the

remaining material is relatively slag-free, homogeneous high-quality, high-carbon steel.

Conclusion

The archaeological and experimental data described above have demonstrated and prove, for the first time from anywhere in the world, the successful use of wind in iron smelting. Prior to this work it was generally believed by archaeometallurgists that wind-powered smelting was not possible. It seemed improbable that winds of sufficient speed and constancy could be guaranteed; gusting and more particularly calms, no matter how short in duration, would produce an uncontrollable system liable to irreversible 'freezing'. It was assumed that such a furnace, if it were possible, would be supplied with air by wind blowing directly down the tuyeres. What the trials showed was that, rather than relying on direct wind pressure, it is the indirect acting of the wind blowing over the top of the furnace that creates a strong *venturi* which lowers the pressure within the furnace and sucks air through the tuyeres. Thus these furnaces are wind-powered, not wind-blown. The air blast achieved in this way is continuous, a feature which has long been recognized as decisive in the development of the blast furnace capable of producing cast iron, and which is not achieved by the intermittent pumping of bellows.

Not only were there doubts about the viability of wind-power, many specialists in early furnaces felt that the conditions necessary for complex smelting reactions to take place could not be met in a furnace of the design indicated by the *Samanalawewa* data. It was felt that the all-important low-oxygen reducing conditions would not be achieved in such a low, 'open' structure. The smelting trials demonstrated that this was not the case and that the west-facing furnaces were easily capable of reaching and sustaining high temperatures and reducing conditions. In fact, so efficient is the furnace that the process of smelting and carburization to steel is faster than any other recorded for pre-modern furnaces. The wind blowing over the furnace creates a 'bubble' on top of the furnace that seals it, trapping inside the vital hot, reducing gases.

Although it is not unusual to find areas of high-carbon steel within the more customary low-carbon iron produced in bloomer furnaces, its unpredictable occurrence makes it a product not generally sought-after. There are very few smelting processes which were capable of producing, in a single operation, usable quantities of high-carbon steel. It is generally held that to achieve a slag-free high-carbon steel of this quality a crucible refining stage would be necessary.

Given the sophistication of the west-facing furnace it is hardly a surprise to find it capable, even in amateur hands, of producing high-carbon steel. This 'furnace steel' is comparable in quality to the crucible steels, produced in India and Sri Lanka from the 11th century AD onwards, which became famous as the material from which Islamic (Damascus) swords, were manufactured. From the writings of al-Kindi (Allan 1979) in the9th century AD we know that Sarandibi steel was much prized at the time for sword-making in the Islamic world. Al-Kindi does not specify whether, or not, *Sarandibi* steel was manufactured in crucibles, and the evidence from Samanalawewa now raises the possibility that 'furnace steel' may have reached the Arab world, via Indian Ocean trade routes, at a time before India gained ascendancy in the refining and trade of crucible steels.

The replication experiments of 1994 answered many questions which had been posed by the archaeological data. In solving the mysteries surrounding the west-facing technology a new set of questions presents itself. Future work will pursue vari-

ous avenues of research and will address such questions as where and with whom was the high-carbon steel traded? How far does the industry extend beyond the immediate *Samanalawewa* area and can it be traced elsewhere in the island? What are the earliest origins of this technology? What more can be deduced about the nature and potential of the use of wind-power in these furnace structures? To answer these questions a number of practical strategies are envisaged. Continued field surveys at *Samanalawewa* and in other areas will be needed to identify new sites. Limited excavations at chosen sites will be required to retrieve charcoal samples for further radiocarbon dating and to trace the chronological and geographic development of the technology. A program of metallographic analysis of samples taken from contemporary artefacts will be initiated to determine the end-use of high-carbon steels locally. It is possible that steels were produced exclusively for export, while only the low-carbon iron was used for local tool and weapon manufacture. Future plans will also involve more smelting trails using sophisticated equipment to measure and record airflow patterns, temperatures and gas conditions within the furnace. Some of this experimental work will have to be conducted under laboratory conditions and possibly inside a wind tunnel. Whatever is undertaken, it is certain that the work will attract considerable international interest and the spotlight will continue to be on *Samanalawewa*, and *Pambahinna*. Although perhaps ambitious, it would be exciting to envisage organizing an international conference of archaeologists and archaeometallurgists at *Pambahinna* during the windy season to both demonstrate the process and to discuss aspects of South Asian metallurgy.

Notes

Dr Gill Juleff is an Archaeologist who worked with the Samanalawewa Archaeological Project. She can be contacted at Pixton Park House, Dulverton, Somerset, TA 229 HW, England.

[1] The Samanalawewa Archaeological Project was run through the Archaeological Department of Sri Lanka and was funded by ODA (the British Overseas Development Administration), the British Council, the British High Commission in Colombo, the Society for South Asian Studies (British Academy) and by agencies involved in the Samanalawewa Hydro-Electric Scheme; Balfour Beatty and Sir Alexander Gibb and Partners. Valuable assistance at Samanalawewa was also provided by CEB (Ceylon Electricity Board), KHK and by the then Sabaragamuwa Affiliated University College.

Many individuals have supported the project in a variety of ways and without their contributions the project would not have achieved a fraction of the results described in this report. I would like especially to thank Professor J.W.D. Somasundara for his continuing provision of accommodation for project staff and archive material at *Pambahinna*, and for his nurturing of links between the project and the AUC. Special thanks also to Mr Ganeshrajah of CEB for his encouragement and practical support of the project, and to Dr S.U. Deraniyagala, Director- General of Archaeology, for permission on carry out the work. Other individuals who have played important roles in the work of the project include Tim Perry, P.B. Karunaratne, A. de Mel, Drew Shotliff and Tim Malim. Finally, the project is indebted to all the people of the *Samanalawewa* area who have contributed to the project.

References

Allan, J.W. 1979. *Persian Metal Technology 700-1300 AD.* London: Ithaca Press.

Coomaraswamy, A.K. 1956. *Mediaeval Sinhalese Art (2nd edition).* New York: Pantheon Books.

A Dramatic Episode of Labour Migration: Marathi 'Coolies' in the Sabaragamuwa Rubber Estates during the Early 20th Century

Eric Meyer, Institut National des Langues et Civilisations Orientales (INALCO), Paris

Abstract

By the end of the first decade of the 20th century, some newly founded Ceylon rubber companies which were short of labour due to competition from the Malay peninsula, attempted to import 'coolies' from Western India, using the kangani system which had provided Ceylon plantations with a regular flow of workers from the southern Tamil regions of India since the beginning of the coffee industry. The experiment ended in failure after a few years, with awful casualties. The survivors who came back to India had a harrowing tale of suffering and gross injustice to tell, that found sympathetic listeners at a time when the action of Gandhi in defence of Indians overseas was becoming popular in India. The issue led to an exchange of letters between the Governments of Bombay and Colombo in 1914-1915; inquiries were made and evidence recorded both in India and Ceylon, and a report published in 1916, but the case was soon forgotten. Extensive evidence available in the Colombo records provide an account of plantation history as seen by the 'subalterns'. It also offers material to understand the working of labour mobilisation through the un-indentured recruitment system, the relations between planters and kanganis and between estate companies and *raj*. It finally raises questions about the supposedly smoother running of the system with the Tamil immigrant, and the relative lack of evidence of ill-treatment of 'coolies' in comparison with the coffee era.

Introduction

It is well known that, from the coffee days the Ceylon planters relied on Indian labour drawn from a single source, the surplus workers of the southern part of present Tamilnadu, both from the paddy deltas and their drier hinterland. At the census of 1921, out of 330,459 persons enumerated in estates and born in India, the Trichy district came first with 105,231 persons, followed by Tanjore (45,511), Madurai (31,876), Salem (31,668), Pudukottai (19,782), Tinnevelly (19,574), Ramnad (18,566), and South Arcot (18,530) [1].

The migration of a few thousand Indian 'coolies' from the border between the present Indian states of Maharashtra and Karnataka, to the Ratnapura district in Sri Lanka, might appear as a very minor episode. But it is one that deserves a detailed study: it has left a lot of written documents, which, apart from telling a moving tale of human suffering worth recalling for itself, raise important issues regarding the working of the *kangani* system, the living conditions under which the major stream of workers were employed in colonial Ceylon, and the relations between the colonial powers and the planters. The evidence provides a rare account of plantation history as seen by the 'subalterns', which compares with the Sumatra east coast situation studied by Breman[2] and others; and an account of the same episode as seen by the planters and the colonial power. It offers material to understand the working of labour mobilisation through the un-indentured recruitment system, the relations between planters and *kanganis* and between estate companies and the *raj*. It finally raises questions about the supposedly smoother running of the system with the Tamil immigrants, and the relative lack of evidence of ill-treatment of 'coolies' by the beginning of the 20th century in comparison with the coffee era[3].

© 1998 Sabaragamuwa University Journal, vol. 1, no. 1, pp. 11-28

The Story

The Nivitigala group of estates was started by P.D.G. Clarke in 1906 in a hilly region a dozen miles south east of Ratnapura, and was managed by him until October 1914. It became the major component of the Grand Central Rubber Estates Company (Ceylon) which was incorporated in July 1910. When the opening was completed after the war, the Grand Central was among the largest estate companies in the island, controlling about 18,000 acres. During their opening phase, these rubber estates required labour for felling the forest, holing and planting rubber trees, building factories, sheds, lines and bungalows, and for road work. By 1906, the demand for Tamil workers by the plantations newly opened in the Malay peninsula, and the better agricultural conditions in South India, were such that labour shortage became a major problem in Sri Lanka[4]

P.D.G. Clarke and his like, whose business it was to start estates as cheaply as possible, and then sell them back to existing or newly founded companies, were already noted in the Ratnapura district as landgrabbers acquiring highlands by dubious means, one of the tricks being to pay next to nothing to the peasants, open the estate and settle with the Crown or influential private claimants through Colombo lawyers once the company money was pouring in[5]. Clarke and his long time associate Moir who were short of labour and not prepared to pay higher wages or advances to recruiting *kanganis*, attempted to use the recruiting system set up by the Ceylon Labour Commission[6] with the encouragement of government, to attract 'coolies' to Ratnapura from Western instead of Southern India. The project probably originated from the presence in Ceylon of a few western Indian workers who were employed by the PWD and the CGR as road and railway 'coolies'.

The superintendent sent his head dispenser, Tippilai Suppiah, to India in 1912 'to supervise the recruiting of *kanganis* and to see if the 'coolies' were physically fit', under the aegis of the Labour Commissioner (Scoble Nicholson) at Trichy and his sub-agents at Hubli and at Guntakal, a major railway junction in the north-western part of the Madras Presidency with easy connection to Belgaum and Sholapur[7]. Suppiah distributed leaflets in Kannada and Marathi, and enlisted professional recruiters, to whom he paid advances for the 'coolies', and railway fares up to the depot set up by the Ceylon Labour Federation at Guntakal. There Suppiah examined the recruits and found them healthy, but he could not communicate with them since he did not know their language. He did not follow them to the estate as he was in India until February 1913, and he apparently fell ill when back in Ceylon. A few other intermediaries seem to have been employed in the same capacity for this and other estates: L.B. Daniel, a former dispenser of the Colombo central prison, and Pina, a head-kangani from Mysore.

As soon as 1.10.1912, an inspection medical officer, Dr. Langley Hunt, reported that the dispensary on the Nivitigala group left much to be desired 'only one junior dispenser being in charge, the senior being in India recruiting 'coolies'', and he commented on 'the poor class of 'cooly' imported to the district, a large percentage being totally unfit for work'; he requested that this situation be remedied, but nothing came out of his report. According to W.G. Berry, the young superintendent who took charge in 1913 at Peenkande, one of the estates of the Nivitigala group, 132 Marathis came in October 1912; after eight months, finding them 'unsuitable', he asked them to repay their debt and gave them a *tundu* to go to the nearby Rilhena and Palugampola estates, but some remained with one of the recruiters, Abdul Khan, who ill-treated them. According to Clark there were up to 400 marathi in the different estates of the group, who after 4 to 5 months complained of being underfed and began to leave.

In June 1913, Bhimappa Durgappa, the father of two young recruits from Hookery Taluk, who was alarmed because he had received no news from his children for one and a half years, sent a petition to the police in Belgaum. Bhimappa stated that his son and daughter had been attracted to Ratnapura by the beginning of 1912, and that he had sent his son-in-law to Ceylon in April 1913 to trace them, without any result. The intervention of a Christian missionary forwarding the petition to Poona, and the publication of the letter of a returnee in the local press, prompted the D.I.G. of Police in Poona to order an enquiry in India. The police investigation made later in Ceylon in July 1914 revealed that the girl had disappeared, while the boy who was still on a local estate (Doloswalla), had recently married, but was ready to come back home if his debt and that of his wife were paid.

Shortly afterwards (6.8.1913) five peasants (two Maratha-Kunbi and three Mahar) from Khandalee in the Miraj Junior State, near Kolhapur, sent a petition to the Chief of this small princely state. They explained that a group of peasants (six Kunbi, five Mahar, and two Dhangar) had been recruited in their village in October 1912 by three agents (one Muslim from Gulbarga and two Hindus from Sholapur), and sent to Ceylon with a promise of free passage and return after six months. Only two Kunbi were allowed to return leaving the others as safety, and they initiated the petition with the parents of the others explaining that they were ill-treated and retained against their will. Their statements were then collected, but no action followed.

In January 1914, Boone, the police Magistrate at Ratnapura, informed the Government Agent of the complaints of the 'coolies' of Nivitigala group and of their poor state of health which he attributed to their being underfed: 'it was not so much ankylostomiasis that was the matter, but that they were unable to resist such diseases owing to being underfed (...) I saw a cooly lying on his back, obviously dying of starvation'. This led to an inspection on 15.1.1914 by medical officer Dr. Lunn, who reported that on the Nivitigala Group of estates there had been 290 deaths in 1913, and that basic sanitation and decent housing were lacking, adding that 'coolies' under three of the kanganis did not get enough food. But again no action was taken.

The intervention of the Indian authorities eventually compelled the Ceylon government to examine the affair. Such an intervention was very unusual until then: whereas the central Indian authorities kept a tab on migration to the West Indies, Africa and the Indian Ocean islands, they considered that unindentured migration to Ceylon was a sound and smoothly running business, and left it to the Madras authorities which found it in their interest not to interfere. But the agitation by Gandhi and the Congress in defence of Indian 'coolies', and the sympathetic attitude of the Viceroy Lord Hardinge openly proclaimed in his Madras speech of November 1913, made it impossible for India to ignore the 'cooly' grievances[8] . And that affair came under the purview of the Bombay government, whose secretary Robertson was the most resolute critic of laissez-fair in migration matters. In January 1914, he decided to transmit to the Government of Ceylon the Miraj petition of August 1913 and later, the statements of two signatories of the petition.

Meanwhile, a letter written by a young returnee (Irappa, a Lingayat) appeared in the Kesari (3.2.1914), the widely read and closely watched Poona Marathi newspaper launched by B.G. Tilak (then in prison). He described in pathetic terms his story and the fate of his companions. The public disclosure of this case prompted the Bombay government to order the Poona police to collect evidence from several 'coolies' who had returned from Ceylon. The Inspector General of Police reported in April that the testimonies contained allegations sufficiently serious to warrant further investigations. The collector at Sholapur then made a personal enquiry and concluded that 'the stories told in the statements were substantially true'. His findings were immediately

transmitted by Bombay to Colombo for comments, the full set of evidence being forwarded later.

Faced with these pressing requests, the Colonial Secretary in Colombo was compelled to instruct Thaine, the Government Agent at Ratnapura, to report on the petition submitted by Bhimappa Durgappa and to hold a detailed enquiry. In August, he collected the evidence of planters, kanganis and a few 'coolies' of Peenkanda and Rilhena, the estate where the Marathi 'coolies' who had quitted the Nivitigala group were then working. Thaine concluded that there was nothing to make a fuss about: according to him, kanganis and recruiters were to blame for having misled the recruits about the actual labour conditions in Ceylon, but there was no actual case of starvation, and the accusations of ill-treatment by the planters were gross exaggerations.

This attempt at whitewashing the estate staff was short lived: on 15.8.1914, Crossman, the new Police Magistrate at Ratnapura, sent reports of ill-treatment of Marathi on Peenkanda Estate, after having acquitted 'coolies' (including a girl of 9 or 10 and obviously sick people) accused by the manager, W.G. Berry of having escaped from the estate without paying their debts. The 'coolies' gave evidence to the effect that they were not given food when sick, and were beaten by the kangani as soon as they attempted to complain to the manager or to a judge.

This report which corroborated the stories of the 'coolies' in India led the Colonial Secretary to communicate with the Planters' Association of Ceylon and make them understand that if they did not take up the matter themselves, the Government would do so (4/5.9.1914). The minutes of the Assistant Secretary and of the Secretary show that they were aware that 'coolies on estates in charge of Mr P.D.G. Clark, superintendent, Grand Central Rubber Company, were not properly treated'. Their position was that 'the estate superintendent who does not look after the health of his labour force and sees himself that sick coolies are properly fed, is not wanted in Ceylon'. In his delayed answer (12.10.1914) the President of the Planters' Association, H. Kennedy, tried to dodge the issue: 'No useful purpose would be sought at this date by an enquiry into the various cases by the Association. (...) The class of 'coolies' recruited is unsuitable and the experiment is not likely to be repeated'. The Secretariat was somewhat unsatisfied with the answer but would possibly have dropped the matter in the context of the war, if the issue had not been revived at the initiative of the young Police Magistrate and the 'coolies' themselves.

On 26.10.1914, encouraged by the sympathetic attitude of the magistrate, an important group of Marathi 'coolies' possibly incited by their kangani went to the Police Court to obtain protection. The superintendent W.G. Berry followed them and accused them of having quitted service without permission. Eight 'coolies' were thus charged, but the Police Magistrate acquitted them and in a report dated 2.11.1914 he condemned in severe terms the action of the planter, pointing out that the cases proved negligence of sick 'coolies', inadequate supervision of labour by the superintendent, lack of medicine on the estate, and insufficient wages. He termed the attitude of Berry 'scandalous neglect' and 'failure to fulfil his duties'. For the workers 'to remain on the estate under its present superintendent would be a serious risk to their lives'.

The Colonial Secretary received the report of the Police Magistrate, and, soon after, a complaint by Berry, saying that he would appeal against the judgement, as well as a private letter from the General Manager of the Grand Central Company in support of Berry. He then contemplated setting up a commission of inquiry on the particular situation in this group of estates. But the Government insisted that 'the Planters' As-

sociation should be allowed to show their anxiety to secure proper labour conditions without government pressure' (minute of 12.11.1914) and suggested to the Planters' Association a commission with a wider scope covering the whole province of Sabaragamuwa (including the Ratnapura and Kegalla districts), with Thaine (notoriously pro-planter) as President, a medical officer and a representative of the Planters' Association 'to show as against any scandals in Peenkande that in other parts of the province exceptional care is taken of the labour force '. This was hardly enough for the Planters' Association, which found the members of the Commission 'eminently satisfactory' but added that 'they will not ask for an enquiry but will be glad if one is held' (18.11.1914), while the Sabaragamuwa branch of the Association wrote that they had the intention to 'take up the matter very strongly' and suggested that a local enquiry without the medical officer would be enough (22.11.1914)

The Commission sat from January to April 1915, but reported only in February 1916, after the 1915 riots which kept the Government Agent busy. They decided to question neither ordinary 'coolies', 'because it was impossible to obtain from them reliable informations' [sic], nor the judges, and to collect evidence only from planters and kanganis. Their biased report, which bears the marks of the stiffening of the colonial attitude during the war period, exonerated the planters in general, while charging some kanganis; it stands as a typical justification of the Planters' *raj*. Its main target was the Ratnapura Police Magistrate and more generally the judiciary and the proctors, and its only practical suggestion was to change the law to prevent judges from giving 'coolies' certificates to lawfully quit an estate. The report, although printed, was never tabled before the Legislative Council as a Sessional Paper, contrary to most other commission reports, and it was not widely circulated.

Next to nothing is known of what happened later to these Marathi 'coolies': most of the survivors must have come back to India. In 1915, there were only 10 Marathi workers left at Peenkande, according to the evidence of W.G. Berry. The census of 1921 enumerated in the Ratnapura District among the estate population 687 males and 656 female born in India and included in the category 'others', i.e. neither Indian Tamils nor Indian Moors (the same category for the whole of Ceylon estate population being 2296 and 1549 respectively and each of the other districts having no more than 200 persons of that group, except Badulla 524 and 425, and Kegalla 388 and 240). 312 males and 308 females gave Canarese as their 'race' (actually language), 12 and 20 Marathi, 368 and 388 Telugu.[9] The Census of 1946 enumerated 202 Marathi, 75 Telugu, 239 Canarese, and 1546 'other races' in Ratnapura[10]As regards the General Central Company, it was one of the major beneficiaries of the post-war rubber boom, distributing dividends of 7.5% in 1923, 27.5 % in 1925, 12.5% in 1927, and 5% in 1929.[11]

The View from Below: The Testimony of the Marathi 'Coolies'.

The evidence collected in India provides us with examples of the 'subaltern' reading of the events. The reader will refer to the propaganda leaflet of the Ceylon Labour Commission reproduced in the appendix to this paper, to get an idea of the extent to which promises made to the recruits before they left fuelled their illusions, and their disappointment when they were so blatantly broken.

To start with two unsolicited documents, the petitions of Bhimappa Durgappa and of the Miraj villagers:

> That he had two children, one son daughter, named Ramappa and Satyawa respectively. And that the above two children were taken to Trichinopoly and Ratnapur by agents of coffee [sic] plantations for working in their gardens as coolies, promising to pay them for the man 1

Re a day and for the women half that amount. The agent had been to our place and took them one and a half years ago. They are supposed to be working in Ceylon on the estate of Doloswalla. Since their departure nothing has been heard of them. The petitioner sent his son in law Pera, from Bhilkundi, aged about 30, in order to trace the above said persons and bring news of them two months ago. But he too has not returned and nothing has been heard from him. It is said that these agents of coffee plantations do not allow persons when once taken to go back to their country. They do not even allow them to keep correspondence with their relatives. So the petitioner begs that his children be traced in the Ratnapur coffee plantations and should be brought back to his place so that he might see them before he dies. He is willing to bear all the costs of their travelling if the government asks him to do so.

This is an individual petition sent by an enterprising villager. It differs from the second document, which is the outcome of a collective initiative of a whole village, in which all the actors of the social life in Maharashtra are found. The document was written by a Brahmin public writer in the small capital of Miraj Junior State, at the request of two Kunbi (the local dominant peasant caste from which the Maratha chiefs were drawn) who had returned, and of three elder members of Mahar families (the untouchable caste acting as general labourers and village watchers) whose relatives remained in the island. Their story is that they were led to believe that they would stay only six months in the plantation:

After the expiry of 6 months, these persons longed for going home but they were not allowed to do so. Two of them were reluctantly allowed to come back here only when the rest of them became sureties for their return, and that too within the laps of one and a half months. These persons state that it is next to impossible to expect the return of their comrades, and that the work is exacted by repeated punishments, like that exacted from prisoners, and also they are under watch at night. Under these circumstances we can see no reason to entertain the least hopes of their liberty and consequently we have been pining for them every day and night. We have none besides them to take care of ourselves in our old age and in the absence of the release of these persons, our homes are sure to be destitute of their inmates, which is nothing but the extinction of our lines.

One has the outline of the main themes of the complaints: false promises, abduction and abuse of the 'coolies' in Ceylon, the impossibility to return, and the lack of communication between India and Sri Lanka.

The third document is the letter published in the *Kesari*, which cannot be considered as an entirely unsolicited testimony, but it is free from interference by any authority. The young Irappa, who says he is 15 years old, gives a vivid account of his dramatic experience which can be considered as a standard story. His evidence later taken successively by the Police Inspector and by the District Collector tells the same tale, except for a few details:

About a year ago, I and two of my friends had been to a place [in Sholapur] and put up at an hotel where we met a man, by name Sitaram of Hubli, who recruited coolies for Ceylon. He told us that some labourers were wanted for Ceylon, and described the work there and the wages in glowing terms. He pressed us to go with our family and take service there. He made us to understand that men received wages there at 1 Re and women at 12 As a day, that the climate of Ceylon was excellent and the work very light. He said he would give us an advance if required. We agreed to go and asked him for an advance of 20 Rs each. He said he would pay the advance at Hubli and took us there on 20.12.1912. At Hubli he told us that he was going to go aside to recruit 'coolies' and that we would receive the advance at Krishnapalli [Trichy] depot, and got us despatched by one Bhairappa Khetri. When we reached Krishnapalli we were told that we would get the advance at Tuticorin from the agent there and that we should proceed with Shankar Kangani. When we reached Tuticorin we were told by a sahib that the money could not be paid to us but would be remitted to the places where we wanted it to be sent. We were given good food there and were taken to a boat. There an officer asked us in Hindustani if we were going away willingly to work in Ceylon and we replied in the affirmative as we were told by the agent previously to say so, and we got on

board of steamer no. 122. One of the passengers told us that our clothes would not be allowed to come back till we die. We became anxious but had to remain silent. We reached Colombo after 18 hours. We got there in another steamer with a sepoy and got to shore. (...) After walking a distance of 4 miles we were despatched in a steam car of Pingam company, and the journey occupied 7 hours. For 3 days we were given only rice and no work, and the 4th day we were taken before the manager who told us in Hindustani that we were sold by Sitaram of Hubli depot for 15 Rs to Bhairappa Khetri of Bangalore depot, Khetri in turn sold us to Shankar kangani for 30 Rs and Shankar had sold us to manager for 50 Rs. Thereupon he told us that we should work punctually and we would get 7 seers of rice per week as wages and we were to purchase salt, chillies and so on for our use by selling part of that rice. These 7 seers are equal to 2 ¼ seers of our side.

My two friends were put on the work of carrying iron loads for a building and as my age was only 14 or 15 I was employed in tapping the rubber trees and collecting the gum therefrom. I had to do this work from 5 to 11 a.m. and the gum collected ought to weigh not less than 3 lbs. a day. If the quantity was found to be less, I was not given any rice that day. I was to get it only after making up the deficiency the next day. The two companions of mine got ill after two weeks on account of the hard work and were continually sick for one month. They were not given any rice during that period. The reader can better imagine their sufferings. I felt very much for them, but as I was to work from 5 a.m. to 11 a.m. and from 12 a.m. to 6.30 p.m., I could not get time to look after them. However, I managed to cook for them and give them part of my rice and attend to them. Their health got so much worse that their body began to sink and rot. When the doctor was told to treat them he gave them a white powder one day and they got a great burning sensation in their stomach. The doctor was informed accordingly, but he did not take any notice. They both died after a month. There was no funeral and their dead bodies were thrown under a rubber tree to serve as manure. I was also so much harassed that I was beaten with instruments used in tapping the rubber trees if I was not able to collect 3 lbs. of the gum by 11 a.m. I was also whipped constantly. From 12 to 6.30 p.m. I was to cut tea leaves [?] and was struck with the pair of scissors used in picking the leaves.

This continued for seven months and I made up my mind to run away, preferring death from wild animals. I had buried under earth 4 Rs taken from Sholapur with me. I took with me these 4 Rs and ¼ seer of pulse and fled into the forest. After 1 ½ hours four sepoys came with lanterns in search of me. I concealed myself under a stone at the foot of a hill and though they came close they did not notice me and went away. I travelled by night and laid concealed during day time for fear of being caught. On the eighth day I reached Colombo. I did not dare go near the steamer for fear of being caught by a servant of Pingam company and began to cry. A man approached me and enquired if I was a runaway cooly and I told him my story. He sympathised with me and told me to throw away my clothing and to rub off the stamps of my arm with sand and water, and that the company servants go away at 3 p.m. to a liquor shop and that was a good time to get into the steamer. I prostrated myself and rolled at the feet of the assistant driver of the steamer and paid him 4 Rs for my fare. He consulted his superior and locked me up in the engine store room. The company's sepoy came and made the search among the passengers and went away. When the steamer left the shore I was taken out of the room and some merchants who sailed with me gave me some clothes. I reached Tuticorin next day. I travelled up to Guntakal without a ticket and the station master allowed me to go when I told him my story [in his evidence he explains that he joined a group of *sadhus* from Rameshwaram and Srirangam who were allowed to travel free]. I walked to Raichur and Saidapur and there I was given a lift in a goods train up to Gulbarga. I went thence on foot to Sholapur. I am now sick and will take 8 or 10 months to recover. I have still on my body the marks of whipping and of the blows from the instrument. The motive in publishing this is that the people may not be deceived by the recruiting agents.

Among the numerous testimonies collected by the Miraj Mamlatdar, the Poona Police and the Sholapur Collector, and even the Ratnapura Government Agent, one finds similar stories, although the emphasis is put by the witnesses on different details.

One of the most obvious feature of that 'view from below' (which is not so apparent in the evidence of the Lingayat young man) is the feeling that they were loosing their

cultural moorings when in Ceylon. In most cases witnesses insisted that they were misled by false promises regarding the location and nature of the work. They were usually made to believe that they were to be employed in India in places known to them (close to Hubli, or to Trichy, or near Rameshwaram). When Ceylon was mentioned the crossing was described by the recruiters as very short ('a furlong of sea to cross'). In the Hindu cultural context, this meant that they would not lose caste. Some witnesses pointed out that being imprisoned in the estate, they lost their notion of time and space: 'we were hampered on all sides'; 'thus we were hemmed in'; 'there are no feast days and holidays there and it is difficult to estimate how time passes'. The impossibility to send and receive any letters was very much resented, it increased the feeling of being lost, the urge to come back home by any means, and the desire of the parents left behind in India to rescue their family. Even if there are only scanty references to Sita and Ravana, parallels with the Ramayana were unescapable. In the same vein, several returnees stopped at Rameshwaram to get the *darshan* of the god, and some travelled with *sadhus* via Srirangam or Tirupati, begging their way back home. The muslims among them did the same and visited the tombs of local saints.

The anxiety about religion, caste and purity is obvious in the descriptions of living conditions in the lines (they call them *chawls*) 'in which labourers of all castes lived together'; in the stories of widowed women or unmarried girls forced to live with or be raped by men on the estate; in the general feeling of outrage because 'dead people were not buried according to their religion, but thrown in the pits of rubber plants to serve as manure'. The preoccupation with purity is very much in evidence, even among the Mahar recruits, especially women, which indicates that 'sanskritisation' was in progress in that community as well as among Marathas. The 'modern' sanitary measures taken in the immigration camps arose the suspicion of the 'coolies', in a way reminiscent of the movement led by Tilak against anti-plague measures: 'Women were examined by a female and men by a man. The clothes were taken off and we were given small pieces of cotton to wear. Our clothes were disinfected by putting them in a machine. They stamped us with a seal on the chest, and in the case of women, on their wrists' [vaccination is viewed as a kind of cattle branding]. [After the arrival in Ceylon] 'the person accompanying us told us to bathe in the water tank to wash off our sins [sic], as we were from a country where plague and cholera exists. (...) But we refused the European officer to measure our women by touching our persons'. In the same way, many recruits were wary of the registration process in the camps. Here the reminiscence is still more impressive, but one cannot ascertain if they were aware of Gandhi's campaigns in South Africa. Their reaction might as well have been spontaneous when they refused to give their thumb impressions at Trichy.

Among the general complaints were false promises concerning advances and salaries, the feeling that there was a six months contract with free return passage, heavy work, general sickness, the lack of proper food, no rice given to sick workers, constant watch and arrest of runaway workers, and the regular practice of whipping. Moreover, the 'coolies' shared the resentment about being deprived of freedom except on reimbursing the debt to the kangani, about having been sold like slaves, reinforced in the case of the sale of a gang of workers by a kangani under the *tundu* system, and about the money transactions between the kangani and the planters. Most workers resented European planters refusing to hear their complaints and referring them to their kanganis, as for example an old Muslim, Saiphansab Momin, who was taken before the planter after an unsuccessful escape.

> I told sahib in telugu that we had no food to eat, we were starving and we were not supplied with rice and I proposed that we should be tied to a tree, blinded, and shot dead thereon.

Sahib told us to go. We were taken to another sahib, I also uttered the same words, he asked Abdul kangani why he had brought an old man like me for the work. Sahib kicked him saying that he received money for nothing.

The planter did not confirm to the stereotype of the benevolent dorai, which the 'cooly' (and the Governor of Ceylon together with the Planters' Association) expected him to be.

The descriptions of the odyssey back to Sholapur are very similar to those given by the young Irappa, except that in some cases the runaway 'coolies' were ill treated and forced to work without payment on their way to Colombo, and in other cases helped by local traders or peasants; and that many of the returnees did not benefit from free travel and had to trek their way back by begging or doing odd jobs along the road. The travel for most of them took two or three months, just like in pre-modern India, in striking contrast with the outward journey by rail - a contrast of which they were quite conscious.

The View from Above: The Planters and the *Raj*.

Faced with a serious scandal indirectly involving the Ceylon Labour Commission set up by the Planters' Association in India, the planters consistently attempted to minimise the facts and to lay the blame on some erring subordinates, on the 'coolies' themselves or on indiscreet judges. The colonial authorities attempted to mend matters by giving India a satisfactory answer while keeping good relations with the planters, and they eventually avoided a crisis. It can be noted that in the very different political context of the late 1930s they were not so successful.

The position of the planters is found in plain terms in the letter sent by the President of the Planters' Association on 12.10.1914:

> The conclusion we have arrived at is that no useful purpose would be served at this date by an enquiry into these cases by the Planters' Association. The Hattaraganga and Sholapur cases are old ones, and it seems too late to reopen them. The remaining cases which pertain to various divisions of Nivitigala group and to Doloswalla are certainly not pleasant reading. It is evident that the class of cooly recruited, viz Marathis. Is unsuitable, and the experiment is not likely to be repeated, and there is no doubt that false representations were made to the coolies in respect of the wages they would earn in Ceylon. The blame for this is in all probability attachable solely to the professional recruiters who were employed by the kanganis at the different estates. Neither the superintendent nor the Planters' Association can be made responsible for any misstatement made in India, other than those made on the printed forms which are distributed through the Ceylon Labour Commission.[12] The Planters' Association has strenuously deprecated the employment of professional recruiters as being the main cause of Ceylon getting a bad name in South India a few years ago. (...) It is likely that many of the charges against the kanganis on the estates are true. **It is also probable that these coolies, not understanding the kangani system, took exception when an ordinary cooly would not have complained** [my emphasis]. It is in the kangani's interest to turn his coolies out to work and so get his pence money. (...) It is evident that these coolies were unsuited for estate work and they probably malingered as much as possible, thereby incurring odium from their kanganis, which resulted in short rations and possibly forcible coercion to induce them to work. (...) In respect to the prosecution of the child I may mention that the P.A. have of late expressed their disapproval of the imprisonment for bolting of women and children. (...) Further reasons for not instituting an inquiry are that the manager of Nivitigala group is not now in the island; that the coolies are scattered and it would be almost impossible to get them together to give evidence; that the Government Agent has been so sensible and as he has covered the whole ground (...) the P.A. could not arrive at another conclusion. There is no doubt whatever that the rush into rubber necessitated the obtaining of thousands of fresh coolies, many of them of a very undesirable class. But since the rush has subsided, there has been time to look around. It cannot be denied that the present ar-

rangements for the well being of the Tamil cooly are much more satisfactory than used to be (...) and we do not think that it is possible for the conditions expressed in the papers under review to ever happen again.

The significant arguments are: First, that this attempt at importing Marathi 'coolies' should be viewed as an experiment. The colonial logic, which prefigures that of totalitarian states, being that individuals and populations can be displaced to suit a rational organisation of society and economy, and that according to a Darwinian taxonomy reinterpreting the brahminical views, some groups are suited for some tasks and others are not (see the well known stereotypes of the 'martial races' and of the criminal tribes'). The human drama is thus expressed in terms of the failure of an experiment for want of a proper 'anthropological' analysis, of a lack of a match between the demand and the offer, of the unsuitability of the Marathi to the kangani system evolved for another 'race'. Second, that Ceylon is not and must not be held responsible for wrong-doings and atrocities committed in India. This is another version of the image of the subcontinent as the matrix of vices and epidemics, and the meaning of the bath so nicely expressed by the Mahar women finds its colonial echo. In other words, Ceylon is a clean and policed colony, India is not[13]

The private letter sent to Reginald Stubbs (Colonial Secretary) by Lionel Cos (General Manager of the Grand Central Ceylon Rubber Estates Ltd) does not burden itself with such arguments and subtleties. It provides a straight example of the means by which the planters used to put pressure on the Colonial Government, in the name colonial brotherhood.

Dear Mr Stubbs,

I am much obliged for your letter of 4th instant. It is such a pity that every Police Magistrate does not have at least two years training as a planter. He would soon realise the utter impossibility of getting coolies to be treated or to be sent to hospital. You cannot force a cooly into hospital any more than you can Europeans and they have the greatest dislike to go there. Young Berry is a fine type of a young Scot and he has the welfare of his labour force **very much** [Cos' emphasis] at heart.

Yours sincerely

Since the planters' raj was no longer exercised by the planters themselves (who were often 'Unofficial Police Magistrates' in the planting districts during the coffee days), judges and administrators should be made to act according to the planters' interests. Ceylon planters used to be an assertive and outspoken class. Those interviewed by Thaine in August 1914, and by the Sabaragamuwa Commission headed by him the following year, felt confident with a man who rather conformed to their expectations, and their discourse can be considered as a genuine expression of their psyche.

Among the different superintendents, there was the self assured type of manager (G. Hawkins at Rilhena) who declared that

during one year neither a head-kangani nor any cooly has complained of being discontented; if any cooly has any complaint to make he comes to me direct: I understand a little Canarese and have an interpreter in Marathi and Hindustani. I had no complaint of ill treatment by the head-kangani: when they came to me they looked ill, but now they are healthy. (...) I know nothing about the original agreement on which the coolies came. Each cooly has a passbook in which his debts are entered [this is contradicted by the evidence of his own 'coolies', who state that they did not know they had a debt]. A cooly can earn 30 Rs a month if he works properly. On Sunday he would get cash payment.

W.G Berry (Peenkanda) belong to another type of superintendents who saw the cooly as intrinsically lazy, which in their view legitimised the use of compulsion to make them work:

These Marathi coolies took no interest in their work. (...) There was trouble in getting them out to work. If they did not work they did not get rice. (...) The men usually worked but the women were lazy. When I found this discontent I took steps to get rid of them. There were no complaints of ill treatment by kanganis or insufficient food. (...) There were no rows among the coolies, they were a peaceful lot.

He then proceed to deny every complaint regarding short pay, hopeless indebtedness. Lack of sick rice, ill treatment, impossibility to exchange letters, constant watch, and high mortality. But in the evidence collected one year later by the Sabaragamuwa Commission, Berry recognised that a great many of the 'coolies' were ill in 1914 and that their kangani forced them to work and stole their pay:

Abdul Khan [kangani] did all sorts of terrible things to the coolies. He frightened the sick coolies to say that there was nothing wrong with them, and told them they must go to the muster ground. When it was suggested by the dispenser to send a sick cooly to hospital, the kangani refused to allow him, saying he would never come back. One cannot force a cooly to go to hospital.

If Berry changed his mind about that kangani, it is because according to him he incited his gang to go to court and give notice to quit, thus betraying his master and disrupting law and order on the estate. O'Neill, a conductor who was present on Peenkande when the Marathi 'coolies' were enrolled, told the Commission a similarly muddled story: the Marathi were healthy when they came, none of them refused to work nor was dissatisfied; he did not notice so many deaths in 1912-1913, 'not more than 3 or 4 per month', any way, they were lazy people...

P.D.G. Clarke did not bother with contradictions. Heavy mortality on Nivitigala group was the point at issue. If there was no hospital on his group of estates, the reason was that 'the Managing Director, Mr. Forsythe, when he came out in 1913, decided that the cost was prohibitive' [about 1,000 Rs per bed]. But in the latter part of his evidence he laid the blame on the bureaucrats of the Medical Department who condemned his plans.

- You are aware of the high mortality figures. You do not dispute the figures?

- No. We were employing a very poor class of cooly, who eventually simply collapsed.

- Who was recruiting these coolies?

The kanganis as well as the dispenser.

- If the dispenser was sent out specially to examine the coolies how came it that he brought over such coolies?

- To all appearance they were healthy coolies, but the climate was so adverse to them that they simply collapsed [sic]

- What about the complaints [of being underfed; made in India]

- The complaints were no other than the usual grumbling. I do not say Abdul Khan was a good reliable man with his labour, but I did not see any grounds for complaint between the labourer and the kangani. (...) It was a question between the kanganis and themselves and it was not known to me.

Clarke then admits that he had heard of a complaint about kanganis stealing the rice of their 'coolies', and had made his European conductor to distribute food himself to these half-starved people 'who when they got their rice sold it, probably for liquor; it was this way they got into this emaciated condition'. Questioned about whether it was not his duty to relieve their distress and if he was aware of a number of 'coolies' found dead on the road, he answered that these were people recruited by Mr. Moir. 'Who employed Moir?' - 'The company.' The latter part of his lengthy evidence is full

of contradictions and rash judgements, the heavy mortality by dysentery being attributed to changing weather conditions and to the food habits of the 'coolies' themselves. Especially low caste members and tribals were described as 'absolutely filthy creatures in their food and person'.

In the political context of the 1910s, no colonial government, whether pro-planter or not, could condone such rash expressions of racial prejudice and sheer exploitation. Its aim was to project the image of the planters as a responsible and sensible class, or to justify their actions with rational arguments. There were two possible responses: scaling down or isolating the case. Accordingly, the first report transmitted by Thaine in August 1914 concluded that, first, there was nothing really unusual, and second, the message to be addressed to India was, 'they are better off with us than with you'. This discourse is very similar to that of a widely circulated book which gave in 1900 a epitome of the myth of the happy cooly:[14]

> Compared with his condition at home, [the Tamil cooly] is much better off here, where he is free, well housed, his food guaranteed him and medical comforts provided. He is allowed vegetable and fruit gardens. (...) He is never oppressed by his master, who generally respects his customs and prejudices. His own ideas, it may be remarked, are few, (...) his tastes are very simple. (...) An unjudicious benevolence towards the Tamil cooly would render him useless for any purpose. The outcome of treating [him] too considerately would be laziness and industrial degeneracy.

Thaine laid the blame on the false promises made by recruiters in India, and maintained that 'the stories of cruelty were gross exaggerations'. The complaints were made by 'lazy 'coolies' who refused to work'. It was true that corporal punishment was actually practiced:

> Some accuse the superintendent of giving them a thrashing; there is I think probably some truth in this complaint but it is difficult to believe that the coolies are in a worse condition than they are in India.

Armed watchers were a necessity because

> a cooly has no right to quit the estate without permission and is liable to be prosecuted. [the Colonial Secretary annotated: except after giving a month's notice]. It is probable that the kangani uses every possible means of preventing the cooly from leaving the estate until he has paid his debt. His attitude in that respect is not different from that of any other creditor.

As regards rape of unmarried women, burials in rubber pits and the like, 'if such things occurred it is difficult to believe that they would not have been brought to the notice of the superintendent', and a complaint made to the Police Magistrate.

The actual recourses of the Peenkande 'coolies' to the Police Magistrate and his clear pronouncements wrecked the latter argument. The planting community was obviously worried about the increasing involvement of the judicial power in their affairs. The report of the District Magistrate of Ratnapura which denounced the state of starvation of the 'coolies' brought before the judge for quitting service was received by the planters as an aggression against their authority when it was leaked to the Colombo and later the Madras press. Thaine was therefore compelled to choose the second response as President of the Sabaragamuwa Commission.

The report first attempted to draw a red herring by giving an idyllic picture of the situation in the province and of the conditions under which the immigrants were taken charge of after being selected at the depots in India. It went on to deny that the 'coolies' were overworked:

> This allegation does not appear to us to have the slightest foundation in fact; on the contrary we find, not only from the evidence, but also from our own observations and experience, that

work on estates in Ceylon except perhaps in the case of new clearings, when usually Sinhalese are employed, is of the lightest description, and infinitely easier than the task of other labourers in Ceylon.

It then suggested that the laziness of the Indian 'coolies' was at the root of the problem. [Note that in other circumstances it was the laziness of the Sinhalese which was put forward to explain the employment of Indians]. If they were underfed, it was because they did not work regularly: 'There are cases where even a healthy cooly does not seem to earn enough, but in such cases the fault will invariably be found to lie with the cooly'. The 'coolies' were not underpaid: 'The better proof that their pay is sufficient is that they remit money in India', and also that they can sell surplus rice to obtain cash. However, the commission considered it unnecessary to precisely state the salary rates! Instead it argued, that 'coolies' were not badly treated when sick: they were given food and there were dispensaries everywhere (except on Peenkande...), the only problem was with dispensers, often inefficient and sometimes fond of the bottle. Lines were not always healthy at the opening 'but it is largely a question of time and money'. The 'coolies' were not unfree: most of them frequented Sunday markets, many travelled to and from India, and armed guards were not there to forbid them to quit, but only to ward off thieves. They were never unjustly punished, and sometimes it was to 'punish the ill-treatment of women and children by some coolies' [sic]. Their condition was definitely better than in India where they are not looked after at all.

The commission having thus isolated the case of the Marathi 'coolies' on Nivitigala, proceeded to apportion the blame between two spoilsports, Clarke, the former manager, and the Ratnapura District Judge. The former should have better looked after the health of his 'coolies' and he 'showed a strange lack of appreciation of the situation'. These 'coolies' wee 'unsuited for estate work', loitered in the bazaar and ate jungle fruits, then they became ill and died. But one 'cannot hold Clarke entirely blameless in the matter', especially because he took no notice of repeated warnings of the administration (which is thus exonerated) regarding the mortality rate, lack of piped water, poor sanitation, lack of a hospital and of qualified dispensers. However, the major trouble was with the judges who by explaining their rights to the 'coolies' and giving them discharge certificates encouraged them to give notice and quit service. 'The sympathetic attitude of the bench toward the cooly' must have incited them, and especially kanganis, to do what they formerly considered as 'an act of dishonesty towards their employer'. As regards these new kanganis like Abdul Khan, they were using their gangs as pawns to obtain higher *tundu* amounts, selling their labour to the highest bidder, this speculation being 'assisted if not actually organised by certain proctors'.

Conclusion

The questions which the Sabaragamuwa Commission evaded, are yet to be answered: Was the story of the Marathi 'coolies' an isolated case? And why did it take such a dramatic turn?

The mechanisms which enabled the Ceylon planters to mobilise and retain a large amount of bonded labour on their estates have been analysed by several scholars.[15] There is a general consensus that with a few exceptions the system was running rather 'smoothly' until the late 1930s. D. Wesumperuma rightly remarks that the correspondence between India and Ceylon on 'cooly' migration is surprisingly meagre as compared with the correspondence between India and the colonies under the indenture system, as if Ceylon was considered a part of India (yet, migration to Assam and Burma was strictly monitored by the authorities) or if the absence of a previous his-

tory of slavery distracted the attention of the Indian administration. Nevertheless, the lack of documents is not synonymous with an absence of problems.

It was not the first time that an 'experiment' ended in failure. An earlier example is found in the autobiographic manuscript of a civil servant in Badulla in the 1860s, H.Mooyart:

> The coffee planters imported by way of experiment a large gang of coolies under contract from Ganjam in the North-east coast of India. (...) The new recruits unused to the climate and food refused to work and were committed by the magistrates to gaol in my custody. While there, cholera broke out among them and many died. I succeeded in stopping the outbreak by sending them to the hills to build huts for themselves, until my representation of their case to Government led to their release and discharge, though much reduced in numbers[16]

High morality rates were quite common at the beginning of the coffee period, and remained a recurrent feature during the opening phases of every successive plantation boom.[17] Apart from epidemiological factors (there were outbursts of malaria - jungle fever - immediately after the felling of forests) these early phases were also characterised by unscrupulous enterprise, tight money, and lack of state control. In local records, such as Government Agent's diaries, there are frequent allusions to ill treatment and heavy casualties on the pioneer tea and later rubber estates, especially in the mid/low country, where the absence of any dispensary, the neglect of workers, the lack of sick rice, the ordering of the sick 'coolies' off the estate, were a common feature.[18] During the rubber boom, competition for labour with Malaysia should have led a to better bargaining position for the 'coolies'. However, the planters by recognising the control of the kanganis through the *tundu* system and by setting up the Labour Commission controls in India, ensured that there was no rise in wages during that period. The kanganis benefited and not the 'coolies', as there was no rise in wages during that period. The evidence collected by the labour Commission of 1908 is quite explicit. To quote A.H. Thomas, describing himself as 'a very old planter' who arrived in Ceylon in 1861:

> We call the cooly a free agent, but he is not. When he is on the estate and highly indebted to the head-kangani he is more or less a slave, and that is why I condemn the head-kangani system so much. Very often the cooly wishes... - in fact to begin with he comes from the coast a perfect stranger to Ceylon; he comes not purposely to make money, but to find out where his relations are, and when he has found them, after being a few months on the estate, he wishes to go to them. His kangani naturally does not wish him to go, because he loses his head money. He cannot go to his master because his master will not receive him without the kangani, so he is helpless. He does not wish to repudiate his debt. He absconds - what we call bolt - and I think myself that the cooly has done the only thing he can, and is quite right. (...) A superintendent told me the other day: 'I never talk to my coolies, I never talk to my sub-kanganis, I only talk to my head-kangani. I do everything through my head-kangani, and the cooly dares not come up to the bungalow.[19]

While the 'coolies' were left with the 'weapons of the weak', the power of the kanganis had largely increased by the turn of the century, not only because there was a growing labour shortage, but also because the superintendents were now mere managers, paid according to profits, with a rapid rate of turnover. They spent as little as possible on salaries as long as the plantation was unproductive, were not primarily interested in obtaining a regular and faithful labour force, and were probably prepared to discharge the 'coolies' when no longer needed. In his evidence before the Labour Commission of 1908, F.J. Wright, planter in the low country district of Kalutara, explained that at least six gangs came and left during the phase of opening, many 'coolies' dying, the others bolding. Superintendents took less interest in gaining the confidence of their workers and were therefore inclined to use harsh management

practices. Some plantations became micro police states, and cases of violence by watchers and kanganis were not uncommon in the 1910s.[20]

The kanganis became experts at manipulating the debt system to control their gangs, a practice which 'never having been sanctioned at the level of government legislation escaped the scrutiny of the Colonial Office. The tacit consent awarded by the local government perpetuated a system of control which contained the worst aspects of indentureship and free labour contracting'.[21] They were increasingly greedy, as they were themselves involved in land-buying in India and usually indebted to Chettiar moneylenders. The average amount of indebtedness could vary between 7.50 Rs (in an old established estate) and 60 Rs (where the pressure of the local Chettiar was heavy) according to the evidence before the Labour Commission of 1908. But in the case of our Marathi 'coolies' it was as high as 80 Rs. In a way, our case is the culmination of a general trend. But it also bears very specific features.

There was another attempt to recruit Marathi 'coolies', by the head of the embarkation depot for Malaya who, when faced with labour scarcity in the Tamil region, 'began to search outside the Madras Presidency. A hundred recruits were signed on at Ahmednagar. (...) These men were Marathas. (...) Of the hundred who signed, only 29 arrived at the depot on the coast, so Dr. Foster went to Ahmednagar to examine the recruits and explain about emigration to Malaya; when they were so informed, the majority refused to emigrate. (...) Soon after, it was established that this recruitment in another province was illegal, and no further Marathas were taken.'[22] The Ceylon recruiters were not so careful: 'It is on record that the professional recruiters who were enlisting workers for the Malaysian plantations resorted to the practice of handing over to the kanganis from Sri Lanka those of the recruits who were rejected'[23]

We are thus referred to the usual explanations. These migrants were unfit, they were unacquainted with the kangani system, with the Tamil language in use on Ceylon estates, and the recruiting ground was too far from the island to enable the workers to freely circulate on ancient routs. The latter factor was certainly very important. While Tamil migration was by no means a new feature in the relations of India with Sri Lanka, Marathi migration took place on new routes, like indentured migration, for which mobilisation required cheating and compulsion. The geographical and cultural proximity between the two countries allowed the 'coolies' to return to India and tell their kin a tale of success, erasing the ugly side of plantation life in order to keep face. The Tamil workers were able to keep their cultural moorings, to hold religious festivals and to develop new cults inside and outside the estates, which helped them accept their fate[24]

Other factors are worth exploring. First, as many of these migrants had some previous experience of a free labour market in Sholapur, where they used to work in or around cotton mills, they could not accept the kangani system based on debt bondage. They were individually recruited in town markets, in cheap hotels, near the station, or at the entrance of factories. These people (of whatever caste) had already severed their links with the village.

Secondly, in the case of whole family groups recruited with the permission of village elders, the nature of hierarchic relations in rural Maharashtra differed from that of rural Tamilnadu. Many recruits were from the Maratha-Kunbi dominant peasant caste and their Lingayat neighbours, who were definitely more vocal and assertive than their Vellala counterparts in the south. Many were untouchable Mahar peasants, who were not as tightly bound to a master as were Tamil adimai 'coolies', and had acquired in the course of time the dynamism of a mobile and forward looking community. Well regarded (some of the 15th century bhakti saints belonged to their commu-

nity) and traditionally provided with a small service tenure as village watchers, they were people on the frontier of two cultures (there are Marathi and Kannada speaking Mahar). The advent of the British opened new opportunities for them: employment as sepoys in the Bombay army, where their courage was legendary[25] and later 'cooly' work for the building and maintenance of railways in Western India.

According to E. Zelliott[26], the anti-Brahmin Maratha movement led by Phule, the Mahar protest against the closing down of careers for them in the army (which was to culminate with the emergence of Ambedkar as national leader, and later with the Dalit movement), and also the activism of Tilak, although separate and often antagonistic, belong to the same tradition of assertiveness. This might explain why the Marathi speaking 'coolies' refused their fate and found understanding listeners when they told their story. Among these mediators on the Indian side were the Miraj chief (his neighbour and powerful kinsman the Maharaja of Kolhapur had extended his help to the to the non-Brahmin movement); a Christian missionary; the editors of the Kesari[27]; and finally the government of Bombay and the Viceroy himself. On the Ceylon side there was a single police magistrate and possibly a few proctors.

It is likely that their fate would not have attracted the attention of mediators if their experience had not exactly coincided with the culmination of the action of Gandhi (relayed in India by Gokhale and the Congress) in favour of Indian workers in South Africa. British Indian and national Indian attitudes towards Sri Lanka were to be durably informed by a view which is resumed in Hardinge's Madras speech of November 1913, although it was not aimed at Ceylon:

> In all this they have the sympathies of India, deep and burning, and not only of India, but of those who like myself have feelings of sympathy for the people of this country.

Appendix

Ceylon Labour Commission, Trichinopoly: Notice to Coolies Willing to Go to Ceylon[28]

From time immemorial coolies are being imported into Ceylon from South India. There is no restriction in the matter of coolies going to Ceylon and there is no binding and no contract to be made.

1. Ceylon - Lanka - is a land equally important to Hindus, Mohammedans and followers of Christianity. There are famous shrines and it is noted for its healthy climate
2. The work is light. Handsome pay is given. Men get from 6 to 8 As, and women from 4 to 6 As, and boys who are able to work get As 3 to 6.
3. Coolies can work beyond the prescribed time and earn more. If the family consists of one man, one woman and a boy able to work, they can earn Rs 30 to 40 per month.
4. The superintendent in charge of the plantation hands over monthly pay to the coolies themselves.
5. Coolies can see the superintendent personally and he will immediately enquire into all particulars and give the needful relief. He understands the language of the coolies.
6. The accounts of the coolies are ordinarily kept by the superintendent himself.
7. Accommodation is provided free. Medical treatment is given, and vegetables are stored in the gardens.

8. Coolies can worship according to their religion and celebrate festivals according to their customs. Schools are established for the education of their boys.
9. All implements required for the work are supplied free by the estate.
10. All labourers are entered in a list kept at the place of the Labour Commission Agent. Their relations will get news through these agents regarding them.
11. The superintendent in charge of the estate will assist the coolies as far as can in sending letters or money to the relations of the coolies.
12. Shops are on the estates or nearby. Coolies can get at cheap rates rice, vegetables and other things. The coolies are also supplied with rice by the estate.
13. Coolies could never be forced to work beyond the prescribed time.
14. Coolies and their families are well treated and care is taken of them.
15. Almost all the planters pay the passage money.
16. Assistance will be given to parents and others who wish to take back their sons, daughters and other relations. Not only this but arrangements will also be made to send them back.
17. The cooly Labour Commission does not accept coolies wrongfully. Before registering their names our agents explain to them in detail the conditions of service. The coolies who do not accept these conditions are refused at once. No false contracts are made with coolies.
18. The superintendent is ever ready to explain to their satisfaction when they are in doubt as to their accounts being correct.
19. The Ceylon Government supervises to see that no inconvenience is caused to the Indian coolies on account of the rules made by them regarding their passage and medical inspection.
20. Our agents do not admit for service children when their guardians ask for them.
21. Ceylon is a country similar to India; it is not a foreign kingdom. Since ancient times it is connected with India. No fears need to be entertained regarding the sea voyage. Rail is being rapidly constructed between India and Ceylon. Then coolies may travel hereafter by rail.
22. The Ceylon Labour Commission will take all care about labourers from the time they are admitted to the service until they are booked by the steamer. They also see that they are not robbed and no injuries caused to them.
23. If the coolies have to pay off any debt, the Labour Commission will send money to their village or to the agent nearest their homes if they so wish.

Notes

Eric Meyer is Professor of History at the Institut National des Langues et Civilisations Orientales in Paris. He has carried out extensive research on property relations and agrarian change in colonial Sri Lanka. He can be contacted at 2, rue de Lille, 75343 Paris CEDEX 07, France.

[1] Census Publications, Ceylon 1921, *Estate Statistics* (volume III), Colombo, 1924, p. 132.

[2] J. Breman, *Taming the Cooly Beast: Plantation Society and the Colonial Order in Southeast Asia*, Delhi, 1989.

[3] D. Moldrich, *Bitter Berry Bondage*, Kandy, n.d. 1988.

[4] D. Wesumperuma, *Indian Immigrant Plantation Workers in Sri Lanka, a historical perspective, 1880-1910*, Nugegoda, 1986, pp. 132-138.

[5] See E. Meyer, 'From Landgrabbing to Landhunger: High Land Appropriation in the Plantation Areas of Sri Lanka during the British Period.' *Modern Asian Studies* 26, 2, pp. 321-361.

[6] D. Wesumperuma, op cit., p. 69-74.

[7] The following description is taken from the sources listed in the appendix [Note 28].

[8] H. Tinker, *A New System of Slavery: The Export of Indian Labour Overseas, 1830-1920*. Oxford, 1974, especially p. 329.

[9] Census of Ceylon 1921, op. Cit., vo.l III, pp. 112, 129, 136-137.

[10] Census of Ceylon 1946, vol I, pp. 162-163.

[11] Ferguson's *Directory*. 1939, p. 925.

[12] The English version of one of these leaflets is reproduced in the appendix

[13] See E. Meyer, 'Enclave' plantations, 'hemmed-in' villages and dualistic representations in colonial Ceylon. *Journal of Peasant Studies* 19(3&4), p. 199-228.

[14] H.W. Cave, *Golden Tips*, Colombo, Cave, 1900, pp. 183, 189.

[15] Notably M. Roberts, 'Indian Estate Labour in Ceylon during the Coffee Period', *Indian Economic and Social History review*, III, 1 and 2, 1966; D. Wesumperuma, *Indian immigrant Plantation Workers in Sri Lanka, a historical perspective, 1880-1910*, Nugegoda, 1986; R. Kurian, *State, Capital and labour in the Plantation Industry in Sri Lanka, 1834-1984*, Amsterdam (doct. diss.), 1989.

[16] H. Mooyart, *Reminiscences*, pp. 25-26, 1863 [Peradeniya Library]

[17] See the controversy between van den Driesen and K.M. de Silva, seconded by Michael Roberts; also Donovan Moldrich, ...op. cit., pp. 85-166. On mortality after 1906, Diaries and Administration Reports of Kegalla, Ratnapura and Matale for 1906, Sessional Paper 61 of 1907, Labour Commission Report of 1908, especially the evidence for Sabaragamuwa Province.

[18] For example, the case of Hunugala Estate in SLNA 30, Kegalla diary, March 1893; and SLNA 6/9667-68, in which 40 deaths occurred in three months owing to bad treatment

[19] Ceylon, *Reports and Proceeding of the Labour Commission,* Colombo, 1908, p. 305.

[20] For example, Kegalla diary, October 1916: 'An Afghan watcher whose custom it was to visit the cooly lines [on Erracht estate] to persuade coolies to turn out for muster visited the lines as usual and pointing a gun at a woman told her to go out and threatened her to shoot her if she didn't go. He pulled the trigger and as the gun was loaded the woman received the charge in her face. There is no doubt that the act was an accidental one. The watcher appears to have been well liked' [sic]. See also R. Kurian op. cit. P. 89.

[21] R. Kurian op. cit. P. 104

[22] H. Tinker, op. cit. p. 58; the episode is unfortunately undated.

[23] D. Wesumperuma, op. cit., p. 227

[24] See R. Jayaraman, The Kaman Festival among the Tamilian Estate Labourers in Ceylon. *The Eastern Anthropologist* 19(1), 1966.

[25] P. Mason, *A Matter of Honour, an account of the Indian Army, its Officers and Men*. London, 1974, pp. 15-17.

[26] Eleanor Zelliot, Mahar and non-Brahman Movements in Maharshtra, *Indian Economic and Social History Review* VII, 3, 1970, pp. 397-416

[27] N. Krishnamurty, *Indian Journalism*, Mysore, 1966, p. 242; Gordon Johnson, *Provincial politics and Indian Nationalism*, Cambridge, 1973.

[28]Sri Lanka National Archives, Colombo. Colonial Secretariat Pending File no. 2693: Alleged Ill Treatment of Indian Coolies Employed in Ceylon Estates; Report on the Condition of Workers in the Province of Sabaragamuwa, Colombo, Government Printer, 1916 (copies available at Peradeniya University Library, Sri Lanka, and Rhodes House, Oxford).

Japanese Language Teaching at Sabaragamuwa University: A Report from a Japanese Volunteer Teacher

Kazuko Yamamoto, Japan International Cooperation Agency

Introduction

I was assigned to the Faculty of Social Sciences and Languages at the Sabaragamuwa University of Sri Lanka as a senior volunteer through the Japan International Cooperation Agency (JICA) from October 1996 to September 1997. The history of Japanese Language education at this university had started earlier with the first volunteer sent through JICA in July 1993 to what was then the Sabaragamuwa Affiliated University College until April 1996. The main purpose of sending a senior volunteer this time was to develop a syllabus for new students at the new faculty, to reconsider text books and teaching materials, and to also teach Japanese to students of the Faculty of Business Studies. I will present a short report on the Japanese Language course at the Department of Languages.

Outline of the Course

The course was taught from December 4, 1996 to April 8, 1997, to 12 Year 2 students in the Department of Languages (2 male and 10 female). Their major subject was English, their minor subject Japanese. Two lecturers, Rev. A. Wijitha and myself, shared the teaching responsibilities. Lecture hours were 6 per week, amounting to 90 hours per semester. The main text books used were:

1. Association for Overseas Technical Scholarship (AOTS). 1995. *Shin Nihongo no Kiso 1* . 3 A Corporation;
2. Japan Foundation Japanese Language Institute. 1995. *An Introduction to the Japanese Syllabary*. Bonjin Corporation.

Shin Nihongo no Kiso 1 had been used from 1993 by Sabaragamuwa University, and picture materials, the English translation, tapes and a video of this text book were donated by the Japan Foundation to this university continuously from 1993 to 1996. As some books had been distributed to the library, I decided to continue using this text book. At the beginning of my term as a lecturer I had to copy every lesson from the text book and distributed these to the students, but due to a lack of copy paper we confronted a serious situation. We decided to ask the university to make 20 copies of the main text book and to lend these out to the students.

An Introduction to the Japanese Syllabary introduces students to the writing syllabary Hiragana and Katakana.

Planning the Content

I was required to develop a syllabus for the new students at the Department of Languages, in the Faculty of Social Sciences and Languages, which had started on 4 November, 1996. All students were admitted to the second year, as they had completed a diploma programme at the Sabaragamuwa Affiliated University College, Belihuloya. For the BA programme in Languages, Japanese was offered as a minor subject. When I started to write the syllabus I had little information about the students who would select Japanese. As far as I knew at that time, they had no prior knowledge of Japanese.

© 1998 Sabaragamuwa University Journal, vol. 1, no. 1, pp.29-32

In the syllabus for these second year students, I decided to first teach the Japanese syllabary. Grammar and vocabulary would be taught by the direct method. The main text book was to be completed within one year, and *Kanji* characters were introduced as well. There were six hours of instruction per week. Teaching responsibilities were shared with Rev. A. Wijitha, who for 4 hours took charge of explaining the grammar of every lesson in Sinhala. I was in charge of the productive and practical drills, focusing on conversation and listening comprehension.

Implementing the Course

1. Orientation:

The Inauguration ceremony for the new semester was held on November 4, 1996, after which the students selected subjects, which they seemed to find rather difficult. Among the students who were interested in offering Japanese Language, there were two different groups: one had a strong motivation, the other was just interested in a language popular in Sri Lanka. Some of them were worried whether they could follow the course. Under such circumstances, we took steps to make the students aware of the situation and to relax them by explaining how we planned to teach the lessons. We described in detail the clear advantages the students could gain by learning Japanese, especially as teachers included a native speaker and Rev. A. Wijitha, a Sri Lankan who had been in Japan for about 20 years.

2. Class work content:

First, I introduced Japanese pronunciation and explained how to write and read *Hirahana* and *Katakana*. For most foreigners writing Japanese syllabary is a big problem, but as Sri Lankans are used to non-alphabetic characters, they are quicker at mastering them. I assumed that they could learn the shape and sound of two types of characters well by giving suitable exercises. The only problem in learning how to write *Katakana*, was that they faced difficulties in writing words of foreign origin. *Katakana* is used to write loan words from English, German, French and so on. Even Japanese people are sometimes not sure how these words should be written in *Katakana*. I dealt with this problem by setting limits to the amount of words which were to be introduced through the main text book.

Shin Nihongo no Kiso 1 is a sentence pattern centered book used all over the world, easy for teachers to use and easy for students to follow. There are 25 lessons. We aimed at finishing the 25 lessons in one year. As indicated above, Rev. Wijitha explained grammatical points of the lessons during 4 hours, using Sinhala as well as Japanese, and during the remaining two hours, I practiced oral drills, as well as conversation and listening skills, and comprehension of the text book. In oral drills I used only the vocabulary which the students had already learned and tried to speak only Japanese. At first, this unfamiliar teaching method caused students some confusion, but they gradually adjusted to this type of activity.

The order of activities in the classroom was introduction to new vocabulary and sentence patterns, oral drills, conversation and listening to the text book. Depending on the number of new grammatical points in a lesson, introduction to a sentence pattern and oral drills had to be done again and again within the same lesson. Using picture materials was very useful in introducing new words. Students could get the meaning of new Japanese words through visual materials without translating into English or Sinhala. After the new words, a new sentence pattern was introduced by using the words which the students had already learnt. At this time I tried not to use new words and not to translate into English. Introduction of a new sentence pattern is a very im-

portant part of class work. Teachers should prepare introductions for each new sentence pattern and should think of how best to attract the interest of the students, how to explain the appropriate situation, in which the sentence would be used and when one would select the expression. The reason why teachers should prepare introductions for each new sentence, is that teachers have to imagine students' reaction to the teacher's introductions. I had to consider, especially as I was teaching in Sri Lanka, that students have little information about Japan, Japanese culture and Japanese behavioural characteristics. At times, much information would have to be given to the students. Teachers also need to check the level of the students' comprehension. Once the introduction is done well, it is quite easy to continue with the drills.

There are many types of drills, such as substitution drill, transformation drill, completion drill, question and answer drill, and so on. Drills have been done not only between teachers and learners, but also between learners and learners. To get good results from drills, a combination of drills should be considered depending on the type of function of a new sentence pattern. Even though some drills were somewhat repetitive and simple, students did good work in the class room. I am sure, the oral drills helped the students to gain confidence and to have no hesitation about speaking Japanese.

After the oral drills the students read conversations from the text book and performed parts through role play. Students also learned non-language messages through individual performances.

In accordance with *Shin Nihongo no Kiso 1*, the following subjects were taught:

Lesson 1: Particles; position of interrogative words
Lesson 2: Demonstrative words; expression of age
Lesson 3: Demonstrative pronouns and adjectives; interrogative words asking prices
Lesson 4: *Masu* verb; expression of time
Lesson 5: Particles
Lesson 6: Volitional forms
Lesson 7: Particles
Lesson 8: Adjectives
Lesson 9: Particles
Lesson 10: Expressions of existence
Lesson 11: Cardinal numbers, ordinal numbers and auxiliary numbers
Lesson 12: Comparison between two items and among more than three items
Lesson 13: Expressions of desire

3. Examinations:

There were two course units in the Japanese minor. Two examinations were held for one semester. One was a written and the other an oral examination. In the written exam paper Japanese syllabary, *Hiragana* and *Katakana*, vocabulary, grammar, and idiomatic phrases were tested. For this first examination only, romanized characters were used. For the oral examination two types of questions were used. Students had to answer questions asked by the teacher, and also had to answer questions after reading a short paragraph.

Problems and Solutions

Two different types of problems affected Japanese Language teaching at Sabaragamuwa University. The first is due to the relatively great distance between the university and Colombo. The second problem is directly related to Japanese teaching itself.

The former problem results in a lack of information regarding the Japanese language and Japanese Studies. In the library there are only few books which have been donated by the Japan Foundation over the past three years.

In the future, for students who have completed an advanced level examination in Japanese and wish to take Japanese as a major subject, books regarding economics, political sciences, sociology and Japanese literature should be available in the library. This is a small matter, as the university can afford to acquire books and build up its resources gradually. Last year the Japanese Government donated 700 books to the public library in Colombo, so students can have access to information if they are willing to make an effort.

The other problem is that Sabaragamuwa University will face the difficult task of getting enough teachers. In 1997 the three year BA degree course started in November, and students selected Japanese as a major and as a minor. The University requires capable teachers, as Sabaragamuwa University is the second university providing Japanese Language education, the first being the University of Kelaniya. In order to maintain standards and develop resources, the university needs to gather capable teachers. Nowadays in Sri Lanka Japanese Language teachers are required to be of superior quality, because of improving levels of the learners. They should know and think about speech habits, language education, patterns of studies and so on. Teachers should design syllabuses which are suitable to the level of proficiency of the learners, motivate students during class work and give practical class activities to increase their competence and confidence. If Sabaragamuwa University could attract experienced teachers, it will produce good results in both Japanese Language and Japanese Studies.

Evaluation

I spent my time with twelve students in the Department of Languages during the first semester. At first they were surprised at the unfamiliar way of teaching but they did good work, learnt Japanese by heart, and submitted exercises for every lessons. They were very eager to speak in Japanese, even out of the classroom. I expect a great deal from their attitude. I appreciate their effort and awareness of the issues. I handed over this class to a new JICA volunteer in the second semester, who introduced some *Kanji* characters, completed the main text book and covered the syllabus.

Before leaving Sri Lanka, I gave an additional listening class for some students for about 2 months. During a total of 19 hours the *Tanoshiku Kikou 1* listening text book was completed. In every class they concentrated on listening to a Japanese tape. They had a keen sense of listening, and even only with a hint they became skilful in recognising words. This helped them to gain self-confidence and encouraged them to speak Japanese.

Finally, I had a nice time with the students during my year at Sabaragamuwa University. I appreciate the great help, cooperation and understanding of the university towards Japanese Language education. I have also learnt a lot about the circumstances of teaching Japanese Language in Sri Lanka. I hope the Japanese Language and Japanese Studies courses at Sabaragamuwa University will do well in the future.

Physics Education in Sri Lanka with Sinhala as the Medium of Instruction

Indral K. Perera, Sabaragamuwa University of Sri Lanka

Abstract

This article presents a detailed overview of physics education in Sri Lanka starting from the lower secondary school level to postgraduate research studies in the university. It begins by casting a glance at the development of general education in this island, dating back to ancient times. It highlights the adoption of the mother tongue in general, and Sinhala in particular, as the medium of instruction and also how the assimilation of technical terms in Sinhala has lead to the expansion and purification of the Sinhala vocabulary. Student performances in physics at the national G.C.E.(O/L) and G.C.E.(A/L) examinations are discussed while presenting various methods to be adopted for enhancing an interest in physics among students and the general public. Finally, it outlines physics education at Sri Lankan universities and discusses measures to be taken if we are to improve the future prospects of the Sri Lankan physicists.

Introduction

In its broadest sense it can be said that physics is a study based on understanding natural phenomena and it develops the process of logical thinking. It organizes our knowledge of the surroundings into a more orderly and an acceptable form and can successfully be employed to solve problems of practical importance to mankind.

Starting from the secondary level of education physics or as it has been quoted once by an eminent scientist (Salam, 1983) "The Queen of the Sciences", should play a significant role in the science curriculum since, by its very nature physics is a fundamental science and in the course of its development has permeated all other subjects, its study providing a unique interplay between logical and experimental disciplines. Be it the basic scientific theories, especially at a microscopic level, or the instrumentation and techniques in other sciences and/or industry, starting from the simple electric bulb to the more complex super-computers, particle accelerators, bubble chambers, electron microscopes and the remarkable lasers, that have revolutionized our world view, all have evolved from physics. In fact, as stated by Finkelstein (Zukav, 1979: 21) "physics is - among other things - an attempt to harmonize with a much greater entity than ourselves, requiring us to seek, formulate and eradicate our most cherished prejudices and oldest habits of thought, in a never ending quest for the unattainable".

The purpose of this communication is then to detail physics education in Sri Lanka, starting from the lower secondary school level to postgraduate research studies in the university. It highlights the adoption of the mother tongue in general, and Sinhala in particular, as the educational medium, replacing gradually the colonial language, English, in this multi-racial and multi-religious society of ours comprising the majority Sinhalese community (~ 73 %), Sri Lankan & Indian Tamils (~ 18 %), Muslims (~ 7 %), and others. The total population of this island which was once known as Ceylon, is at present in the region of 18.5 million people (Statistical Pocket Book, 1996: 7). In fact, Sri Lanka is its oldest name with 'Sri' as the title of respect and 'Lanka' meaning the resplendent, in both Sanskrit and Pali, the oldest languages in the Indian subcontinent (Rohanadeera, 1997).

© 1998 Sabaragamuwa University Journal, vol. 1, no. 1, pp. 33-42

As physics education has to be viewed in the context of general education and training systems in Sri Lanka, it is appropriate to begin by casting a glance at the development of general education in this country.

The Development of General Education in Sri Lanka

Educational traditions in Sri Lanka may be said to be legendary and as documented in the chronicles (Dipavamsa, 1912), it was the Buddhist monasteries that nurtured and cherished education. Some of these leading monasteries were seats of higher learning at that time and were equivalent to the present day institutions of university status (Guruge,1969). Widespread archaeological remains in the country provide sufficient evidence of numerous technological achievements that cannot be surpassed even today (Uragoda, 1995: 48 - 54). Good examples are:

1. The ancient irrigation schemes in the dry zone designed to be complete water and soil conserving eco-systems considering not only the major principles of hydraulic engineering, but, also the agricultural, social, economic and cultural aspects of the entire village community in the region (Wickramanayake, 1995: 41 - 47).

2. Massive mansions like Lowa Mahapaya and stupas like Ruwanveliseya, Jetavana, Abhayagiri and Mirisawetiya, the tallest brick edifices in the world, all requiring elaborate calculations or tedious empirical process of trial and error (De Silva, 1995: 1 - 10).

3. The manufacture of high quality iron and steel in wind powered furnaces and their use in the production of impressive surgical instruments (Mendis, 1995: 11 - 40).

These achievements bear ample testimony to the high level of knowledge of science and technology or, in the broader sense, of physics, of the ancient Sinhalese. But the knowledge of physics which existed in medieval Lanka was only acquired by a limited sect who needed to apply it in their various crafts. Very often it was handed down from father to son and was not in general, included in the curriculum of the then *pirivena* or monastic education.

The advent of the Portuguese, in the year 1505, brought about an end of an era to this tradition of monastic education in the maritime provinces which were under their jurisdiction, and the centres of learning shifted from the Buddhist monasteries to the Catholic missions. The Dutch who took over from the Portuguese in the 17th century were the first to set up a wide network of schools. Education in Sri Lanka took a turn for the better with the change of administration from the Dutch to the British in the early 19th century and though plagued with many a short comings (Vithanage, 1997: 8), the take-off point of the present school system were the recommendations made by the Colebrook Commission in the year 1831.

The Mother Tongue as the Educational Medium

Towards the latter part of the Colonial period two significant developments did take place. The first was the free education scheme initiated in the year 1945 (Sessional Paper IV, 1943), and today the state provides free education to all students from the lower kindergarten to the first degree in the university. The second was the adoption of the national languages, as the medium of instruction. This was also initiated around the same time and in the year 1950, the mother tongue became the medium in the primary schools (Educational Reforms, 1950). It was extended progressively to the secondary schools and in the mid nineteen-sixties reached some of the faculties

in the university. At present, the mother tongue is the medium of instruction for the Sinhalese and the Tamils, in almost all educational establishments including the universities, English being taught as a separate subject to all students. The other ethnic groups, however, have the option of selecting the medium including English.

This change in the educational medium from English to the mother tongue which was strictly implemented during the 1956 to the 1977 period provided an avenue for a large majority of the population to gain educational success and thereby access to career opportunities and subsequently to elite status. This policy, however, raised some important issues that needed urgent attention.

In the first instance, the national languages were not in a state to be adapted directly to modern scientific teaching. Technical terms and phrases that were peculiar to physics had to be assimilated, also leading to the expansion and purification of the Sinhala vocabulary. One such term was "*Bhauthika Vidyava*" - the Sinhala term for physics. If an attempt is made to analyse (Perera; 1986A) this term it can be stated that the word "*Bauthika*" is composed of the two words '*Bhutha*' and '*Ika*' of which *Bhutha* refers to the four elements, '*Aapo*' - water or liquid, '*Thejo*' - fire or energy, '*Vayo*'- air and '*Pathavi*' - matter or earthly elements. The Buddhist, however, would go further and analyse (Hettiarachchi; 1988) these four elements as cohesion, heat, motion and extension respectively. Thus, Bhauthika Vidyava is the study or the investigation of these primary elements. Some others (Ven Narada; 1973) extend the meaning of Bauthika to include life or the human mind, in which case it is a science that applies to all living things as well. This is remarkable, since it reflects the world view at which the modern 21st century physics is pointing.

The preparation of glossaries, dictionaries and/or technical word lists in the mother tongue were, however, not always as simple. It has sometimes been extremely difficult to coin words in Sinhala (or Tamil) for some technical terms in English. A good example is the term "LASER", which is an acronym for 'Light Amplification by Stimulated Emission of Radiation'. As the laser is an instrument that emits a highly coherent and powerful beam of light generated by stimulated emission of radiation, the English term provides an excellent description of the relevant apparatus. Though Sinhala words have been coined for each of these technical terms describing the process, to formulate a corresponding term in Sinhala that creates the same impact as the "LASER", has so far been somewhat impossible. In such instances, the usual practice has been to use a term such as "Laseraya" or "Laserya" to identify such an instrument in Sinhala. Two other examples of similar adaptations that are used very often are 'voltmeteraya' and 'ammeteraya' the accepted Sinhala terms respectively for the voltage and current measuring instruments voltmeter and ammeter.

Fortunately, this is not the case for all laboratory instruments as more refined Sinhala terms has since been formulated. "Durekshaya" and "Anveekshaya" are two such terms coined to identify the optical instruments the 'telescope' and the 'microscope' respectively. This is also true for most other technical terms in physics including those that have been formulated using abbreviations. The 'electro-motive force' or the "emf" is one such term, which students in physics encounter very often while studying basic electricity. The corresponding Sinhala term is 'Vidyuth Gamaka Balaya' or "V. Ga. Ba".

Free education and the national language policy generated a tremendous demand for education and to serve this pressing need new educational establishments had to be set up. Today, the 4.5 million or so school going children have the option of following a course of study leading up to a degree in any one of the twelve universities including the Sabaragamuwa and the Rajarata Universities inaugurated recently, in the

year 1996. These policies coupled with improved educational facilities also contributed to the growth of the literacy rate, which, though presently slightly lower, was in the region of 90% (Statistical Pocket Book: 1988: 28) and one among the highest in the Southeast Asian region in the 1980's.

The multi-faceted education system prevalent in Sri Lanka, is largely a cumulative outcome of various reforms that took place, especially since the attainment of independence in 1948. When this complex domain of education is viewed from a broad perspective three sectors can be recognised, the school system, the university system arıd the programmes that cover vocational, technical and community education needs of the people. Of these, the school system provides general education for all, comprising primary schools, junior secondary schools and senior secondary schools. It is by far the largest of all three and the school going population as a percentage of the total population has increased from 13% in 1943 to 18% in 1950 to 23% as at present. The age of admission to schools is 5 years, education being compulsory for all children under 14 years.

Physics at the Secondary School Level

In schools, the span of primary education is 5 years and at this level hardly any physics is taught. Junior secondary education extends from Grade 6 to Grade 10, where science consisting of physics, chemistry and biology is taught as a single subject to all students. In the physics component of this integrated science curriculum an endeavour has been made to furnish the students with a comprehensive knowledge of the essential principles of elementary physics. Furthermore, an attempt is also made to highlight, at every opportunity, the physical principles related to natural processes and also to sophisticated technology we encounter in day to day life.

At the end of this coürse the students are expected to sit for the national examination designated the General Certificate of Education (Ordinary Level), abbreviated as G.C.E.(O/L). At this examination up to nine subjects are offered by students with science and mathematics as separate subjects. According to statistics, only about 20 - 25 % obtain pass marks for this science paper, the student performance in its physics section being relatively poor.

A careful analysis of the answers provided by the students at these national examinations indicates that their overall understanding of the fundamental concepts in physics, the S.I. system of units and graphical representations are very poor (Controller's Report; 1985, 1993). It has also been highlighted that students in general avoid problems involving numerical calculations and also those involving practical work in physics. This study clearly indicates that at the initial stages of science education the concepts and ideas of physics have been either incorrectly presented by the teacher or wrongly understood by the students. A dilemma, as it is a major weakness of even most students who qualify to continue their studies in the sciences.

The senior secondary or the last two grades in the school system are only for students with a strong academic aptitude, the criteria for admission being based on the performance at the G.C.E.(O/L) examination. For students who intend to follow science based courses a credit pass in science or mathematics is essential. At this level, science is taught as four separate subjects chemistry, physics, botany and zoology. Physics is a compulsory subject for all students following science based courses apart from agriculture at the National G.C.E.(A/L) examination, the performance at which is the basis for selection to the universities. The physics curriculum of the G.C.E.(A/L), consisting of the usual sections like measurements, mechanics and hydrostatics, properties of matter, thermal physics, waves & vibrations, current elec-

tricity, fields and electronics, and radiation, is equivalent to that in Great Britain. The texts recommended for this course are also those recommended for the British Examination which includes Nelkon & Parker's "Advanced Level Physics" (Heinemann), together with some textbooks written in the national languages by Sri Lankan university academics. One major drawback of the local examination is the absence of physics practicals. This was introduced in the early 70's to provide an equal opportunity to students throughout the island as lack of sufficient funds has hindered the provision of laboratory facilities to most schools in the rural areas. It has, however, had a detrimental effect on the students as physics practicals may have assisted them to understand the intricacies of the subject. In addition, it has also prevented them from obtaining hands on experience with laboratory instruments.

As the system of education, examinations too were inherited from the British, but were progressively modified to adapt to the local curriculum specifications. As the numbers grew in view of the multi-language situation, Sinhala, Tamil and English, and in view of the time constraints in releasing results of the G.C.E.(A/L) examination, multiple choice and fixed response type questions were used among a few free response type questions in the question paper. The latter type which was in use earlier required detailed marking schemes leading also to a lack of uniformity in marking.

On account of the multiple languages, a problem encountered at examinations is ambiguity. The same question can give different meanings to the candidates in the three different media. This is also found in physics texts translated to Sinhala, where the exact meaning is not conveyed to the student.

Surprisingly, at this level too, even free education and the national language policy have had a little impact on student performance at public examinations in subjects like physics. During the last several years less than 40% have achieved pass marks at the G.C.E.(A/L) examination and distinctions in physics seem to be very scarce (Controller's Report; 1986 - 1988, 1992). This poor performance in physics has been an accepted feature at national examinations, and apart from zoology and pure mathematics students' achievements in the other science subjects seem to be more satisfactory. A previous study (Perera; 1987) has revealed that sections such as optics and heat are the most popular while questions based on electricity, magnetism and fields are the least attempted. It has also indicated that students are even unable to state in full most of the physical laws and definitions. Their lack of mathematical and practical knowledge may be the reason for the poor comprehension of simple applications of even the basic concepts in physics. The students in the biology stream are in general the worst affected, as no mathematics is taught at the Advanced Level. As very low priority is given to physics practicals, the situation is further aggravated. With this background in mind, we have to consider teaching physics to the first batch of students at the Faculty of Applied Sciences of the Sabaragamuwa University, where those recruited followed the biology stream at their respective schools.

It is imperative that concepts and ideas of physics should be introduced in such a way that they are correctly understood by the students, from the initial stages of education. It may be useful to find simple applications of the so-called "difficult" concepts with everyday examples that can easily be visualized by the students. To a large extent the responsibility of this task lies with the teacher. Much emphasis may have to be placed on the recruitment process of school teachers and also on organising proper in-service training programmes for them. Relearning correct ideas and concepts after being taught differently, is a difficult task for the student as there is evidence that in general, the pupil's mind is remarkably resistant to change. Therefore,

sufficient preparation is also necessary on the part of the teacher before conducting a physics class at any level.

Another important factor at this stage would be to examine the popularity of physics based courses in the university. A careful investigation carried out several years ago (Ratnasiri; 1984) has shown that, over the years, the great majority of students who score the highest marks have opted for engineering. In fact, even lowering the selection criteria has not enabled us to fill all vacancies in the physical science streams.

Physics Education - What is Wrong?

As a first step towards improving the image of physics, serious consideration should be given to curricula reforms starting from the junior secondary level, since far less prominence is given to mathematics and physics at this stage. Poor knowledge of mathematics does show up later, especially because mathematics can be regarded as "the language of physics". The professional physicist may go further and claim that quantum mechanics comprising more complex mathematics is the real language (Palmer, 1997). After all, it is well known that physical ideas can be expressed most elegantly, precisely and rigorously in mathematical terms. Another factor that requires thought is the introduction of physics practicals at the G.C.E. (A/L) examination. In the examination oriented education system of Sri Lanka, students cannot be expected to take much interest in practicals, and besides, only a few stereo-typed experiments are conducted in class. It should not be forgotten that physics is an experimental science that relies on data obtained by precise and well defined experimental methods, and then arrives at its conclusions by rigorous mathematical reasoning.

The low percentage of distinctions in physics and the large numbers of students who in general fail the physics paper at the Advanced Level examination, suggest that the physics knowledge of the average student is mediocre. This signifies that it is important to develop and to sustain an interest in this subject. This is partly the responsibility of the teacher and the best approach to be adopted would be to employ inquiry oriented teaching strategies together with experimental demonstrations or use of audio-visual aids in class. It can also be suggested that teachers occasionally deviate from text-book material and expose students to the latest developments and to the challenging and interesting world of physics. For this purpose it may be the most appropriate to select and highlight fascinating areas of physics, directly relevant to the everyday world, such as magnetism, electrical or thermal conductivity, or perhaps optical properties of materials (Chandrasekhar, 1997).

Additionally, it is important to develop an ability in students to read critically and with understanding and to think logically to express themselves coherently by written and oral means. Teaching sessions should be followed by suggestive questions by the teacher and it is necessary to encourage or provoke students to find appropriate answers. Furthermore, tutorial classes and trial examinations are essential as well.

A recent survey carried out in the United Kingdom (Van Dyke; 1997), has clearly indicated that apathy towards physics at the G.C.E. (Advanced Level) classes is not only confined to Sri Lankan students. About 25 % of the 1000 students considered in this survey replied that their physics course required too much listening and note-taking rather than been encouraged to read and discover for themselves. Some others commented that their interest in the subject related directly to the enthusiasm and the ability of the teacher. They preferred even to assist the teacher with practical demonstrations in class, as they were keen to improve their experimental technique. Almost 43 % of the students felt that more time should be spent by the teacher in discussing

basic ideas and concepts in physics. The lack of sufficient knowledge in mathematics, necessary to attain a good understanding of physics, was once again a main issue. Many students who responded felt that their mathematics knowledge was not adequate for them to cope with university level physics and wanted more mathematics to be taught at this level.

It was also interesting to note that a large majority (~ 70 %) of the students preferred traditional classical areas such as classical mechanics, classical electricity and classical wave theory, to form a substantial part of the physics curriculum while only ~ 40 % felt that it was important to include modern topics such as particle physics, electronics, applied optics and the like.

Physics in the University

Physics in the universities in Sri Lanka has developed far beyond infancy with an independent physics department in the science faculties in eight of the twelve universities. It is also taught as a service subject at the University of Moratuwa where the main emphasis is on degree programmes relating to engineering and architecture. At the other three universities physics is taught as a subject in the B.Sc. programmes offered by their respective Applied Sciences Faculties. At the university, the typical physics undergraduate course begins with traditional courses such as mechanics and properties of matter, heat and thermodynamics, optics, acoustics, E.M. theory, relativity, quantum mechanics, atomic, molecular and nuclear physics and particle physics, etc., and then move on to more applied fields such as electronics, applied electricity, laser physics, space and earth physics and the like. Of a total university student population of about 55,000, less than 2500 read physics for the B.Sc.(General) degree examination, the best being selected to follow the B.Sc.(Special) degree course in physics. Such special degree programmes are conducted in almost all established departments in the science faculties and the mode of selection varies from university to university. Some universities select students after their first year examination, some after the second year, and some after they complete their general degree. The special degree course is of four year duration and the total number of students following such courses in physics is less than 80 in all establishments, the pick of them being recruited to the university staff.

It is interesting to note, however, that the intake into special degree courses in chemistry, botany and zoology is quite substantial. The standards of the Sri Lankan B.Sc. special degree programmes are equivalent to those in Great Britain and in other western countries. To maintain standards, some departments have senior academics from western countries serving on their examination boards. With regard to the language media most of the general degree courses are conducted in the mother tongue, though the students have the option of following English medium lectures. The special degree courses are mainly conducted in English.

The constraints imposed by the lack of adequate laboratory facilities and necessary funds, together with the shortage of skilled technicians, have inhibited the growth of research and development activities in physics. Nevertheless, a few of the universities conduct research programmes leading to Ph.D. degrees, some with assistance from foreign universities and funding agencies. The accepted practice is to send young academic staff members abroad for post graduate qualifications, a requirement to be confirmed as a university lecturer. As a result, there is an acute shortage of mature physicists in the country, the total number being limited to about 80 holding Ph.D. degrees.

Physicists in Sri Lanka - The Scope

Today the physics based courses are at a very low ebb in popularity in Sri Lanka. This fact has been highlighted at the stage of university admissions and also when selections are made for the special degree courses. This may be in keeping with the manpower requirements of our country. For instance, over the past few years the employment of physics graduates in industry, whether public or private, has been virtually zero, though there had been instances when such graduates had been recruited, along with others as management trainees. Thus, the only avenue open for them is the academic sphere or more specifically, the university or the research establishments in the country. This is surprising, as physics is a field that has permeated into almost all other sciences and has brought about revolutionary changes in all facets in research and day to day life and is now in the forefront of the ever so important high-tech industry.

To begin with, the perfection of mechanics coupled with hydro- and aero-dynamics, thermodynamics and material sciences, have lead to the development of engines, turbines, motor vehicles and aircrafts. In addition, the development of electrical machinary, nuclear reactors and the know-how leading to the various power stations, that can be considered as the remaining features of energy technology may not have been possible without a thorough knowledge of electro-magnetism and nuclear physics. Besides, this 'era of information' may not have dawned if not for physics. It was the enormous progress in Solid State physics in general, and semi-conductor physics in particular, that showed us the way to the transistor. Consequently, the birth of the transistor coupled with electro-magnetism, semi-conductor physics and quantum mechanics have provided the basic foundation necessary for the development of devices like the telephone, telefax, telegraph, the radio, the television, the computer, and also numerous other measuring instruments. These coupled with the appearance of the Laser, which was brought about by arduous and meticulous research into basic phenomena in optics and quantum mechanics, heralded the 'photonics age' in the West. At the very early stages, the fascinating properties of the laser even excited the imagination of the scientist, and was termed "the solution looking for a problem". But today after many years of its discovery it has proved its worth by invading almost all areas of science and technology, the manufacturing industry, the biological and biomedical technologies, and long distance communication systems (optical) with a wide range of applications (Perera, 1986B). In fact, so dramatic are the advances brought about by the many applications of physics in various spheres of human endeavour, glimpses of the future range from apocalyptic visions of space warfare with laser guns, the high precision needed for operation provided by sophisticated electronics technology, to idyllic presentations of life styles with robotic house maids and butlers at home (Perera, 1988).

So at a time when the fast moving laser photons are even replacing electrons in high performance electronic devices paving the way for the 'optical super computer', we in Sri Lanka are far behind as we have been rather slow in keeping pace with the explosive growth of physics and its applications. This is particularly true with regard to the associated basic sciences, which we have pursued in only a marginal way, as contrasted to the various technologies themselves. It has widely been felt that instead of pursuing the same rigorous and costly processes the developed nations had passed to achieve the present state of technological and economic development, we can acquire their knowledge and skills through the transfer of technology alone. In many developing nations such an attitude has proved naive, simplistic and also overly optimistic. Such leap-frogging into advanced technology without the transfer or the development of a good base in sciences would not in anyway realise any benefits to our

society. It would in fact, be like a child skipping adolescence to leap into adulthood. Rather, the best approach would be to develop basic sciences locally, as otherwise it would be impossible for us to cope with newer advances made elsewhere in physics.

It is essential to comprehend that basic sciences in general, and physics in particular, hold the key to development. It is true that the associated technologies are capital intensive. But then the so-called labour intensive appropriate technologies pursued in our country are inefficient and have only limited success. This lamentable situation has arisen more because of a lack of constructive science and socio-cultural policy and a neglect of value systems, rather than because of a shortage of financial resources only. In Sri Lanka, 'physics for development' is not an acceptable theme. It is so unacceptable that even today physicists are a neglected lot. It is indeed disheartening to realise that junior academics pursuing physics or related fields are not even considered when presidential scholarships are awarded for higher studies. This is surprising, as Physicists hardly need special training for industrial research or for that matter other positions of importance. If at all they need some training, it would be in the form of a short apprenticeship to acquire the necessary additional skills that may be needed for them to fit into a particular work environment.

A clear policy with the objective of producing physicists of international eminence and of outstanding ability is urgently needed in our country. They should be the leaders in their disciplines. The importance of such a policy is demonstrated by the large number of physics graduates, some Sri Lankans, employed in various sectors abroad. Their training should be sufficient to handle whatever aspects in the local industry. In fact, they should be the ones who should be responsible for rapid and revolutionary changes in the way of life of the Sri Lankans.

Note

Indral K. Perera is Professor of Physics and Head, Department of Physical Sciences, Sabaragamuwa University of Sri Lanka. He can be contacted at the Department of Physical Sciences, Uva Campus, Sabaragamuwa University of Sri Lanka, Buttala, Sri Lanka.

References

Chandrasekhar, B. S. 1997. *Why Things Are the Way They Are*. Cambridge: Cambridge University Press.

Colebrook Commission. 1931. *Colebrook Commission Report*. Colombo: Government Press.

Examination Department. 1985. *Controller's Report: The National G.C.E.(O/L) Examination*. Sri Lanka.

Examination Department. 1993. *Controller's Report: The National G.C.E.(O/L) Examination*. Sri Lanka.

Examination Department. 1986 - 1988. *Controller's Report: The National G.C.E.(O/L) Examination*. Sri Lanka.

Examination Department. 1992. *Controller's Report: The National G.C.E.(O/L) Examination*. Sri Lanka.

Examination Department, Sri Lanka.

De Silva, T. K. and P. Nimal. 1995. Scientific principles reflected in our ancient ruins - production of arts and architecture. In *Sciences Education Series No. 36*, Colombo: Natural Resources Energy and Science Authority.

Geiger, W. (ed.) 1912. *Dipavamsa and Mahavamsa*. London: Pali Text Society.

Educational Reforms. 1950. *Ceylon Government Proposals*, Parliamentary Series, Fourth Session of First Parliment, No. 2.

Guruge, A. W. P. 1969. *Education in Ceylon, Centenary Volume - Part 1,* Ministry of Education, Sri Lanka. Chapter 10.

Hettiarachchi, S. B. 1997. Sri Jayewardenepura University, Sri Lanka, , (Private Communication).

Mendis, D. L. O. 1995. *Scientific principles embodied in the evolution and development of the ancient water and soil conservation ecosystems,* in Sciences Education Series, *No. 36,* Natural Resources Energy & Science Authority, Colombo, Sri Lanka, 11 - 40.

Palmer, S. and Palmer. K. *Three Pieces to Sweeten Physics, P*hysics World, 10, 48.

Perera, I. K. 1986 a. *Teaching of physics in Sri Lanka,* International Conference on Communicating Physics, University of Duisberg, Federal Republic of Germany (Unpublished).

Perera, I. K. 1986 b. *The Laser - 25 Years of Development,* Vidyodaya J. Arts, Science & Letts., 14, 103.

Perera, I. K. 1987. *Performance of Students in physics at the National G.C.E.(A/L) Examination,* Regional Conference on Secondary School/ University physics Interface, Colombo, Sri Lanka (Unpublished).

Perera, I. K. 1988. *Sri Lanka in the Year 2015,* First Annual Sessions ofthe Organisation of Professional Associations (OPA), 1, 110.

Ratnasiri. P. A. J. 1984. *Section E - Presidential Address,* Proc. Sri Lanka Association for the Advancement of Sciences. 40 (2), 63.

Rohanadeera, Mendis. 1997. Sri Jayewardenepura University, Sri Lanka (Private Communication).

Salam, Abdus. 1983. *Development: the Human Dimension,* Inaugural Sessions of the Roundtable Conference, Islamabad, Pakistan, Internal Report, IC/PD/6, International Centre for Theoretical physics, Trieste, Italy.

Sessional Paper IV. 1943. *Special Committee Report on Education*, Ministry of Education, Colombo, Sri Lanka.

Statistical Pocket Book. 1996. Democratic Socialist Republic of Sri Lanka, Department of Census & Statistics, Ministry of Finance and Planning, Colombo, Sri Lanka, 7.

University Year Book. 1997. University Grants Commission, Colombo, Sri Lanka.

Uragoda, C. G. 1995. *The ancient soil and water conservation eco-systems of Sri Lanka,* in Sciences Education Series, *No. 36,* Natural Resources Energy & Science Authority, Colombo, Sri Lanka, 48 - 54.

Van Dyke, E. 1997. *A-Level Physics - do students like or loathe the subject,* Physics World, 10, 60.

Ven Narada Maha Thero. 1973. *Teachings of the Buddha,* Colombo Apothecaries Press, Colombo, Sri Lanka.

Vithanage, Gunaseela. 1997. *What S. W. R. D. Bandaranaike's language policy achieved*, The Island, 8th October, 8.

Wickramanayake, V. E. A. 1995. *The ancient soil and water conservation eco-systems of Sri Lanka,* in Sciences Education Series, *No. 36,* Natural Resources Energy & Science Authority, Colombo, Sri Lanka, 41 - 47.

Zukav, Gary. 1979. *The Dancing Wu Li Masters,* Suffolk, Chaucer Press Ltd.

Information Sources of the Tea Small Holdings Sector in Sri Lanka

Rohana P. Mahaliyanaarachchi, Sabaragamuwa University of Sri Lanka

Abstract

The low levels of adoption of improved technologies in tea small holdings may be a factor responsible for not reaching optimum production levels. This situation is caused among other factors, by weaknesses and lapses in the dissemination of information to tea small holders. Research was carried out by using a combination of a cross-sectional survey and case studies. Primary data was gathered from field studies on the tea small holdings sector. A total of 317 farmers were interviewed. Analysis was done mainly by using CATMOD and χ^2 statistical analytical methods. In the tea small holdings sector a formal information source, the extension officers of the Tea Smallholdings Development Authority (EO/TSHDA), has become the most available and useful information source. The second most available information source for tea small holders are neighbouring small holders. This, however, has been ranked fifth regarding overall usefulness. For formal sources availability and understandability are important characteristics for their overall usefulness, while for informal sources trustworthiness of the source and relevance of the information supplied are considered important.

Introduction

The total registered area under tea cultivation in Sri Lanka is 192,524 ha. of which about 45.7 percent are accounted for by the small holdings sector (Bandara, 1994). The total tea production in the island has been fluctuating around an average of 200 - 240 million kg, during the last 10 years. Out of this production over 50 percent has come from the tea small holdings sector. In 1991, 1992 and 1993 the percentages of contributions to local production from the small holdings sector were 50.3, 53.05 and 54.05 respectively (TSHDA, 1994). The estimated cost of production of made tea in the small holdings sector was around Rs. 55/kg., while it was around Rs. 75/kg. for the estate sector. The average Colombo Auction price for made tea in 1993 was Rs. 68.88/kg. (Bandara, 1994). The average estimated yield in the small holdings sector for 1993 was about 1500 kg/ha. (Bandara, 1994). The average yield in the estate sector is around 1000 kg/ha/year (Ministry of Plantation Industries, 1993). However, according to the tea small holdings sector experts, viz. Deputy General Manager (Extension) of the TSHDA and former General Manager of the TSHDA the optimum average yield could be about 2400 kg./ ha.

In this paper I will focus on the following research problem. Considering the cost of production and yields received, the tea small holdings sector has greater potential than the estate sector for expansion and improvement. The low levels of adoption of improved technologies in tea small holdings may be a factor responsible for not reaching optimum production levels. One important reason among others may be weaknesses and lapses in the dissemination of information to tea small holders.

The objectives of this study are as follows:

1. To identify the information sources used by farmers and their relative usefulness.
2. To ascertain significant characteristics such as availability, amount, relevance, timeliness, understandability, trustworthiness of the information disseminated to farmers.

© 1998 Sabaragamuwa University Journal, vol. 1, no. 1, pp. 43-51

For this research, a stratified random sample of tea small holdings was drawn from the 1983 Tea Small Holdings Sector Census Report. The Divisional Secretary's (former Assistant Government Agent) division was considered the primary sampling unit. Stratification was done on the basis of geographical distribution of tea small holdings. The survey was conducted in Kandy, Matara, Nuwara Eliya and Badulla districts which represent all the categories of tea small holdings in Sri Lanka. Three kinds of questionnaires, for extension officers (EO), tea small holders and research officers of Tea Research Institute (TRI), were designed by the researcher. During the initial stages of the field work, the questionnaires were pre-tested to ascertain whether the intended information could be obtained without any problems. Based on the pre-testing, necessary changes were made in the questionnaires.

Mainly, primary data which was gathered from field studies on the tea small holdings sector was used. A total of 317 farmers were interviewed. There were only 4 EOs from TRI and 61 EOs form TSHDA. The EOs were interviewed by the researcher himself. Apart from the cross-sectional survey method to collect information, a case study with six small holders was carried out.

Data analysis was done mainly by using CATMOD and χ^2 statistical analytical methods.

Results and Discussion

Ten information sources can be listed as being generally used by tea small holders. The researcher identified these sources by using his own experiences and observations, and by consulting with extension experts in tea small holdings sector. The information sources are EOs of TSHDA, EOs of TRI, higher officers (HO) of plantations, radio, news papers, news bulletins, sales representatives/ merchants of commercial firms, leaf collectors, labourers of nearby plantations and neighbouring small holders. The characteristics of these information sources and their usefulness to tea small holders were examined in this study.

Six characteristics of the information source were tested. They were availability and trustworthiness of the source, and the amount, understandability, relevance, and timeliness of the information supplied.

1. Availability:

Availability of information sources is the accessibility of the information source, whenever information is needed by the small holder. Highest availability is reported for EO/TSHDA (53.6 percent at anytime and 35.0 percent at sometime) with a weighted mean score of 2.2. This is the major formal information source available to tea small holders. The study of cases I,II,IV shows the EO/TSHDA as the major information source. These are the most successful farmers among the six case studies. Sivayoganathan(1982) reported that agricultural extension workers were an important source of information in the adoption of selected rice production practices among farmers in Anuradhapura District, although under the training and visit (T&V) system of extension, the contact farmers were expected to serve as the primary source of information to non-contact farmers. He further pointed out that availability of the source accounted for the largest proportion of explained variability in the perceived relative usefulness. Jayasena and Herath(1986) recorded in their study, that EOs of the rubber sector were the main available source of information to rubber small holders. Experiences of Vanuatu Island also showed, that field extension officers were the major source of information to coconut farmers (Lewis, 1984).

The second most available source are neighbouring farmers (8.2 percent at any time and 35.3 at some time) with a weighted mean score of 1.51. In fact, Sivayoganathan (1982) found that contact farmers (CF) were the second most available and useful information source. Jayasena and Herath (1986) also noted that in regard to availability, neighbouring small holders were recorded in second place. It is interesting to note, that formal interpersonal information sources are perceived as the most useful, followed by neighbouring farmers (informal) as the second. Mass media, both news bulletins and radio, were recorded in third place. Availability of a radio was reported by 36.9 percent (4.4 percent at any time and 32.5 percent at some time), and that of news bulletins by 33.3 percent (8.5 percent at any time and 25.9 percent at some time). However, of the six cases only one small holder listened to the radio. In the above mentioned studies mass media also received the third place in terms of usefulness.

Workers on nearby plantations serve as an information source to 28.7 percent (5.7 percent at any time and 23.0 percent at some time). For pruning and plucking most of the small holders use hired labourers from nearby plantations. The reason for the low appreciation of plantation workers as an information source may be that most of the small holders do not consider them trustworthy. However, according to the case studies two informal sources are available to the small holders at any time.

Availability of the other five sources was very low. Extension officers of TRI don't seem to pay adequate attention to small holders. The case studies have shown EO/TSHDA, neighbouring small holders, plantation workers, and news bulletins as the main available information sources. Radio is the only exception. The remaining five characteristics are described for these five sources only.

2. Trustworthiness:

Trustworthiness can be described as receiver's acceptance of and reliance on an information source. Three formal information sources, EO/TSHDA, radio and news bulletins have high scores for trustworthiness. Of the respondents, over three-fourths trusted these sources very much. The two informal sources have lower trustworthiness. About three-fourths of respondents assigned low trustworthiness to these sources.

These results show that, farmers trust formal sources more than informal ones. The case studies confirm, that successful farmers consider formal sources more trustworthy than an informal ones (cases I,III, IV).

3. Amount of technical information supplied:

The amount of information supplied to the small holders depends on the availability of the source (frequency and duration of the contact) and knowledge level of the information source. Small holders get most information from EO/TSHDA. In fact 88.8 percent reported receiving information from these sources (54.1 percent substantial and 34.7 percent some). The other four information sources do not seem to differ very much with respect to the amount of information supplied by them.

4. Understandability:

Understandability is defined as the ability of the receivers to understand the information disseminated by the source. The understandability of a source depends on several factors, such as language, jargon, use of audio-visual teaching aids, and simplicity of the message. According to the information given by extension officers of TSHDA, 58.5 percent used farmer's language without complex technical words and 41.6 percent used complex technical words to some extent.

Information disseminated by EO/TSHDA had the highest level of understandability, followed by news bulletins. 68.2 percent of respondents reported very good understandability for EO/TSHDA, while the corresponding percentage for news bulletins was 63.5. Among informal sources, neighbouring small holders and plantation workers were ranked third and fourth respectively. Radio was ranked lowest. This is so, because farmers cannot listen repeatedly, if they do not understand a message immediately. They cannot stop the program and go back to the point that was not quite understood or heard properly, and after the broadcast there is nothing to remind the farmer of the information heard (Oakley & Garforth, 1985). Another reason would be the casual way in which people generally listen to the radio. They often listen while they are doing something else. For this reason radio is not a good medium for putting across long, complex items of information.

5. Relevance:

Relevance means suitability of the information for the purposes of the small holders. Relevance of information depends on quality of the content, timeliness, suitability and applicability of the message. Information disseminated by the three formal sources, EO/TSHDA, radio, and news bulletins was considered relevant by the small holders. Information disseminated by the two informal sources, however, was not considered to be highly relevant.

6. Timeliness:

Timeliness is dissemination of information at the required time. Timeliness of the transmission of the information in agricultural activities is very important, because these activities are very closely time-bound. Hence for most of the agricultural activities, information should be conveyed before the onset of the season. In tea cultivation for most of the activities such as fertilizing, pruning, pest and disease management technical information should be disseminated before the season. For some routine practices like plucking which is carried out continuously information can be disseminated at any time.

Most of the respondents reported receiving the information from the sources examined either before or during the season. The majority indicated that EO/TSHDA and news bulletins supplied information before the season, whereas the radio and the other two informal sources, supplied information during the season.

7. Overall usefulness:

Overall usefulness of the information source depends on the combination of characteristics such as availability, understandability, relevance etc., as examined earlier. The EO/TSHDA was perceived by the small holders to be the most useful information source; 64.1 percent rated it as very useful. Previous studies by Sivayoganathan (1982) with paddy farmers, Jayasena & Herath (1986) with rubber small holders, and Lewis (1984) with coconut farmers in Vanuatu Island have also shown official information sources as the most useful for the farmers. The case studies also reveal EO/TSHDA as the most useful information source in most cases. The mass media sources news bulletins and radio were rated second and third in terms of usefulness.

Usefulness of the informal sources such as neighbouring small holders and plantation workers, was lower than the three formal sources. But, nearly 90 percent of the respondents reported that these informal sources were still useful to them. The case studies clearly show that the usefulness of the information of the informal sources is high, when used in combination with formal sources.

The Relationship between the overall Usefulness of Information Sources and their Characteristics

A chi square test was used to analyse the relationship between the overall usefulness of information sources and their particular characteristics.

1. EO/TSHDA:

The overall usefulness of the EO/TSHDA as an information source to tea small holders is positively related with it's availability, trustworthiness, amount of information, understandability, relevance and timeliness. Cramer's v correlation coefficient indicates that all these characteristics have strong relationships with overall usefulness. If the message is not relevant and is not understood well, then such information is not useful to the farmers. Consequently, the source of the message is also considered not useful, because the message is a product of the source.

The overall usefulness of the EO/TSHDA as an information source has a strong relationship with availability, understandability and relevance. The following three models were developed and tested by using log linear model (model with three variable interaction) of CATMOD:

Model 1:

Overall usefulness x availability x understandability

df=1 G^2= 0.07 p=0.7813

Model 2:

Overall usefulness x availability x relevance

df=1 G^2= 0.07 p=0.0495

Model 3:

Overall usefulness x relevance x understandability

df=1 G^2= 0.06 p=0.7875

The analysis of variance shows that the main effect models fit since the likelihood ratio (G^2) test for three variables is not significant. The overall usefulness of the EO/TSHDA can be explained by using the above models. Interaction of availability, relevance, and understandability is related to the overall usefulness of EO/TSHDA as an information source.

The EO/TSHDA is not always available to the small holder due to the heavy work program of these officers. They have to pay more attention to non-extension work such as subsidy inspections. An EO/TSHDA has to cover about 1500-2000 small holders, so that he can spend only very limited time with a small holder for extension activities (Mahaliyanaarachchi, 87-95). Hence, availability is an important factor for the overall usefulness of the EO/TSHDA as an information source to the small holders. The case studies also show that wherever availability of the EO/TSHDA was high, his overall usefulness was also high (cases I,III,IV) and vice versa (cases V,VI).

As the major source of technical information to the small holders, messages given by the EO/TSHDA should be relevant to the farmer. Still 41.6 percent of EOs/TSHDA are still using complex technical words to some extent. It is very important for an EO/TSHDA to speak in the farmers' language as far as possible, to help small holders understand complex technical information.

2. Radio:

The overall usefulness of the radio as an information source to tea small holders is positively related with it's availability, trustworthiness, amount, understandability, relevance and timeliness. Cramer's V correlation coefficient indicates that understandability and relevance show high relationships with overall usefulness.

Farm radio broadcasting will be attractive to farmers only if it is topical and relevant to their problems and broadcast at times convenient to the farmers. The information should not only be relevant but should be easily understandable to the farmers with short and clear messages. It is very important to speak in everyday language and repeat the main points carefully, to help the listeners to understand and remember (Oakley & Garforth, 1985).

Understandability and relevance which are highly related with overall usefulness of the radio have been used to develop a model. It was tested by using the following log linear model (model with three variable interaction) of CATMOD.

Model:

Overall usefulness x relevance x understandability

df=1 G^2= 0.90 p=0.3416

The analysis of variance shows that the main effect model fits since the likelihood ratio (G^2) test for the three variable interactions is not significant. While the main effects model fits, overall usefulness of the radio is strongly related with the interaction of its understandability and relevance.

3. News bulletins:

The overall usefulness of the news bulletins as an information source to tea small holders is positively related with its availability, trustworthiness, amount, understandability, relevance and timeliness. Cramer's V correlation coefficient indicates that the availability and understandability have high relationship with the overall usefulness. The amount of the information and its timeliness show medium relationships.

Printed media can combine words, pictures, and diagrams to convey accurate and clear information thus increasing the understandability of the message. Their advantage is that they can be referred to again and again. This makes the bulletins an ideal source as permanent reminders of extension messages. Anyhow, these can only be useful, if a reasonable proportion of the user population is literate. Furthermore, printed media depend on a reliable distribution network (Oakley & Garforth, 1985).

In the case of news bulletins, availability and understandability are the independent variables strongly related with overall usefulness. The model developed by using the above variables shows that the main effect model fits since the likelihood ratio (G^2) test for the three variable interaction is insignificant at the level of 0.05.

Model :

Overall usefulness x availability x understandability

df=1 G^2=0.06 p=0.8128

The overall usefulness of the news bulletins as an information source significantly correlates with availability and understandability.

Out of the six case studies only two (case I and IV) received information from news bulletins. This is mainly because they are not published regularly and not distributed in time. This is why in most of the cases news bulletins were not identified as useful.

4. Neighbouring small holders:

The overall usefulness of the neighbouring small holders as an information source to tea small holders is positively related with trustworthiness, amount, understandability, relevance and timeliness. Only availability has no relationship. This may be because unlike other sources neighbouring farmers are always available to be contacted. Sivayoganthan (1982) found that availability has not shown a significant relationship with the usefulness of the other farmers as an information source.

Cramer's V correlation coefficient indicates that relevance and trustworthiness of the information source have a high relationship with overall usefulness. Understandability poses no problem, because small holders share the same language and idiom and do not use unfamiliar jargon. Timeliness is not a problem because neighbouring farmers are available at any time.

Among neighbouring small holders, trustworthiness and relevance are independent variables highly correlated with the dependent variable. The main effects model fits since the likelihood ratio (G^2)test for the three variable interactions is insignificant.

Model :

Overall usefulness x trustworthiness x relevance

df=1 G^2=0.06 p=0.8063

The overall usefulness of the neighbouring small holders as a source of information is greatly related to the interaction of its trustworthiness and relevance.

One extension officer has to cover about 1500-2000 small holders. So, it is not easy if not impossible for the EO to make close contacts with each and every small holder. Therefore, attempt should be made to multiply the efforts of the extension officer through neighbouring farmers. On the one hand it may be economical and on other hand it may be more rapid and successful.

5. Plantation workers:

The overall usefulness of plantation workers as an information source to tea small holders is positively related to trustworthiness, amount and relevance. Cramer's V correlation coefficient indicates that overall usefulness is strongly related to trustworthiness and relevance. By using these two variables a model has been developed.

Model:

Overall usefulness x trustworthiness x relevance

df = 1 G^2 = 0.01 p = 0.9309

While the analysis of variance shows that the likelihood ratio test for the three-variable interaction is not significant, the main effects model becomes the best fit model. So the interaction of trustworthiness and relevance relates to the overall usefulness of the workers of plantations as an information source to the small holders.

Conclusion

In the tea small holdings sector, the EO/TSHDA as a formal information source has become the most available and useful information source. Most of the previous studies done in other sectors in agriculture in Sri Lanka have shown a similar trend. In both the plantation and domestic food crop sector, involvement of government bodies has increased especially after independence. Consequently farmers seek most assistance, including information, primarily from government officials, so that official flow of information has dominated the information dissemination system. The second most available information source for tea small holders are neighbouring small holders, which have, however, been ranked fifth regarding overall usefulness. Farmers consider trustworthiness and relevance of the source in relation to overall usefulness, and not only availability. Small holders trust formal information sources more than informal sources, and consider information disseminated by formal sources more relevant.

The overall usefulness of formal sources is strongly related to availability, understandability and relevance. Since, farmers consider relevance of the information in relation to overall usefulness whatever be the sources, extension officers should consider this factor, while they plan extension programs. Relevance means that the innovations should be suitable for farmers. For formal sources availability and understandability are important characteristics for their overall usefulness while for informal sources trustworthiness of the source and relevance of the information supplied are considered more important.

More than half the small holders seek more technical information. Small holders prefer to receive information from the EO/TRI. This may be because they know that the EO/TRI has close and direct contacts with researchers of the TRI. Therefore, the small holders expect these officers to have valuable and the latest information. Feedback to research from the farmers is an important process in agricultural development. However in the tea small holdings sector it is very poor. Further, research findings are not tested and adapted to the conditions of the small holdings sector. It is necessary to test suitability of innovations to the small holdings. Testing will help increase the effectiveness of the information dissemination process.

Communication linkages in the tea small holdings sector are an important component in the dissemination of technical information. The dissemination process should not be complicated and/or lengthy, because if the length of the communication chain is increased distortion and losses tend to occur (Wijeratne,1988).

Some of the communication chains are as follows:

1. TRI(RP) → EO(TSHDA) → Tea Small Holders
2. TRI(RP) → HO(Plantations) → Labourers of Plantations → Tea Small Holders
3. TRI(RP) → EO(TSHDA) → Tea Small Holders
4. TRI(RP) → EO(TSHDA) → Radio → Tea Small Holders
5. TRI(RP) → EO(TSHDA) → News Bulletins → Tea Small Holders

The above communication links are not long and complicated. There are only two or three steps in each chain, and the occurrence of distortion and losses in the information dissemination process would be minimal.

With respect to the diffusion of information and innovations, the communication networks or the structures of patterned flows of information between interconnected individuals both vertically and horizontally, are important (Sheridan, 1981). The study of communication networks is especially important, because once information regarding an agricultural innovation enters a social system, the diffusion process occurs mainly through interpersonal communication (Yadev, 1967). This study has found, that neighbouring small holders and workers of adjacent plantations are important sources of information to tea small holders, although they are secondary to formal sources.

Note

Rohana Mahaliyanaarachchi is a Senior Lecturer and Head, Department of Agri Business Management at Sabaragamuwa University of Sri Lanka. He can be contacted at the Faculty of Agricultural Sciences, Uva Campus, Sabaragamuwa University of Sri Lanka, Rahangala, Boralanda, Sri Lanka.

References

Bandara, S.M.J. 1994. *Report of the baseline survey of tea small holdings*. Ministry of Public Administration, Parliamentary Affairs and Plantation Industries, Colombo.

Jayasena, W.G and Herath H.M.G. 1986. *Innovation, receptivity and adoption in rubber small holdings of Sri Lanka*. Agrarian Research & Training Institute, Colombo.

Lewis, J. 1984. *Getting the message to the people*. Agricultural Information Development Bulletin, 6(3), 9-10.

Mahaliyanaarachchi, R.P. 1987-1994. Personal experiences. TSHDA, Sri Lanka.

Oakley, P. and Garforth, G. 1985. *Guide to extension training*. Food and Agriculture Organization, Rome.

Sheridan, M. 1981. *Peasant innovation and diffusion of technology in China*. Ithaca, New York.

Sivayoganathan, C. 1982. *Importance of contact farmers as a source of information in the adoption of selected rice production practices among farmers in Anuradhapura district, Sri Lanka*. Ph.D. thesis, Texas A & M University.

Tea Small Holdings Development Authority. 1994. *Annual report for the year 1993*. Colombo.

Wijeratne, M. 1988. *Farmer, extension and research in Sri Lanka*. Ph.D. thesis, Wageningen, Netherlands.

Yadav, D. P. 1962. *Communication structure and innovation diffusion in two Indian villages*. Ph.D. thesis, Michigan State University.

Computer Modelling of Noise Transmission

R.G.N. Meegama, Sabaragamuwa University of Sri Lanka

Abstract

One of the causes of noise pollution is sound generated by machinery in various industries. Before the commencement of construction of an industrial plant, it is necessary to conduct an Environmental Impact Assessment (EIA) study to analyse the effect of noise on the neighbouring community. In this article, a computer model is presented to predict the level of noise pollution due to a proposed industry.

Introduction

In this paper a computer model is developed, that could be used to predict the distribution of noise levels due to a proposed industry and provide useful advice on mitigation measures.

This study was carried out under the sponsorship of the National Building Research Organisation (NBRO), a state institute concerned with research on environmental pollution in Sri Lanka. It carries out air and water quality surveys as well as noise measurements in existing industries. These measurements are used by the government to issue environmental licences. The data are also used for research activities at the NBRO.

The activities of the NBRO include taking measurements and accumulating data on air dispersion and noise. These data are then used for computer modelling. Initially, a noise level meter was calibrated to estimate the existing noise levels in an industry. Then measurements were taken, and the data stored in an IBM PC for analysis. The NBRO has used this computer model in several case studies and found that the values of noise levels obtained differ with the actual values only by a small margin.

Research Method

At the initial step, noise transmission in the open air with attenuation factors were taken into account. During field visits to various industries the levels of noise generated were recorded. Industries situated in urban, semi-urban and rural areas were selected, in order to consider differences in ambient (background) noise levels. The data accumulated was programmed in a computer using Pascal (Radford Arthur S.,1983), according to a structured programming methodology (Donovan John J.,1988)

1. Noise from a single source:

When a sound source is placed at a point S, the noise generated at point P situated at a distance r from S can be calculated using the following equation (Cheremisinoff, 1989:45):

$$L_p = L_s - 20*\log(r) - 8$$

where Lp = sound pressure level at P in dB(A)

Ls = sound pressure level of the source in dB(A)

r = measured distance in metres.

© 1998 Sabaragamuwa University Journal, vol. 1, no. 1, pp. 53-59

The above equation provides only the theoretical noise level due to S. In order to get the actual noise level at P, the ambient noise in the area around P has to be considered. If the noise is tonal or impulsive, 5 dB(A) should be added to the final result.

2. Noise from multiple sources:

When several sound sources are placed at points S_1, S_2, S_3, ..., S_n (Figure 1), the noise generated at point P is calculated according to the following algorithm (Bernack L.L.,1971):

a. Get the sound pressure level of the first two sources.

b. Calculate their difference.

c. Add a pre-defined value (see Table 1) depending on the difference to the larger.

d. Repeat the above steps until all the sources are processed.

Figure 1: Multiple Sources

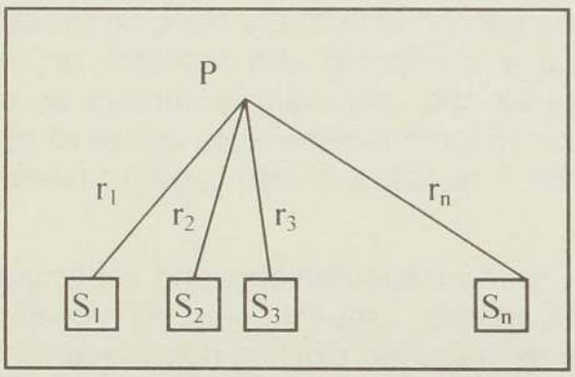


Table 1: Resultant Noise of Two Sources

difference dB(A)	value to be added
0	3.01
1	2.54
2	2.12
3	1.76
4	1.46
5	1.19
6	0.97
7	0.79
8	0.64
9	0.51
>=10 and <15	0.41
>=15 and <20	0.14
>20	0.04

3. Noise from a movable source:

A single source is operated at points S_1, S_2, S_3,....., S_n situated at distances r_1, r_2, r_3,....., r_n from P respectively. The source is in operation for h_1, h_2, h_3,....., h_n hours at those locations (Figure 2).

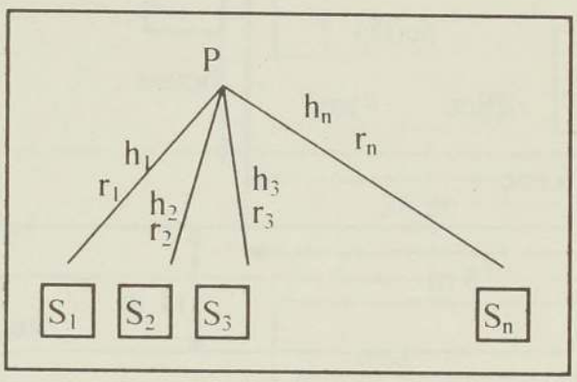
The average noise generated at P due to this movable source is calculated according to the following steps (Wabramann C.G.,1975):

a. $$S = \sum_{i=1}^{n} h_i * \exp((r_i/10)*2.3025)$$

b. $L_p = S/T$

where Lp = the theoretical noise level at P and T = total working hours per day.

Figure 2: Continuous Single Source



The following assumptions have been made in performing the calculations in the above three cases:

a. There is no sound attenuation between S and P.

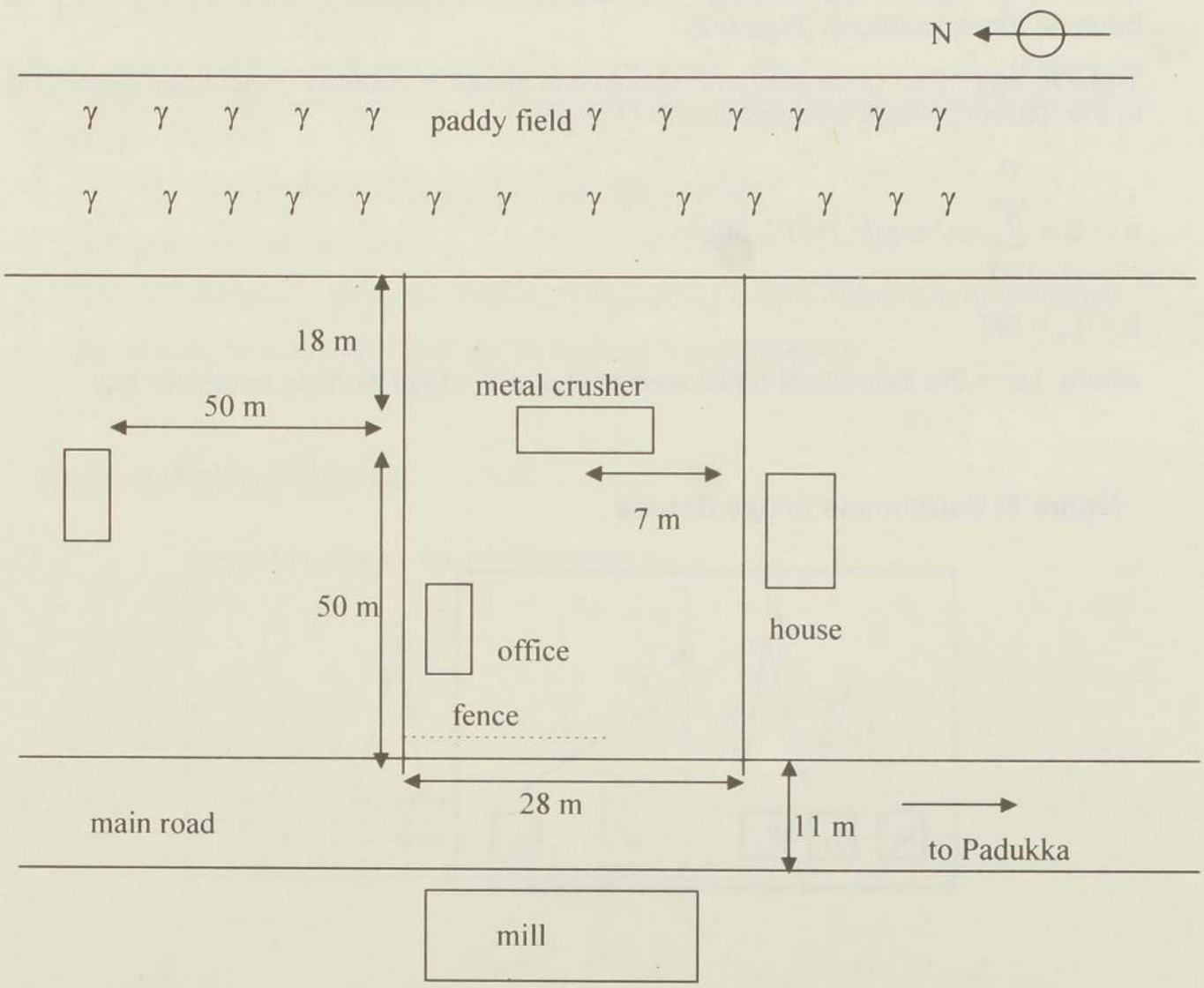
b. The points S and P are on the same ground level.

c. The area is considered an open space.

Case Study

The following analysis is based on a case study of a metal crushing machine located in Padukka, Sri Lanka.

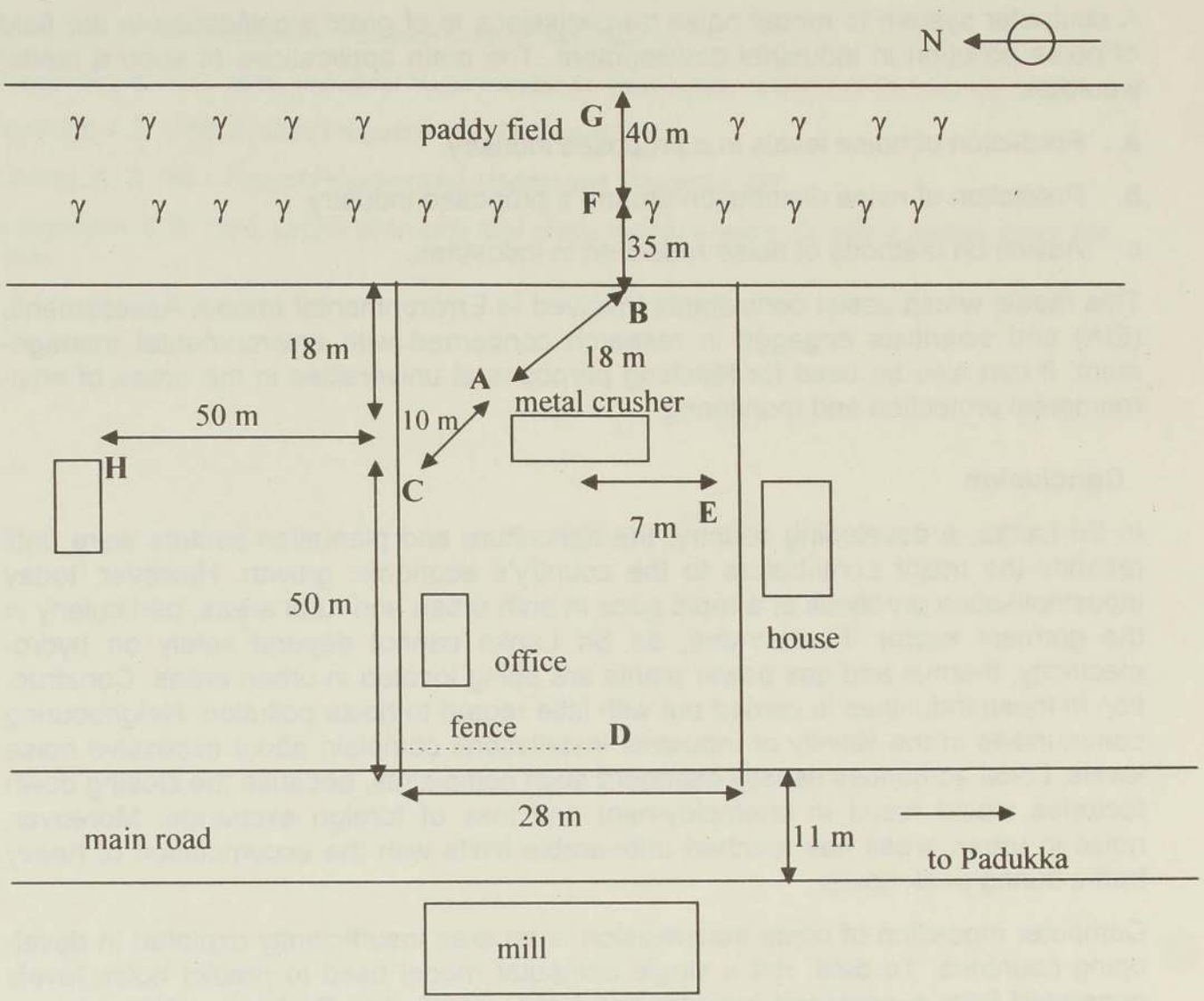
Figure 3: Description of the Premises (not drawn to scale)



Boundaries : North : wall - cement blocks / East : paddy field / West : main road / South : wall - cement blocks

The following diagram shows the points where the noise levels were measured. Eight points around the premises were identified as suitable locations to take the measurements. However, it was not possible to take noise levels outside the southern boundary due to inaccessibility.

Figure 4: Locations of Noise Level Measurement



The results of the case study are provided in Table 2.

Table 2: Noise Levels in Case Study Locations, Metal Crushing Machine, Padukka

Location	L_{eq} dB(A)	max dB(A)	min dB(A)
A	92.2	100.4	79.8
B	75.8	84.4	65.5
C	79.9	89.8	67.1
D	64.7	78.3	58.8
E	89.2	105.7	68.8
F	65.8	75.6	59.6
G	63.3	76.9	60.2
H	61.0	67.3	50.6

Significance and Possible Applications

A computer system to model noise transmissions is of great significance in the field of noise pollution in industrial development. The main applications of such a model would be:

a. Prediction of noise levels in a proposed industry.

b. Prediction of noise distribution around a proposed industry.

c. Advice on methods of noise reduction in industries.

This model would assist consultants involved in Environmental Impact Assessments (EIA) and scientists engaged in research concerned with environmental management. It can also be used for teaching purposes at universities in the areas of environmental protection and monitoring.

Conclusion

In Sri Lanka, a developing country, the agriculture and plantation sectors were until recently the major contributors to the country's economic growth. However, today industrialisation proceeds at a rapid pace in both urban and rural areas, particularly in the garment sector. Furthermore, as Sri Lanka cannot depend solely on hydroelectricity, thermal and gas power plants are being located in urban areas. Construction in these industries is carried out with little regard to noise pollution. Neighbouring communities in the vicinity of industrial installations complain about excessive noise levels. Local authorities usually disregard such complaints, because the closing down factories would result in unemployment and loss of foreign exchange. Moreover, noise in urban areas has reached unbearable limits with the accumulation of heavy traffic during peak hours.

Computer modelling of noise transmission is an area insufficiently explored in developing countries. To date, not a single computer model used to predict noise levels generated from a proposed industry has been patented in Sri Lanka. Although advanced computer systems are now available in the business field, these are not used to protect the environment. Expert knowledge in the use of computers in environmental protection is not available at present in Sri Lanka.

To understand and control noise pollution at the planning stage before commencement of actual construction, accurate prediction of noise levels is needed for the control of noise pollution. Computer modelling of noise pollution is therefore a valuable planning tool.

Note

R.G.N. Meegama is a Lecturer at the Department of Physical Sciences at Sabaragamuwa University of Sri Lanka. He can be contacted at the Faculty of Applied Sciences, Uva Campus, Sabaragamuwa University of Sri Lanka, Buttala, Sri Lanka.

References

Barnack, L.L. 1971. *Noise and Vibration Control*. McGraw-Hill, N.Y.

Cheremisinoff, P. N. 1989. I*ndustrial Noise Handbook*. New Jersey Institute of Technology, USA

Donovan, J. J. 1988. *System Programming*. McGraw-Hill, N.Y.

Radford, A. S. 1983. *Pascal Programming*. Hodder and Stoughton, UK

Wabramann, C.G. 1975. *On the averaging time of rms measurements*. Technical Review, Brüel and Kjær.

A Review of the Effects of the Use of Sulphites in Food

B.M.T.C. Gunaratne, Sabaragamuwa University of Sri Lanka

Abstract

Sulphiting agents, including the bisulphite and metabisulphite salts of sodium and potassium, are widely used in the preparation and/or storage of foods and beverages. They function as agents for freshening, preservation, reducing, bleaching and the control of enzymic and non-enzymic browning, and as antioxidants. The wide use of sulphites is of concern now that it has been well documented that a subset of human individuals with asthma experience bronchospasm on exposure to these agents.

Introduction

Sulphiting agents such as sodium and potassium metabisulphite, sodium bisulphite and sulphur dioxide play a major role in food preservation. Sulphites can be added as a gas (SO_2), a spray, a medium for dipping, and is mainly added during food processing. They can act as reducing agent, bleaching agent, as a anti oxidant, processing aid and as an agent to control of enzymic and non-enzymic browning. As sulphites have been used extensively, in the recent past, health problems have appeared due to sulphiting agents.

Asthma is the most common problem and the actual causal mechanism has not yet been identified. It is supposed to be multi-causal. In the United States, research has been carried out to study the way asthmatic reactions develop. (Freedman, 1977). The incidence is very high among steroid dependent (severe) asthmatics and the effects always vary with the patient's disposition. For instance one patient may tolerate up to one particular level of sulphites, while another patient may experience asthmatic reactions at the same level. In Sri Lanka the size of the asthmatic population has not yet been identified and childhood asthma may be a severe problem. Effects of sulphiting agents may be life threatening in children who suffer from asthma.

To reduce risk from sulphiting agents, a good approach may be to minimise the use of such materials, as their use cannot be stopped completely, because alternatives for sulphiting agents are difficult to find. The other way to minimise this problem is to make the public aware of the related hazards and to encourage them to avoid highly sulphited food.

Uses of Sulphiting Agents in Foods

A variety of sulphiting agents, including SO_2 sodium and potassium bisulphite, sodium and potassium metabisulphite, and sodium sulphite have been widely used for a long time as food additives (Taylor, et al, 1986). Sulphiting agents are added to food for many technical purposes, including the control of enzymic and non-enzymic browning, antimicrobial action, as an antioxidant and reducing agent, bleaching agent and as a variety of processing aids. In many products sulphite serve more than one purpose.

Alternatives to the sulphiting agents are not easy to identify. Possible alternatives usually provide a narrow range of benefits, are often less effective and are almost always more expensive.

© 1998 Sabaragamuwa University Journal, vol. 1, no. 1, pp. 61-67

Chemical Reactions and the Fate of Sulphite in Food Systems

Sulphites react readily with many food components such as aldehydes, ketones, reducing sugars, proteins and amino acids, and form various combined organic sulphates. Some of the reactions are desirable and some are undesirable.

The extent of reaction is dependent on the pH, temperature, concentration of sulphite and the relative component of the food matrix. An equilibrium always exists between the combined and free form of the sulphite, although some of the reactions are virtually irreversible, while others are more readily reversible. The reactions remove free sulphite from food which often diminishes their effectiveness in the food products (Modderman, 1986). The dissociable combined form of sulphite can serve as a reservoir for free sulphite, but the irreversible reactions remove sulphite permanently from the pool of free SO_2 (Joslyn, 1954).

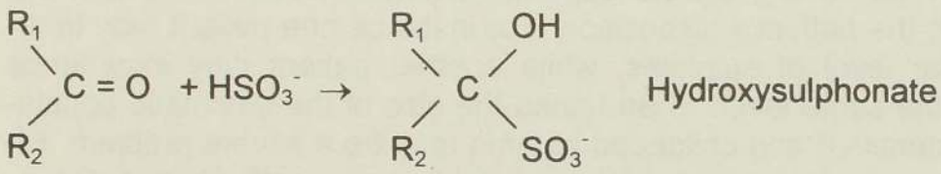
Reactions between sulphite and carbonyls such as aldehydes and ketones will primarily form hydroxysulphonates which are very stable at pH 1-8.

Fig 1: Illustration of the Formation of Bisulphite Ion in Aqueous Media and Reaction with Carbonyl Compound to Form a Hydroxysulphonate.

$H_2O + SO_2 \rightarrow H_2SO_3$ (SO_2 dissolves readily in H_2O)

$H_2SO_3 \rightarrow H^+ + HSO_3^-$ $pK_1 = 2$

$HSO_3 \rightarrow H^+ + SO_3^{2-}$ $pK_2 = 7$



Hydroxysulphonate

This reaction enables sulphite to prevent the formation of enzymic and non-enzymic browning by binding the carbonyl intermediates of browning reactions. In general all carbonyl hydroxysulphonates have good stability, with a,ß-unsaturated carbonyl hydroxysulphonates as the most stable.

Reducing sugars do not readily react with sulphite as carbonyls. To form sugar hydroxysulphonates, a considerable excess in molar quantities of reducing sugar is required. Sugar hydroxysulphonates are much less stable than carbonyl hydroxysulphonates. At low pH, sugar hydroxysulphonates have better stability (Joslyn, 1954).

Sulphite can break down the disulphide bonds of proteins and amino acids and form thiols and S-sulphonates.

In addition to these reactions, sulphite reacts with many vitamins, including B_1, B_{12}, C, and K resulting in the loss of vitamin activity (Joslyn, 1954).

Applications in the Food Industry

1. Inhibition and control of micro-organisms:

Sulphites are often used to prevent the growth of micro-organisms. The effect is exerted through bacterial fermentation. Fresh fruits intended for jams and sauces are often preserved by sulphites to prevent decay.

Actual mechanisms of the anti-microbial action of the sulphite is not well understood; however, it is believed that undissociated sulphurous acid is the active form possessing antimicrobial activity. In this regard, the pH of the food system should be low enough (<4) to have a significantly inhibitory effect. The combined sulphites do not have anti-microbial action (Joslyn, 1954).

2. Inhibition of enzymic reactions and/or non-enzymic (Maillard) browning:

Sulphite can effectively prevent or minimise non-enzymic browning by forming stable hydroxysulphonates with carbonyls and reducing sugars as mentioned in the previous section. In this respect, sulphites are widely used in dehydrated fruits and vegetables to prevent the discolouration of the finished products. Sulphite can also inhibit some oxidative enzymes such as polyphenol oxidase, ascorbate oxidase, lipoginase, and peroxidase and therefore can retard the enzymic browning resulting from polyphenol oxidase.

Sulphites are commonly used in fresh vegetables and fruits when enzymic browning presents a serious problem (Joslyn, 1954).

Physiological Effects

The safety of the continued use of sulphite in foods has been questioned on the basis of their alleged role in the initiation of asthmatic reactions in certain sensitive individuals. Numerous cases of sulphite-induced asthma have been reported in the medical literature (Freedman, 1977). These cases of sulphite-induced asthma were confirmed by positive challenge with capsules or solutions containing inorganic sulphite. The recent restrictions on the use and labelling of sulphite stem from concerns regarding the potential of these compounds to initiate adverse reactions in sensitive individuals.

Although sulphites are apparently safe for consumption by most subjects, numerous studies have described individuals with sulphite sensitivity who experience adverse reactions on ingestion of sulphiting agents. The most common complaint is asthma, although other types of adverse reactions have been reported occasionally. Sulphite-induced asthma is most likely to affect steroid dependent patients suffering from asthma (severe asthmatics) (Taylor, et al 1988).

Methods for Analysis

The following analytical methods are described in Hillary et al. (1989):

1. Monier Williams Procedure:

This is the standard analytical method (AOAC Association of the Official Analytical Chemists) used by many analysts and institutions for determining sulphur dioxide. In principle, sulphur dioxide is released by a stream of nitrogen and the separated gas is collected in dilute alkali. Alternatively, sulphuric acid may be determined gravimetrically.

For the present, the regulatory analyst has reliable methods for "total" sulphur dioxide equivalents based on the Monier Williams procedure. The procedure measures both free sulphur dioxide (i.e. residual sulphite) and sulphur dioxide which is reversibly combined to food components. Such a procedure provides more information on products of added sulphite than does a procedure for "free" sulphite. The Monier Williams procedure has the added advantage that it has been applied to numerous food systems and it has proven to be very rugged.

2. Iodometric Method:

In general, iodometric methods are quick and have sufficient accuracy to be useful. In principle, the sample is diluted and treated with sodium hydroxide to release the sulphur dioxide. The solution is then acidified and the sulphurous acid is determined by titration with a standard iodate solution, using starch as an end point indicator. Variations of the method may exist.

3. Pararosaniline Method:

In principle, the sample is dissolved and treated with dilute sodium hydroxide solution to release bound sulphur dioxide. The sample solution is then reacted with pararosaniline and formaldehyde and produces a violet-purple compound with sulphur dioxide, which can be measured colorimetrically at 550 nm. Sulphur dioxide is then determined by comparison of the absorbency of the sample with a standard curve.

Methods of Diagnosis

The preferred method for the diagnosis of sulphite sensitivity is a double-blind challenge test with capsules and/or acidic beverages containing one of the sulphite salts, normally $K_2S_2O_5$. This challenge test determines whether an individual will react to oral ingestion of free inorganic sulphite (Simon, 1989).

Possible Mechanisms for Physiological Effects

Although the mechanism of sulphite sensitivity is unknown and likely to be multiple, it is generally accepted that the overwhelming majority of reactions to sulphite in persons with asthma are a result of the inhalation of sulphur dioxide. It has been well demonstrated that persons with asthma are hyper-reactive to inhaled SO_2. As noted earlier, when sulphites are placed in to solution, SO_2 is generated. The higher the temperature and the lower the pH, the higher is the amount of SO_2 produced. Therefore, in the warm and acidic environment of the mouth and stomach, the generation of SO_2 will be favoured (Simon, 1989).

This mechanism is more likely to be decreased in patients with reactions to ingestion of sulphited beverages. This mechanism could also be invoked for reactions to some ingested foods and beverages only, if it is also assumed that the SO_2 formed is eructated and inhaled. This theory would not, however, explain why only a small percentage of persons with asthma are sulphite sensitive, and why reactions occur in patients with no clinically demonstrable gastroesophageal reflux.

Another possible mechanism to explain at least a small minority of sulphite reactions would be IgE-mediated, immediate hypersensitivity reactions. Although sulphite alone is likely to be too small a molecule to be antigenic, it is such an active molecule that it could easily become a hapten. There have been isolated case reports of sulphite-sensitive individuals with positive skin tests to sulphite that could either be passively transferred or associated with positive leucocyte histamine release studies *in vitro*.

However, because of the rarity of this occurrence, skin tests are not an adequate diagnosis test to rule out sulphite-sensitivity.

A third possible mechanism involves sulphite oxidase deficiency. Through normal biochemical pathways, particularly during the metabolism of sulphur containing amino acids, significant quantities of sulphite are produced. Normally, this intracellular sulphite is rapidly and completely oxidized by the enzyme sulphite oxidase to inactive sulphate. Reports of complete sulphite oxidase deficiency have appeared in the medical literature (Bush, et al, 1986). The subjects were infants with multiple developmental abnormalities.

It has been postulated that some sulphite-sensitive persons with asthma might have a reduced level of sulphite oxidase. They would otherwise appear normal with levels capable of handling endogenous sulphite production. But with the ever-increasing exposure to sulphite in our air, food, and pharmaceutical, their levels would be in adequate and leave some sulphite available to provoke asthma by as yet unknown mechanisms. Studies have confirmed that some sulphite sensitive persons with asthma do indeed have lower levels of sulphite oxidase When compared with normal control subjects and non-sulphite sensitive control subjects with asthma.

Studies on Asthmatics in Sri Lanka

One study termed *Food Allergy and Asthma - All in the Mind?* was carried out in 1987 (Jayesinghe and Satharasinghe,1987) of the Sri Jayewardenepura Hospital. 45 asthmatic patients were selected for this research. The majority of patients felt that these food items always brought on wheezing. Of these 45 patients, 26 indicated a positive history of multiple food items precipitating acute asthma. Of these 26, 23 patients responded to controlled challenge study with common food juices.

Another important study that has been carried out in Sri Lanka was the investigation of the *Probable Trigger Factors of Childhood asthma in Sri Lanka* (De Sylva and De Sylva, 1988). In this study 60 children suffering from asthma participated, and comprised 32 males and 28 females, whose ages ranged between 7 months and 11 years. 49 out of the 60 children (81%) displayed reaction to food.

From these studies it can be concluded that food induced asthma is a major problem in Sri Lanka, especially among children. But very little research has been carried out, the least of all population studies.

International Regulations and Recent Modifications

The levels of sulphites accepted in consumer goods in the United Kingdom are indicated in Table 1.

In the USA use of SO_2 in products listed under Table 1 are not specified. Generally speaking, since 1959 sulphites have been classified by the Food and Drug Administration of the United States (USFDA) as GRAS (Generally Recognized As Safe) substances, if they are used in food according to the Code of Federal Regulation (CFR). However, numerous reports of sulphite induced asthma and some cases of sulphite sensitivity had prompted the re-examination of the GRAS status of sulphite in 1984 (Anonymous, 1985: 96). Consequently, on August 8, 1986 USFDA banned the use of sulphite in fruits and vegetables intended to be served or sold raw to consumers (Anonymous, 1986: 51). Subsequently on January 9, 1987 it was announced that any food containing a detectable level of residual sulphite (i.e. > 10ppm SO_2), either directly from the addition during processing or indirectly from other ingredients, must be labelled with the disclosure of the sulphite content.

Table 1: Acceptable Levels in the United Kingdom

Product	SO_2/ppm
Non alcoholic beverages/glucose drinks	350
Soft drinks for consumption after dilution	70
Soft drink without dilution	70
Soft drinks intended to be frozen before consumption	70
Fruit juice /concentrated fruit juice	350
Fruit spread	100
Jams	100
Pickles and fruit based products	100

Table 2 indicates the level of sulphites accepted in consumer goods in Sri Lanka.

Table 2: Acceptable Levels in Sri Lanka

Product	SO_2/ppm
Fruit cordial concentrate	70
Fruit squash concentrate	70
Fruit syrup concentrate	70
Ready to serve fruit drinks	70
Chilli sauce	100
Tomato sauce	100
Jams, jellies, marmalades and preserves	100
Synthetic/artificial cordials	70

Acceptable Sulphite Levels for Human Consumption

Concern has also arisen in recent years regarding the possibility that many consumers may be exceeding the acceptable daily intake (ADI) of sulphite, although the recent report of the American Ad Hoc Review Group on the Re-examination of the GRAS (Generally Recognized As Safe) status of sulphiting agents indicates that these concerns are probably unwarranted (Life Science Research Office, 1985). They estimate that the total intake of sulphite as SO_2 in about 10 mg/Capita/day, which is well below the ADI of 42 mg for a 60 kg person (Anonymous, 1985).

Conclusion

Asthma induced by sulphites appears to be a problem in certain populations. This is induced by numerous factors, including the threshold of sensitivity to sulphites, the mechanism of sulphite sensitivity, the level of residual sulphite in food, the form of sulphite in food and the amount of food ingested.

Studies conducted in Sri Lanka indicate that this could be a severe problem in Sri Lanka as well, and the reduction and regulation of sulphite use, as well as avoiding of highly sulphited foods in asthmatic populations, needs to be promoted.

Note

B.M.T.C. Gunaratne is a Lecturer at the Department of Physical Sciences, Faculty of Applied Sciences, Sabaragamuwa University of Sri Lanka. He can be contacted at the Sabaragamuwa University of Sri Lanka, Uva Campus, Buttala, Sri Lanka.

References

Anonymous. The re-examination of the GRAS status of sulphiting agents. Bethesda, Md. : Life Sciences Research Office, Federation of American Societies for Experimental Biology, 1985:96.

Anonymous. Sulphiting agents: Revocation of GRAS status for use of fruits and vegetables intended to be served or sold raw to customers. Fed Reg 1986: **51**, 2502.

Bush R.K., Taylor S.L., Holden K, Nordlee J.A., Busse W.W.: Prevalence of Sensitivity to Sulphiting Agents in Asthmatic Patients. *Amer. J. Med.* 1986: **81**, 816-820.

Coker L.E.: Uses and Analysis of Sulphites in the Corn Wet Milling Industry. *J. Assoc. Off. Anal. Chem.* 1986: **69**, No 1: 8-10

De Sylva D.S., De Sylva I.D.: Probable Trigger Factors of Childhood Asthma in Sri Lanka. *CJC*, 1988: **15**, No 1: 13-18.

Freedman B.J. : Asthma Induced by Sulphur Dioxide, Benzoate and Tartrazine Contained in Orange Drinks. : *Clin Allergy*, 1977:**7**: 407-415

Hillary B.R., Elkins E.R., Warner C.R., Daniels D, Fazio T. Optimized Monier-Williams Method for Determination of Sulphites in Foods: Collaborative Study. *J. Assoc. Off. Anal. Chem.* 1989: **72**, No 3: 470-475.

Jayesinghe N.S., Satharasinghe R: Food Allergy and Adult Asthma-All in the Mind. *SLMA*(A), 1987:**77**: 61-62.

Joslyn M.A., Braverman J.B.S.: The Chemistry and Technology of the Pre-treatment and Preservation of Fruit and Vegetable Products with Sulphor Dioxide and Sulphites. *Ad. Food. Res.* 1954: **5**: 97-159.

Modderman J.P.: Focus on Sulphites in Foods. *J. Assoc. Off. Anal. Chem.* 1986: **69**, No 1: 1-3.

Simon R.A.: Sulphite Challenge for the Diagnosis of Sensitivity. *Alergy Proc.* 1989: **10**, No 5: 357-362.

Taylor S.L., Higley N.A., Bush R.K. : Sulphites in Foods: Uses, Analytical Methods, Residues, Fate, Exposure Assessment, Metabolism, Toxicity and Hyper Sensitivity. *Ad. Food. Res.* 1986: **30**: 1-76.

Taylor S.L., Bush R.K., Selner J.C., Nordlee J.A., Wiener M.B., Holden K.H., Koepke J.W., and Busse W.W. : Sensitivity to Sulphited Foods among Sulphite-sensitive subjects with Asthma. *J. Allergy. Clin. Immunol.* 1988; **81**, No 6: 1159-1167.

Cutting through Territories: Naipaul's *A Way in the World*

Rajiva Wijesinha, Sabaragamuwa University of Sri Lanka

Abstract

In the last couple of decades the West Indian writer V S Naipaul has emerged as perhaps the most articulate exponent in literature of what might be termed the post-colonial condition. Having begun as a novelist, and then moved on to travelogues, he has recently developed a new art form that combines autobiography, travel and historical meditations. This paper examines his latest offering in this field, *A Way in the World*, and the manner in which form and content are blended to provide an imaginative study of characters and societies in a state of transition. This study begins with the concept of evasion, which Naipaul in common with his brother used to characterize some aspects of post-colonial societies. *A Way in the World* moves between the Trinidadian society in which Naipaul grew up and various significant moments in colonial history that highlighted the search for identity in the midst of racial and political uncertainty. In exploring the implications of Naipaul's eclectic analysis of all this, I suggest that he upholds the necessity of a clear-sighted pluralistic approach to facilitate release from the limitations the (post) colonial condition could otherwise impose.

In an interview he granted me in 1983, Shiva Naipaul made significant use of the word 'evasion' in describing local attitudes to the racial tensions prevalent in Sri Lanka at the time (1). At the time I thought he was exaggerating considerably. Two months after he left however riots broke out in Sri Lanka on a scale previously unknown, to set the stage for a cycle of violence that still continues. I realized then that I too had been guilty of the evasions the younger Naipaul had diagnosed, and that the outsider with a ruthless eye, the character to which following his brother he was laying claim, was far more clear-sighted about the situation in a country such as ours than those coping at firsthand with the inadequacies as well as the apparent certainties colonialism had left behind.

It was of that interview and those perceptions that I was reminded, on reading V.S. Naipaul's latest work, *A Way in the World*; and though one has to be diffident of course about readings based on the pronouncements of a younger brother that were made a decade earlier, I would suggest that it is the idea of evasion that holds together the various different sections of which the book is composed. I would add of course that more than one sense of the word is involved. With regard to most of the characters who are placed and scrutinized, the writer is concerned with the way in which they avoid reality; but one gets a clearer picture if one also thinks of the word as signifying escape in particular contexts, especially those involving the narrator who is even more obviously identifiable in this work with Naipaul himself than was the central character in *The Enigma of Arrival*.

That work had charted the enigma of the writer's arrival at an equilibrium his upbringing had seemed to deny him. Born into a community that seemed even more distinctively than others to be composed of outsiders, albeit in a colony to which all the other communities that constituted it had also in fact been transplanted, the character Naipaul presents had gravitated towards the mother country that seemed to offer him at least an intellectual refuge. Culture however, and what he thought of as an entirely different tradition of continuity, would always it seemed mark him out as alien. The book however, in depicting the narrator's gradual perception of the transitory nature of even what seemed most solid, charts too his increasing awareness of

© 1998 Sabaragamuwa University Journal, vol. 1, no. 1, pp. 69-76

an identity as secure as any other, his sense in the end of having arrived at a position in which he belonged no less than his peers from different backgrounds.

That book then was about healing, the development of confidence in the context of the conflicting social and historical claims to which the postcolonial persona is necessarily subject. This one, which could be seen as a sort of sequel, is the opposite, an assessment of the manner in which confidence built on evasions, in the negative sense of the term, can betray, and compound the traumas of the transitions the post-colonial situation imposes. Shedding light on this phenomenon, in a way that might have been anticipated from the dissection of Britain too in *The Enigma of Arrival*, is an account of aspects of the colonial situation itself, to provide a precursor to the evasions of subsequent days.

The book consists of nine sections, in two of which the narrator scarcely appears. These are the chapters which deal with Sir Walter Raleigh and Francisco Miranda, who had both dreamed, two centuries apart, of triumphant conquests in the Gulf of Desolation, where Trinidad lies next to the northern coast of Venezuela. Both had managed to persuade backers in Britain to finance expeditions for them. The former is portrayed on his last journey to the Indies in 1618 to find El Dorado, the existence of which he had boldly asserted after his previous visit there twenty years earlier; after a long imprisonment he had last succeeded in persuading the King to release him with the promise of bringing back a fabulous fortune. The penalty of failure was death, and it is the inevitability of this that he faces, waiting on his ship until he finally has to accept that the advance party he had sent out will bring nothing back.

Miranda, in 1806, dreams of revolution rather than gold, of liberating Venezuela from the Spanish. His first attempt at invasion had failed, and he had lost several men and a couple of ships. We see him for much of the chapter waiting in Trinidad, hoping for further support, but receiving little. Then with a small force he lands on the continent again, and meets no resistance, but receives no popular support either. So, knowing that he will not be reinforced, he is forced once again to withdraw to Trinidad where he finally realizes, as time passes and he is treated with increasing scorn, that the cause is hopeless. In the end he manages to get back to England but then, a few years later, when the revolution under Bolivar really begins, he returns in what he hopes will be triumph. Setbacks follow however and he is handed over to the Spanish, and taken to Spain to die in jail.

The two men are very different in their backgrounds, and their stories too are told in different ways. Raleigh was an Englishman in the great days of Elizabethan conquest and if by the time of King James he was seen as a pathetic figure, he was still an adventurer going forth to discover new territories. Miranda on the other hand was a Venezuelan, a colonist always aware of the superiority of those who actually came from Spain. He is constantly driven therefore, to America and Russia and France as well as England, in his attempts to develop an identity of his own; yet he always has to hark back to his colonial roots, for it is only in terms of his call for independence that his audiences can respond in a manner that assures him a satisfactory enough identity.

Again, much of the first section of the chapter about Raleigh is in the form of a dialogue with his surgeon, who is the spy sent out to monitor his activities, and who confronts him with the speciousness of his earlier claims and his callousness towards those he had led. Later, after news of the advance party is brought back, together with tidings of the death of Raleigh's son, we see him largely through the eyes of the Indian (in fact the bastard son of a Spanish governor) who is taken back to England by Raleigh, witnesses his execution, and then finally gets back to the New World

where he tells his story to a Spanish historian. In the case of Miranda, much of the first part of the story is taken up with what he might have written to his wife in England, letters full of self-acknowledged uncertainties which go over his past in a manner that emphasizes his essential diffidence about the various roles he has played. At the same time we see him too in dialogue with Hislop, the British governor of Trinidad, who is also in a state of distraction, terrified of the traps into which he might fall in trying to govern a territory recently taken over from the Spanish and full of racial tensions and practices he cannot understand. The account of them dining together on the night of Miranda's arrival, each hoping that the other could provide the security both so desperately lack, is rivetingly ironic.

And adding to the irony is our awareness of the context in which their bizarre dialogue takes place. In that chapter itself we note that outside, in the grounds of Government House, recently enslaved Africans chatter in an unfamiliar language, to be replaced shortly by Chinese sent by the British East India Company. Further away, in the countryside, mock French aristocrats make their fortune on land obtained because they had brought slaves, even mortgaged ones, into the country; while for their part the slaves poison each other to win favour with their masters, and dress up at night as kings and queens and dream of eating pork when their revolution succeeds. Then from earlier chapters we know that the Spanish had taken over Trinidad supposedly by treaty, but that Raleigh discovered years later in a jail five of the kings who were supposed to have signed the treaty, 'the last aboriginal rulers of the land, held together on one chain, scalded by bacon fat, and broken by other punishments.' (V. S. Naipaul, *A Way in the World*, Heinemann, London 1994, p. 41. All page references henceforth will be to this edition). And we know too that after independence there would be 'Mohammedans of a new kind' who launched another revolution and killed several policemen and 'then, as so often happened during slave revolts in these islands, the rebels appeared not to know what to do; all energy and exaltation had been gathered up and consumed in the drama of the attack, the surprise, the drawing of first blood, the humiliation of the people in authority.' (pp. 37-9)

And it is in the awareness of this context that we should note too the similarities between Raleigh and Miranda, both of them pursuing dreams of what amounts in the end simply to self-assertion. In Miranda's case we are given the background, the characterization of him as '"the son of a shopkeeper from Caracas"'(p. 285), so that to some extent we can sympathize with the anxiety to create a new identity for himself. With Raleigh no such excuse is possible, though we note the need to rival other adventurers of the period. With regard to both however is, underneath the doubts and the desperation, the ruthlessness that leads them to use others without compunction in pursuing their dreams. And the point is that, in this sort of context, all that seems acceptable: in a world of adventurers cut off from accountability, where exploitation is permissible as far as most people are concerned because they can be seen as alien and other, ordinary limitations do not apply. In the end the dream of the self is all that remains.

It is in terms of such factors then that we can trace the similarities between these two historical figures and the two Trinidadians, not quite contemporaries but slightly older than him, whom the narrator also studies. The age difference is important, as Naipaul stresses. Blair, the younger of the two, both of them black in contrast to the narrator, both from poorer backgrounds, 'was more than ten years older than I, and in Trinidad that difference in age was important. It meant he had been born in a darker time.' (p. 353) In the case of Lebrun, his age placed and indeed confined him even more securely. He had first come to prominence in the Grenadians' oil strike of 1937, and is described by Foster Morris, the British chronicler of that event whom the narrator

meets years afterwards in London as "'the most dangerous man...a fluent Spanish speaker and his business was to travel round Central America and the West Indies and West Africa and talk revolution.'" (p. 92)

The first anecdote we hear about Lebrun involves his sexual taunting of Morris, and this is a theme that recurs. The narrator, like Morris, emphasizes that Lebrun was "'very good-looking and I'm sure he did very well that way'" (p.93) but it is in that area that he feels most threatened - "'I thought the man was a communist. Then something happened. He couldn't bear the sight of the young French *cooperants*, prancing about in Africa, as he thought, and he didn't like the sight of the African women of the university with their white boy friends. He began to threaten everybody, in a quiet way. He went wild, and then he calmed down"....The old man wild in free Africa, expressing old hurt.' (p. 132)

These are the words that recur in Naipaul's account of Lebrun, hurt, anguish, rage, rawness, all tied in with the shame he "'had carried for twenty years" about the belief of his mother's uncle, taken to England and made much of in his youth a century previously, that "'things were better in the old days'" of slavery (p.115). It is this he has to exorcize, so that in the end he moves through the Marxism that had sustained him for so long into a primitive racism that finds a ready disciple in the French West African dictator who obeys his injunction to "'Take an axe to the root.", obeys because 'the advice so matched the ruler's own needs.' (pp. 148, 155). Lebrun's pain, exacerbated by his white wife having left him, led to greater excesses which now left him exultant though he had earlier as a revolutionary disapproved of the Back-to-Africa movement - 'He went to all kinds of tyrannies; to countries of murderous tribal wars; to collapsed economies. But when he came back he spoke on the television and radio as though he had been granted a vision of something more ideal, an Africa stripped of all that was incidental and passing." (p. 131)

In one sense then Lebrun could be said to have found fulfilment, more than the revolutionaries like Miranda whom he had written about, to whom earlier the narrator had compared him in 'Thinking of the ironies in Lebrun's life, that at the end he should have been like the people he had written about in his first book, and feeling almost superstitiously that there was a circularity in human lives (p.129). That was when Lebrun was no longer welcome in the West Indies, where his ideas of social revolution were too much for the sort of chief minister who had in fact taken over from the British, to whom all that mattered 'was his chieftancy, his position; that was what he was keen to protect.' (p. 108) Years later however, in Africa, Lebrun had found reasons to condone such attitudes. Yet even then 'He never tried to stay in the places he had visited. He always came back to his base, in England, Europe, Canada. He had learned his lesson from the West Indian islands in the 1950s and 1960s, and wished to threaten no one.' (p. 131)

This was certainly an advance on Miranda who had allowed himself to be carried away by his own rhetoric, who had acted however diffidently on the assumption that others subscribed to his messianic rhetoric. With regard to both however the salient point is the desolation they both cause amongst people open to their evasions. And though the excuse might be offered that such desolation would occur anyway, that the West Indian chief minister destroyed as many of his people as did the West African dictator, Naipaul's point is the need to attribute and accept responsibility precisely, without excuses and evasions.

And this in the end is what Blair does, which is why he is killed, in the East African state to which he had been invited as an adviser, expected 'only to put a squeeze on the Asian community.' (p.366). The narrator himself had expected that to happen,

having seen back in Trinidad how the 'almost religious exaltation of the early days of the black movement had given way very quickly to the simplest kind of racial politics. In Trinidad that meant anti-Indian politics and constant anti-Indian agitation.....I had found ways, as a man on my own, of detaching myself from the racial under-currents of the place. I felt that with Blair here all that was going to change' (p. 355).

The narrator turned out to be mistaken. Through a few anecdotes Blair makes it clear that he is now clear-sighted about the racial preconceptions and predilections he like others had acted on, and that he has moved beyond that in his approach. The narrator connects this approach with Blair's origins, in a community which we are told twice had maintained its integrity so that its people 'didn't have the combativeness and nerves of black people who had grown up in mixed communities' (p. 24). Despite this Blair had developed racial passion, perhaps because he 'might have been granted another vision of his isolated community living in the debris of old estates; he might have taken their story back and back, to unmentionable times. And he might have decided then - like me as a writer - to remake himself' (p.363). But now, in their last meeting, he makes what was 'like a statement, made without excuse or apology, that after the passion of his politics he could now be another kind of man, ready for new relationships' (p.365). Unfortunately the place in which he found himself, to which he had made his way through a dramatically changing world, was not ready for this; having begun to tread on important toes, he was killed by members of the regime he had been brought in to support on the grounds of simpler solidarities.

It is Blair's death that concludes the book, and the title of the last section, 'Home Again' refers most obviously to the return to Trinidad of Blair's body, more obliquely to the restoration of Blair by himself to a more inclusive vision. In addition of course this section is also concerned with the narrator, and its title refers too to his rediscovery in Africa of tensions similar to those he had been through in Trinidad, between blacks and Indians. And just as he registers parallels between himself and Blair, developing fresh identities to cope with shifting circumstances and needs, so too he also notes connections between himself and those belonging to the country, the Indians from whom he had kept himself detached. Specifically here he talks about a lawyer who despite the 'excesses of the president's rule...had reached a personal point of rest and reconciliation, and had a bright vision of the future'; but at the same time he confesses that he will spend the next few years "doing everything I can every day to getting every shilling I possess out of the country." (p.350) This of course confirms the public suspicions of the blacks, that the local Asian community was 'sending money abroad and sucking the country dry'; but the description of the situation suggests no clear alternative. And the narrator, who had already remade himself, settling in England from where he could safely make trips to countries such as this, to observe and return to security and constantly renew and recreate his writing voice, is sympathetic.

And the same sympathy we see extended to the Trinidadian Indian who had made himself a Venezuelan, with a new name and children who spoke only Spanish so that 'there would be no ambiguities about them; they would be the kind of Venezuelan stranger I had in the beginning taken their father for'. He guards his Venezuelan passport 'carefully (the way I handled my own British passport, always nervous, when I was travelling, of losing it, and doubting whether, if I lost it, I would be able to explain myself to anyone in authority) (pp.220, 222). The section is entitles 'A New Man', and refers obviously to this successful refugee; but equally well it shows us the narrator in a confident, settled mode, no longer subject to the uncertainties that had dogged him in his encounters with Lebrun and, earlier, with the British writer Foster Morris. His assessment now of the landscapes of Trinidad and Venezuela, as he ex-

plores them for the historical work that also brings in play his own memories, is assured, allowing him to range across the historical processes that brought in and removed so many transient populations.

At the same time the section registers that the old remains along with the new; the new Venezuelan, Manuel Sorzano, has to revert to the superstitions of his Hindu ancestry to help out his son, the member of the Guardia, who cannot cope with the Latin concepts of sexual honour he has to adopt with his new identity. The irony is deft but brilliant - '"I grow up in the old days, with different ways. The older people used to look after that side for you.....We can't arrange anything for them here, and they don't want anything old-fashioned like that....The boys have to go out and get. They have to be men in a new way, and they don't really know what to do.....And is extra hard for them, because all the time they still have the old-fashioned bashfulness which they get from me.'" (pp.231-2). And the section ends with the salutary reminder that one has to be careful of the identity one adopts, in the light of the fate that befell the man who called himself a Chief Executive and was kidnapped by guerrillas for a ransom - '"When they find he have no big company behind him, to pay up, they shoot him. In this country you have to know how to handle yourself.'" (p.236)

That there should be limitations to the personas one adopts has of course been a constant theme, though presented more heavily earlier when there had been much more for the narrator to lose. It was in the chapter on Lebrun that the question had been most starkly put, when he had as it were been 'invited to shed my racial or cultural burdens and to be part of their brotherhood'. That, the narrator suggests, is the sort of deal Lebrun had made 'years before, in much harder times', though it was not a deal he was able to sustain. The narrator, on the contrary, realizes early enough that 'there were other yearnings that no shedding of skin could have assuaged...These yearnings could be assuaged only in the self I knew...to yield was to cease to be myself, to trust to the unknown' (pp.123-4). That is the clearest statement of the need for clarity about oneself, in order to make a coherent way in the world; it is what almost all those who are explored thereafter, Lebrun and Raleigh and Miranda, the French West Indian divorcee Phyllis and the English East African apologist Richard, lack, in seeking new pastures in which to fulfil their visions of themselves.

That aspect of personality, the need to maintain one's integrity while adapting one's approach to changes in the world outside as well as within, had been the principal theme of the preceding section, 'Passenger', which deals with the narrator's relationship with the British writer Foster Morris. Morris had written about the Grenadian oilfield workers' strike of 1937 in a manner that seemed to the narrator false, because he 'saw us as versions of English people and simplified us' (p. 79). Meeting him in England however the narrator realizes that that approach had been in essence an attitude, that even the renegade Englishman had had a basically supremacist view about the blacks, a view made up of the certainties of his background as well as the anxieties he faced in having to deal directly with such different people. At first this unsettles the narrator; later he realizes that Morris' narrative has to be seen at another level as well, as being part of the historical record that lays bare not only the colonized but the colonizers too - ' Over four centuries the vision constantly changes; it is a fair record of one side of a civilization' (p. 102).

And this attitude also informs the narrator's awareness of the need to shift his own approach too, with regard to the vision he presents in his own writings. With advice from Morris he abandons the semi-autobiographical work that exalted his own persona and shifts instead to a comic mode that, he had recognized earlier in his own critique of Morris' book, was what permitted balance against the passions that might

otherwise have obscured reality. It was this that liberated him from the solipsism he had sensed earlier, 'the fabrication, the turning away from the truths I couldn't fully acknowledge, (that) pressed me down further into the little hole I had created for myself' (p. 84).

Later he shifts again, though this time he acknowledges a greater debt to Lebrun than to Morris whose comments now seemed to him no longer objective; and later still he recognizes that there is no need for him to feel resentful or defensive with regard to Morris, for he himself has now become someone Morris 'had said goodbye to' (p. 101) in the description coined by Graham Greene to suggest how, despite early promise, Morris had been left behind as a writer. And it is through the confidence born of his newly won ability to see clearly that the narrator can comment on Morris, not perhaps entirely objectively, but with the ability to place his work in both historical and personal context.

So much for the various people the narrator meets on his way through the world, people to whom he too says goodbye, though in his case it is as he moves on beyond them to the assured persona he is able to present. Yet that persona, we should remember, should be seen in the light too of the first three sections of the book, not only the straightforward 'History' that gives us the narrator on the threshold of his escape from 'A Smell of Fish Glue' to the other worlds he needed to know about in order to 'write about this world' (p. 27); but also the strange allegories that sandwich this, the opening one about the undertaker with a sense for beauty, and the 'Unwritten Story' that was shaped in the narrator's mind over some years.

In this story there is another narrator, called simply that, not a writer or traveller, though that 'would be true to the actual experience', and not a man on the run because that 'requires pertinence at all times' and 'wouldn't have tied up with what was to come at the end of his journey'; he is instead 'a narrator who is a carrier of mischief' which 'would also hold certain historical ironies' (pp.45-6). Thus this narrator is not quite the narrator of the larger book, but there are aspects of shared experience, and perhaps traces of what that narrator might have become had he accepted the invitation of the brotherhood to which Lebrun had once subscribed. And, as that narrator would have done, this one too, through a form of love, and 'pain rather than love', decides to 'turn his back on these people...put them out of his mind.' (p. 64).

The narrator's increasing involvement that also prompts the need for detachment is gradually but compellingly built up. We see him at the brief stop with the Central Europeans who are amongst his co-conspirators but whom he sees as 'all appetite' and 'oppressive', we note the contrast with the resigned Indians, the companionship of the boys who guide him until he too yields to appetite, fed by 'the passivity of the boy' next to him, which one he does not know; and then we follow the move towards something more with the boy he can now distinguish as the one who thought he was fated to die - 'the passivity of the boy adds to the narrator's mood, builds up to tenderness, made deeper by a feeling of being unable to help, tenderness that turns to a melancholy like the melancholy he had seen earlier in Lucas's face in the firelight' (p.60).

And after the narrator determines to go away, accepting that the villagers 'will remember him as the man who stayed long and wasn't straight with them, who promised many things and then went away' (p. 64), he is brought face to face with evidence of an old betrayal too, 'a doublet of Tudor times, new clothes of three hundred and fifty years before'(p. 67), a symbol of all the promises made and broken since the arrival of the first adventurers from across the seas. It is such promises, born of various forms of self-assertion that pay little heed in the end to the ostensible beneficiar-

ies, that Naipaul explores in the narratives that follow; and it is the inevitability of the betrayals he charts that justifies the detachment of his narrator, seeking new ways of perception that eschew involvement.

But what does he offer instead? That I think is where the strange figure of Leonard Side comes in, the '"dark Indian man...quite a good-looking man, in spite of the hairy fingers I had seen dressing the dead body"' in '"Parry's Funeral Parlour"' (p. 4). What characterizes him is his '"idea of beauty"' which horrifies the schoolteacher who describes him to the narrator - '"That idea of beauty - mixing roses and flowers and nice things to eat with the idea of making the dead human body beautiful too - was contrary to my own idea. The mixing of things upset me. It didn't upset him"' (p. 7).

As the rest of the book makes clear, it did not upset the narrator either. At the end, in talking about Blair's death, the book comes full circle with the idea that his body 'would have been laid out in Parry's chapel of rest' (p.369); Leonard Side would no longer have been there to make the dead human body beautiful, but in a sense the narrator had already done that, in his celebration of what Blair had arrived at, and the view that his life remained undiminished by the betrayal that had caused his death. Side then and his unfathomable 'inheritance' act as an opening metaphor for the narrator's own compulsions, the kaleidoscope he presents to substantiate his own view of the world. The first section ends with the assertion that 'We cannot understand all the traits we have inherited. Sometimes we can be strangers to ourselves.' (p.9) What the novel conveys however is that we can and should explore without evasion the actions and the attitudes we adopt, and place them in the social, cultural and historical perspectives that will allow us to be clear about what they mean.

> ... during my time in Ceylon and so on, looking at say the Tamil problem or trying to find out about it, it is - I've been struck by the inability of people here to look at themselves, and to look at history over the last twenty-five years, and there is a sort of whining attempt to blame it all on the British, or to blame it all on some abstract history that occurred two thousand years ago; the classic evasion of course being, you say, "Look, you've had all these disturbances over a period of twenty years or so," and the response is not to say, "Yes, we've had them and it's terrible and we must try and understand it and stop it from happening,", the response is, "But other people have worse things" - which is a form of evasion. It is a form of self-deception; in fact, it is a form of lying. (Naipaul in Wijesinha, 1983: 20)

Note

Rajiva Wijesinha is Professor of English and Dean of the Faculty of Social Sciences and Languages at the Sabaragamuwa University of Sri Lanka. He can be contacted at Faculty of Social Sciences and Languages, Sabaragamuwa University of Sri Lanka, PO Box 02, Belihuloya, Sri Lanka.

References

Naipaul, V.S. 1994. *A Way in the World*, London: Heinemann.

Naipaul, V.S. 1987 . *The Enigma of Arrival*. London: Viking Press.

Wijesinha, R. 1983. Interview with Shiva Naipaul. *The New Lankan Review*, 1: 17-21.

Satan as Self-Deceiver in Milton's *Paradise Lost*

Nidhani De Andrado, University of Peradeniya

Abstract

This paper examines the self-deceptive role of Satan in John Milton's *Paradise Lost* . The central research problem is to determine whether Milton resolved the contradiction that Satan as a being of archangelic intelligence (knowing the inevitable consequences) would still choose to rebel against a omnipotent God. By explicating Satan's four soliloquies, this paper reveals the complexity of this character as portrayed by Milton. The conflict between Satan's intuitive knowledge of the sublime and his deliberate choice to pursue evil is effectively presented in these soliloquies. This paper concludes that by showing how the former archangel consistently chooses to repulse his sublime feelings and elevated thoughts, and instead resorts to self-deception and duplicity, Milton overcame the challenge of delineating a convincing, yet scripturally authentic portrait of Satan.

Introduction

The figure of Satan as self-deceiver has long been part of the Judeo-Christian tradition. As John Steadman observes, " No less a person than Christ himself had called the devil a liar and the father of lies [in the Gospel of St. John 8:44]" (Steadman 230). However, John Carey points out that the unlikelihood of Satan's rebellion against God has worried Biblical commentators (Carey 136). Citing the work of Stella Revard, Carey states that "both Anselm and Aquinas argued that Satan could not . . . have directly wished for equality with God, since he would have known this was impossible" (Carey 136). Clearly, Milton faced a challenging task in *Paradise Lost*. In order to be convincing Milton had to delineate the character of Satan in consonance with the scriptural version, and also demonstrate how a being of archangelic intelligence could choose to rebel against an omnipotent God. Carey asserts that Milton evaded the latter issue by omitting to depict the unfallen Satan and thus "set aside the problem of showing perfect intelligence operating imperfectly" (136). However, it is inaccurate to state that Milton failed to explain this apparent contradiction in the character of Satan. Milton effectively portrays a complex Satan who, in his pursuit of evil, has to contend with his "conscience" and his archangelic "intuitive" knowledge of the sublime (*Paradise Lost* Book IV. 23, V. 489) . A close analysis of Satan's soliloquies reveals how the "Prince of Hell" consistently chooses to repulse his elevated thoughts and feelings by resorting to self-deception and duplicity (*Paradise Lost* Book IV. 870).

Satan's soliloquies are distinct in content and perspective from his public speeches. While addressing an audience, Satan tends to "boas[t] without foundation, aggrandiz[e] himself, [and] set up situations to promote himself. . ." (Shawcross 33). He practices a rhetoric of deception to persuade his audience (be they angels, human beings or his compatriots) for his own ends. On such occasions Satan's lies are obvious to a careful reader. Steadman observes that in order to prevent misinterpretation, Milton either introduces his own comments, or employs a more reliable character such as God, Abdiel or Michael, to expose the "spurious quality of the values, claims and logic of Hell" (236). An example is Satan's attempt in Book IV to justify his presence in Paradise by resorting to various excuses. Gabriel immediately points out that "To say and straight unsay, pretending first / Wise to fly pain, professing next the Spy, / Argues . . . a liar trac't / Satan . . . " (IV. 947-50). Clearly, the public utterances of Satan are untrustworthy. In contrast, Satan's soliloquies provide "access . . . to the true Satan" (Carey 134). When by himself, Satan no longer attempts to conceal his

© 1998 Sabaragamuwa University Journal, vol. 1, no. 1, pp. 77-85

real motives, struggles and thoughts. These unguarded speeches reveal the inner workings of Satan's mind as he freely expresses the conflicting ideals of good and evil within him. Such insights to the "true Satan" can be found in four soliloquies in Book IV and Book IX, each of which merits explication.

Analysis of the First Soliloquy

The first of Satan's soliloquies occurs in Book IV (lines 32-113) when Satan pauses on Mount Niphates, prior to continuing his journey to Eden. Satan begins his speech by addressing the sun, which evokes memories of his former life in Heaven. He comments on the sun's "surpassing Glory" and its supreme position "like the God / Of this new World" (32,34). Satan states that he "hates" the sun's beams since it brings " . . .remembrance from what state / I fell, how glorious once above thy Sphere;" (37-39). Satan's mind reverts to his fall which he attributes to "Pride and worse Ambition" which led him to war against God (40-41). Satan then proceeds to give his opinion of God. He alludes to the omnipotence of God in the phrase "Heaven's matchless King." He also acknowledges God as creator and benefactor by stating that ". . . he created what I was / In that bright eminence, and with his good / Upbraided none. . ." (43-45). Satan recognizes the justice of God whose "service" was not hard, for "What could be less than to afford him praise / The easiest recompense, and pay him thanks, / How due! . . ." (46-48). He admits that he acted unjustly against God who "deserv'd no such return from me " (42-43).

Satan then analyzes the cause of his downfall. He censures himself for being "forgetful" of what he owed God, and admits that being "lifted up so high / I disdein'd subjection . . ." (49-50). He acknowledges that God was free of blame since "Heaven's free love dealt equally to all" (68). Satan also admits that he had "the free Will and Power to stand" (66). Satan condemns himself with the words "curs'd be thou; since against his thy will / Chose freely" (71-72).

The above reflections contrast sharply with Satan's public accusations against God and Heaven, where he projects himself as a liberator of oppressed angels. When addressing his compatriots, Satan avoids any self-condemnation and instead blames God for "temp[ting]" him to war (I. 642). He also questions God's omnipotence and boasts to his followers that he "shook [God's] throne" (I.105). Moreover, in the presence of his compatriots, Satan denies God as creator and claims to have been "self-begot, self-rais'd" (V.860). In public, Satan also denounces the "Tyranny of Heav'n" and poses as a champion of freedom (I.124, II.822).

Despite his public lies, however, Satan's soliloquy shows that he is definitely aware of the true nature of God, as well as of his own blasphemy. Satan perceives the wretchedness of his fallen condition when he states, "Me miserable! which way shall I fly / Infinite wrath, and infinite despair? / Which way I fly is Hell; myself am Hell (73-75). At this climactic point of his despair, Satan seems on the verge of repentance as he calls on himself "O then at last relent: is there no place / Left for Repentance, none for Pardon Left? " (70-80).

Although he realizes the misery and evil of his own position apart from God, Satan chooses to reject the option of repentance. He mounts various arguments to support his decision. He first maintains that "Disdain forbids me, and my dread of shame / Among the Spirits beneath . . ." (82-83). Yet, Satan is forced to concede that the adoration of his compatriots does not ease his "torments inwar[d]" (88). He admits that "While they adore me on the throne of Hell . . . ./ The lower still I fall, only Supreme / In misery . . .(91-92). Satan then develops a second argument against the option of repentance. He states that even if he could repent and be re-instated, it would only

result in a "heavier fall." His reasoning is that " . . . highth [would] recall high thoughts, how soon unsay / what feigned submission swore. . ." (95-96) Interestingly, Satan can only think in terms of "feigned submission" and he rules out the possibility of "true reconcilement" (98). He refuses to consider the fact that God could grant sufficient grace to bring about true reconcilement, provided he seeks God's help, as Adam and Eve do after their fall (X. 1097, XI.3). Instead, Satan chooses to believe that "[Far] from granting hee, as I from begging peace" (104).

Having persuaded himself against the option of returning to Heaven, Satan renounces his nobler feelings in the lines, "So farewell Hope, and with Hope farewell Fear, / Farewell Remorse: all Good to me is lost" (109-110). Satan then firmly establishes himself in evil with the words, "Evil be thou my good." In the final lines of the soliloquy, Satan returns to his diabolical plans as he envisions the sharing of "a Divided Empire with Heav'n's King" (111).

Undoubtedly, this soliloquy in Book IV gives valuable insights into the mind of Satan. The first part of this speech reveals that despite his fallen condition, Satan still possesses archangelic knowledge to recognize the goodness and divine nature of God, as well as to perceive his own unjust misdeeds. However, from line eighty onwards, Satan reasons against this higher knowledge and the possibility of repentance. Essentially, Satan practices a mode of self- deception to persuade himself that the only alternative before him is to do evil, which he chooses to affirm. By the end of the soliloquy, Satan has deluded himself to the point of imagining himself in possession of a "Divided Empire." Satan blinds himself to the fact that 'Heaven's matchless King" in His omnipotence has the power to eventually bring forth good out of evil (IV. 112, XII. 470).

Analysis of the Second Soliloquy

Satan's second soliloquy (Book IV. 358-392) takes place in Paradise when he initially beholds Adam and Eve. He first comments on their beauty that although "earth-born," they are "to heavenly Spirits bright / Little inferior" (361-62). Adam and Eve's presence stirs sublime feelings in Satan as he states that "[they are beings] whom my thoughts pursue / With wonder, and could love . . ." (362-63). They seem to remind Satan of God as he notes that " . . . so lovely shines / In them Divine resemblance, and such grace / The hand that form'd them on thir shape hath poured" (363-5). Satan then thinks of the doom ahead of the human pair. His tone seems sad when he states " Ah! gentle pair, Yee little think how nigh / Your change approaches . . ." (366-7). Satan appears to regret his task of bringing about "woe" and destroying "all these delights" that Adam and Eve enjoy in Paradise (367-8). Satan expresses his lack of hostility towards Adam and Eve and claims he is "no purposed foe / To you whom I could pity thus forlorn" (374-75).

As the above quoted lines reveal, Satan is clearly responsive to beauty and love, as embodied in Adam and Eve. Carey insightfully comments that "Satan's reasons for feeling he could love Adam and Eve - that they look so like God - naturally surprises the reader, since we have been led to suppose it is God Satan hates" (140). Yet, as a former archangel, one might realistically expect Satan to have a consciousness of divinity and to possess sublime feelings. Therefore, at this point of the soliloquy, Satan's regret at causing harm to Adam and Eve may be considered a genuine expression. It almost seems as though Satan might repent and abandon his destructive plans.

Satan, however, checks the flow of his better thoughts, and returns to his evil stance. He attempts to distort and minimize his diabolical intent towards Adam and Eve with

the words " League with you I seek, / And mutual amity so straight , so close, / That I with you must dwell, or you with me" (375-7). He depicts himself as a generous host who offers "room," "entertainment," and opens the "widest gates" to welcome his human friends and their "numerous offspring" to his abode in Hell (382-3, 385). Despite this mockery, Satan cannot ignore the evident fact that his evil scheme "may not please" Adam and Eve (378). Satan then attempts to justify himself by presenting two excuses. First, he deflects responsibility to God by stating that "Thank him who puts me loath to this revenge / On you who wrong me not for him who wrong'd" (386-87). He seems blind to the falsity of these charges against God, which Satan himself contradicted by his self- condemnation in the previous soliloquy. Secondly, Satan claims that his objective of "conquering this new World" is validated by " . . .public reason just, / Honor and Empire with revenge enlarg'd" (389-390). Although he fails to clarify how his evil actions can qualify as "public reason just," Satan seems satisfied with his dubious arguments. He concludes his soliloquy by insisting that he is "compell[ed] / To do what else though damn'd I should abhor" (392).

This second soliloquy shows Satan's reasoning process. His first reaction to Adam and Eve is one of admiration and wonderment as he perceives their beauty and resemblance to God. Satan also displays remorse at the idea of injuring the "harmless innocence" of the human couple (388). These expressions indicate that despite his degradation, Satan still has some angelic propensities. However, Satan does not allow his elevated thoughts to lead him. Instead, Satan finds reasons to vindicate his actions by disguising his real motives and blaming God. Despite obvious inconsistencies in his arguments, Satan chooses to deceive himself to the extent that he feels "compell[ed]" to follow the course of evil (391). As Milton comments, "So spake the Fiend, and with necessity, / The Tyrant's plea, excus'd his devilish deeds" (393-94).

Analysis of the Third Soliloquy

Another soliloquy of Satan occurs in Book IX (98-178) when he re-enters Paradise in the form of a serpent. Satan begins by describing the grandeur of Earth. He favorably compares Earth to Heaven as he exclaims " O Earth, how like to Heav'n, if not preferr'd / . . . . For what God would after better worse would build" (99, 103). Next, he admires the celestial bodies "That shine, yet bear their bright officious Lamps, / Light above Light, for thee alone, as seems" (104-105) Satan then observes the increasing complexity of life on earth which is " Productive in Herb and Plant, and nobler birth / Of creatures animate with gradual life / Of growth, Sense, Reason, all summ'd up in Man" (111-113). The loveliness of Earth seems to evoke a feeling of desire in Satan as expressed by the lines "With what delight could I have walkt thee round" (114). These remarks convey a sense of Satan's yearning as he scans the Earth and longs for " . . . sweet interchange / Of Hill and Valley, Rivers, Woods and Plains / Now Land, now Sea, and Shores with Forest crown'd . . ." (115-117).

Satan's words reveal his sensitivity to the beauty and glory of Earth, and show that he is capable of finer feelings. Satan appears to regret his inability to "joy" and "delight" in the pleasures and scenes of Earth (114-115). Further, Satan's repeated references to "Heav'n" and God in this part of the soliloquy suggest that he misses his former divine life (99, 103, 107). Satan's tone is poignant as he realizes his alienation from goodness and beauty, and observes that " . . . I in none of these / Find place or refuge . . ." (118-119). These reflections seem a possible turning-point for Satan.

However, while acknowledging the "torment within" him, Satan has no intention of returning to God (121). He convinces himself that " . . .all good to me becomes / Bane, and in Heav'n much worse would be my state" (122-23). He spurns any options

of reconciliation by stating that "But neither here seek I, no nor in Heav'n / To dwell . . ." (124-25). Nevertheless, Satan foresees his continued unhappiness when he states, " Nor hope to be myself less miserable" (126). Regardless, he affirms his evil plans "to make others such / As I . . . . / For only in destroying I find Ease / To my relentless thoughts . . . "(129-130). In these lines one can observe the subtlety of Satan's self-deception. Instead of confronting himself as the cause of his own alienation and misery, and addressing the root problem, Satan misleads himself to think that destruction is the only reasonable and inevitable course before him.

Having confirmed himself in evil, Satan gives vent to his diabolic and perverse intentions. He seems to relish the prospect of spreading "destruction [that] wide may range" (134). He anticipates earning "the glory sole" for marring in one day "What he *Almighty* styl'd, six Nights and Days" (136-37). Besides, Satan resorts to self- deception as is obvious from his statement that "I in one Night freed / From servitude inglorious well nigh half / Th' Angelic Name and thinner left the throng" (140-142). Satan is clearly lying to himself since Raphael, a more reliable narrator, says that the fallen angels numbered "the third part of Heaven's Host" (Book V. 710). Further, in claiming to be a liberator, Satan fails to recognize that his compatriots remain in servitude to him in Hell.

In addition to lying, Satan also displays his jealousy of humankind. He resents that "a Creature form'd of Earth" should have built for him " Magnificent this World, and Earth his seat, / Him Lord pronounc'd, and O indignity! / Subjected to his service Angel wings" (153-55). Despite his disdain of humanity's lowliness, Satan is compelled to acknowledge his own degradation as he assumes the form of a serpent. He recognizes the irony of his situation as he exclaims "O foul descent! that I who erst contended / With Gods to sit the highest, am now constrain'd / Into a Beast, and mixt with bestial slime" (163-165). Faced with the undeniable fact of his debasement, Satan resorts to his usual strategy of inventing arguments to justify his evil. He validates himself by stating, "but what will not Ambition and Revenge / Descend to? who aspires must down as low / As high he soar'd . . ." (168-170) . Satan also rallies himself with the thought of revenging God and the idea that "spite with spite is best repaid" (177).

This third soliloquy reveals the complexity of Satan's thoughts and emotions. Initially, Satan displays sublime feelings as he responds to the magnificence of the earth. However, as he becomes conscious of his inability to partake in the delights of Paradise, Satan's attitude to earth becomes increasingly destructive. Towards the latter part of the soliloquy, Satan's speech is one of lies, distortions, and hateful emotions. The final image of Satan that is conveyed is of an irrational being who is bent on destruction, while fully aware of its degrading consequences.

Analysis of the Fourth Soliloquy

Satan's final soliloquy takes place in Paradise as he observes Eve, prior to tempting her to disobey God (Book IX. 460-492). Before examining Satan's speech, the narrator's comments leading to this passage are worthy of consideration. Milton relates how Satan is captivated by Eve's " . . . Heav'nly form / Angelic, but more soft, and Feminine," (457-458). Eve's appearance seems to negate Satan's evil intentions since "Her graceful Innocence, her every Air / Of gesture or least action overaw'd / His Malice, and with rapine sweet bereav'd / His fierceness of the fierce intent it brought" (459-462). Eve's presence also stimulates the sublime thoughts of Satan, for as Milton observes, "That space the Evil one abstracted stood / From his own evil, and for the time remain'd / Stupidly good . . ." (463-465).

According to Carey, "this passage seems to indicate that Satan's natural tendency when caught unawares is to love. Beauty and delight are his natural element" (139). This statement may seem too idealistic since Satan frequently displays evil and hatred in his rhetoric and actions (IV 110, IX 129). Nonetheless, it is not unreasonable to assume that as a former archangel, Satan must have some remnants of his heavenly disposition. Given this context, it is quite plausible to accept that on beholding Eve, Satan was genuinely " . . . disarm'd of guile, of hate, of envy, of rage."

However, Satan does not dwell at this elevated state for long. His sublime thoughts come to a halt by " . . . the hot Hell that always in him burns, / Though in mid- Heaven . . ." (466-67). Satan "soon" chooses to return to his evil position as "Fierce hate he recollects, and all his thoughts / Of mischief, gratulat[es] . . ." (470-472). Satan then begins his soliloquy by chiding his thought and asking "Thoughts, whither have ye led me, with what sweet / Compulsion thus transported to forget / what hither brought us . . ." (472-75). He renounces his better feelings as he reminds himself to seek " . . .hate, not love, nor hope / Of Paradise for Hell, hope here to taste / Of pleasure . . ." (475-77). He re-asserts his mission which is ". . . all pleasure to destroy" (477). Satan attempts to justify his evil by claiming he has no other option since "Save what is in destroying , other joy / To me is lost . . ." (478-479). Clearly, Satan is once again practising self- deception by deluding himself to think that destroying humanity is his only alternative. As Carey comments, "Satan chooses not to escape his diabolism" (139).

Having confirmed himself in evil, Satan next focuses attention on his scheme to beguile Eve. He urges himself to "not let pass" the "occasion which now smiles" (479-480). Satan rejoices to "behold alone / The Woman opportune to all attempts" (480-81). In the midst of his scheming, however, Satan cannot deny the debasement of evil. He realizes that his strength has depleted to the level that even Adam "though of terrestrial mould" would be a "foe not inforrnidable" (485-86). Satan admits that ". . . so much hath Hell debas'd , and pain / Infeebl'd me" (487-88). Perhaps as a result of knowing his vulnerability, Satan seems defensive as he approaches Eve and observes that " . . .terror be in Love / and beauty" (490-491). However, by now Satan is too established in evil to retract his plans. Instead, he resorts to his characteristic deception by approaching Eve with "Hate stronger, under show of love well feign'd" (492).

This fourth soliloquy shows the internal struggle of Satan to overcome his sense of the sublime with hatred and evil. Initially, Satan's unconscious response to the beauty of Eve is one of awe and admiration. It takes a deliberate effort on Satan's part to "recollect" his mission and to muster his hatred. From that point on, however, Satan devotes himself to his plans of destruction. He obstructs any sublime feelings as he directs his energies to gathering "stronger hate" (491). Commenting on this soliloquy, Carey concludes that "This incident shows that [Satan] is not a destructive automaton, but a creature who chooses to destroy the human race against the promptings of his better nature" (139).

Conclusion

Having analysed the main soliloquies of Satan, one gains many insights into his character and his mental processes. These soliloquies share a common pattern as they reveal three stages in the progression of Satan's thoughts. The first stage is the awakening of elevated feelings in Satan's mind. In all four soliloquies, Satan displays a spontaneous and unconscious response to one or more aspects of the sublime ideal of beauty, truth, and goodness. It may seem surprising that Satan retains an

appreciation of the sublime, even after his fall. Nevertheless, this text implies that the former archangel's basic nature, although "faded [in] splendour" is still present, and that Satan possesses the "regal port" and presumably the "intuitive knowledge" of his heavenly days (IV. 869-70, V. 489). Given this awareness, in the first soliloquy Satan acknowledges the truth and goodness of God, while in the third soliloquy he appreciates the beauty of Paradise and its creatures. The second soliloquy shows Satan admiring the goodness and beauty embodied in Adam and Eve. As his sublime feelings are evoked, Satan seems to momentarily "abstract" himself from evil and appears poised to repent and align himself with heaven once again (IV. 79-80, IX. 463).

However, once Satan becomes conscious of the direction of his thoughts, he hastens to repudiate the sublime. The fourth soliloquy demonstrates how Satan wilfully rejects the "Sweet Compulsion" of loving thoughts, and he strives to "recollect" hate (IX. 471, 473-74). In the first soliloquy too, Satan spurns "all Good" and asserts that "Evil be thou my Good" (IV.10).

This re-affirmation of evil may be considered the second stage of Satan's thoughts. Satan arrives at this stage by presenting various reasons and excuses in order to validate his choice of diabolism. In the first soliloquy Satan thinks of several reasons such as "shame" and ambition, to convince himself against reconciling with God. The second soliloquy shows Satan making excuses, including the duties of "honor" and "empire" so as to justify his actions against the human couple (IV. 390). In the third and fourth soliloquies, Satan argues the inevitability of his evil deeds since "pleasures" are permanently alienated from him. By mounting these numerous arguments, regardless of their discrepancies, Satan persuades himself that evil is the only reasonable course for him to follow.

After establishing himself in evil, Satan's third stage of thinking reflects his fanatical dedication to causing destruction, despite the consequences to himself and to others. In the third and fourth soliloquies Satan insists on "destroying" the happiness of Adam and Eve, and "marring" the world, although he realizes that "thereby worse to me rebound" (IX.128, 136). Satan"s thought process is clearly irrational since no reasonable being would pursue an obviously self-destructive course of action. The best example of Satan's irrationality is his statement that "Revenge, at first, though sweet, / Bitter ere long back on itself recoils, Let it; . . . " (171-172). Undoubtedly, by this third stage, Satan is too consumed by thoughts of "revenge" and "empire" to rationalize the foolishness and futility of his actions (IX. 171, IV. 111,390).

As described above, the three stages of Satan's thoughts show a gradual process of self-deception. Satan invariably chooses to reject his knowledge of the sublime as he argues himself into the position of evil and destruction. By consistently ignoring the truth, Satan's thinking becomes increasingly irrational, delusory and distorted. As C. S. Lewis observes, " I do not know whether we can distinguish his conscious lies from the blindness which he has imposed on himself . . . . he has become more a Lie, than a Liar, a personified self- contradiction" (97). The ultimate result of Satan's "blindness" is that he deludes himself to believe that he could accomplish revenge against God by attacking "this new favourite / Of Heav'n. this Man of Clay" (IX.174-75). Satan overlooks the obvious fact that God in his omnipotence has the power to decree that "Heavenly love shall out do Hellish hate" and that eventually, God would "redeem what Hellish hate / So easily destroy'd" (III.298,301).

Clearly, the climactic self-deception of Satan is his denial of God's omnipotence. Carey maintains that Satan's "indecisiveness about God's omnipotence" is a result of his fallen condition since the " fallen Satan . . . is a creature of moods, apprehending reality through mists of self-deception and forgetfulness" (137). However, Carey is

mistaken in assuming that Satan's self-deception was the result of his fall. Instead, it is more accurate to state that Satan fell from his heavenly stature as a result of self-deception. This statement is supported by the evidence of the text. God describes the fallen angels that they " . . .by thir own suggestion fell, / Self-tempted, self-depraved . . ." (III. 130-131). Similarly, Abdiel accuses the pre-fallen angel of being "to thyself enthralled," thus implying Satan's distorted thinking and self-deception (VI. 181). Besides, *Paradise Lost* maintains that Satan conceived of sin while still in heaven, prior to his fall (II. 750-60). In addition, Satan himself admits that as an angel he became "forgetful' of his obligation, and "Understood not that a grateful mind / By owing owes not . . . (IV. 55-56). This textual evidence proves that even as an archangel, Satan deliberately chose to repress his higher divine knowledge and to mislead himself in the path of evil, which resulted in his eventual fall. Therefore, contrary to Carey's assertion of a "logical flaw," one may conclude that the unfallen Satan practiced self-deception in heaven, just as effectively as the fallen Satan does in his soliloquies.

This conclusion, however, does not imply imperfection or "fallibility" in God's creation of the archangel. As God declares, Satan was created "just and right / Sufficient to have stood, though free to fall" (III. 97-98). Despite this sufficiency, however, Satan admits that he "chose freely" to follow his own thoughts and inclinations rather than obeying the will of God (IV. 72). Nevertheless, one wonders how a being who dwelt daily in the presence of God could freely choose to suppress his archangelic knowledge, and instead surrender himself to self-deception and lies. Steadman observes that "[Satan's self-] delusion was quite consistent with Milton's conception of the evil temptations which befell unrepentant sinners who should '. . .Hard be hardn'd, blind be blinded more, / that they may stumble on and deeper fall' " (235-236). These words seem to echo the scriptural words that "They look and yet do not see; they hear but do not listen or understand" (The Gospel of St. Matthew 13:13) . This paradigm of wilful disobedience and rejection of God is most applicable to the character of Satan. Through his portrayal of Satan, Milton convincingly demonstrates how an archangelic being of superior intelligence ruins its perfection through a process of self-deception and disobedience.

Milton's characteristic of Satan as a self-deceptive figure undoubtedly enriches *Paradise Lost* in many ways. At the level of the narrative, Satan's character gains complexity and "fictional depth" through his "deceptive state of consciousness" (Carey 137). By expressing his doubts, his despair, and revealing the "hateful siege of contraries" within him, Satan becomes a compelling personification of evil (IX. 121-122). According to Merrit Hughes, Milton created Satan as "an example of the self-deception of others which are incident to the surrender of reason to passion" (Carey 177). Undoubtedly, the figure of Satan as self-deceiver serves as a challenge and warning to all readers of *Paradise Lost*. Readers are challenged to examine their motives and be cautious of their own acts of self-determination. Through his portrayal of Satan, Milton reminds his readers that "true and lasting freedom must . . . recognize its relativity to God and his commands without which it is meaningless, self-defeating and alienate" (Shawcross 115). Finally, Milton's achievement in *Paradise Lost* cannot be described only in terms of great literature. The theological and philosophical dimensions of this work are equally impressive. These facts explain why

> . . . *Paradise Lost* still seems to have the power to arouse fresh response . . . more than three hundred years after [Milton's] death. (Griffin 259)

Note

Nidhani De Andrado is Assistant Lecturer in English at the English Department, University of Peradeniya. Her research interests include 19th and 20th century British poetry and fiction, and biblical perspectives in literary texts. She can be contacted at 23/3 Station Road, Colombo 6, Sri Lanka.

References

Carey, J. 1989. Milton's Satan. In *The Cambridge Companion to Milton*, Danielson, Dennis (ed.). Cambridge: Cambridge University Press.

1988. *Christian Community Bible (Catholic Pastoral Edition)*. Manila : Claretian Publications.

Griffin, Dustin. 1989. Milton's Literary Influence. In *The Cambridge Companion to Milton*, Danielson, Dennis (ed.). Cambridge: Cambridge University Press.

Hughes, Merrit. (ed.). 1957. *John Milton: Complete Poetry and Selected Prose*. New York: MacMillan.

Lewis, C.S. 1942. *A Preface to Paradise Lost*. New York: Oxford University Press.

Shawcross, John T. 1982. *With Mortal Voice: The Creation of Paradise Lost*. University Press of Kentucky.

Steadman, John M. 1959. *Milton's Epic Characters*. Chapel Hill: North Carolina University Press.

The Effects of Genotypes and Media Supplements on Callus Induction and Plant Regeneration in Rice (*Oryza Sativa* L.) Anther Culture

K.K.D.S. Ranaweera, Sabaragamuwa University of Sri Lanka

Abstract

A study was undertaken to develop a suitable protocol for anther culture of four rice varieties and their hybrids. Different rice genotypes were shown to have an unequal capability in callus induction from anthers and in plant regeneration from anther-derived calli. Each genotype, however, had a rate of callus formation as well as a regeneration capacity specific to the genotype. Potentials for callus induction and regeneration of hybrids were higher than that of their parental genotypes. Blaydes medium supplemented with 10% potato extract (PE) and 2 mg/l of 2,4-D was found to be the most suitable composition for callus induction (10.33%). The addition of 30% PE in to the MS based medium supplemented with 1.5 mg/l IAA and 2.0 mg/l kinetin gave the highest rate of green plant regeneration. Haploid rice plants obtained through anther culture were compared with diploid parent plants. Haploid leaves contained more chlorophyll 'a' and 'b' although their ratio in both haploid and parent forms was equal. Furthermore, haploid plants have recorded a greater tillering capacity.

Introduction

Anther Culture has been shown to be an excellent technique to obtain genetically distinct haploid and homozygous dihaploid plants from hybrids in a single step (Miah et al., 1996: 285-288). Success in haploid plant production through anther and pollen culture was achieved in a number of plant species. The pioneering work of Guha and Maheshwari (1964:497, 1966:97-98) on *Datura* created considerable interest in this technology among tissue culturists (Nitsch, and Nitsch, 1969: 473-497). Among the factors affecting the anther culture in different genotypes of rice, composition of the medium (especially during the initial stages of the culture), conditions under which the donor plants were grown and culture conditions are of primary importance in successful induction of calli from anthers (Chen, 1986: 3-25; Chu, et al. 1975 :657-688; and Rybczynski, 1990: 57-70).

The role of growth regulators in callus formation and subsequent plant regeneration have long been recognized. However, a lesser number of studies have been carried out to investigate the inter-relationship of growth regulators with other factors, like additional supplements to the medium. Significant differences among genotypes even under the same culture conditions have been observed previously (Quimio and Zapata, 1990: 188-192). The present study demonstrates the effect of growth regulators and other supplements on callus formation and subsequent plant regeneration in rice anther culture, while revealing the influence of the genotype and of culture conditions on these developmental processes.

Materials and Methods

1. Materials:

Four varieties and two hybrids (Table 1) were grown in the field and under green house conditions. Panicles at the stage of 2-3 days before the heading phase were selected to obtain anthers for culture.

© 1998 Sabaragamuwa University Journal, vol. 1, no. 1, pp. 87-92

Table 1: Varieties and Hybrids Used as Donor Plants for Explants

Variety	Hybrid
Katalao	Katalao X Belozerno
Belozerno	
Italika 70	Italika 70 X Pioneer
Pioneer	

Blaydes medium (Blaydes 1966: 748-753) supplemented with potato extract and 2,4-dichlorophenoxyacetic acid (2,4-D) at different ratios was used to induce callus formation and to determine the optimal composition of the medium. Calli obtained were transferred to a MS based medium (Murashige and Skoog, 1962: 473-497) supplemented with 1.5 mg/l IAA and 2.0 mg/l kinetin with and without PE in different concentrations.

2. Methods:

Preliminary studies showed better results when the panicles (anthers) were incubated at 6°C for 48 hours and therefore this pre-treatment was adopted in the experiment.

The methodology employed by Niizeki and Oono (1968: 554-557) was used for callus induction from rice anthers. Callus tissues obtained were incubated under cool white fluorescent light (1000 lux) at a 12 hour photo-period at 30°C for plant regeneration.

Comparative content of chlorophyll in parents and haploid regenerants, ploidy of which was confirmed in separate studies (Personal Communication - Harchenko P.L. !986), was determined according to Milyaev and Primah (1969: 69-72).

Results and Discussion

Results revealed that the PE was capable of inducing callus and the optimal combination of PE and 2,4-D was 10% and 2.0 mg/l respectively (Table 2). However, the least significant difference analysis at 5% level of significance revealed that there is no interaction in the effects of those two components. Callus formation in the medium supplemented with 30% PE was even lower than that in the medium without PE. It was also observed, that calli derived in the above medium were able to promote plant regeneration.

Callus formation was first observed after 20 days of inoculation of anthers of Katalao X Belozerno hybrid. However, callusing on a large scale started after 30-35 days. Different genotypes were shown to be dissimilar with respect to the ability of callus formation (Table 3). Hybrids produced calli at a higher frequency than the parental genotypes. The hybrid, Italika 70 X Pioneer gave the best results. These results are in agreement with the findings of other researchers (Andersen, et al. 1988: 289-292; Foroughi and Zeller, 1990: 77-80; Ranaweera and Pathirana, 1992: 309-35), indicating that different genotypes of the same species require different compositions of media for callus induction from anthers. Calli formed from anthers of different genotypes were diverse in terms of their size, colour and form. However, only smooth and compact callus tissues of yellowish white colour at the age of 30 days were selected for further culture, because it has been previously shown that such calli have a better chance of regeneration (Zapata et al. 1983: 27-46).

Table 2: Effect of 2,4-D Concentration and Potato Extract in the Induction Medium on Callus Formation from Anthers (Medium: Blaydes)

Content of Potato extract	Callus formation %				
	Concentration of 2,4 D (mg/l)				
	0.2	1.0	2.0	3.0	4.0
Without potato extract	4.48	4.80	6.0	4.63	3.65
10 % Potato extract	7.33	7.50	10.33	7.33	7.03
20 % Potato extract	6.85	7.35	7.68	5.33	4.88
30 % Potato extract	2.95	3.60	4.48	1.95	1.13
LSD_{05}=1.60					

Table 3: Callus Formation Capability of Different Genotypes

Variety / Hybrid	Number infected	Callus formation	
		Number	%
1. Katalao	5	84	5.60
2. Belozerno	3	66	4.40
3. Katalao X Belozerno	4	101	6.73 LSD_{05}-0.99
4. Italika 70	6	75	5.00
5. Pioneer	3	113	7.53
6. Italika 70 X Pioneer	6	201	13.40 LSD_{05}-1.76

Note: 1500 anthers/genotype were used for culture in replication and each treatment was repeated three times.

The formation of shoots and roots could be first observed within 8-10 days after incubation. About 15 shoots were formed in a single culture tube. It was also found that the capacity of callus tissues of different genotypes to produce regenerants was varied (Table 4). The highest regeneration rate was observed in calli derived from the hybrid Katalao X Belozerno. According to the results obtained it can be assumed that certain genotypes apparently have greater potential for callusing and subsequent plant regeneration. The reason for this variation has not been explained. It can, however, be hypothesized that this capacity is due to heterosis of the hybrids, super dominance in particular. In all genotypes, the media with supplements such as hormaones stimulated a higher percentage of calli to produce albinos. Yet, in each case where the media were supplemented with PE, the number of albino plants was reduced. Usually haploid plants are characterized by a darker green colour. This was also experimentally confirmed by the study (Table 5), the results of which showed an increased activity of both chlorophyll 'a' and 'b' in haploid plants. However, the ratio of these two forms of pigment was statistically proven to be equal. This phenomenon could not be clarified, as the literature relevant to this field is insufficient. Moreover,

haploid plants were observed to have a higher tillering capacity and a larger total leaf area per plant.

Table 4: Effect of Genotype and Potato Extract in the Culture Medium on Plant Regeneration from Anther-Derived Calli (Basal Medium: Murashige and Skoog with 1.5 mg/l IAA and 2.0 mg/l Kinetin)

Variety/Hybrid	Potato extract	Regenerants				
		No	Albino plants		Green plants	
			No	%	No	%
Katalao	PE -	248	241	97.18	7	2.82
	PE +	308	296	97.10	9	3.90
LSD_{05}=0.61						
Belozerno	PE -	107	96	90.65	11	09.35
	PE +	140	116	82.86	24	17.14
LSD_{05}=3.14						
Katalao X	PE -	168	144	85.72	24	14.28
Belozerno	PE +	184	143	77.72	41	22.28
LSD_{05}=3.92						
Italika 70	PE -	134	129	96.27	5	3.73
	PE +	153	146	95.43	7	4.57
LSD_{05}=0.81						
Pioneer	PE -	199	193	96.99	6	3.01
	PE +	213	203	95.31	10	4.69
LSD_{05}=1.03						
Italika 70 X	PE -	167	156	93.42	11	6.58
Pioneer	PE +	179	161	89.95	18	10.05
LSD_{05}=1.39						

Table 5. Content of Chlorophyll in Leaves of Anther-Derived Haploid and Diploid Plants

Form	Chlorophyll content mg/dm^2 leaf area			Ratio Ch a/b	Total leaf area per Plant
	Ch a	Ch b	Total		
Diploid Form (Parent Form - Belozerno)	1.83	0.37	2.20	4.945	133.0
Haploid Form (Derived anthers of genotype-Belozerno)	3.00	0.68	3.67	5.411	391.1
LSD_{05} =>	0.12	0.06			27.0

Notes

K.K.D.S. Ranaweera is Senior Lecturer in Food Science and Technology and Head, Department of Natural Resources, Sabaragamuwa University of Sri Lanka. His research interests include plant tissue culture and agricultural bio-technology. He can be contacted at the Faculty of Applied Sciences, Uva Campus, Sabaragamuwa University of Sri Lanka, Buttala, Sri Lanka.

The author is grateful to Prof. U.L. Ghuzov, People Friendship University, Moscow, Russia and Dr.P.N. Harchenko, All Union Rice Research Institute, Krashnodar, Russia, for their help during the course of this research.

References

Andersen, S.B., Due, I.K., & Olesen, A., 1988. Results with anther culture in some important Scandinavian varieties of wheat. *Acta Agricultura Scandinavia*. 38: 289-292.

Blaydes, D.F., 1966. Interaction of kinetin and various inhibitors in the growth of Soybean tissues. *Physiologia Plantarum* 19: 748-753.

Chen, Y., 1986. Anther and pollen culture of rice. In *Haploids of Higher Plants in Vitro,* Hu, H., & Yang, H. (eds.) Beijing: China Academic Publishers.

Chu, C.C., Wang, C.C., Sun, C.S., Hsu, K.C., Yin, C.Y., & Bi, F.Y. 1975. Establishment of an efficient medium for anther culture of rice through comparative experiments on the nitrogen sources. *Scientia Sinica* 16, 659-688.

Foroughi, W.B., & Zeller, F.J., 1990. *In vitro* microspore reaction of different German wheat cultivars. *Theoretical and Applied Genetics*. 79: 77-80

Guha, S., & Maheshwari, S.C., 1964. *In vitro* production of embryos from anthers of *Datura*. *Nature* 204: 497.

Guha, S., & Maheshwari, S.C., 1966. Cell division and differentiation of embryos in pollen grains of *Datura in vitro*. *Nature* 212: 97-98.

Harchenko, P.N., 1986. *Rice anther culture works at AURI*. Unpublished Laboratory Seminar Sessions, All Union Rice Research Institute. USSR.

Miah, M.A.A., Pathan, M.S. & Quayum, H.A., 1996. Production of salt tolerant rice breeding line via double haploid. *Euphitica* 91: 285-288.

Milayev, Ya.N., & Primah, N.N., 1969. A Rapid method for comparative determination of pigments in leaves of Maize and Tobacco (in Russian). *Plant Selection and Breeding* 12: 69-72.

Murashige, T., & Skoog, F. 1962. A revised medium for rapid growth and bio assays with tobacco tissue cultures. *Physiologia Plantarum*. 15: 473-497.

Nitsch, J.P., & Nitsch, C., 1969. Haploid plant from pollen grain. *Science* 163: 473-497.

Niizeki, H., Oono, K., 1968. Induction of haploid rice plants from anther culture. *Proc. Japan Acad.* 44: 554-557.

Quimio, C.A., & Zapata, F.J., 1990. Diallel analysis of callus induction and green-plant regeneration in rice anther culture. *Crop Science*. 30: 188-192.

Ranaweera K.K.D.S. & Pathirana R., 1992. Optimization of media and culture conditions for callus induction from anthers of sesame cultivar MI 3, *J. Nat. Sci. Coun. Sri Lanka.*, 20(2): 309-315.

Rybczynski, J.J., 1990. Plant tissue culture of *Secale*: A review. *Euphytica* 46: 57-70.

Zapata, F.J., Khush, G.S., Crill, J.P., Neu, M.M., Romero, R.O., Torrizo, L.B., & Alejar, A., 1983. Rice anther culture at IRRI. In *Cell and Tissue Culture Techniques for Cereal Crop Improvement*. Peking: Science Press.

Industrial Forestry and Resource Conflict: The Discourse on Pine Plantations in Sri Lanka

Ralf Starkloff, Sabaragamuwa University of Sri Lanka

Abstract

Symbolic and material dimensions of a resource conflict over pine plantations in the highland Uva of Sri Lanka are discussed. The discourse among foresters, farmers and environmentalists is reconstructed and analysed. The eco-hydrological consequences of monocrop tree plantations are investigated. The discussion is based on ethnographic research among the social groups involved in the so-called 'pinus controversy'. The imposition of high-productivity industrial silviculture on vulnerable micro-catchments of small farming communities undermined the production conditions of water resources and thereby impairs local agricultural and household production. The dominance of the foresters and their ideological debate with environmentalists marginalised the knowledge and grievances of the farmers and prevented the resolution of the controversy.

Introduction

During the late 1980s and early 1990s the so-called 'pinus controversy' was among the prominent themes in Sri Lankan environmental discourses, involving foremost farmers in the hill-country, especially in the highland Uva, the Forest Department of Sri Lanka and its British advisors, as well as Sri Lankan environmentalists. Of the latter, journalists organised in the Sri Lanka Environmentalist Journalists Forum (SLEJF) became significant catalysts in the construction of a public debate, while several natural scientists at the University of Peradeniya were drawn into the controversy as scientific arbiters of the various claims presented. The claims of the three main interest groups involved were highly divergent, betraying the variance of their interests. The farmers argued that the pine plantations established by the Forest Department in the catchments of their micro-watersheds were adversely affecting the yields of their local water sources and therefore jeopardised their rice and vegetable cultivation, and household production. The foresters, by contrast, claimed that the pine plantations were not only the most productive resource development technology for a budding indigenous paper industry, but also an excellent means of soil conservation and watershed management in the hill-country. Environmentalist groups, such as the Sri Lanka Environmental Congress (SLEC), the Public Campaign for Environment and Development (PCED) and SLEJF transformed the claims of farmers into a battle-cry against an 'alien invader' 'not suitable for the country'.

As these claims show, the 'pinus controversy' was not only about the material transformation of landscapes, but also about the construction of discourse in terms significant to specific historical and political Sri Lankan contexts. This discourse serves to advertise and legitimise claims and practices of adversarial participants to a resource conflict. The farmers expressed their concerns in terms of the local and personal consequences which they experienced. Viewing their identities as both traditional paddy and modern vegetable farmers, their pervasive lament "Watura Nae!" (no water!) signified that water scarcity is a threat to their livelihoods. Meanwhile, foresters couched their activities in terms of a global modernising discourse which had evolved from economic productivism to the Brundtland imperative of integrating growth and sustainability. Finally, environmentalists opposed the foresters' developmentalist stance with a mix of defensive nationalism and environmental traditionalism, asserting the value of indigenous trees and lifestyles. For the supra-local adversaries there

© 1998 Sabaragamuwa University Journal, vol. 1, no. 1, pp. 93-116

was thus more at stake than the adverse consequences of a new land use technology. *'Pinus'* had become a focal metaphor for the clash between two opposed images of identity and destiny.

By now, in 1997, the 'pinus controversy' is a non-issue, having ended in a stalemate which hardly satisfies any of the parties involved. The foresters have stopped planting pines and are commencing the exploitation of existing plantations. The farmers continue to seek more or less desperate means of coping with water scarcity, chiefly through community water supply schemes and individual pump irrigation. The environmentalists have turned their energies to different issues, such as golf courses, hotels and coal power plants. Since the passions of controversy have subsided it appears a good time for a critical assessment of the social construction of an environmental issue from the perspective of an ethnographic researcher who was drawn into the controversy at the time. While I utilise elements of a constructionist perspective[1], my stance as a researcher is not one of aloof detachment. My participation in the discourse on pines seeks to contribute to an enhanced understanding of the social and ecological aspects of some very tangible adverse consequences of environmental change.

From 1990 to 1993 I lived in the village of Kitulwatte[2] in the highland Uva near Bandarawela and carried out ethnographic field research on the social and environmental transformations experienced by this community. I complemented my participant observation and in-depth, open-ended interviews in Kitulwatte with comparative data from field visits to ten other villages in the Uva and Sabaragamuwa Provinces, all of which are affected by pine plantations in their micro-catchments. Furthermore, I observed and interviewed foresters, development consultants, academics and environmentalists involved in the debate over pines. Between 1995 and 1997 I repeatedly returned to Kitulwatte to study the impact of community water supply schemes on water availability in the micro-watershed.

Kitulwatte is a typical highland Uva village in the Uma Oya catchment. Its hamlets are nestled on the lower slopes of the basin's rolling hills along a central stream, the Kitulwatte Oya. Its landscape is a patchwork of land use forms supporting the villagers' livelihoods, including *patana* grasslands, fragments of old-growth forests along hillstreams, homegardens with houses, paddy/vegetable fields, and since the 1970s pine and eucalyptus plantations. The population grew six fold in the 100 years to 1992 from 316 to 1996 inhabitants.[3] People's livelihoods depend on farming paddy and vegetables, various artisan occupations and state employment. In 1991 the majority of the population was ethnically Sinhalese and *goigama* (farmers) by caste (76 percent of the Sinhalese). There were small Sinhalese caste minorities (Vahumpura 8.6 percent, Chalia 1.8 percent) and about two percent Muslims and Tamils (Starkloff 1994). Landownership was highly fragmented, particularly of fields in the valley-bottom along Kitulwatte Oya where vegetable and paddy cycles are rotated. Of these, 91 percent of all holdings were 0.5 acres or less, and only 32.8 percent of all households (98.9 percent *goigama*) owned paddy fields (Starkloff 1994). Land for population and cultivation expansion is extremely limited, especially since the establishment of pine plantations in the village's *patana* grasslands. Cultivation and household production are dependent on water supplies from small streams originating in the micro-catchment hills above the village. Villagers abstract water from streams into an intricate network of small channels supplying fields in even remote locations. Water for household use is traditionally obtained from spouts installed in streams and used *in situ*, or carried predominantly by women in a *kale* (aluminium, plastic or clay pot).

In this article I will reconstruct and assess the symbolic and material dimensions of a resource conflict ensuing from the establishment of pine plantations in the Intermedi-

ate Zone hill-country of Sri Lanka. This is about the contestation, appropriation and utilisation of a resource base in which the state prevailed in opposition to farmers and environmentalists. The latter two never forged a significant alliance, but rather talked past each other. I will demonstrate, that the dominance of foresters and development professionals as well as the ideological nature of their dispute with environmentalists effectively marginalised the claims and concerns of those who are affected daily by the consequences of pine plantation establishment, the farmers. Moreover, I will suggest that the dominance of industrial silviculture, while being productive from the narrow fragmented perspective of single-commodity production, has undermined Kitulwatte's overall eco-systems productivity, on which the maintenance of the landphase of the local hydro-cycle depends.

Figure 1: 1954 Land Use in the Kitulwatte Micro-Watershed[4]

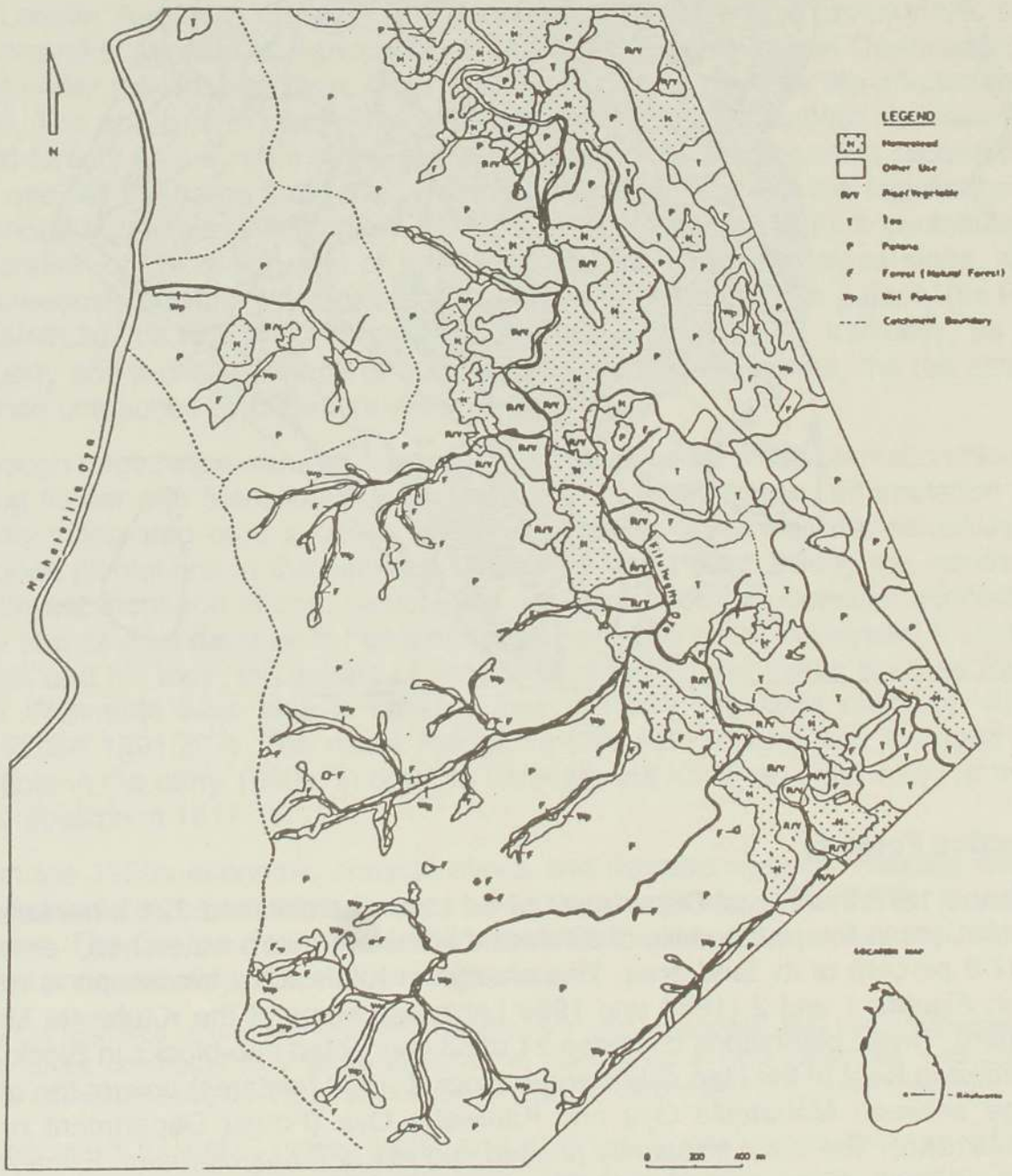
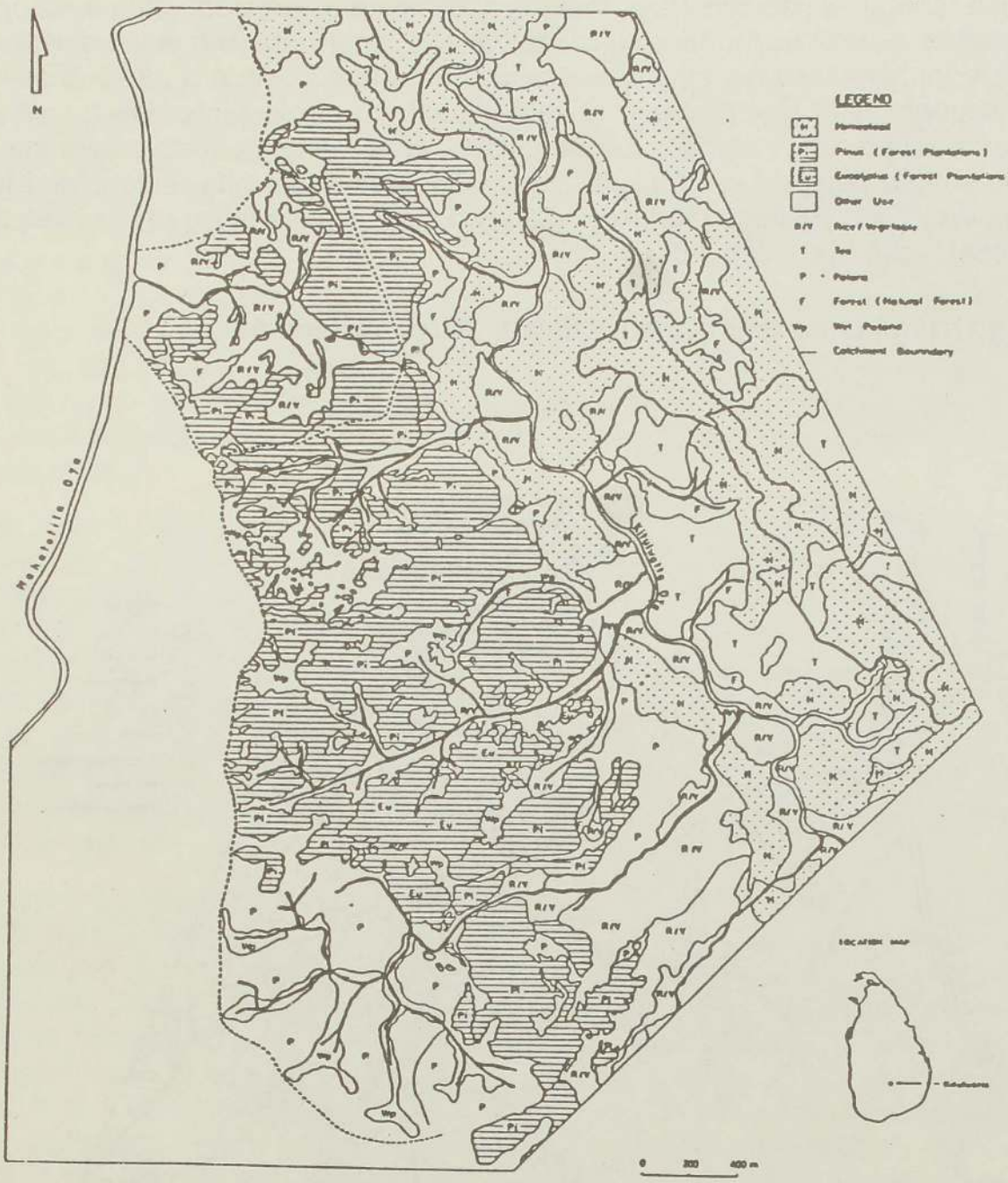


Figure 2: 1988 Land Use in the Kitulwatte Micro-Watershed



Production Forestry

In 1976 and 1978 the Forest Department of Sri Lanka established 221.2 hectares of tree plantations in the *patana* hills of Kitulwatte's western micro-watershed, amounting to 47.8 percent of its land area. This change in Kitulwatte's landscape is represented in Figures 1 and 2 (1954 and 1988 Land Use Maps of the Kitulwatte Micro-Watershed). These plantations comprise 21 of 53 connected sub-blocks in Block X of the Diyatalawa Beat of the Haputale Range. Block X (530 hectares) covers the entire hill range between Mahatotila Oya and Kitulwatte Oya (Forest Department of Sri Lanka 1991a&b). The most frequently planted species is *Pinus caribaea*. Eucalyptus comprises roughly 15 percent of the plantations, of which *Eucalyptus grandis* is the most prevalent species.

In the highland Uva tree plantations were established exclusively on so-called *patana* grasslands controlled by the state, which claims exclusive property rights in the country's 'crownlands'. The *patanas* have consistently been depicted as 'denuded, degraded, eroded lands' by Sri Lanka's foresters (Perera W.R.H. 1988:6-9; Bharathie 1990:1; Bandaratilake 1988:11), who sought to delegitimise the land use practices of local farmers and to promote the exclusive appropriation of the *patanas* by the Forest Department. Incidentally, the British tea planters and government administrators of the colonial period legitimised the appropriation of village and forest lands for tea and coffee plantation establishment with the same wastelands imagery.

From the 1890s until 1938 *patana* afforestation was in an experimental stage, during which the suitability of various species and planting techniques were tested. The most significant result was the difficulty of raising indigenous forest species in plantation lots on climatically and edaphically adverse sites, and the relative ease with which the Australian eucalyptus could be grown. With careful management indigenous species were established under the canopy of experimental eucalyptus lots (de Rosayro 1945/46IV:139-147).

Sri Lankan foresters consider the forestry policy of 1938, pronounced by D.S. Senanayake, Minister of Agriculture and Lands in the transitional Ceylonese government under the Donoughmore Constitution, the turning point for the afforestation program. The anti-colonial and nationalist spirit of the times identified the island's vanished forests as a symbol of the social and ecological disintegration caused by colonial rule. At the same time, the emergent nation anticipated the significance of indigenous economic development. *Patana* afforestation would thus contribute to the restoration of the nation and of the fabled forests of the Sinhalese kings, while simultaneously providing 'a satisfactory means of economic use of *patana*' (de Rosayro 1945/46I:207,IV:139-147; Premachandra 1988:vii; fieldnotes). Ironically, as private property and a critical source of taxable foreign currency income, the tea estates remained untouched by the afforestation programme.

Although beginnings were on a small scale and involved a few plantation blocks providing timber and fuelwood to surrounding towns and villages, afforestation was instantly celebrated as a success. Of great symbolic value was the establishment of windbelt plantations in the highland Uva in the late 1940s. During the months of the southwest monsoon strong, desiccating winds prevented successful agricultural activity and caused damage to homesteads. By planting small eucalyptus blocks on the ridges and hill tops, the impact of wind was reduced, and towns such as Palugama near Welimada were able to develop their lucrative vegetable cashcrop cultivation (NARESA 1991:207). The name Palugama (desolate village) was changed to Keppetipola in the early 1960s, in order to venerate the Kandyan chief who led the failed Uva rebellion in 1817-18.

From the 1960s economic considerations and developmentalist ideology dominated the rationale of the country's forestry policy. In an editorial of the Forest Department's Journal *The Ceylon Forester* of 1961 'the value of research in forestry' in 'the so-called under-developed countries' is discussed:

> Forest research is directed towards making their vast, untapped and even neglected forest resources contribute their share towards the building up of new industries, and creating a new economic base for the good of society. (Forest Department of Ceylon 1961:3)

In the effort to make 'more, better and cheaper goods' productivity considerations were at the centre of forestry research. Trees pose the vexing problem that their growth patterns are not easily synchronised with the requirements of economic growth. Trees are slow. The maturation of a mahogany tree takes up to 60 years.

This circumstance is a serious handicap to the desire for 'the highest yield and the best financial return' (Forest Department of Ceylon1961:3-4). Finding 'suitable' fast growing species and speeding up growth by scientific means was and continues to be of foremost interest in the minds of foresters.

> The development of faster growing and superior races within a species by genetic research and forest tree breeding could greatly increase the profit factor in forestry. ... Ecological research concerning the growth and vigour of plants in severe environments and under unfavourable climatic conditions, combined with trials with exotics, would be of tremendous value in solving the problem of afforesting waste and arid tracts of land. (Forest Department of Ceylon 1961:4)

It is noteworthy, that 'ecological research' is here exclusively concerned with the effects of 'severe environments' on different plant species and not with the effects of these plants on the environments.

By 1965 the Forest Department concentrated on planting 'exotics', rather than pursuing lofty genetic research schemes to produce super trees. Exotics merely required several years of trials to determine the most 'suitable' species. The self-sufficiency orientation of the SLFP governments and the escalating balance-of-payment crisis during the early 1970s motivated the expansion of the afforestation scheme. The development of a local paper industry precipitated the wide-spread introduction of pine plantations (Bandaratilake 1988:10; Vivekanandan 1988:21).

Evaluation of trials had determined that *Pinus caribaea* grew best in the hill-country grasslands and provided long fibre pulp adequate for paper production. This species is a tropical pine which grows in the coastal regions of the Caribbean. The significant environmental values taken into consideration in finding proper matches for Sri Lankan plantation sites were annual rainfall, temperature ranges, length of drought periods and pH levels of the soils. *P. caribaea* thus fell well within the local parameters (Vivekanandan 1988:21-22). The ecological context of the species' Caribbean habitats was not taken into consideration. In particular, no hydrological information is provided in Vivekanandan's report on provenance research, which is exclusively concerned with the trees' 'performance' (Vivekanandan 1988:21-25). *Pinus caribaea hondurensis* is by now the dominant variety grown in the island (Perera A.1988a:29).

The local choice of pines, and of the Honduran variety in particular, was determined by the objective of paper production, and the availability of knowledge and seed materials circulating in international forestry development networks. Tropical Commonwealth countries receive assistance from the Oxford Forestry Institute (OFI) in England, which is responsible for the study and popularisation of *Pinus caribaea*. OFI maintains a data bank, which provides foresters of tropical countries with 'sound advise on obtaining a matching seed source' for their designated plantation sites (Wood 1988:2). British Overseas Development Administration (ODA) funded international research concluded that *Pinus caribaea hondurensis* from Belize was superior in performance to any other species and varieties studied (Wood 1988:1). As a result of this single minded determination, *P. caribaea* is by now 'the most widely planted tropical pine in the world' (Wood 1988:2).

Globally, *pinus* and *eucalyptus* are among the most frequently planted genera replacing clear-felled forests and grasslands with monocrop plantations. They are an integral component of the Tropical Forestry Action Plan designed by the United Nations in conjunction with the World Bank and the World Resources Institute 'to conserve and develop tropical forest resources on a long-term sustainable basis' (FAO 1987; World Resources Institute 1985; Environmental Defense Fund 1987; Shiva 1987; Wood 1988; Hamilton 1983).

By the end of 1990, the Sri Lankan Forest Department had grown 18,570 hectares of eucalyptus and 18,614 hectares of pine in its Up-Country Division, making these the most frequently planted species in the island's watersheds (Bharatie 1990:34). The decisive factors in the choice of these genera are the relative ease and speed of establishment, which reduces the cost of labour and other material inputs, and their fast growth, which provides for the earliest possible returns on investments and the greatest volume of timber, fibre, oil and/or resin per unit of time.

Afforestation is almost exclusively a concern of the Sri Lankan state. Although fast growing species are comparatively more profitable than indigenous forest species, a cropping cycle nevertheless takes 30 years, so that 'private institutions or investors are hardly interested in so long-term investments [sic]' (Jaakko Poeyry 1986:59). In addition, the state as the largest landowner (nominally 80 percent of the island's land area) is the only actor controlling sufficient space for afforestation purposes. Afforestation is thus an infra-structural service which requires the state to act as a producer of a basic resource.

Plantation establishment in Kitulwatte in 1976 and 1978 falls within the period of single-minded productivism. Between 1965 and 1978, the Forest Department planted in the highland Uva on a large scale without foreign project assistance (Jaakko Poeyry 1986:13; Perera W.R.H. 1988:8). Approximately 8.8 percent of the land area of the Bandarawela Assistant Government Agent Division came under tree plantations. As in Kitulwatte, they are located invariably where the upper catchments of hillstreams had remained under grassland. Nobody anticipated yet, that the plantations would drastically alter the eco-hydrological conditions of the human livelihood systems on which they had been imposed.

The timing of planting is determined by the pattern of the rainy season. To ensure a reasonably high survival rate, seedlings need to be in the ground at the onset of the rains in October and stabilise before the first dry period in February. Seed availability, speed and robustness at the nursery stage render *pinus* and *eucalyptus* highly economical plants. The nursery time of pines and eucalyptus is comparatively short. After eight to nine months the seedlings are strong enough to be transplanted and the next nursery is produced for the following year's planting season. By comparison, indigenous species require one and a half years of nursery time and seed collection from indigenous stock is cumbersome and labour intensive. The simplicity of pines and eucalyptus render them manageable and more productive.

In Kitulwatte, two months before planting, ground preparation was carried out by private contractors who hired approximately 100 labourers in the village at minimum wage levels. Men and women cleared the ground, men dug holes and women planted the seedlings. According to a District Forest Officer in Badulla and an Assistant Conservator of Forests in Colombo, standard ground preparation procedures were designed to prevent soil exposure and erosion in steep areas. Very steep slopes required patch-weeding of 1 square metre, and steep slopes had to be weeded in strips of one foot width, with eight feet of grass-cover left between two strips. The removed plant matter was to be deposited along the contour to arrest erosion. On gentle slopes the entire area was to be cleared by burning and by uprooting plant remnants in the soil. After planting, the ground had to be patch- or strip-weeded three times during the first year, twice in the second year, and once in the third year. After the third year weeding would become unnecessary, as the emerging canopy shades out the *patana* vegetation.

Karunawathi, a participating female labourer, reported that the actual practice of ground preparation in Kitulwatte deviated considerably from this complex scheme.

The entire planting site was burned and clear-weeded, after which the remaining debris was dried and burned. One single ring-weeding around the plants was carried out one year after planting. This simplified procedure would have saved a considerable amount of labour time and cost. However, after land preparation for plantation establishment, the soil had been exposed in its entirety, had been turned over and treaded during weeding, and had been left without a root structure. It was therefore vulnerable to the erosive impact of unmitigated and prolonged rainfall during the inter-monsoon and monsoon periods from October to January. The process of land degradation in tree plantations started with their inception.

Respondents recalled that most villagers at the time had an uncritical attitude towards the plantations. Their right to vegetable cultivation in the *patanas* and forest gullies had remained unquestioned, the plantations offered temporary employment, and an increase of tree cover was considered a desirable change. The fact that the villagers had not been consulted about the afforestation project did not meet with much objection. Villagers recognised the right and power of the state to claim control of the grassland hills and reported invariably that no conflict between villagers and the foresters had occurred.

Only Gunasingha, a village leader and political activist, and some of his neighbours communicated apprehensions about the possible impact of the trees on the village's water situation to Forest Department officials. He knew that residents of Malpotha, a neighbouring village, had experienced a marked decline of their water sources ten years after planting of pines in their hills. The foresters reassured the delegation from Kitulwatte that within fifteen years they would have more water than ever before, as increased forest cover would create a better watershed.

'Conservation' Forestry

In the 1980s, the productivist rationale for tree plantations became linked with environmental concerns. Not only was 'the environment' becoming a central theme in the global development debate of the 1980s, but in Sri Lanka local and foreign agencies started to worry about the impact of soil erosion on the viability of their most costly and most prestigious project, the Mahaweli Programme. A network of large dams, reservoirs and hydro-electric power stations had been built in the hill-country. Thousands of families had been resettled in the dry zone lowlands and depend on the irrigation capacity of the scheme. The country's emergent industrial and service sectors, as well as private consumers depend on a growing supply of electricity. The rising costs of imported fuel had motivated a shift to a local and renewable source of energy. By 1990, 49 Billion Rupees had been spent on the Mahaweli Programme (MASL 1991).

Administrators and consultants of the Mahaweli Programme argued, if land use practices in the Upper Mahaweli watershed caused erosion and unbalanced seasonal stream flow, the reservoirs would silt up and capacity for irrigation and energy production of the scheme would be impaired (Tschakert & Decurtins 1989; Schubert 1991; FORLUMP 1992). Thus, the Mahaweli Authority in conjunction with several foreign aid agencies initiated a watershed management programme in the upper Mahaweli region, which would improve conditions in an integrated effort by targeting various land use forms in the macro-watershed for erosion control measures.

The Forest Department aligned its planting efforts with this objective in several foreign aided projects during the 1980s/90s, involving USAID, the World Bank, FINNIDA, ODA, the United Nations Development Programme, and the Dutch government. At the centre of these forestry projects is the assumption that trees provide the

best protection against erosion and 'conserve soil and water resources' (Jaakko Poeyry 1986:74; Bandaratilake 1988:12). The reduction of forest cover in the upper Mahaweli watershed to eight percent of its land area was accordingly considered 'alarming' (Jaakko Poeyry 1986:4; Bandaratilake 1988:11). *Patanas* and abandoned degraded tea estates were singled out for afforestation. The foresters postulated the need for 'some kind of vegetative cover which could survive and grow under the adverse conditions of these sites ... to protect the soil from erosion' (Bandaratilake 1988:11). USAID assisted the Forest Department's Reforestation and Watershed Management Project (RWMP) with US$ 16.15 million in grants and loans. Around 9713 hectares of tree plantations in the upper Mahaweli watershed were raised between 1980 and 1987, 85 percent of which were pine and eucalyptus (Bandaratilake 1988:13; Jaakko Poeyry 1986:11).

The new conservationist orientation within Sri Lankan forestry couched afforestation in the symbolic terms of a global environmental discourse concerned with the environmental sustainability of development (WCED 1987; FAO 1987). By becoming explicitly conservationist, afforestation enhanced its value as it claimed to integrate economic growth and environmental protection. The 1986 draft of the *Forestry Masterplan for Sri Lanka* states two significant objectives: 'to maintain, conserve and *create forests* for the preservation and amelioration of the environment', and 'to work the forest to the highest possible economic advantage' (Jaakko Poeyry 1986:8 [emphasis mine]). While the draft repeatedly asserts that industrial and fuelwood production and environmental protection are the dual purpose of forest plantations (Jaakko Poeyry 1986:s5,s9,57,75), no doubt is left as to the priorities of afforestation:

> These plantations will be very important from the protective point of view too even if their primary purpose will be commercial wood production. (Jaakko Poeyry 1986:78)

By the mid-1980s Kitulwatte's farmers were experiencing the same decline of their water sources as their neighbours from Malpotha ten year before. By 1991, fifteen years after planting, the springs and wells under the pine and eucalyptus hills were still declining and the promised turn-around failed to materialise. Gunasingha grasped the fundamental error of the foresters. During our first encounter in the valley-fields of Lower Kitulwatte, he pointed to the pine plantations and stated:

> Fifteen years ago the Forest Department planted a fake forest in our hills and now we don't have water. A real forest should have trees like in the gully forests. (Gunasingha, fieldnotes)

The structures of forests and tree plantations are radically different. Tree plantations are monocrops, consisting of individuals of a single species of the same age, growing more or less at the same pace and at the same level of height. Pines and Eucalyptus are fast growing species which reproduce within 15 years, and healthy individuals are harvested after 30 years by clear-cutting. In the highland Uva, as in most locations elsewhere, the pine plantations have no understory and ground cover at all. They do not attract any birdlife, and only few mammals and reptiles. By contrast, the flora and fauna of forest fragments comprise a complex interactive network of a great diversity of species. The forests' canopy is multilayered and the ground is covered with herbacious plants and shrubs.

The Forest Department claims that by planting trees which occur in forest habitats it has created forests. However, their designation as 'forest plantations' is a deceptive euphemism. Far from 'maintaining the forest cover' (Jaakko Poeyry 1986:s1) of the island through *afforest*ation, the Forest Department has raised tree monocultures. The process of tree plantation establishment structurally resembles monocrop cultivation of tea, rubber and coconut, as well as vegetables and grains, and is rather unlike the evolution of forests.

The foresters' second ecologically disastrous assumption stated that *patanas* were 'grass infested' wastelands and needed to be replaced with trees (Jaakko Poeyry 1986:56). The Uva grasslands were a component of an old and stable ecological system, which was maintained in the interaction of distinct biological factors and geo-climatic phenomena, such as cattle and their herders, fire, exposure to desiccating winds, and seasonal root dormancy of grasses. The so-called '*patana* debate' among Sri Lanka's foresters advanced opposing and inconclusive accounts of the historical evolution of these grasslands (Pearson 1899, deRosayro 1945/46, Holmes 1951, Pemadasa 1984). 300 years ago Robert Knox, a British seaman held captive by the Kandyan king for twenty years, remarked on the hydrological fecundity of and the lack of tree cover in the highland Uva:

> ... full of small hils, but noe trees one them ... the wood growes onely in spots ... the other ground without woods bareth onely a longe flagie or reede like grasse [sic]. (Knox [1681] 1989: 10,12)

> The province of Ouvah ... is a Country well watered, the Land not smooth, neither the hills very high, wood very scarce, but what they plant about their houses. But great plenty of Cattle, their land void of wood being the more apt for grazing. ... In this Country grows the best Tobacco that is on this land. Rice is more plenty here than most other things [sic]. (Knox [1681] 1989: 27-28)

> This Country, as you stand one the hils, appereth low to them and full of small hils, but noe trees one them and flatt valys betweene them, which are thire rice fields and very well watered. ... they are hard put to it to gitt wood for firring ... The hils generally are stony barren land baring onely (Illucke) or such flage grasse ... the valies or rice fields fruitfull and good Land. Aboute thire townes are Lymes, plantaines and Jacke trees, the Countryy poppolous and healthful. [sic] (Knox [1681] 1989: 10)

Local Knowledge

The explanation of the ecological failure of afforestation by the majority farmers in Kitulwatte rested primarily on the temporal association of the establishment of the tree plantations with the progressive decline of their water. In their experience the water vanished as the trees grew taller. Queried about the causal link between the occurrence of the two phenomena, most respondents stated that '*pinus* sucks water'. All of our respondents recognised the lack of undergrowth, the matting of pine needles, and the dry, hard and eroded soil in the pine plantations. Yet, only a minority of more inquisitive and perceptive villagers stated that these phenomena caused the reduced infiltration capacity of the soil.

Gunasingha was the keenest observer among the villagers. His level of reflexivity included the recognition of the lack of status and power of his knowledge. He argued that the easily decaying leaf litter of mixed broadleaf forest trees absorbs moisture and provides nutrients for undergrowth. Meanwhile, the deep roots of pines 'suck up all the water' and their needle litter covers the ground 'like a roof'.

> Without litter and undergrowth there is nothing to retain the moisture. The soil is washed off and the bare rocks show on the surface. All the water runs off during the rainy season. No water is retained in the soil and therefore no water is available during the dry season. This is only my view. What can I say after all the foresters and scientists have said about the *pinus*? Afterall, I am just a farmer. (Gunasingha, fieldnotes)

Chandralatha, who squatted in a *varrichchi* (wattle and daub) house directly under a pine lot, argued the following about soil erosion and the pattern of stream flow:

> Under the pines the soil is infertile and eroded. They are easily burnt. The rains wash away all the soil. Now, when it rains there is a lot more silt in our streams. During the rainy season

there is a lot more water in the streams than before the *pinus* was planted. Earlier there was a steady flow of water all year. Now there is too much water in the rainy season and too little in the dry season. (Chandralatha, fieldnotes)

The villagers' observations and explanations are based on day to day experiences of coping with water scarcity over a period of several years. They suggest, that the pine plantations had the opposite of the presumed conservationist effects. Instead of reducing erosion and balancing uneven seasonal waterflow, they exacerbate both problems. Consequently, the irrigation capacity and household water supply of Kitulwatte were seriously impaired. Villagers are now pumping water with kerosene pumps from Kitulwatte Oya, or, where the distance to the Oya is too far, have either reverted to rainfed cultivation or abandoned their fields altogether. Household water uses now require long walks to distant wells and unreliable water supply systems.[5] Residents of Diyatalawa, Malpotha, Patanawatte, Nawala, Makulella, Matetilla, Kinigama, Bandarawela, Borelanda and Ihalagalagama in the Uva and Sabaragamuwa Provinces confirmed this experience: as the plantations grew taller, their water sources declined.

In addition, people in Kitulwatte complained about the loss of pasture and consequently of their cattle herds, the loss of land for village expansion, the loss of wildlife habitat, and about the difficulty of walking in hills covered with pine needles and gravel. Moreover, they reported an inordinate increase in the wild boar population, which thrives on the mycorrhiza fungi with which the Forest Department inoculated the pine seedlings to facilitate water uptake and nitrogen fixing. The boars enter the fields and homegardens during the night and raid the farmers' crops.

Since the late 1980s, the residents of Kitulwatte made a number of attempts to communicate with the Forest Department, as well as with politicians and state administrators, in order to call attention to their predicament.

Gunasingha reported that the presidents of the various village welfare and development societies signed letters to the Forest Department, the Chief Minister of Uva Province, the Minister of Lands of Uva Province, the local Member of Parliament, and the Department of Agriculture. While the Forest and Agriculture Departments failed to reply altogether, the Uva Lands Minister came for a site visit and was shown the situation in the village. He reported to his Chief Minister, who replied that he could not accept the villagers' statements. He is reported to have declared, that 'American forestry experts' had assured him that the problem did not occur in other countries where pine had been planted.

During the *udagama* (village awakening) development project in Kitulwatte the villagers presented the pine plantations and the water crisis as their priority issue. They had met with the Assistant Government Agent of Bandarawela in 1991, who stated that the pines would be cut or interplanted with indigenous tree species. No action followed this promise.

At the official opening of the 'awakened village', community leaders met with the President's wife and presented her with a *sandeshaya* (poetic message/petition). In pre-colonial times the people would send a *sandeshaya* for benevolent intervention in situations of distress to their king. Although no direct reply had been received from the presidential couple, villagers had listened to radio announcements in which the First Lady stated, that many farmers had voiced complaints about the pine plantations and water scarcity. An official inquiry would be launched. The farmers should inform the Forest Department and 'measures needed to be taken'.

During the Presidential Mobile Service in Badulla in 1991, an institution designed by the Premadasa government 'to bring government to the people', the co-ordinator of the *udagama* project in Kitulwatte presented Kitulwatte's concerns to the President. Premadasa was reported to have replied that this was 'a serious problem' and that 'solutions would have to be found'.

Distrust and a sense of despair permeated the comments of villagers about the evasive responses of their government servants and political leaders.

> I don't believe anything will ever be done about the *pinus*. (Lokubanda, fieldnotes)
>
> We have been destroyed by *pinus*. (Abeysingha, fieldnotes)
>
> What is the use of talking to the authorities? It is the government who planted these trees. We can drink poison and die. That's what has happened to us with the *pinus*. (Heenbanda, fieldnotes)

Eventually, the political and administrative systems responded by fitting the farmers' problems into the context of various development schemes, such as the *Udagama* village development project and the Community Water Supply and Sanitation Project[6]. However, these merely supplied means of coping and left the pine plantations and thereby one significant cause of water scarcity untouched. How is a community water supply scheme to fill its pipes and tanks from sources without sufficient water yields?

Debates

Still, from the late eighties '*pinus*' became an issue of public debate. Complaints from villages affected by water decline after the establishment of tree plantations were catching the attention of environmentalist organisations in Colombo. Newspapers picked up the issue and became a forum for the exchange of arguments between foresters, environmentalists and concerned readers. Scientists at Peradeniya University in Sri Lanka began to debate the ecological implications of pine plantations. Meanwhile, the residents of the affected villages remained very much at the periphery of these debates. They assumed the victim role in a public drama beyond their control or making.

In 1988 Peradeniya University in collaboration with the British High Commission held a symposium on 'Reforestation with Pinus in Sri Lanka'. At this event foresters and academics presented papers and held discussions with a select audience of concerned professionals. Farmers were conspicuously absent. Despite the exclusion of one of the main groups of affected actors, some of the villagers' concerns were raised, and some first doubts and admissions of problems were voiced. The symposium papers and transcripts betray a defensive edge which was absent from the assertive optimism of the Forestry Masterplan. The symposium was opened by H.P.M. Gunasena, Professor of Agricultural Sciences, who summarised the contentious issues of the 'pinus controversy': (1) excessive water consumption, (2) soil erodibility, (3) depletion of soil nutrients, and (4) reduction of organic matter in the soil's A-horizon (1988:iv-v).

The defensive arguments of foresters and of academics engaged in USAID funded research for the RWMP, stated that the pine plantations provided 'excellent features for erosion control' (Bandaratilake 1988:10). They asserted that the needle litter protected the soil 'completely' from erosion (Bandaratilake 1988:13) and permitted the percolation of 'some' water (Perera W.R.H. 1988:8). It was said, that water from catchments planted with pine was 'crystal clear', demonstrating the lack of erosion (ibid). Their research revealed that in pine plantations the soil quality was improved,

undergrowth and broadleaf tree species established satisfactorily, and erosive runoff was reduced (Perera A.1988b:56; Gunawardena 1988:55; Bandaratilake 1988:14-15). The principal reason for land degradation in pine plantations, the argument continued, was the impact of fire. The plantations pose a fire hazard as the trees produce flammable resinous compounds which burn easily under dry conditions. The land use practices of nearby cultivators and herders were held responsible for causing the frequent plantation fires. While pine trees are fairly fire resistant from their sixth year, the fires destroy potential undergrowth and consequently promote erosion. Where fire protection was practised, soil and watershed conservation was effective (Bandaratilake 1988:15; Perera A. 1988a:30,37; 1988b:58; Gunawardena 1988:55).

Evidence for the defensive arguments outlined, was generated from research carried out by the Forest Department and its scientific consultants at the RWMP research station in Wewelthalava in the Ginigathena area (Bandaratilake 1988:14; Perera A. 1988b:56). This area is located in the highest rainfall region of the western hill-country (5000 mm per year) and experiences no prolonged drought. The research plantation is permanently staffed, the trees receive proper silvicultural treatment, and fire protection poses no problem (Gunawardena 1989:92-97 [1988]).

This data hardly qualifies to assess the effects of pine plantations on catchments in the Intermediate Zone of the highland Uva. Here, considerably lower rainfall (1600-1700 mm) and a long dry season with desiccating winds comprise the dominant limiting factors for undergrowth in the tree plantations.[7] The former Conservator of Forests, W.R.H. Perera, was well aware of this fact. Concerning the pines planted in the Uva grasslands he stated:

> In the dry *patanas* and on dry denuded lands, the amount of undergrowth is practically nil. (Perera W.R.H. 1988:8)

He also conceded the negative effect of the pine plantations on groundwater recharge:

> It is correct that when fast growing species with high rates of wood production are grown there is a high rate of water use. Thus, depleting the soil water. [sic] (Perera W.R.H. 1988:8)

Forest scientist A. Perera arrived at the same conclusion:

> Another site factor is the seasonal dry spells in some pine planted areas (e.g. in the Uva basin). This coupled with high evapo-transpiration potential of pines could cause moisture stresses intense enough to suppress undergrowth composition. [sic] (Perera A. 1988b:58)

Furthermore, A. Perera and Gunatilleke indicated that the pine plantations failed to receive regular silvicultural treatment (Perera A. 1988a:33; Gunatilleke 1988:41-42). This implies foremost, that the plantations were not thinned at prescribed intervals. However, despite these insights, A. Perera insisted on a reductionist conclusion: recurring 'forest' fires are the dominant cause of 'ecological retrogression' (Perera A. 1988b:58). This emphasis on fire damage shifts responsibility away from the foresters to the residents of adjacent villages. It also begs the question why there are so many fires in just about all of the plantations every year.

In the latter part of 1991 the 'pinus controversy' in the highland Uva received increased media attention and prompted a governmental inquiry. The Public Campaign for Environment and Development (PCED), organised by Colombo based professionalised NGOs, submitted a report to the United Nations Conference on Environment and Development in Rio de Janeiro, which reflected the perspective of Sri Lanka's non-governmental organisations on the country's environmental situation. In prepara-

tion for this report, the NGOs had organised a fact-finding campaign with public hearings all over the island, during which local residents voiced their grievances.

Bandarawela was the location of one of these hearings. Local farmers and environmentalists, such as the Young Conservationists in Mirahawatte presented the water crisis in the highland Uva as a consequence of the tree plantations. The environmentalist journalists of SLEJF attended the hearing and were taken on various site visits in the basin. They published several articles in the national press which created a dramatic impression of the relationship between pines and water scarcity. The media attention worried the Minister of Lands, Irrigation and Mahaweli Development, who instructed the Forest Department to set up a commission of inquiry to investigate the allegations.

The so-called 'Pinus Commission' was not an independent body of inquiry, but was controlled by the Forest Department, the very target of the environmentalists' criticism. The foresters invited several scientists from Colombo and Peradeniya Universities, as well as representatives of the Central Environmental Authority and of environmentalist NGOs to join the commission. A one day site-visit to the Bandarawela area was arranged during the inter-monsoonal rainy season. The Sri Lanka Environmental Congress (SLEC) together with local NGOs in Bandarawela organised and scheduled several site inspections in the area without conferring with the members of the commission, including the SLEC representative.

The site visit was a fiasco. The environmentalist activists failed to carefully prepare the site inspections and repeatedly presented untenable arguments. For instance, the commission was shown a location in Bandarawela town where water decline was evidently caused by urban settlement in the micro-catchment area, rather than by a nearby pine plantation. The activists angrily refused to recognise the fact that pines are not the only possible cause of water scarcity. Their assertion that a tree from 'temperate climates' was locally unsuitable, was dismissed by the foresters who were after all planting tropical species of pine. Increasingly observation and discourse were replaced by antagonism and aggressive exchanges.

During the commission's appearance in Kitulwatte, the residents for once controlled the site visit and the commission was informed by the villagers about the loss of irrigation and household water, and the siltation of agricultural fields. The foresters conceded that the tree plantations might have an adverse hydrological impact, and proposed to experiment with the partial replacement of pines by indigenous tree species, as well as to carry out a hydrological study in Kitulwatte. After leaving the village, the commission was caught in heavy thunderstorms and the foresters decided to cancel all further site inspections. They returned to Colombo on the same day. The environmentalists were outraged and a prolonged period of angry exchanges of accusations and recriminations ensued.

Back in Colombo both SLEC and the Forest Department wrote separate reports (SLEC 1991; Forest Department of Sri Lanka 1992). The foresters did invite the SLEC representative to the commission to submit her comments. The SLEC report on the 'pinus commission' was published in December 1991. The Forest Department never published its own report. The arguments in both reports restate the preconceived notions of the adversaries, supported by a selective reading of the limited findings of the site inspections. The foresters reiterated their tactical promise to carry out experiments and further research, and again waited for the storm of public criticism to blow over. No further meetings were held, and the issue eventually evaporated from public attention.

The farmers had been relegated to the role of passive victims, who provided a backdrop for the environmentalists' agenda. The issues raised by 'the people's voices' became fragmented 'sound bites' in the environmentalists' narrative. PCED's video-film and report represented Sri Lanka in Rio de Janeiro as an ancient indigenous culture with a legacy of ecological wisdom, threatened by perpetual alien invasions seeking to destroy this culture and its environment.

> From the time a group of mariners including Vasco-de-Gama accidentally landed in Kolomthota to the present times when the trans-national companies have established their sovereignty here, Sri Lanka has had to encounter pressures from various sources. Such impacts can be considered as invasions where components suitable to our environment and to the ways of life of our people were eliminated and alien forces were imposed on us. In the past the Chola, Pandya, Kerala and Java people and in recent times the Portuguese, the Dutch and the English made such invasions with inimical interests in mind and the people were stirred to embark upon freedom struggles. In view of such struggles, the Sri Lankan nation has survived over 2500 years as a free country and a nation with its own identity. But, the all-pervasive invasion of the global development model of our time and its political network of dependency is steadily entrapping our people. (PCED 1992:xviii)

> Sri Lanka is an agricultural country. Our traditional farming system, which had ensured and sustained the self-sufficiency of the country is being destroyed by alien agricultural systems. This has led to a major crisis in Sri Lanka. (PCED 1992:1)

Here, a defensive nationalist discourse functioned as an entrenched idiom by which to frame a simplistic adversarial image of the dynamics of socio-ecological change. Environmental traditionalists perceived themselves as visionaries who advertise the sufferings of an innocent but entrapped people, and call upon them to reassert their indigenous ways against a corrupt economic system dominated by foreign invaders. Armed with the dichotomous framework of 'the alien' and 'the indigenous' they denied the 'alien western' tree a place in Sri Lanka's hills and proclaimed indigenous colonisation of the Uva *patanas*. (*The Island* 10 August 1991; *The Sunday Times* 14 August 1991; *Sunday Observer* 4 August 1991). *Pinus* had turned into a symbol for the stakes of the nation's destiny. The environmentalist interpretation posits a destructive western model against the image of an indigenous culture in harmony with its environment. Thus, the state plants alien invaders, while the indigenous people have faith in the benefits of indigenous trees. Both sides are uncompromisingly committed to planting trees. Neither is prepared to consider that planting trees in grassland ecosystems may undermine the specific eco-hydrological conditions prevailing in the highland Uva.

Given visibly destructive effects of industrial development and the hegemony of nationalism, the environmentalist narrative resonates in the grassroots of society. However, responsibility for local people's active role in the country's socio-ecological transformation is denied and instead projected onto the state and its alien trees. Vegetable cash crops and dense human settlement on mountain slopes contribute to water scarcity in Kitulwatte as well. Environmental traditionalism ignores the complexity of the social construction of ecological crises. It mystifies the circumstance that all human participants in contemporary ecological systems are subject to the contradictory imperatives of production in nature and economic production. Tragically, their defensiveness renders environmentalists ineffective in the arduous task of puzzling out how contemporary societies may sensibly repair their social and ecological relations.

In 1992 and 1993 I discussed pines and hydrology with local and expatriate foresters at various levels of the institutional hierarchy of the Forest Department. A Range Forest Officer (RFO) in Haputale, who was responsible for managing the tree plantations

in the Kitulwatte micro-watershed, was unable to find the plantations in Kitulwatte on his maps and reported that he had never visited the site or communicated with the residents of the surrounding villages. He repeatedly urged me to address my questions to his superior, the District Forest Officer in Badulla. Upon my insistence, he stated that up-country plantations were established on 'useless, barren' land without any trees, in order to produce industrial timber and pulp wood. Asked whether he had any knowledge of water and erosion problems in the plantations, the RFO replied:

> There are no water problems caused by *pinus* plantations at all. Block X of Diyatalawa Beat is a watershed region for Matathila Oya and other minor streams. Planting trees on useless land strengthens the watershed functions of the area and reduces soil erosion in comparison to barren land. (Haputale Range Forest Officer, fieldnotes)

An Assistant Conservator of Forests (ACF) in Colombo cautiously pointed out that there had been criticism concerning the excessive water absorption of pine trees, the lack of undergrowth and the plantation's susceptibility to fires. This was, however, not true everywhere since some sites in the Wet Zone had lush undergrowth. Nevertheless, the policy regarding pine was under review.

By contrast, a District Forest Officer in Badulla (Uva Province) was rather explicit about the ecological problems of the plantations.

> *Pinus* is not good for soil erosion and water conservation. I cannot reject the opinion of the public, as it is not contrary to fact. (Badulla District Forest Officer, fieldnotes)

He added a critical dimension to the debate. Tree plantations require continuous thinning of unhealthy and excess trees. The DFO assumed that after 20 years only one quarter of the trees planted initially should remain in the plantations. The thinned out biomass would be sold as timber and for paper pulp processing. However, no thinning operations had been carried out as the pine plantations proved to be an economic liability. Up to 1992, there had been no appreciable commercial demand for pulp, timber, poles or firewood from pine, since its market price was above that for Albizia pulp wood from private sources.

The higher price of pine results from ecological constraints. The hill-country sites, where most pines were planted, are highly erodable and often difficult to access. Mechanical harvesting and removal with heavy machinery is therefore environmentally destructive. Manual harvesting, however, incurs high labour costs. As pine proved to be unprofitable, the State Timber Corporation did not carry out prescribed thinning operations. Meanwhile, the Forest Department lacked funds for silvicultural treatment beyond the third year after plantation establishment. As a consequence the plantations were not managed at all.

The DFO argued that in improperly managed plantations over-crowding leads to an excessively dense canopy blocking too much sunlight for undergrowth to occur. It also causes extreme needle matting, preventing undergrowth establishment, and inordinate evapotranspiration. In combination with fire damage these phenomena simultaneously cause reduced groundwater infiltration and increased water uptake. If plantations were thinned to 1/4 of the current density, water yields should increase and evolving undergrowth should reduce erosion. The DFO therefore advocated and had experimented with canopy opening and underplanting of indigenous and/or nitrogen-fixing species.

Nevertheless, viewing management failure as the primary cause of water scarcity once again evaded responsibility as it shifted blame from the foresters to market forces beyond their control. The volatility of markets and the failure of rational management certainly render environmental planning highly vulnerable. However, the

choice of forestry technology and the power of foresters remained unquestioned. High productivity processes in monocrop cultivation induced exclusive resource appropriation by a single commodity producer commanding state control over the hydrologically vital micro-catchments of the highland Uva villages. This practice is structurally incompatible with the requirement for diversified resource sharing in complex co-dependent ecological systems. The loss of the *patanas* and the imposition of pine plantations affected adverse transformations in the ecological and social fabric of Kitulwatte's landscape. Environment and development continue to be at variance in contemporary forestry practices. The issue is not simply a quantitative question of how many pines are too much, but qualitative: what kind of floristic structure is ecologically sensible?

Once the Forest Department recognised the problem of neglect of plantation management, it obtained funding and consultants from ODA for thinning operations. The ODA consultant for up-country plantations was apparently discomforted by my information concerning the impact on the local population of the plantations he had been charged with cleaning up. Although he insisted that the farmers' evidence and claims regarding erosion and water decline were 'spurious', as no scientific proof was available, he sought repeated discussions with me and requested me to report on my research to evaluators from ODA's home office in England. I recommended that he take the evaluators to the Kitulwatte plantations, 'to see for themselves'. During a rush through the local countryside, innumerable offices and meetings, the evaluators viewed the plantations from Welimada Road while passing in their jeep. I related my research findings during a five minutes briefing at the Forest Department.

Although the ODA forester conceded that *patanas* had been an unsuitable siting choice for afforestation, he was not willing to accept the potentially unorthodox implications of community-oriented watershed management. When I suggested that villagers did not necessarily seek 'social' or 'protection forestry', but would perhaps prefer the regeneration and improvement of *patana* grassland for pasture, he replied angrily that clear-felling and the return of the land to local communities was unacceptable. Trees are the objective of forestry. Foresters do not grow grass.

The Eco-Hydrological Thesis

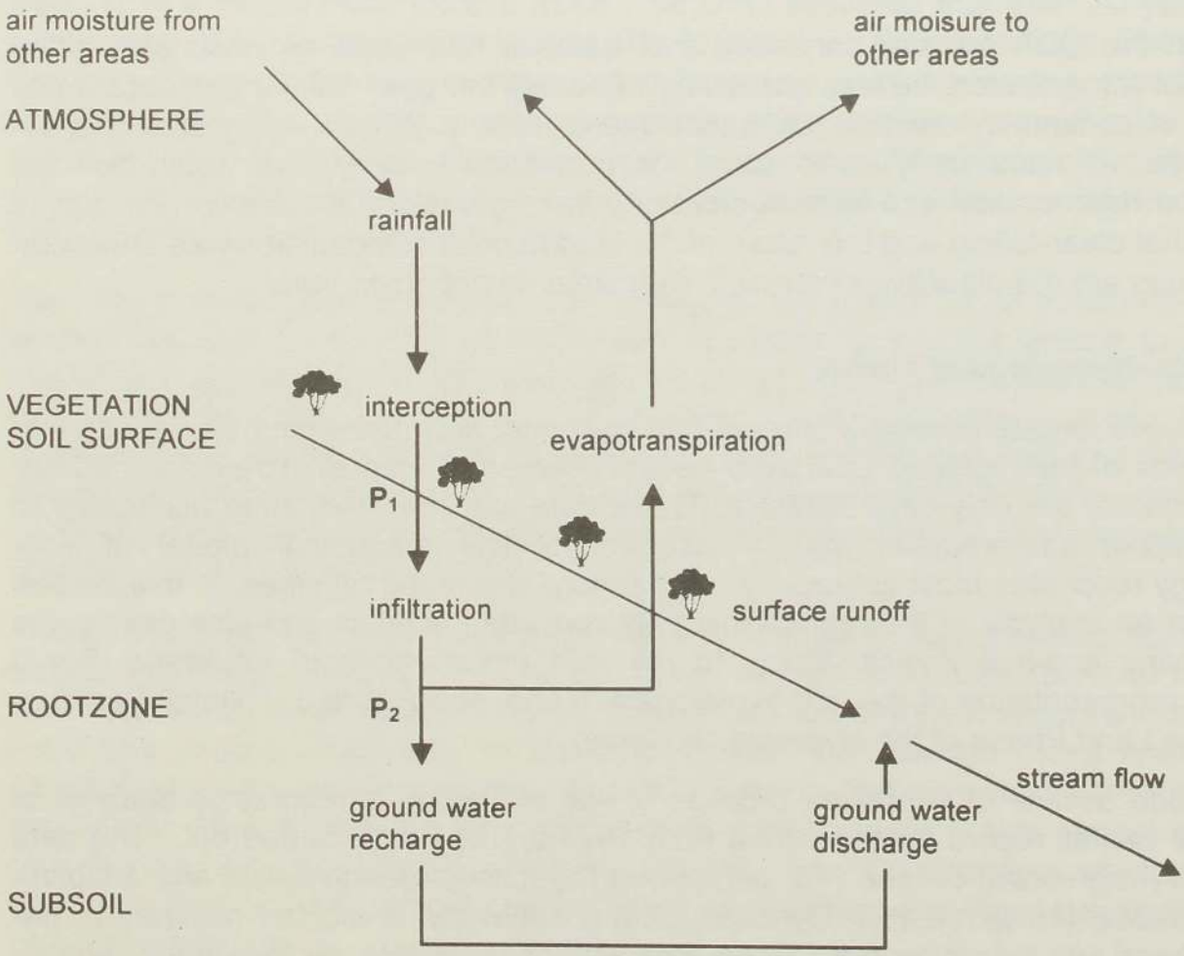
Comparative long-term data on stream and soil water flow in the pine plantations and grasslands of the highland Uva were never collected. Farmers' experience and observations are the only data available. These data are, however, more accessible to ethnographic interpretation than measurement. The theoretical model of eco-hydrology resonates most coherently with farmers' discourse on pines. In this section I present an analysis of the relationship between water scarcity and pine plantations by applying eco-hydrological theory to my field observations in Kitulwatte. For a graphic representation of the eco-hydrological model see Figure 3 (Rainfall Partitioning in the Land Phase of the Hydrological Cycle).

To exclude decline of rainfall as a cause of water scarcity, a regression analysis of the local rainfall record for the period from 1971 to 1991 was carried out.[8] The data show an insignificant decline (4.2 percent) in Diyatalawa/Bandarawela and a significant increase (15 percent) in Dyraaba Estate. Kitulwatte is located half-way in between these two recording sites, in an area with considerable micro-climatic variability. The data indicate that water scarcity is not the result of rainfall decline or failure, but of long-term changes in the structure of the landscape.

In the tree plantations the interaction of increased evapotranspiration with reduced infiltration of rainwater causes progressive desiccation. Fast growing tree species

densely planted in the grassland micro-catchments of the Uva hills, drastically increase soil water consumption and transpiration (Hamilton 1983:114-115; Bruijnzeel 1986:5). Increased evaporation of rainwater from the plant surface to the atmosphere is caused by the increased interception capacity of the plantation canopy (Chapman 1989:50; Kovacs, Zuidema & Marsalek 1989:114). Reduced infiltration capacity of the plantation soil is a consequence of increased erosion induced by the removal or inhibition of plant cover at ground level (Chapman 1989:52; Oyebande & Balek 1989:254; Falkenmark 1989:31). The failure of undergrowth establishment under the plantation canopy, particularly at the ground level, resulted from a combination of factors. As the plantation canopy closed, sun- and drought-tolerant, fire and wind resistant grasses, herbs and shrubs, were shaded out. The import of seed material of shade-tolerant species by animals is minimal. The soil is poor in vital nutrients, especially nitrogen, due to the high uptake level of pine and the slow decay of pine needle litter. Where needle matting occurs, soil contact of deposited seeds and emergence of seedlings from the soil are obstructed. Seed material is washed off by erosive runoff. Most significantly, if seedlings establish during the rainy season, they fail to survive the prolonged dry season of the highland Uva, particularly as the pines' high evapotranspiration desiccates the upper soil layer. Fires on the plantation ground, fuelled by dry needle litter, exacerbate this effect. While *patana* grasses are adapted to both seasonal desiccation and fire, shade-tolerant undergrowth requires the moister conditions of riparian forest fragments.

Figure 3: Rainfall Partitioning (P) in the Land Phase of the Hydrological Cycle



(Source: Falkenmark and Lundqvist 1992)

The lack of undergrowth leaves the plantation soil vulnerable to continuous erosion. The impact of rainfall remains unchecked, as intercepted rainwater coalescing around pine needles and falling from the canopy strikes the ground with higher kinetic energy than free-falling rain (Bruijnzeel 1986:8). The litter of fallen pine needles fails to provide an uninterrupted protective layer against the erosive impact of rainfall. Especially on steep slopes, it is washed off together with the soil and gravel. In locations where needles do accumulate, their slow rate of decay reduces the permeability of the litter layer and causes increased runoff.

The absence of absorptive litter and humus layers reduces infiltration capacity. Lack of undergrowth and paucity of animal and microbial life in the soil prevents the formation of macropores in the root zone along which soil water can travel downwards and be redistributed to the soil matrix (Chapman 1989:51-52; Falkenmark 1989b:39; Kovacs, Zuidema & Marsalek 1989:114; Oyebande & Balek 1989:236-237). In addition, increased evaporation from bare soil causes the upper soil layers to dry out, harden and crack, resulting in both reduced infiltration and vulnerability to erosion (Chapman 1989:55; Oyebande & Balek 1989:237).

These combined processes of degradation prevent the formation and maintenance of a soil structure which is conducive to a high rate of infiltration. During rainfall events the upper soil layer saturates rapidly and the larger proportion of rainfall is lost to immediate surface runoff. The interactive effects of increased evapotranspiration and reduced infiltration result in the worst possible consequences for the water situation in Kitulwatte. While the amount of rainfall has remained fairly constant, the transformation of the *patana* hills from grasslands to tree plantations has decisively altered its relative distribution among the three pathways of the landphase of the hydrological cycle. Surface runoff and evapotranspiration are simultaneously increased relative to groundwater recharge. While less water enters the soil, more is consumed in the rootzone. Consequently, groundwater recharge and discharge in springs is reduced and eventually subsides. Increased surface runoff causes high streamflow and frequent floods during and shortly after rainfall events. Dry season flow is reduced or disappears as plantation trees consume an increasing proportion of a diminished quantity of soil water.

Only slow and steady release of groundwater throughout the year can compensate for the extreme annual variations of rainfall and erratic dry and wet spells experienced in the highland Uva. The failure of groundwater recharge has reduced the irrigation capacity of Kitulwatte's micro-watershed below the threshold of viability, and has rendered farmers and household water consumers vulnerable to unpredictable climatic events.

Far from providing watershed protection and erosion control, the tree plantations have caused severe land degradation and resource competition in Kitulwatte's micro-watershed. The Forest Department has not only appropriated a large land area and has thereby excluded local residents from its utilisation. By planting fast growing monocrop tree plantations it has imposed high productivity land use which monopolises vital resources at the expense of other participants of the local ecosystem. The pine trees are the first upstream water users of the micro-watershed. In addition, they appropriate the area's soil nutrients and available solar energy. Their resource demands are a consequence of the particular requirements of the planted species in combination with their vast numbers. As a result, other plant species fail to receive sufficient sustenance. They cannot establish among the pines at all, and in insufficient numbers under eucalyptus. This circumstance deprives most animal species from vital resources and limits their opportunities for surviving in a suitable habitat.

Resource competition is therefore the ultimate cause of land degradation. Erosion and reduced infiltration capacity of the soil result from the plantation's lack of species diversity. Consequently, human downstream users are deprived of sufficient supplies of water. Viewed from this perspective, the Forest Department's appropriation of the *patanas* has not converted 'useless and barren' land to productive uses. It has rather replaced the production and distribution of complex and indispensable water and biomass flows which have sustained a wide range of local ecosystem participants, including local human actors, with the dominance of a highly specialised and resource intensive process of industrial biomass production.

Conclusion

In her controversial and influential book 'Staying Alive', Vandana Shiva (1988) has argued that industrial production and 'production in nature' are structurally incompatible. Industrialism defines productivity as the maximisation of commodity output per unit of scarce resources. Optimal resource use involves both exclusive resource appropriation and the externalisation of social and environmental costs of production. By contrast, in ecological systems productivity is measured by the maintenance of a complex distributive network in which sufficient resources are cycled to assure the mutual conditions of production of its participants. Participants of ecosystems are therefore 'co-dependent' (O'Connor 1989). Thus, from an eco-systemic perspective, industrial production depends on non-industrial production processes as its resource base, yet tends to neglect the reproduction of this ecological capital.

The imposition of an industrial silvicultural production system in the highland Uva has threatened local relations of co-dependency by simultaneously exceeding the carrying capacity of the local hydro-cycle and by undermining its conditions of production. The pine plantations' inordinate level of evapotranspiration and concurrent reduction of infiltration capacity of the soil has reduced ground water recharge, and disturbed the relative balance of seasonal streamflows. Local residents are paying the cost of the pine plantations' externalities in the form of reduced crop yields, repayment of loans for irrigation pumps, fuel costs, and expenditure of free labour for largely unsuccessful participatory water supply schemes designed to cope with water scarcity. Farmers lack the political means for the articulation of their grievances, as well as the property rights which would entitle them to control the micro-catchments on which their agricultural and household production depends. Meanwhile, urban professionalised environmentalists appropriated the *pinus* issue to construct their own ideological agenda. By focusing on 'alien invaders' rather than the structural incompatibility of high-productivity silviculture and diversified production of local livelihoods, the underlying rationality of contemporary forestry technology remained unchallenged.

Their knowledge and grievances ignored, delegitimised and manipulated, the farmers consistently resort to a desperate and in the long run self-defeating response. They set the pine plantations on fire. The relationship between anger and widespread arson deserves closer study. Far from being merely accidental or a prank, I suggest that fire is a pertinent metaphor for anger in the cultural context of the highland Uva. Fire and drought are consistently interpreted as means of punishment by deities angered by people's conduct.[9] Be that as it may, the following facts require careful consideration. In Kitulwatte's micro-catchment foresters judged all but two of the pine woodlots as successfully established within twenty years (Forest Department of Sri Lanka 1991a, b). The species *Pinus caribaea* is fire resistant only after six years (Bandaratillake; fieldnotes). Accordingly, the pines in Kitulwatte were not burned before they became fire resistant. Villagers reported that they experienced declining water yields after six years of plantation establishment. The research of the Free Uni-

versity of Amsterdam and the Fiji Pine Commission confirmed water decline after six years (Waterloo 1994). Thus, only as the villagers recognised the impact of the pines on their water resources, they started to set fire to the plantations.

Desperate responses are the result of the political and administrative systems' inability to resolve the 'pinus controversy' with the fundamental interests of local residents in mind. A viable social movement among farmers and environmentalists, which would exert adequate pressure on those systems, never evolved. The professionalised environmentalist organisations rather transferred their interests and claims making activities to other issues once the 'pinus controversy' ran its course. Public attention spans and pressure group mobilisation tend to be relatively short-term, and, as I have shown, adversarial tactics have led to avoidance and inaction. The foresters continued throughout the controversy to control land use activities in the Uva *patanas*, as they retained exclusive property rights and the authority to impose their land use technology. The Forest Department's haphazard commitment to phase-out planting of pine species, however, cannot necessarily be read as a partial environmentalist victory. The pines' lack of economic viability may have motivated their discontinuation as much as public concern. The people of village's such as Kitulwatte continue to cope with living under conditions of water scarcity. The political system did succeed in supplying some means of crisis management in the form of public water supply schemes and loans for irrigation pumps. It responded to people's complaints in a culturally consistent way. People's demands to be heard and serviced by the political system resulted in ongoing development activity. Thereby the evasion of resolutions continued, while a significant challenge of the Forest Department's productive rationality was evaded.

Notes

Ralf Starkloff is Senior Lecturer in Sociology at the Department of Social Sciences, Sabaragamuwa University of Sri Lanka. His research interests are in the interface of society and the environment, especially resource conflict in water and land use. He can be contacted at the Sabaragamuwa University of Sri Lanka, PO Box 2, Belihuloya, Sri Lanka.

[1] For a comprehensive discussion of social constructionism in environmental scciology, see Hannigan 1995.

[2] The names of the village and its inhabitants were changed to protect the identities of my informants.

[3] Department of Census and Statistics 1891 - 1931, 1980; Kitulwatte Village Survey 1990, 1992; Starkloff 1994 (based on Kitulwatte *Udagama* Household Survey 1991 raw data).

[4] I wish to thank the Department of Geography at Sri Jayawardenepura University for mapping and land use calculations on the basis of aerial photographs (Survey Department of Sri Lanka 1954,1988).

[5] For a detailed discussion of the effects of water scarcity on production in Kitulwatte, see Starkloff, 1994 and 1998.

[6] For a detailed discussion of participatory water supply projects in Kitulwatte, see Starkloff 1996.

[7] Baker ([1855] 1983), Domrös (1971) and Schweinfurth (1982) have discussed the highland's distinct geo-climatic conditions.

[8] Department of Meteorology (1971-1991). I wish to thank Lalith Chandrapala at the Department of Meteorology, Colombo, Sri Lanka, for his data analysis and insights. For comprehensive documentation of the rainfall data analysis see Starkloff 1994.

[9] According to local myth, the goddess Pattini burned the city of Madurai to punish the murderers of her husband; and timely rains depend on proper ritual practice and righteous conduct by the people and their rulers.

References

Baker, S. [1855] 1983. *Eight Years in Ceylon*. Dehiwala: Tisara Prakasakayo.

Bandaratilake, H.M. 1988. Development of Pine Plantations in Sri Lanka, in Gunasena H.P.M., Gunatilleke S. and Perera A. (eds.) *Reforestation With Pinus in Sri Lanka*, 10-18. Peradeniya.

Bandyopadhyay, J. 1988. The Ecology of Drought and Water Scarcity. *The Ecologist* 18(2): 88-95.

Bharatie, K.P. 1990. *Administration Report of the Conservator of Forests Sri Lanka for the Year 1990*. Battaramulla: Forest Department.

Bruijnzeel, P. S. 1986. Environmental Impacts of Deforestation in the Humid Tropics. A Watershed Perspective. *Wallaceana*, 46: 3-13.

Chapman, T. 1989. Hydrological systems and processes, in Falkenmark, M. and T. Chapman (eds.) *Comparative hydrology*. Paris: UNESCO.

Department of Census and Statistics. 1891-1931. *The Census of Ceylon, Town and Village Statistics*. Colombo.

Department of Census and Statistics. 1980. *Census Prelisting*. Colombo.

Department of Meteorology. 1971-1991. Rainfall Data for the Dyraaba Estate, Diyatalawa and Bandarawela Rainfall Recording Stations. Colombo.

deRosayro, R.A. 1945/46. The Montane Grasslands (Patanas) of Ceylon: An Ecological Study with Reference to Afforestation. *The Tropical Agriculturalist*, 101/102, I-V.

Domrös, M. 1971. The Rainfall Pattern of the Uva Basin in Ceylon. *The Ceylon Geographer*, 25, 1-4.

Environmental Defense Fund. 1987. The Failure of Social Forestry in Karnataka. In *The Ecologist*, vol. 17, no. 4/5.

Falkenmark M. and J. Lundqvist. 1992. *Coping With Multicause Environmental Challenges - A Water Perspective on Development*, keynote paper presented at the International Conference on Water and the Environment, Dublin (26-31 January).

Falkenmark, M. and T. Chapman (eds.). 1989. *Comparative hydrology*. Paris: UNESCO.

Falkenmark, M. 1989. Comparative hydrology - a new concept , in Falkenmark, M. and T. Chapman (eds.) *Comparative hydrology*. Paris: UNESCO.

FAO [Food and Agriculture Organization of the United Nations]. 1987. *The Tropical Forestry Action Plan*. Rome: FAO.

Forest Department of Ceylon. 1961. Editorial: The Value of Research in Forestry, *The Ceylon Forester*, 5(1&2): 3-5.

Forest Department of Sri Lanka. 1991a. *Survey of Plantations. Haputale Range, Diyatalawa Beat, Block 1*. Battaramulla: Forest Department.

Forest Department of Sri Lanka. 1991b. *1:20,000 Plantation Sketch Map, Badulla District, Sheet No. 370*. Battaramulla: Forest Department.

Forest Department of Sri Lanka. 1992. *Draft Report on Environmental Hazards at Bandarawela*. Battaramulla: Forest Department.

FORLUMP [Forest / Landuse Mapping Project]. 1992. *A Sri Lankan - British Project. Project Description*. Polgolla: FORLUMP.

Gunasena, H.P.M. 1988. Symposium Objectives, in Gunasena H.P.M., Gunatilleke S. and Perera A. (eds.) *Reforestation With Pinus in Sri Lanka*, iv-v. Peradeniya.

Gunatilleke, N. 1988. Soil and Nutrient Cycling under *Pinus*, in Gunasena H.P.M., Gunatilleke S. and Perera A. (eds.) *Reforestation With Pinus in Sri Lanka*, 38-45. Peradeniya.

Gunawardena, E.R.N. 1988. Hydrological and Soil Erosion Studies on *Pinus* in Sri Lanka, in Gunasena H.P.M., Gunatilleke S. and Perera A. (eds.) *Reforestation With Pinus in Sri Lanka*, 46-55. Peradeniya.

Gunawardena, E.R.N. 1989. Application of Stanford Watershed Model to Watershed Research in Sri Lanka, in Madduma Bandara, C.M. (ed.) *Hydrology of the Natural and Mand-Made Forests*. Kandy.

Hamilton, L. S. (ed.). 1983. *Tropical Forested Watersheds: Hydrologic and Soils Response to Major Uses or Conversions*. Boulder: Westview Press.

Hannigan, J.A. 1995. *Environmental Sociology. A Social Constructionist Perspective*. Routledge: London.

Holmes, G.H. 1951. The grass, Ferm and Savannah Lands of Ceylon, their Nature and Ecological Significance. *Imperial Forestry Institute*, Paper 28.

Jaakko Poeyry. 1986. *Forestry Masterplan for Sri Lanka*. Main Report. Helsinki.

Jayal N.D. 1985. 'Emerging Pattern of the Crisis Water Resource Conservation', in Bandyopadhyay J., N.D. Jayal , U. Schoettli and Chatrapati Singh (eds.) *India's Environment*: Crisis and Responses, 178-90. Dehradun: Natraj Publishers.

Kitulwatte Village Survey. 1990. *Files of the Divisional Secretariat*, Bandarawela.

Kitulwatte Village Survey. 1992. *Files of the Divisional Secretariat*, Bandarawela.

Knox, R. [1681] 1989. *An Historical Relation of the Island Ceylon*. Dehiwala: Tisara Prakasakayo.

Kovacs G., F. Zuidema & J. Marsalek. 1989. Human interventions in the terrestrial water cycle, in Falkenmark, M. and T. Chapman (eds.) *Comparative hydrology*. Paris: UNESCO.

MASL (Mahaweli Authority of Sri Lanka). 1991. *The Mahaweli Programme*. MASL: Colombo.

NARESA [Natural Resources, Energy and Science Authority of Sri Lanka]. 1991. *Natural Resources of Sri Lanka. Conditions and Trends*. NARESA: Colombo.

O'Connor, M. 1989. 'Co-dependency and indeterminacy: A critique of the theory of production'. *Capitalism, Nature, Socialism* 3: 33-57.

Oyebande, L. & J. Balek. 1989. Humid warm sloping land, in Falkenmark, M. and T. Chapman (eds.) *Comparative hydrology*. Paris: UNESCO.

PCED [Public Campaign on Environment and Development]. 1992. *Citizen's Report on Environment and Development - Sri Lanka*. PCED: Colombo.

Pearson, H.H.W. 1899. The Botany of the Ceylon Patanas. In *Journal of the Linnean Society*, vol. XXXIV.

Pemadasa, M.A. 1984. Grasslands, in Fernando C.H. (ed.) *Ecology and Biogeography in Sri Lanka*. The Hague.

Perera, A. 1988a. Growth and Performance of Pines in Sri Lanka, in Gunasena H.P.M., Gunatilleke S. and Perera A. (eds.) *Reforestation With Pinus in Sri Lanka*, 29-37. Peradeniya.

Perera, A. 1988b. Ecological Issues On Pines in Sri Lanka, in Gunasena H.P.M., Gunatilleke S. and Perera A. (eds.) *Reforestation With Pinus in Sri Lanka*, 56-60. Peradeniya.

Perera, W.R.H. 1988. 'History of Pinus Plantations in Sri Lanka', in Gunasena H.P.M., S. Gunatilleke S. and A. Perera (eds.) *Reforestation With Pinus in Sri Lanka*, 6-9. Peradeniya.

Schubert, B. 1991. *Report on the Planning Workshop for Phase II (10/1991 - 9/1994) of the Upper Mahaweli Watershed Management Programme*. Berlin.

Schweinfurth, U. 1982. The Uva Basin in Ceylon: Ecological Set-Up and Evaluation. *Climatological Notes*, 30.

Shiva, V. 1988. *Staying Alive: Women, Ecology and Development*. London: Zed.

Starkloff, R. 1994. *"No Water!' Socio-ecological Transformations in an Uva Basin Village in Sri Lanka'*, PhD Dissertation, Brandeis University.

Starkloff, R. 1996. Participatory Discourse and Practice in a Water Resource Crisis in Sri Lanka, in S. and N. Bastian (eds.) *Assessing Participation - A Debate From South Asia*. Delhi : Konark Publishers.

Starkloff, R. 1998. Water Scarcity in Kitulwatte: The Social Causes and Consequences of Environmental Degradation in a Highland Uva Village of Sri Lanka. *World Development*, 26:6.

Sunday Observer. 1991. *Uva battles South for Uma Oya waters*, 4 August.

Survey Department of Sri Lanka. 1954. *Aerial Photographs 54/13/51&52*. Colombo.

Survey Department of Sri Lanka. 1988. *Aerial Photographs 8894/8895*. Colombo.

The Island. 1991. *Bare mountains, dry streams*, 10 August.

The Sunday Times. 1991. *Bandarawela dying a dry death as pines quench their thirst*, 14 August.

Tschakert, H. & S. Decurtins. 1989. The Project Concept of Watershed Management in Relation to the Upper Mahaweli Area. In *Hydrology of the Natural and Mand-Made Forests* (ed. Madduma Bandara, C.M.). Kandy.

Vivekanandan, K. 1988. Provenance Research on *Pinus caribaea*, in Gunasena H.P.M., Gunatilleke S. and Perera A. (eds.) *Reforestation With Pinus in Sri Lanka*, 19-28. Peradeniya.

Waterloo, M. J. 1994. *Water and nutrient dynamics of Pinus Caribaea plantation forests on former grassland soils in Southwest Viti Levu, Fiji*. Den Haag: Koninklijke Bibliotheek.

WCED [World Commission on Environment and Development]. 1987. *Our Common Future*. Oxford: Oxford University Press.

Wood, P.J. 1988. An Overview of the Status of Tropical Pines Relevant to Sri Lankan Conditions, in Gunasena H.P.M., Gunatilleke S. and Perera A. (eds.) *Reforestation With Pinus in Sri Lanka*, 1-5. Peradeniya.

World Resources Institute. 1985. *Tropical Forests: A Call for Action, Parts I&II*. New York: WRI.

SUBSCRIPTION FORM

Regular Subscription Service

The fee for local subscribers in Sri Lanka is RS. 600 per year (2 issues). Overseas subscribers receive the journal for US$ 20.00 per year. These prices include shipping cost and applicable taxes.

Journal Exchange Agreement

Institutions which publish their own academic journal on a continual basis can regularly receive the Sabaragamuwa University Journal absolutely free of charge, if they agree to send their journal regularly free of charge to the Sabaragamuwa University of Sri Lanka. This unique arrangement gives the Sabaragamuwa University, a rural university in a developing country, the opportunity to gain access to academic scholarship from around the globe.

I / We wish to subscribe to the
Sabaragamuwa University Journal

Please check where applicable:

[ ] Sri Lanka: RS. 600.00 (per year/ 2 issues)

[ ] Overseas: US$. 20.00 (per year/ 2 issues)

[ ] Exchange Agreement: We agree to regularly send our journal:

_____

in exchange for the regular receipt of the **Sabaragamuwa University Journal**

Please send the Sabaragamuwa University Journal to:

Name:

Position:

Institution:

Address:

Country:

Tel: Fax:

Email:

Signature:

Please send exact payment in the form of cheque or bank draft made out to:

Sabaragamuwa University Press

Send your completed subscription form and payment to:

Sabaragamuwa University Press
Sabaragamuwa University of Sri Lanka
PO Box 2
Belihuloya
Sri Lanka

For further inquiries please contact the Co-ordinating Editor.

Information for Contributors

The Sabaragamuwa University Journal is a refereed journal and accepts articles from all academic disciplines.

Articles should be up to 20 pages and include a brief Abstract of less than 200 words. Abstracts first state the central research problem(s), then the method(s) employed, and finally the central conclusion(s).

Articles must be typed, preferably using Microsoft Word 6 or 7, Arial 11 Font, double-spaced, on one side only of white A4 paper or US equivalent.

Titles and headings should be brief and clear, in bold type.

Longer quotations should be indented, single-spaced and without quotation marks.

Brief quotations inside text should use single quotation marks.

Non-English terms should be in italics, e.g. *chena* or *sine qua non*.

Date format used in text : 2 February 1998.

In the text use either 'percent' or '%' consistently. Use letters for numbers from one to ten and numerals from 11 onwards; but use numerals or letters consistently in a range or series of numbers, e.g. 5 to 10.

Use either British ('labour') or American ('labor') spelling consistently.

Titles of figures or tables should be in bold type and placed above, and notes and sources for the same under each figure or table. They should be numbered consecutively, separately for tables and figures. Column headings should clearly define the data presented. Table borders should be in ¾ point and simple.

Figures which cannot be reproduced in MS Word should be submitted on a separate A4 sheet accompanied by concise information about titles, notes and sources, as well as their location in the text.

Use either footnotes or endnotes; these should be standard MS Word 6 or 7 format.

First drafts should be submitted as hard copy (on paper) only. Final drafts should be submitted as hard copy and on 3 ½ HD floppy disk, preferably MS Word 6 or 7.

All quoted and paraphrased intellectual property of other authors, as well as other works of the contributing author(s) must be properly referenced.

Works cited in the text should be indicated as follows: (Weber, 1978: 234) or (Gombrich & Obyesekere, 1990: 22-250); i.e. author(s), year of publication: page number(s). Use 'et al.' when citing a work by more by more than two authors, but list all the authors under References.

To distinguish citations of different works of the same author published in the same year, use letters, i.e. (Perera, 1988a, 1988b).

All works cited in the text, including sources for tables and figures, must be listed alphabetically under References, beginning on a separate sheet of paper. Use the following style:

Bo… …*conomy and Society*. Berkeley: University of California

Co… …& J. Marsalek. 1989. Human interventions in the …n *Comparative Hydrology*, Falkenmark, M. & T. … UNESCO.

Jo… …sent Pattern of Land Use and Policy Planning. *Lo-*

C… …*The forest gardens of highland Sri Lanka: An in-*…*system for reclaiming deforested marginal land.* Pa…merican Association for the Advancement of Science …co, CA, USA.

U… …1974. *Deity Propitiation in Urban Sri Lanka*. Unpub…iversity of Edinburgh.

Sabaragamuwa University Journal

Volume 1 Number 1 February 1998

ISSN 1391-3166