PROMOTING NATIVE TREE SPECIES IN LAND REHABILITATION IN HONG KONG, CHINA

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ABSTRACT

Hong Kong has over 100 years of environmental forestry history. The government has planted more than one million trees annually for land rehabilitation since the early 1990's. Exotic tree species are dominant although more native tree species have been tried in the last ten years. Currently, only a few native tree species have proven successful in many sites and are planted in significant numbers. The failure of many native species in previous planting trials is one of the reasons hindering the wider use of native trees in land rehabilitation in Hong Kong. The other reason is the lack of information on the phenology and silvicultural techniques of most of the 390 native tree species, making large-scale production of many native species not yet possible. Despite these difficulties, the government has been promoting the use of native tree species in land rehabilitation in the Country Parks since the mid-1990's. The Kadoorie Farm and Botanic Garden (KFBG), a locally based conservation charity, also set up a native tree nursery in 1997 to conduct research on native tree species with respect to seedling production and reforestation. Due to the shortage of land, urban development has been expanding into the countryside. There are thus increasing numbers of landscaping projects in urban fringe/countryside edge areas where planting native species would be preferable. However, exotic species are still dominant in the landscaping field and commercial supply of native tree species is insufficient. As such, another aim of the KFBG nursery project is to promote the use of native species amongst landscape architects and transfer the information on native tree seedling production to commercial nurseries. This paper describes the nature of the different types of reforestation work in Hong Kong and the problems hindering the use of native tree species are discussed. The research needs for planting native species are identified.

INTRODUCTION

Between 1842 and 1997, Hong Kong was a self-administered British Dependent Territory. Since 1 July 1997, Hong Kong has been a Special Administrative Region of the People's Republic of China but maintains a high degree of autonomy. The legal, political and economic systems remained more or less the same before and after the change of sovereignty. Since the mid 19th century, the population has grown from approximately 3000

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people on Hong Kong Island to about 6.8 million in the whole Territory today, making Hong Kong one of the most densely-populated cities in the world.

Hong Kong lies between 22°09' - 22°37'N and 113°52' - 114°30'E. The Region consists of a large, irregularly shaped peninsula extending from the southeastern coast of Guangdong Province into the South China Sea and has approximately 230 offshore islands. The total land area of Hong Kong is about 1053 km^2, excluding over 37 km^2 of land reclaimed from the sea (STYLES AND HANSEN, 1989). The topography of Hong Kong is rugged; over 800 km^2 of the land area is considered hilly (CHIU & SO, 1986). The highest peak is Tai Mo Shan (957 m) in the central new Territories. The majority of the population resides on the coastal flat land and land reclaimed from the sea.

Hong Kong is more than 100 km south of the Tropic of Cancer but does not have a typical tropical climate. The absolute minimum and maximum air temperatures at the Hong Kong Observatory in Kowloon since records began were 0 and 36.1°C. The mean annual temperature is 23°C (1961-1990). January has the lowest mean temperature (15.8°C) and July has the highest (28.8 °C). At least a few days every winter have temperatures below 10°C, which is in the range known to cause chilling damage to sensitive plant species (DUDGEON AND CORLETT, 1994). Due to the low temperatures in the winter, local ecologists regard Hong Kong's climate as subtropical monsoon (CORLETT, 1999; DUDGEON AND CORLETT, 1994). The mean annual precipitation at the Hong Kong Observatory is 2,214 mm (1961-90) and it is highly seasonal; monthly precipitation from November through February averages < 50 mm and the total sum in these months accounts for only 6% of the annual total. Over 77% of the annual total rainfall falls between May and September with the highest in August (18%). The difference in rainfall across Hong Kong is great, with mean annual rainfall ranging from less than 1600 mm in the periphery to over 2,400 mm on Tai Mo Shan. Typhoons regularly affect Hong Kong in the summer months, bringing strong winds and heavy rains.

HONG KONG VEGETATION

The potential climax vegetation in Hong Kong has been suggested to be tropical semi-evergreen or evergreen broad-leaved monsoon forest, or subtropical evergreen broad-leaved monsoon forest (THROWER, 1975; ZHUANG, 1993). None of the original forest exists today except tiny forest remnants on some remote and steep ravines that may have escaped or recovered from a long history of human destruction. Today, the most common vegetation types are secondary shrub-lands (396 km^2 or 37 % of the total land area), grasslands (177 km^2 or 16.5 %) and spontaneous secondary forests (86 km^2 or 8%; ASHWORTH *et al.*, 1993). Though the date at which major deforestation occurred is uncertain, CORLETT (1997) suggests that it was most likely in the period from 1300 to 1600 AD.

Clearance for cultivation, cutting for firewood and charcoal, and hill fires are believed to be the main cause of deforestation in Hong Kong (DALEY, 1975; JIM, 1986; DUDGEON and CORLETT, 1994; THROWER, 1975). With the rapid economic advancement and the gradual decline in agriculture in the last two decades, only hill fire remains an important threat. In the last eight years, there were 1,083 hill fires in Country Parks. In recent years,

urban development in the rural areas has become an additional threat in the lowlands (CHONG, 1996; TERRITORY DEVELOPMENT DEPARTMENT, 1995; WEBB, 1993).

FOREST SUCCESSION IN HONG KONG

Until the mid 1970s, the harvesting of biomass (mostly grasses, ferns and small shrubs) for domestic fuel was a major factor preventing forest succession on uncultivated hillsides in Hong Kong (CHEN, 1993; CHEN, CORLETT & HILL, 1996). This has now stopped in Hong Kong but still produces "shaven", treeless hillsides over large areas of rural Guangdong. The cessation of biomass harvesting has probably increased the impact of hill fires, both by increasing the fuel load and by reducing the incentive for rural people to prevent fires. A study of the relationship between fire and vegetation in Hong Kong found that grassland persists largely in areas which have been burned in the last 10 years, and is replaced by shrub-land in the absence of fire (CHAU, 1994). Grasslands occupy the most frequently burnt areas and grasslands are the most frequently burnt. On favourable sites, *Machilus*-dominated secondary forest, 10-15 m in height, can develop in a further 30-50 years (ZHUANG, 1993; ZHUANG & CORLETT, 1997), but forest succession is apparently much slower on sites which are remote from tree seed sources or where the soil has been highly degraded (WONG, 1999; ZHUANG, 1997). The only older forests in Hong Kong, apart from some tiny patches in topographically protected montane sites, are Fung Shui Woods (Woodland behind active or abandoned villages that have long been protected by villagers. ZHUANG & CORLETT, 1997; CHU & XING, 1997). However, these are not simply the product of forest succession, and include a variable proportion of planted species. *Machilus*-dominated secondary forest supports both a much higher bird density and a higher diversity of forest-dependent bird species than monoculture plantations of *Lophostemon confertus*, the most widely planted tree species (KWOK & CORLETT, 2000). *Machilus*-dominated forest also typically contains 16-45 tree species in a 400-m^2 plot (ZHUANG & CORLETT, 1997). However, the majority of the 390 native tree species in Hong Kong are confined to upland sites which were, apparently, never completely cleared, but have not succeeded in invading secondary forests (ZHUANG & CORLETT, 1996).

FILTER-BARRIERS TO FOREST SUCCESSION IN HONG KONG

Low seed dispersal, poor seed germination and seed predation together significantly reduce woody species seed availability on degraded grasslands in Hong Kong. This is particularly the case on open grassland without woody species cover, and therefore delays the rate of forest succession (HAU, 1999). Once a seed disperses and germinates, seasonal drought, grass competition and low soil nutrients do not affect its survival. A study in open grassland at Tai Mo Shan showed that seed dispersal into the grassland was approximately one woody species seed per 5 m^2 per year, that is 2000 seeds per hectare (HAU, 1999). The mean percentage seed removal by seed predators over 60 days at this site was 74% (s.d. = 23%, 12 seed species) in 1996 (HAU, 1997). Seed germination rate at this site varied from 0 to 53% depending on species (HAU, 1999). Thus, for the 520 seeds per hectare that

survived seed predation, between zero and 244 seeds may germinate. Seedling survival in the first two years was generally high at this site varying from 70 - 100% (except one out of ten species). Therefore, between zero and 244 woody plants per hectare per year will be able to establish at this grassland in this model. Weed competition and low soil nutrients, however, tend to slow seedling growth. All these together explain the low rate of early succession at this site. The longer the succession period continues before a closed canopy is formed, the higher is the risk of wild fire arresting succession. The current fire frequency at this grassland site is once every ten years, which is considered low by Hong Kong standards (CHAU, 1994). However, forest succession is unlikely to be fast enough to escape the impact of fire at this site.

REFORESTATION IN HONG KONG

Hong Kong has over 130 years of afforestation history and may have been the first territory to start afforestation for purely protective reasons in the tropics. The major justification for afforestation has shifted from health and aesthetic reasons in the 19th century, to soil erosion control and improving water supplies in most of the 20th century, to the current interest in ecological restoration. Forestry in Hong Kong has never been commercially viable. Despite such a long history, afforestation in Hong Kong does not appear to be a great success (CORLETT, 1999). Tens of millions of trees have been planted, but most of the existing forest cover consists of spontaneous secondary forests (about 8% of the land area). These mostly developed after 1945 (most of the Hong Kong vegetation was cut for fuel during the Japanese Occupation between 1942 and 1945; ZHUANG AND CORLETT, 1997). Such secondary forests are dominated by *Machilus* spp., which have not been planted in significant numbers until very recently (CORLETT, 1999). Today, only about 62 km^2 or 5.8% of the land area is plantation woodlands (ASHWORTH *et al.*, 1993). However, most plantations in Hong Kong are monocultures and the invasion of native woody species, especially in young plantations, is significantly impaired by silvicultural management practices such as weeding (ZHUANG, 1997).

Various methods had been tried in the reforestation history of Hong Kong. Between 1871 and 1880, afforestation was accomplished by planting bare-rooted seedlings of both native and exotic species raised in nurseries (FORD, 1880). Seeds were sown in prepared ground in two nurseries. Seedlings were allowed to grow for a year after germination. They were then lifted from the nursery ground, taken to the planting sites and planted in prepared pits. FORD (1880) wrote that afforestation in these 10 years was not very successful. Seventy five percent of the trees planted died. Most of the surviving trees appeared very sick and had little promise of surviving. The failure was attributed to poor nursery practices, post-nursery care and planting skills. Seedlings were not carefully lifted from the nursery ground so that the roots were severely injured. The roots were not properly protected during transportation and transplanting, so that most seedlings died soon after being planted. Some planting holes were not filled-in with enough soil and some seedlings were planted too deep.

Direct seeding experiments were initiated in the late 1870s involving mainly the native pine *Pinus massoniana*, although a few other native and exotic species were also tried (FORD, 1883). The results were satisfactory for pine on sites with good soil and the scale of direct seeding was gradually enlarged. All the suitable sites on the northern side of Hong Kong Island were earmarked for direct seeding in 1883. However, FORD (1883) noted that on south-facing slopes, direct seeding appeared less promising due to the stronger drying influence of the sun. In addition, on steep slopes heavy rains tended to wash away the loose soil together with the seeds. Direct-seeding was first undertaken by spot sowing in prepared pits but in 1883 and 1885, experiments were conducted on broadcast sowing pine seeds on hillside grasslands that had no ground preparation (FORD, 1887). The results were successful and the scale of this method was gradually enlarged in subsequent years (FORD 1889). From 1881 to 1940, direct seeding of *P. massoniana* seeds was the main afforestation method. FLIPPANCE (1939; 1940) noted that although germination was a little variable, much better results were obtained from broadcasting than from spot sowing. Pit planting of bare-rooted seedlings of both native and exotic tree species was used on poorer sites where direct seeding was not appropriate (FORD, 1883). However, FLIPPANCE (1939) noted that direct seeding of *P. massoniana* was gradually found more effective than planting bare-rooted pine seedlings raised in the nursery. Thus, the latter method was discarded for pine trees but retained for broad-leaved tree species, which, in contrast, was generally unsuccessful by direct seeding.

In 1907, an experiment was conducted with a small number of *Castanopsis fissa* seedlings that had been raised from seeds sown in pots, i.e. planting container-grown seedlings. The seedlings were planted out in the spring similarly to bare-rooted *P. massoniana* seedlings on open ground in Pokfulam Road. The results were negative and the method was said to be unsuitable (DUNN, 1908). Except in 1908, this planting method was no longer mentioned in subsequent forestry reports in this period. On the contrary, it appeared in various forestry reports throughout this period that only bare-rooted seedlings were used in afforestation. Daley (1975) also indicated that until the 1950's, planting bare-rooted seedlings was the usual afforestation method.

Afforestation restarted immediately after the end of the Japanese occupation in Hong Kong (1940-1945). It was done mainly by broadcast sowing as nursery stock for planting was not yet available (DALEY, 1975). Planting container-grown seedlings were soon introduced and quickly became standard practice due to higher survival rates and lower dependence on weather conditions (CORLETT, 1999; DALEY, 1975). The decline in reliance on *Pinus massoniana*, due to its susceptibility to fire damage and the occurrence of two serious new pests (CORLETT, 1999) contributed to the disappearance of direct seeding as an afforestation method in Hong Kong.

Experiments with chemical fertilisers were started soon after the war and their use, along with chemical pesticides became routine (CORLETT, 1999). However, weeding has been increasingly undertaken by mechanical rather than chemical means in recent years due to rising environmental concerns (personal observation). Ever since afforestation started, light pruning, adding fertilisers and replacement planting were provided in the first few years after seedlings were planted. Since the 1960's, the annual number of trees planted has increased from around 300,000 to over a million in the 1990's (CORLETT, 1999).

During the pre-war period, the provision of tree nurseries near the major afforestation areas was normal practice. This had the advantage of reducing the cost of transportation and the stress to seedlings during transplantation. However, with the increasing reliance on planting container-grown seedlings after the war, a centralised nursery was formed. Today, most afforestation projects in Hong Kong rely on supplies from the nursery managed by the Agriculture, Fisheries and Conservation Department, which is able to produce approximately one million seedlings per year. Commercial nurseries also serve as a major source of exotic tree seedlings but have, so far, played a minor role in supplying native tree species in local afforestation.

Up to 1882, afforestation was organised by less than 10 forestry staff. "Coolies" (i.e. casual labourers) undertook seed collection and transplanting on a daily basis. With the increase in the scale of afforestation, the government started contracting out seedling supply and planting work in the early 1880's (FORD, 1883). In 1886, the planting operations were carried out through five different contracts: seed supply, nursery production, making tree pits, planting tree seedlings and direct seeding (FORD, 1887). The frequent failures of contractors to fulfil the planting contracts forced the Botanical and Forestry Department to take over the large forestry operations previously carried out by contractors in 1907 (DUNN, 1908). In the transition forestry year 1906-1907, the part of the forestry programme carried out by contractors largely failed while that undertaken by the department was most satisfactory. None of the forestry reports between 1908 and 1940 mentioned forestry contracts. Apparently, the Botanical and Forestry Department employed large numbers of temporary workers to accomplish afforestation after 1908. For example, the average number of daily temporary employees was 58 in 1938 and 116 in 1939 (FLIPPANCE 1939; 1940).

Contractor involvement in afforestation resumed after the war. Since the 1980's, contractors have carried out the majority of the afforestation projects, especially those managed by the Territory Development Department. Normally, an afforestation contract will include the supply of seedlings (if seedlings are not to be supplied by the Government nursery), the delivery of seedlings to the planting site, site preparation, seedling transplanting, and post-planting maintenance, which lasts for 1-3 years (WEBB, 1993; personal observation). The performance of contractors nowadays should also be questioned. All government contracts, including afforestation contracts, in Hong Kong are required to be open for tender, and the lowest tender is usually picked. Despite the fact that afforestation contracts normally have very detailed clauses with respect to seedling specification, post nursery care, the planting method and post-planting maintenance, they are usually ignored so as to maximise profits from very low contract payments. In seedling delivery, in order to maximise the number of seedlings in each truckload so as to reduce the number of trips between the nursery and the planting site, seedlings are put in baskets in several layers and lots of seedlings are damaged or killed during transportation.

Despite the fact that the most commonly planted tree species in the early afforestation history of Hong Kong (1871-1965) was a native pine, *Pinus massoniana* (it lost its importance due to pest problems and susceptibility to fire), Hong Kong relied heavily on a limited number of exotic species in the 1970's and 1980's. Between 1871 and 1990, a total of 150 tree species were named in Hong Kong forestry reports, of which only 33 were

native species (CORLETT, 1999). In recent years, with an increasing concern for ecology, there is greater social pressure to use native tree species in reforestation. Thus, an increasing number of native species has been tried in recent years but a higher percentage of exotic species are still used in reclamation projects on barren lands (CHONG, 1996; WEBB, 1993). To date, with a few exceptions, the survival of all native species has been reported to be very low (e.g. LAY *et al*., 1999). It has been suggested that the dominant use of exotic species in afforestation programmes in Hong Kong can be attributed to the ease of nursery production and the ability of exotic tree species to survive better and grow faster than natives on degraded lands (CORLETT, 1999; CHONG, 1996; WEBB, 1993). However, HAU (1999) shows that good post-nursery care and transplanting precautions as suggested by Forest Restoration Research Unit (1998), can greatly enhance the survival of native tree species in the first two years. In addition to being a confounding factor in scientific experiments, poor post-nursery care and transplanting precautions could lead to very high seedling mortality. This is a possible explanation for the failure of many planting trials using native tree species in Hong Kong and the suggestion that exotic species are better than native species in forest restoration is thus doubtful. Finally, the lack of seed supply and reliable knowledge in silviculture are part of the reasons leading to very few native tree species supply in the commercial market.

DISCUSSION

Despite the fact that various reforestation methods have been tried in Hong Kong, including direct seeding, planting bare-rooted seedlings and container-grown seedlings. No single method seems to be highly successful in reforesting Hong Kong with species-rich secondary forests. In addition, none of the methods are very cost-effective under the present economic conditions, i.e. in a developed, high-wage economy. Creating foster ecosystems to accelerate natural forest regeneration has been proposed as a cost-effective method in the tropics as well as in Mainland China but this is yet not been considered in Hong Kong. A comprehensive forest restoration strategy, combining fire prevention, active reforestation by various means and practices to accelerate natural forest regeneration, is currently lacking. This may be partly attributed to the fact that reforestation in Hong Kong involves several different Government Departments (Agriculture, Fisheries and Conservation Department, Territory Development Department and to a lesser extent, Highways Department and Civil Engineering Department) under different Bureaux.

A forest restoration strategy for Hong Kong

Considering the rugged terrain and very high labour costs in Hong Kong, it is reasonable to assume that reforestation by promoting natural forest regeneration will also be cost-effective. It is possible that the various filter-barriers to forest regeneration on degraded hillsides in Hong Kong can be overcome, making forest regeneration possible. Here, I proposed a low input and efficient planting strategy for Hong Kong, which may also be used in South China in the future.

Fire is the major threat to the terrestrial ecology of Hong Kong (CHAU, 1994). No forest restoration strategy can be successful without effective fire-control measures. Therefore, for any given reforestation site, the first step is to conduct a fire hazard assessment, which should include a fire history review and the identification of fire sources at or near the planting site. A properly designed firebreak network should then be established. The firebreak should consist of a planted tree belt no less than 15 m wide and a no-vegetation belt 10 - 20 m wide outside the tree belt. Tree species in the firebreak should be fast growing. Apart from exotic species such as *Acacia confusa*, native species may also be considered, although as yet, no native species have been tested as firebreak trees in Hong Kong. However, densely planted native *Schima superba* (<1 m spacing) has been widely used in South China forests as a firebreak. In addition, a number of native species are commonly used in South China in green belts for fire prevention. They include *Castanopsis fissa, Liquidambar formosana, Quercus myrsinaefolia, Syzygium cumini, Viburnum odoratissimum, Homalium cochinchinensis, Machilus thunbergii, Schefflera octophylla, Eurya japonica, Camellia oleifera* and *Psychotria rubra* (CHAU, 1994). A complementary publicity campaign on fire prevention should be launched in the rural villages near the planting site. Fire hazard warning signs should be erected along the paths in the planting site to alert countryside visitors.

The second step is to accelerate forest succession by increasing the input of tree propagules to the site. The lack of seed dispersal can be overcome by promoting natural seed dispersal and by direct seeding. The natural seed rain could be increased by the provision of bird perches to reinforce any island vegetation on site. This could be accomplished by planting tree seedlings in patches across the site and using artificial perches (HOLL, 1998). Since only a small area (c. 5%) relative to the total area of the site needs to be planted for this purpose, a higher planting standard can be achieved. Native species should be used and higher planting requirements should be set to ensure high survival and growth. All seedling transportation and planting precautions should be strictly enforced and post-planting irrigation in extremely dry weather should be provided to minimise seedling mortality. To promote faster seedling growth, bigger planting holes should be prepared and fertilisers should be provided. Root-zone competition can be removed by herbicide or by manual weeding if herbicide use is considered too controversial.

The overall diversity of the site can be increased by direct seeding, especially by species that are not well-dispersed either naturally (e.g. the wind-dispersed species) or due to the local extinction of seed dispersers, e.g. the Fagaceae, the *Camellia*, *Styrax suberifolius* and *Tutcheria championii*. To do this, a seed predation experiment and rodent trapping study should be conducted in advance to assess the seriousness of seed predation. Should seed predation be important, seeds for direct seeding should be chemically treated with rodent repellent. Since seed germination in the field could be very low, most seeds used for direct seeding should consists of seed species that at least are known to have high germination rates in the nursery. For example, *Schefflera octophylla*, *Castanopsis fissa*, *Cyclobalanopsis myrsinifolia*, *C. neglecta*, *C. edithiae*, *Machilus berviflora*, *Reevesia thyrsoidea*, *Sterculia lanceolata*, *Pygeum topengii* and *Cordia dichotoma* (unpublished data). The last three species are worthy of special consideration. They fruit either at the

beginning or in the middle of the summer wet season, and in addition to high germination rates, they germinate immediately after dispersal and have a high initial growth rate (they could reach 30 cm in two months). In theory, these attributes would allow them to establish better on degraded hillside sites. However, field trials are needed to verify this.

Ideally, the fire prevention plan should be in force until a closed shrub-land or secondary forest is formed, which will then be relatively immune to fire (CHAU, 1994), which would probably take 15 to 20 years. However, the fire prevention plans may be suspended after the firebreak is fully functional (5 - 10 years). Management of the island vegetation will only be needed for three to five years. Apart from this, the site should require no further management. Additional direct seeding could be done as a booster if resources are available.

Research needs

An obvious hole in the reforestation history in Hong Kong is the lack of scientific research. Very few studies are available in the literature concerning forest restoration ecology in Hong Kong. Most planting trials in the past were not adequately documented (CORLETT, 1999). Basic information on the more than 390 native tree species in Hong Kong is insufficient. The seed germination rates of many species and the nursery techniques required to produce most native species are unknown. However, there has been gradually more and more research interest in this area in recent years. In addition to government departments and universities, the Kadoorie Farm and Botanic Garden, a local-based voluntary environmental conservation and education centre, set up a native tree nursery in late 1997 to promote research in reforestation and the use of native species.

It has been shown that bird perches could significantly enhance the seed rain on degraded hillsides in Hong Kong, however, whether fruit-bearing perches could further increase the seed rain or increase the diversity of the seed rain is unknown (HAU, 1999). A further field study on this should be conducted, as this would affect the species choice for the island vegetation to be established on the reforestation site in order to accelerate natural succession. A large-scale field experiment to demonstrate the effectiveness of island vegetation in accelerating natural forest succession is also needed to convince the administrators and the public that this is a suitable and cost-effective reforestation strategy in Hong Kong. Further seed predation experiments using chemical rodent repellents should be conducted so as to find out if it is possible to minimise seed predation. Currently, direct seeding has only been successful with one species (*Pinus massoniana*) in the reforestation history of Hong Kong. Similarly in South China, only this species was found to be successful in aerial seeding although another native species, *Schima superba*, was also found to be successful when mixed with the pine species (HUANG & SHEN, 1993). However, in view of the far lower cost of direct seeding and the advantages of this method at remote and steep sites, direct seeding experiments using different native species at different times of the year are needed to find out the best species and timing for successful seed germination and seedling establishment. Properly designed planting trials on native species with adequate planting precautions and documentation are needed. One of the aims of these planting trials should be to identify framework species that could facilitate forest

formation (FOREST RESTORATION RESEARCH UNIT, 1998; GOOSEM AND TUCKER, 1995). Finally, the effects of using native species in forest restoration on wildlife should also be monitored.

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QUESTIONS AND COMMENTS

Steve Elliott

Your schools project is very encouraging. Is the quality of planting with the children better than the contractors? What is the scale of the planting?

Billy Hau

There is a problem of scale – in Hong Kong over 1 million trees/year are being planted but only about 50,000 per year by schools. A lot of the native tree planting has failed because of contractor's problems, but we need to resolve the planting problems in order to tell which species are suitable. The contractors have confounded the results of using native species, so it is hard to work out if the problems are with the seedlings or not. It is hard to convince the Government of this, when they let most of the contracts.

Abdur Rashid

Do you have any projects to rehabilitate the indigenous people into caring for the trees and stopping the deforestation?

Billy Hau

The history of Hong Kong is very strange, we have indigenous hill-people, but they are less agricultural now, they have a very city-based mentality although they live in rural areas. The environment is not their concern, they are not interested as they have all the water, fuel etc that they want; they are very developed. I have a warning – if you continue your deforestation, other countries could end up like Hong Kong if you are not careful.

Nigel Tucker

As people's income increases, does the level of education increase, and thus their interest in the environment and the importance of trees?

Billy Hau

That is an argument, but in Hong Kong it is very weak. Everyone works 14-15 hours per day, including holidays, they are very eager to earn money – not interested in the environment around. I blame the UK government – they did not want Hong Kong to have a culture so it was lost. There is some interest in trees and the environment – a few growing, green groups driven by middle-class people who have received a good education, but the public at large is not concerned about the environment.

Pat Dugan

Have any attempts been made to ameliorate the sites with cover crops or succulents, as a precursor to planting, especially fire resistant species e.g. *Desmodia* ?

Billy Hau

No, we are weak in that area of forestry research, we have only just started forest research for wildlife restoration, so have not gone that far yet. So far, we have been using fast-growing exotics to make firebreaks, or we cut 30 m wide firebreaks. However, this is not adopted in every single project in Hong Kong, e.g. if a power company wants to plant a site, they will invest a lot of money in planting, but it would be better to make firebreaks first, or they will waste a lot of money. But planting generates a lot of publicity for the company and improves their green image, which is more important for them than actual results. Other countries too will need to think about involving private enterprises, as an alternative to government money.

Nguyen Van So

Land in Hong Kong is very expensive. Do you have any issues with land availability?

Billy Hau

Land availability is very simple, the Government owns all hilly slopes and farmers own the fertile land in the valleys. Therefore, the Government can make the hills available for planting. However, if we rely on farmers for the other land – it will not be very successful.