Malaysian Journal of Environmental Management 10(2) (2009): 89-114

Issues and Challenges of Sustainable Agriculture in the Cameron Highlands

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ABSTRACT

The challenge of producing enough food is increasingly affecting almost all developing countries as they prioritise support for industry ahead of agriculture. However, in recent decades, many countries, including Malaysia, have realised the need for food security and self-sufficiency and have embarked on an intensive agricultural programme. Consequently, many tropical highlands suitable for crops are suffering environmental damage through intensive farming with little or no enforcement and control. The Cameron Highlands of Malaysia is an example whereby large tracts of pristine montane forests have been cleared for intensive farming, both for food crops and flowers. This paper examines how farmers, with little government help, interact with environment, changing markets, infrastructure development, indigenous peoples, tourism, and other factors. The paper is based on detailed observation and interviews with farmers, grower associations, government officers and indigenous people to gather information related to farming, land degradation, threats to production and possible sustainable farming options. The results show that Cameron Highlands farmers, despite being left alone facing great challenges, are adapting well and are often flourishing. Many have intensified production, and some are moving toward less environmentally-damaging sustainable strategies. Pressure from NGOs and civil society with stricter government regulation has led to better control of land clearance and degradation, but this has forced farmers to move to neighbouring states. Organic farming is taking off though only a small percentage of growers are involved. Overall, the farmers have demonstrated great resilience, learnt new techniques, initiated and supported more environmentally friendly farming methods, and adapted well to environmental and socio-economic change with little or no outside help.

ABSTRAK

Cabaran untuk menghasilkan makanan yang mencukupi semakin mempengaruhi hampir kesemua negara membangun kerana keutamaan sokongan mereka adalah terhadap industri dan bukan pertanian. Bagaimanapun, dalam beberapa dekad

yang lalu banyak negara, termasuk Malaysia, telah sedar tentang keperluan kepada keselamatan makanan dan cukup *self-sufficiency* dan telah memulakan program pertanian intensif. Akibatnya banyak kawasan tanah tinggi tropika yang sesuai untuk tanaman telah mengalami kerosakan alam sekitar melalui pertanian intensif dengan sedikit atau tanpa kawalan penguatkuasaan. Cameron Highlands di Malaysia adalah stu contoh di mana hutan gunung yang pristin telah dibersihkan untuk pertanian intensif untuk kedua-dua tanaman makanan dan bunga-bungaan. Makalah ini meneliti bagaimana petani, dengan sedikit bantuan kerajaan, berinteraksi dengan alam sekitar, pasaran yang berubah, pembangunan infrastruktur, penduduk asli, pelancongan dan faktor-faktor lain. Makalah ini didasarkan kepada pemerhatian yang terperinci dan temubual dengan petani, persatuan penanam, pegawai-pegawai kerajaan dan orang asli untuk mendapatkan maklumat berkaitan penanaman, degradasi tanah, ancaman pengeluaran dan kemungkinan pilihan penanaman mapan. Hasilnya menunjukkan bahawa petani di *Cameron Highlands walaupun diabaikan dalam menghadapi cabaran yang besar dapat menyesuaikan diridengan baik dan malahan berjaya. Ramai yang telah mempertingkatkan pengeluaran, dan sesetengah mereka menuju ke arah strategi mapan yang kurang merosakkan alam sekitar. Tekanan dari badan-badan bukan kerajaan dan masyarakat madani dengan peraturan kerajaan yang lebih ketat telah Pertanian organik telah dimulakan walaupun hanya sejumlah kecil petani yang terlibat. Umumnya para petani telah menunjukkan ketabahan yang lebih, mempelajari teknik-teknik baru, memula dan menyokong teknik penanaman yang lebih mesra alam, dan menyesuaikan diri dengan perubahan persekitaran dan sosio-ekonomi tanpa atau dengan sedikit sahaja bantuan luar.*

INTRODUCTION

Farming in tropical highlands commonly causes serious on-and off-farm environmental impacts (Allenetal 1995; Rerkasem et al. 2002; Forsyth 2007; ICSC 2004). Agricultural development of highlands is being prompted in Southeast Asia, Indo-China, South Asia and elsewhere by increasing market access, smallholder settlement, and trade liberalisation (Lefroy et. al. 2000; APO 2004; Xu et al. 2006). Examining highland agriculture development–environmental degradation problems in Sabah, Lim and Douglas (2000) and in Thailand, Tungittiplokorn and Dearden (2002) and in South Asia, Wilson (2000) noted the focus of farmers and authorities has generally been on intensification, rather than soil and water conservation and control of the pollution.

Cameron Highlands farmers supply over half of Malaysian vegetable needs, and in addition generate sizable foreign earnings (in 1996 between

RM$ 56 million and RM$ 100 million was made from vegetables and flower production gave a further RM$ 20 million). Some of that will be through. Because the Cameron Highlands have been settled and intensively farmed for decades and have a relatively well-developed infrastructure it is likely that some of the lessons learned from studying them can be applied to other countries as they develop and possible to lowland smallholders in peri-urban situations. Most of the research on the Cameron Highlands has examined farming methods and possible improvements, pesticide pollution, nutrient enrichment of streams through excessive manure usage, and soil erosion. The focus has tended to be on physical issues, rather than on causation and trends. Our studies offer some insight into what 'drives' Cameron Highlands farming and how it relates to tourism and indigenous peoples.

We have collected information on land use and environmental problems from the Cameron Highlands between 2002 and 2007, our objectives being to:

- Stock take and assess the character, extent and trends of highland degradation.
- Assess livelihood adaptations and opportunities.
- Identify key threats and priority issues.

The Cameron Highlands are about 715 km² in area (Figure 1), settled between roughly 900 and 1800 m and surrounded by forested peaks rising to 2032 m. Malaysian lowlands are heavily disturbed, so upland forests like those of the Cameron Highlands are an important refuge for biodiversity. The Cameron Highlands are significantly cooler than Malaysia's lowlands, with a mean daily minimum of 14.8ºC, a mean daily maximum of 21.1ºC, which suits temperate crops. The rainfall averages 2660 mm yr^{-1}, humidity is high and there is no marked dry season (Chan 2000). Frequent intense downpours and easily eroded soils combined with farming on steep slopes presents a challenge.

Expansion and intensification of farming in the Cameron Highlands has seriously polluted streams and groundwater with sediment, manure-enriched runoff, agrichemicals and sewage (Amminuddin et al. 1990; Midmore et al. 1996; Wan Abdullah et al. 2001; Wong et al. 2002). Streams are more erratic in their discharge, and have higher peak and reduced low flows (Chan et al. 2003: 245). These streams are very important for lowland padi rice irrigation, fisheries and domestic water supply for large populations (Raine 1995). Cameron Highlands clearance is blamed for raising local mean daily temperatures by 1.5°C (Habu Station) and 0.6°C (Tanah Rata Station) over the last 25 years, and the

mean minimum temperature shows a 2.0°C warming trend over that period.

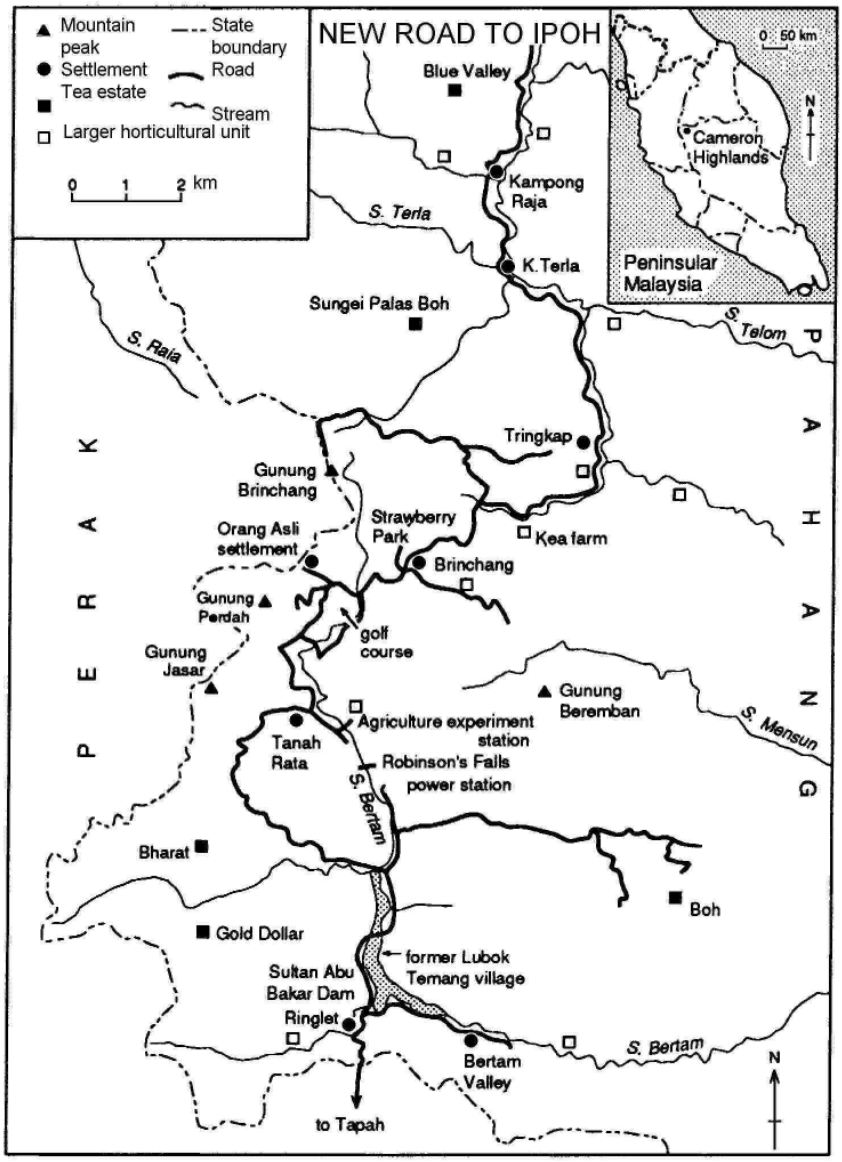

Figure 1. Cameron Highlands

Development began in the Cameron Highlands in the 1920s (Spencer & Thomas 1948; Voon & Khoo 1980). For more than 50 years the route to the Cameron Highlands has been a winding and steep 2-lane tarmac road. In 2003 a new and less tortuous highway made access much easier, especially to the more remote northern areas. Farm produce can be trucked on excellent roads to the cities of Kuala Lumpur and Ipoh within 2 hours and to Singapore or Penang within 6 hours. Three international airports are easily accessible and rail links are being improved. Weaker enforcement of clearance restrictions in the Lojing Highlands roughly 20 km southeast is affecting Cameron Highlands practices. There are over 25,000 ha have been cleared since 1990, much by those who hold land in the Cameron Highlands. This recently prompted the authorities to conduct air surveillance, which was extended to cover the Cameron Highlands (http://thestar.com.my/news/storey.asp?file=/2007/3/26/nation/17254820&sec=nation accessed March 2007). There are proposals for new roads through Malaysia's highlands that could encourage future deforestation and farming expansion (Heang 1990; Nooi 1991).

Cameron Highlands land use can be divided into four sectors:

1) *Cameron Highlands farmers*

Before the 1960s there were limited numbers of smallholder farmers, several tea estates and some slash-and-burn cultivation by indigenous peoples (*Orang Asli*). Most of the farmers and *Orang Asli* were resettled during the 1950s to 1970s 'emergency' to secure villages and the restoration of order in the early 1970s was followed by a growth of smallholders, mainly Malaysian Chinese. These 'squatter smallholders' developed a strategy of 'static shifting cultivation', renewing the upper 15 cm of topsoil on their plots at least once a year. This is environmentally damaging, yielding sediment to streams in the area of collection and when it is spread on plots, and discourages good husbandry.

Clearance was controlled by the 1990s by issuing limited numbers of Temporary Occupation Licenses (TOLs) and outlawing unauthorised landholdings. Rerkasem (2005: 297) estimated farmland in the Cameron Highlands had expanded to 3327 ha by 1990. Hashim (2002) recorded 2500 ha of vegetables (roughly half cabbages) and 600 ha of flowers in a 2000 survey. There seems to have been little *illegal* clearing in the Cameron Highlands since the 1980s: only166 ha of Forest Reserves were cut between 1997 and 2007 and all culprits were prosecuted (http://thestar.com.my/news/story.asp?file=/2007/4/14/nation/17439516&sec=nation accessed April 2007). However, there has been some 'legal'

clearing: a) in the Lojing Highlands by government farms and smallholders; b) recent 'joint ventures' in the Cameron Highlands (see later).

TOLs are issued for 5 to 15 years but involve annual renewals and rental fees (which rose from M$ 350.00 per ha to M$ 1,000 per ha in 2008). Poor soil and water conservation could lead to non-renewal of a TOL, but this has seldom been enforced. Farmers effectively have tenure and TOLs can be rented on, bequeathed or sold. After 2002 the allocation of new TOLs ended. With little opportunity for clearance, Cameron Highlands farmers had to sustain production from the existing pool of holdings, spot loopholes in the restrictions, or open up less secure land elsewhere. The later two are a recent divergence from expanding by taking over TOLs from others and intensifying with fertiliser (and increasingly manure), irrigation, and plastic-sheet rain shelters. Possibly the recent ending of new TOLs and delays issuing the annual renewals since 2005 might have helped trigger the quest for land in the Lojing Highlands and through 'joint ventures'.

Farmers have strong family support and often possess considerable entrepreneurial ability (Clarkson 1968; Voon & Khoo 1980; Shirasaka 1988; Freeman 1999). But, like upland farmers in many countries, they are marginalised, seldom seek official support, and are unprotected from market prices fluctuations, bad weather and crop diseases. Farms are mainly family-managed, although some co-operative groups have formed. It is possible to get 4 or more crops a year of temperate vegetables and flowers. It is rare for land to be left fallow, although crops are varied. Before TOLs smallholders regularly abandoned land and cut new plots, causing deforestation and stream pollution. Sprinkler irrigation, rain shelters, fertiliser and manure use are widespread. Plots slope 20 to 50 degrees and are usually broad, gently-inclined platforms. Soil loss can be high, especially from unsheltered vegetable farms (Aminuddin et al. 2005; Hashim & Rahaman 2006).

Plastic rain shelters reduce rain and sunlight damage and enable crop diversification and easier pest control. The authorities have been trying to control pesticide usage for decades, but large numbers of growers were recently reported to be using banned compounds imported from Thailand and other countries (*New Straits Times* 09/05/07 p.16). Unfortunately, illegal agrichemicals are cheaper and seen by farmers to be more effective. There has been growing consumer concern about pesticides and market controls have tightened since the 1980s. Tests on exported crops have been in force about 20 years, and recently consumer bodies and buyers for supermarkets have been testing crops for contamination. This

has caused some farmers to abandon illegal chemicals, but many now time their applications, shifting to approved materials or no treatment about a month ahead of harvesting to try and pass checks.

Across highland Southeast Asia smallholders are causing agrichemical pollution, biodiversity loss, soil erosion, and sediment and nutrient enrichment of streams (Charlton 1987; Cramb et al. 1999; Rasul & Thapa 2003; Lim & Douglas 2000). In the Cameron Highlands increasing use of uncomposted chicken-manure rather than chemical fertilisers. This causes nutrient enrichment and increases the risk of pathogens in streams, groundwater and produce (together with veterinary pharmaceuticals and hormones).

2) *Plantations*

Cameron Highlands plantations produce tea and their extent has been stable for over 40 years (Tempany & Curtler 1933) comprising about 2800 ha in 2007 (personal communication with estate managers and Majlis Daerah Cameron Highlands, August 2007). There has been some innovation in the last five years with hand-picking replacing mechanical-clipping to reduce costs. Tea is the most environmentally friendly cropping systems in the Cameron Highlands. An evergreen shrub, grown on slopes of up to 60 degrees, it provides groundcover (dense enough to protect the soil from raindrop impact and low enough to avoid intercepted moisture falling as droplets to cause sub-canopy erosion). Tea demands virtually no tillage and it is seldom treated with agrichemicals. Roughly 10% is replanted each year to cope with ageing, temporarily causing greater erosion but the overall soil losses are low (Anon. 1999).

Before the 1940s some estates experimented with coffee and cinchona (source of quinine) but for various reasons abandoned these. In the 1980s there were attempts to establish citrus but disease caused failure. There has been recent speculation that herbal medicines might be planted in view of the lucrative market for such products collected from local forests.

3) *Orang Asli cultivators, hunter-gatherers and forest product extractors*

The *Orang Asli* are indigenous peoples who practised hunter-gathering and shifting cultivation until the 1970s. Growing numbers have taken other employment. They have extensive knowledge of forest products and trails which is of potential for developing new crops and for tourism. Some extract forest products for sale and this may impact on biodiversity. The key forest products are rattan, bamboos, orchids and medicinal herbs.

4) *Tourism*

Malaysian cities are growing and demand for recreational visits to highland areas is expanding, tourism also generates income from overseas visitors. Much of the tourism is day-visit or short-stay, both low-spend, and it yields limited benefit for agriculture or environmental management (Chan 2004). Longer stay, higher-spend tourism, is mainly by golfers or trekkers. Short-stay tourism is likely to expand with improved roads and rising incomes. Agritourism (tourism combined with agriculture) currently caters for day-visit/short-stay and takes the form of roadside attractions like orchid, strawberry and honey producers and butterfly farms. There are limited opportunities for expansion of these attractions because they saturate the market and need to be near roads. Many farmers are located on narrow and steep side tracks and often have poor English and Bahasa Melayu which restricts them. Tea estates attract large numbers of short-stay visitors and contribute to the promoted image of the Cameron Highlands.

METHODS

Data were collected by; participant observation discretely guided by a checklist; structured in-depth questionnaires; and semi-structured interviews with farmers, agency staff, and non-governmental organisations (NGOs) members. Before piloting our questionnaires we gathered local knowledge to ensure we asked focused questions and did not give the impression we were ill-informed outsiders. We gathered information from: a) Farmers. b) *Orang Asli*. c) Tourists. A specially prepared questionnaire was used for each group. In 2002, 2003, 2004 three researchers and four research assistants conducted interviews over a 14-day period each year (in 2002 in December and in 2003 and 2004 in August /September). In 2006 and 2007 farmer surveys were conducted by two researchers during a 14-day period in September. Interviews were one-to-one, with a female interviewer for a female interviewee and a male for males, and were conducted in English, Bahasa Malaysia or Chinese, each averaging 50 minutes.

Farmer interviews were conducted in 2002, 2003, 2004, 2006 and 2007 after viewing each landholding. We produced a GIS map of land clearances, but key farm buildings and access tracks were difficult to locate, so this provided a poor sample frame. We sampled farms above 1000 m altitude around the settlements of Brinchang, Tringkap, Kampong Terla and Kampong Raja. The sampling pattern was opportunistic, conducted by working down each side road trying to contact all farmers

until access became problematic. We mainly made unannounced visits, starting in the morning and ending early evening. The varying time of day may introduce bias but frequent rain meant farmers were often sheltering and easy to contact. Transport of produce takes place on no fixed day so is not a distorting factor. Sometimes farmers were away so there were gaps in coverage in addition to farms in steeper and more remote localities. Gaps were noted and an attempt was made to rectify them during a later visit. We gathered data from some remoter farms using farmer guides with Land Rovers. We also interviewed some farmers through contacts with farming associations. No suitable farm survey or recent census data were available for us to use as a sample frame and there is no reliable total of farmers. Our coverage of flower growers and organic vegetable producers is better because most belong to associations which introduced us. Bigger flower growers do the packing for smaller producers so it was possible to make additional contacts. Having met with a few of the key organic producers it was possible to get introductions to all the others.

We obtained 94 returns in 2006 and 2007 by briefing school pupils from farms to interview their parents using our questionnaires. Even with virtually 100% school attendance, this data misses families without teenage children and results may differ from those collected by researchers (although we can see little difference).

The answer when farmers or officials were asked was that there were about 4000 farms in total in 2007. MARDITECH (1998: 9) estimated there were 1858 vegetable growers and listed 209 flower growers. These estimates include most flower growers but may miss smaller vegetable farmers who do not belong to any grower association. The total number of farms is thus likely to be below 4000. Given that about 85% of landholding is by TOLs, with a few plots inherited or held under some other arrangement, total TOL numbers should also give an indication of farm numbers. Various sources record 1421 TOLs in 2007 (some farmers have more than one TOL), so we feel an estimate between 2500 and 2880 should correct. Including the 94 returns mentioned above we have a farmer sample of 152.

Orang Asli interviews were conducted in 2002, 2003 and 2004.We tried to obtain a return from a spokesperson for homes in 12 larger accessible settlements. We tried to interview each village Headmen, and succeeded in 4 of the 12. Before sampling we made our presence known to the Headman but the sample was not influenced by them. Surveys were undertaken by 3 researchers and 4 research assistants who worked upslope from access roads until all houses were covered (opportunistic

sample). We tried to fill gaps by repeat, visits. There are no accurate population figures available for *Orang Asli* in the Cameron Highlands. Some are non-sedentary and live in inaccessible areas and some work away from the region for extended periods. Attempts to log numbers have been undertaken by State, but the Cameron Highlands includes portions of three States. We have 138 completed returns. There were roughly 30 occupied households in each of the 12 settlements visited. Of the 138 sampled 11 were from individuals encountered in Brinchang or Tanah Rata from the same 12 settlements but there is no double record for households. Thus we have 138 returns out of roughly 360 households in larger villages.

We questionnaired a sample of 150 tourists in 2002, 2003 and 2004 (using 3 researchers and 4 research assistants).We have been unable to get estimates of total tourist numbers. Tourists were contacted in shopping areas, restaurants, taxi ranks, car parks, hostels and cheap hotels, higher-grade hotels, and at key attractions. Tourists were approached at the bus/taxi station, which was the main arrival point for those without cars (this may have missed some self-drive and coach tour visitors) and as they passed interviewers at key localities. The sample was opportunistic, and the likelihood is that we under-represent higher-spend tourists using hire-cars or their own vehicles and some coach trip visitors. During the frequent rainy weather tourists gathered in a few shopping areas and were accessible. The questionnaire explored: backgrounds, origin, attitudes, spending, environmental awareness and interest in possible agritourism or eco-tourism activities.

RESULTS

1. Farmers

We questionnaired 152 farmers from the Tringkap, Kampong Raja and Bringchang areas (see Fig. 1). As discussed above, the total of farms is probably between 2500 and 2800.

Our sample indicated 75.7% held 1-2 ha; 11.2% held 3-4 ha; 10.5% had 5-10 ha, and 2.6% had plots between 16 and 20 ha. In 2006 a typical price for selling-on TOL land was M$300,000 for 0.40 ha (the exchange rate has ranged between about M$ 4.7 to UK£ 1.0 in 2002 to M$ 6.5 to UK£ 1.0 in 2006, reaching about M$ 7.0 to UK£ 1.00 in 2007). Over 83% of the sample we interviewed were over 51years of age, 23.7% were over 61, and 71.7% were Chinese (17.8% were Indian, 3.9% were Malay, 3.3% were *Orang Asli*, and 3.3% were of other ethnicity) . We found 52.6% of our sample had been settled in the Cameron Highlands for over

20 years and some were third or fourth generation settlers. Fifteen years or so ago the main crop for most farmers in the Cameron Highlands was cabbage (and many think it still is). Now the main crop according to our survey was: for 23% of our sample cut-flowers, for 2.6% tomatoes and 17.1% specialised in cabbage. Vegetable growers plant a wider crop mix than 10 years ago. Flower growing has expanded (to between 15 and 23% of all farmers) and, according to grower associations, is continuing to do so. The main flowers are chrysanthemums, with some carnations and a few other blooms. There is developing interest in orchid production, especially *Dendrobium* spp. A few growers have specialised, in: tomatoes, watercress (Rahman 1980), passion fruit, and edible fungi. The latter needs little land but demands costly sheds and marketing can be problematic because the produce must be transported chilled or dried. Fungi growers also compete with big producers in China and other countries and markets are easily saturated. Watercress growers are limited to sites with clean springs but need minimal inputs, get 6 crops a year, and cause very little erosion or pollution. Growers specialising in tomatoes and lettuce appear to be doing well and cause limited pollution because their crops are often grown using hydroponics. The larger landholdings in 2007 were flower producers (some vegetable 'joint ventures' may soon be as large). The export market demands well-packaged, pest-free flowers and there are market incentives to find alternatives to pesticide and fungicides (many use biological controls). Packing demands mean smaller growers must co-operate with larger producers who have the facilities. Sales to Japan, Europe, and increasingly China, have been good and seem more stable than the vegetable market.

Farmers do not practice fallowing; most of our sample cropped their plots continuously, but varying successive plantings. Deliberate crop rotation was undertaken by only 0.7%. We found 93% used chemical fertilisers. There is an ongoing shift from fertilisers to uncomposted chicken manure. Our sample indicates 31.6% have ceased soil renewal, the reasons being: 1) they had installed rain shelters, reducing erosion. 2) Soil transport costs are rising. 3) Soil loss is compensated for by use of manure and fertilisers. 4) Some trap eroded soil to return it to their plots. 5) Some have shifted to shallow-rooted crops which reduce soil losses.

Although less than 800 km^2 the Cameron Highlands supplied over 60% of Malaysia's vegetables and fruit in 2006 and generated considerable export earnings from vegetables and cut-flowers (personal communication 2006 Cameron Highlands Flower and Vegetable Growers Association). Our sample showed 31.6% had expanded landholdings,

mainly before the 2002 cessation of new TOLs. We found that 90.6% of the sample sold to a middleman; roughly 61.8% sold some crops overseas. Singapore was a key market for 25% of our sample, with Thailand, Japan, Taiwan and China being expanding markets for vegetables and flowers. Non-specialist vegetable growers expressed insecurity and vulnerability to market fluctuations, bad weather, crop pests and disease (29% were seriously concerned). Those claiming income reduction attributed it to rising costs of inputs, especially labour and transport. About 10% of the sample blamed falling income on low market prices for vegetables, and 2%, complained water shortages were to blame. Our survey indicates 32.7% of farmers undertake regular off-farm employment. Most of this employment takes place within 20 km. We found that 5.9% reported that their incomes had increased in the last 5 years, 62.5% felt it had been static, and 31.6% reported a fall. Those enjoying raised incomes attributed it to new crop varieties (7%), increased use of fertiliser (7%), more intensive farming (3%), better techniques (3%).

We found 86.8% used sprinkler irrigation, and there has been a recent spread of drip irrigation (11.2%), which is much less wasteful of water and might cut stream and groundwater pollution. Our sample shows 26% felt they occasionally had insufficient irrigation water, 19% were convinced their water was polluted enough to affect cropping, 15.5% were concerned about competing for water, and lack of adequate water for irrigation worried 14% (although 2008 was a wet year and may have reduced concern). Reports of water conflicts were unknown 10 years ago. Smaller and less successful growers reported it was difficult to get credit. Most would like the authorities to act to reduce the threat of market price instability and to help them recover if struck by pests and diseases or bad weather. We found 84.2% of farmers had occasional labour shortage, 10% claimed year-round labour problems and 69% employed foreign labour. Interestingly, 95.4% felt their environment had deteriorated.

Cameron Highlands pesticide pollution has attracted research attention for over 20 years and there have been efforts to try and control it. The results have been limited: recent press articles report widespread use of illegal pesticides. This seems to be because they are seen to be cheap and/or more effective than approved compounds. Media and legislation have had less effect in reducing agrichemical use than supermarket checks of produce.

There are excellent facilities for agricultural research and extension, including a large and modern Malaysian Agriculture and Rural Development Institute (MARDI) Research Station at Tanah Rata. But

outreach has had limited effect, probably because farmers have not sought help. The same is probably true for soil and water conservation and pollution control. We recorded 85% of the sample claimed to practice soil erosion control but only 9% saw erosion as their key challenge. Only 3.3% reported contact with erosion control advisers, yet 20% said they were willing to pay up to 10% of income on erosion control.

2. Plantations

In 2002, 2003, 2004, 2006 and 2007 we visited all 6 tea plantations, interviewing staff and gathering information, but did not conduct a questionnaire survey. In highland Sri Lanka, tea estates have developed tourism as a secondary source of income, using of redundant managers' villas as hotels. There are opportunities to do this in the Cameron Highlands where *Orang Asli* guides could help develop hill-walking and eco-tourism. Development of www-based sales of luxury teas may have helped some of the estates in recent years.

3. Orang Asli

We sampled 12 settlements: Kg Batu 6, Kg. Batu 26, Kg. Chohong, Kg. Sg. Bergantung, Kg. Sg. Getan, Kg. Sg. Kabuk, Kg. Sg. Jarik, Kg. Sg. Riul, Kg. Telimau, Kg. Sg Tiang Atas, Kg. Sg.Tiang Bawah, Pos Terisu. Government maps show 21 *Orang Asli* settlements in the Cameron Highlands, most smaller than the larger and more accessible ones we visited. The sample consists of 138 returns; 70% of respondents were male adults and 30% were female adults. The bulk of interviewees (96.4 %) were of the *Semai* tribal/ethnic group, 1.4% were *Temiar*, 1.4% were *Murat*, and 1.4% were of mixed ethnicity. We found employment was mainly in non-farm labouring or services employment with some taking jobs outside the Cameron Highlands.

In the past the authorities were concerned that *Orang Asli* shifting cultivation caused environmental damage. The settlements we visited had relatively small areas cleared for subsistence crops, nowhere more than a few hectares. Smallholders mainly employ Bangladeshi, Indonesian or Nepalese labourers, possibly because they feel more in control of non-Malaysians (and non-*Orang Asli*) on 2 or 3 year short-stay permits. *Orang Asli* 'joint ventures' began about 2004 (we established this by noting dates scratched in cement structures). Some of these are more than 10 ha in extent, and at least one is ca. 400 ha.

Forest product extraction by *Orang Asli* can be split into two categories: a) Larger scale removal of rattan for the furniture trade, and bamboo for scaffolding, farm rain-shelter supports, and food (shoots). b)

Smaller scale collection of orchids, fruit, honey, medicinal herbs, and butterflies. Larger scale activity is difficult to monitor because considerable profits may be involved and it is surreptitious. In all probability it is expanding (Wazir-Jahan, 1990; Dentan, 1997; Nicholas, 2000). Smaller scale extraction for family consumption and sale at roadside to tourists should be easy to monitor, but we know of no such study.

The *Orang Asli* enjoy traditional rights exempting them from forest clearance regulations so they can 'lease' land or work it with others. Some reported poor returns from these arrangements. It would appear that entrepreneurs, agencies and even foreign labourers form 'joint-ventures'. These may provide some income or employment for *Orang Asli***,** but there could be serious environmental impacts. We noted such developments near four of our seven sampled settlements.

Educational facilities are good and are being upgraded to a high standard. We found 32% had primary schooling, 28% had secondary education. Only 22% of the sample reported cash incomes over M$500 per month. The Government provides most villages with housing, piped water, basic sanitation, and increasingly electricity. Many *Orang Asli* work as tourist guides and on the local golf course (some as golf 'pros'). Our sample indicates 63% of employable age had employment, with 17% of those working in tourism-related jobs.

The villages we visited practised slash-and-burn cultivation for some of their food needs, but this was limited in extent and showed little sign of causing environmental degradation. However, the 'joint venture' clearances were cut from steep forested slopes above 1000m and were suffering erosion. We found 34% of families owned at least one motorcycle and 3% a car or truck, 49% frequently hunted game animals and fish for household consumption, 44% reported regularly extracting rattan and bamboo, and 16% admitted regularly selling such products. We were not able to assess how much control communities' exercise over forest product extraction, but it is likely that there is some management by village leaders. Roughly half of interviewees felt environmental quality was deteriorating.

4. Tourists

In 2002, 2003 and 2004 we interviewed 150 tourists: equal numbers of males and females. We have not obtained reliable estimates of Cameron Highlands total tourist numbers although we interviewed officials and some hoteliers. The majority of our sample made short-stays of less than 3 nights, used cheaper hotels and public transport, and were low-

spenders. Most stopped at roadside agritourism attractions and made a trip to a tea estate. Short-stay tourists were mainly under 35 years of age and came from Malaysia, Singapore, Thailand, and to a lesser extent, Europe, Japan, and the Americas. More affluent tourists tended to fall into the over-35 age group. Some of the latter were attracted by the golf course and originated mainly from Malaysian cities, Singapore and Japan; others were visiting as part of a hire car tour of Malaysia. Short-stay tourists and visitors are limited in how far they can venture from main routes and accommodation. Both short- and longer-stay groups are likely to expand thanks to new road links. As the media prompts 'lifestyle' awareness there may be growth of interest in Malaysian cities in agritourism, trekking, and eco-tourism.

Our entire sample stated scenic or environmental features were the key attraction. All reported concern about environmental degradation, especially: deforestation, littering, stream pollution, building, and unsightly farm rain shelters. There was strong interest by tourists from overseas in improved trekking and eco-tourism.

DISCUSSION

Farmers have been adapting livelihoods to raise yields and to improve their security in the face of fluctuating vegetable prices, rising input costs, and the risk of crop loss to bad weather, pests and diseases. There has been a shift from cabbage production to a wider mix of vegetables, flowers, tomatoes, or in fewer cases: watercress, strawberries, fungi, or passion fruit. We recorded 20 growers (the total) accredited as organic producers of vegetables. A number of farmers have been adapting by opening-up landholdings outside the Cameron Highlands, and since about 2004 there have been 'joint ventures' exploiting *Orang Asli* indigenous rights. Most farmers have invested in sprinkler irrigation and rain shelters.

Livelihoods have improved but stream and groundwater pollution has become problematic. Researchers, who have explored farm development in Malaysian highlands, have focused on yield improvement, soil erosion problems and agrichemical threats, and less on what 'drives' farming. There has been little study of farmer attitudes, capabilities and needs (Ko et al., 1987; Aminuddin et al., 1990; Vincent & Hadi 1993). Research in highlands of mainland Southeast Asia shows unfavourable change in just a single component of the agriecosystem can threaten sustainable development; for example, increased input costs or falling market prices (Rerkasem & Rerkasem 1995). Our studies indicate

a range of challenges to Cameron Highlands farmers, including: soil fertility maintenance; sudden market price reductions; rising costs, bad weather, crop pests and diseases, water shortage, and quality controls imposed by produce buyers. Some of these challenges may prompt desirable changes; e.g. water shortage encourages drip irrigation, produce tests discourage pesticide use, and unsteady vegetable prices encourage a shift to flower growing.

Rain shelters are shown by a number of studies to reduce soil erosion from cultivated *plots*. However, shelters concentrate and shed runoff, and if there are no adequate drains, gulley erosion occurs. This needs further study. Shelters are adopted to improve yields and crop quality and allow diversification, rather than control erosion. Those we interviewed had limited awareness of the off-farm problems caused by their agricultural activities. They were aware of agrochemicals contamination because buyer testing could damage their sales. Water supply for irrigation was problematic between 2005 and 2007 and may have encouraged adoption of drip irrigation, catch drains, and runoff recycling. Drip irrigation uses far less water and fertiliser than sprinkler irrigation and can cut evapotranspiration losses and splash- and runoff-erosion. However, it may lead to accumulation of salts and other contaminants in plots. The risk is that this contamination could damage plots or be periodically carried to streams or groundwater. More research is needed to check the value of drip irrigation in reducing groundwater and stream pollution. We found 11.2% of our sample had adopted drip irrigation within the last five years. The reasons for the shift may be a desire to reduce water demand but there has also been technological improvements and price reduction of drip irrigation. The technique can also cut labour demands. We have yet to assess the level of take-up of catch-drains and environmentally sound wastewater control. A growing number of farmers already apply agrichemicals with irrigation ('fertigation') and collect the return flows for re-application. More research is needed to improve the strategy and, if it works, encourage its adoption. Unusually high rainfall in 2007-2008 and rapidly rising farm input costs may hinder change.

Many vegetable growers have shifted to cut flower production. The indications are that this can significantly reduce environmental damage compared with open and even sheltered vegetable production (MARDITECH 1998). There is a need to check this: elsewhere in the world flower production has been charged with increasing evapotranspiration losses and nutrient enrichment and agrichemical pollution of groundwater, streams and lakes. Lake Naivasha (Kenya) is

often cited as an example; however, the Naivasha literature suggests pollution is by sewage from settlements and vegetable farming, rather than floriculture. Rose and carnation farmers in Kenya use large amounts of fungicides (Cameron Highland growers seem to use less) and more than half the Naivasha flower growing area is unsheltered, which means considerable runoff. Naivasha also has an area of unsheltered vegetable growing at least equivalent to that for flowers. (www.ilec.or.jp/eg/lbmi/reports/_17_Lake_Naivasha_27February2006.pdf p. 283 accessed April 2008). MARDITECH (1998), note that floriculture is mainly under shelters and leads to much less soil erosion and agrichemicals pollution than vegetable farming which is less sheltered. Chrysanthemums under shelters were reported to suffer lower than 1.0 t ha yr^{-1} erosion, which is 80 times less than unsheltered vegetable growing (http://www.e-msss.com/mjss/abs05.htm accessed March 2008). Sediment loads in streams draining vegetable farms were 50-times higher than those from sheltered flower growing areas or tea plantations, and the streams with the highest sediment loads were found to have greater nutrient enrichment (Aminuddin et al. 2005).

Growers we interviewed in 2006 reported flower exports were around M$200 million per year. If a farmer wishes to manage his own flower packaging and marketing he needs to farm over 12 ha, so smaller growers co-operate. There were (excluding recent 'joint ventures') 30 farmers with more than 12 ha in 2006, and all were flower growers. The largest grower has about 40 ha. The average size of a flower farm is 4 to 6 ha, the smallest around 1.21 ha (personal communication 2007 Cameron Highlands Flower and Vegetable Growers Association).

Most of the obvious farm erosion we saw was on paths and plot surroundings. Underestimating the soil erosion problem is likely to be widespread because farmers overlook gradual sheet erosion and occasional serious damage during storms. We noted that land which is not disturbed often develops a crust of algae, liverworts, mosses, lichens fungi and micro-organisms like cyanobacterium, which almost certainly reduces erosion and might lock up some of the excess nutrients from fertilisers and manure. There has been research elsewhere on such cryptogamic crusts and their value. Much of this relates to arid, cold tundra or mountain environments, but there has been some exploration of their value in temperate farming and tropical highland agriculture. For example, Gaskin and Gardiner (2001) made a study in the monsoon highlands of the Nepalese Middle Hills (see also: Eldridge & Greene 2002). If there are benefits (research is needed) farmers could be encouraged to establish crusts.

Farmers are pressured to reduce agrichemical use, but much less attention has been given to controlling over-generous application of chicken-manure which is now more prevalent than chemical fertiliser usage. Our survey showed 83.6% of sampled farmers use uncomposted chicken-manure, and the reported application rates for vegetables were similar to those recorded by Hashim (2003): between 10 and 75 t ha yr^{-1}. Composting chicken-manure, a common practice elsewhere, generates temperatures high enough to destroy most harmful pathogens, although it will not remove heavy metals, hormones and other pharmaceuticals. Rising costs may help reduce fertiliser and manure use.

Administration of the Cameron Highlands is shared between four State Governments, local authorities and Federal Government departments (Oh 2000: 95). This may not help co-ordination and integration, which are vital for good environmental management and sustainable development. Ideally there should be co-operation between all Cameron Highlands stakeholders (farmers, NGOs, the tourism sector, and local communities); it is likely there are opportunities for 'dovetailing' activities for mutual benefit. For example, some farm activities may support tourism and it may benefit other stakeholders to help pay farmers to avoid environmental degradation. The smallholder farmers have a sense of regional identity and strong social capital but there needs to be incentives to encourage good land and water stewardship. The Department of Agriculture runs a scheme (SALM Scheme), which rewards farmers (throughout Malaysia), for adhering to guidelines which include erosion control and better use of chemicals but Cameron Highland farmers seldom participate in this.

Lowlands will benefit from better environmental management in the Cameron Highlands, but lowland people are not aware how much their welfare can be affected by what happens in the hills. So the easiest way to generate funds for improvements may be a charge on tourists entering the Cameron Highlands. A study to promote effective co-ordination, including sustainable development in the Main Range of Peninsular Malaysia was launched in 2000 (Government of Malaysia 2001). Opportunities to clear land in other highlands and through 'joint-ventures' may discourage Cameron Highlands farmers from intensifying use of plots from the existing pool of TOLs.

Few farmers maximise short-term profit, degrade their land, and abandon it when they have enough to invest in another business. Farm innovation in the Cameron Highlands receives little external help and there are rising input costs, market uncertainties, and bad weather, and pest and disease problems. Longer-term unknowns include acid

deposition caused by lowland urbanisation, industry and traffic and global warming. Farmers we spoke to often wished for support to cushion them from sudden market fluctuations but seldom seemed to seek it. Farmers facing poor returns and market insecurity or who have found non-farm employment, may rent their TOLs or make a sharecropping arrangement. If a TOL-holder were to rent land at 2006 rates he would get M$3000.00 per month net without risks. If sharecropping the landowner typically shares 50:50 if there is a profit. A smaller producer (with about 2 ha) in such an arrangement reported that, after deducting wages of 2 Bangladeshi workers (M$1500.00 per month), net profit to owner and sharecropper could be M$4200.00 per month each. If the market prices were bad (as had been the case for most of 2006 and 2007), after paying workers each would get M$825.00 net per month. These arrangements probably help prevent land abandonment, and in some cases owners re-establish control when they leave other employment. But those renting or sharecropping are less likely to invest in improved land husbandry.

Farmers we interviewed reported they rely on social capital in time of need and when innovating, in the form of cash help from relatives or neighbours, informal sharing of expertise, equipment, labour, or transport of produce. Social capital can decline, and if it did might trigger farming change that degrades environmental quality and hits tourism and wider socio-economic conditions. It is desirable that social capital is monitored. Our sample indicates 62.5% of farmers feel community help has not declined but 31.6% felt it had.

We recorded 20 organic growers in 2007, of which 8 had formed a co-operative. The longest established organic farmers had been accredited for 11 years. All organic producers are vegetable growers. Accreditation means poor income for 3 years or more, but once achieved the produce should command higher prices. Organic produce is an expanding domestic and export market, which is by no means saturated. But so far domestic buyers are only from higher income groups. The grower's network with a range of NGOs based in Japan, The Netherlands, Sweden (several growers are accredited by KRAV), New Zealand or Korea, and organic NGOs are now established in Malaysia. NGOs are promoting consumer demand as well as supporting growers. Learning compost making and getting suitable raw materials like organic chicken-manure were key elements of successful organic growing. One group of organic growers ran vegetarian restaurants and food stores which gave them additional sales.

Our studies suggest the organic farmers get roughly 50% better prices for their produce, but have lower yields than non-organic. We have not established how much lower their yields are, one claimed it was about 10% of normal yield (which seems too low). Our sample indicated 38% of farmers thought a shift to organic growing was a possibility, but 60% said they could not find capital, 7% felt it was too hard to get certification, and 9% felt it was too risky. Nowhere near all who are interested could convert, even if they had support, because agrichemicals drift from other farms or contaminate the streams and groundwater needed for irrigation (Wan Abdullah, et al., 2005). Ironically, organic growers are amongst those making biodiversity damaging clearances in the Lojing Highlands, probably because they can clear uncontaminated land with clean water supplies.

Relatively few can convert to organic production, a more realistic goal is for farmers to move to reduce water consumption, cut sediment contaminated runoff and nutrient enrichment of streams and groundwater, and better manage agrichemical usage. Off-farm controls will also be needed to trap sediment that reaches streams and catch some of the nutrient enrichment. Constructing reed or water hyacinth beds and diverting streams through them could achieve this. The trapped sediment could be used to renew plots and the reeds could be composted or converted to biochar for farmers or burnt for power generation if agrichemical contamination is a problem. Alternatively, sediment and compost might be applied to stands of rattan, bamboo and other forest products like medicinal herbs on wasteland. That could help stabilise slopes and discourage forest product extraction (Idris & Mohamad 2002; Vantomme 2003).

CONCLUSIONS

In the Cameron Highlands most farmers have intensified production and in doing so have made some changes which reduce environmental damage and may help sustain production. The main innovations are: plastic rain-shelters, sprinkler irrigation, manure and fertiliser, improved seeds, pesticides and fungicides, a shift from vegetable production to flower growing. It is likely that shelters can reduce erosion from plots (but caution is needed to prevent the intercepted rain from causing gullying or sheet wash off-plot). The availability of manure, together with rising transport costs and other factors (see earlier) have probably been the cause of a reduction in the practice of topsoil renewal. Together these developments should have helped reduce sediment reaching streams.

However, greater use of fertiliser and manure and sprinkler irrigation and an expansion of farming because TOL restrictions are being side-stepped are likely to mean more nutrient enrichment of streams and groundwater. Innovations which may counter this nutrient enrichment are: a shift from vegetable to flower growing, the installation of catch drains and sumps and spread of hydroponics, and replacement of sprinkler irrigation with drip irrigation. More research is needed to confirm the worth of such measures. Recent steep rises in fertiliser and manure costs may discourage their wasteful use. Produce buyer testing for agrichemical contamination seems to help reduce pollution. The impact of clearance opportunities in surrounding highlands and through 'joint ventures' is not clear. Obviously the latter results in loss of some of the remaining montane forest and in similar off-farm problems as established Cameron Highlands farming. Whether availability of land from the aforementioned clearances will discourage the efficient use of land in the existing pool of TOLs is unclear. Organic farming offers opportunities, but may be significantly less productive, and can only be undertaken by those able to obtain unpolluted water in areas which suffer no drift of agrichemicals from surroundings.

Farmers in the Cameron Highlands have strong 'roots' and seldom seem to abandon land. It is evident that innovation is farmer-initiated and that they receive little outside support. The authorities have controlled forest clearance and possibly helped stimulate intensification through TOLs.

Of the farmers interviewed 31.6% claimed to have discontinued soil renewal. Ceasing soil should reduce nutrient enrichment of streams and groundwater, but poorly managed use of fertilisers and manure along with sewage from settlements will still cause pollution. Intensified vegetable production uses 10 to 75 t ha yr^{-1} of chicken-manure, but flower growers generally apply only around 2.5 t ha yr^{-1}, thus a shift to flower growing could have significant environmental benefits (MARDITECH 1998; Hashim & Abdul Rahaman 2006). Research is needed to establish how flower and vegetable production can further reduce runoff and contamination of groundwater and streams. Rising transport costs have recently greatly increased the costs of manure and fertilisers which may discourage wasteful use (but perhaps hinder innovation). Between 2006 and 2008 chicken manure almost doubled in cost. The annual fee for existing TOLs rose in 2008 from M$ 300 to M$ 1000 per ha.

MARDI has demonstration plots showing drip irrigation, hydroponics and catch-drains and a few farms now use such techniques.

Those using excessive agrichemicals and manure and paying limited attention to soil and water conservation have considerable off-farm impact. Organic farming is especially vulnerable, as are river fisheries and irrigated farming in lowlands. It might be hoped that inefficient farmers would release TOLs for others to try more productive and perhaps sustainable and environmentally sound use of already cleared land. Unfortunately, clearances in the Lojing Highlands and through *Orang Asli* 'joint-ventures' jeopardise such hopes.

Simple questionnaire surveys and farm visits used in this study yield information on trends and can help establish causation of agricultural change. Such information can enable governance to shift from reactive responses to a proactive approach more likely to yield improved environmental management and to support sustainable development.

ACKNOWLEDGEMENTS

We are grateful to The British Council (grant HEL No.740), and The British Academy (grant LRG39415) for funding. Gratitude is also due to the Universiti Sains Malaysia and many individuals and bodies in Malaysia. We thank Dr. Julian Clifton for assisting in our research between 2002 and 2005.

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