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Composite farming systems in an era of change: Nagaland, Northeast India

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Abstract: *Composite farming systems, first clearly identified by Rambo, are those in which radically different technologies are found together in a single farming complex. Data from diaries kept by groups of farming families in two Angami Naga villages in northeast India, Khonoma and smaller Tsiesema, detailing inputs into and outputs from wet-rice terraces and jhum (swidden) fields in the years 2000 and 2001, are presented and discussed to detail the workings of related but different composite systems. The 2000–2001 survey caught an important set of changes in midstream. Although returns to labour from the first-year jhums were much higher than those from the wet-rice terraces in 2000–2001, jhums were declining in significance as a growing non-farm economy joined the production of cool-climate vegetables and a spice crop for the Indian market as principal sources of livelihood. This story is told in the light of recent writing on the demise of swidden in the larger Southeast Asian region, and it is suggested that greater attention be paid to the composite systems, which are not uncommon in this region. This might help diversify what has perhaps been an oversimplified discussion.*

Keywords: *composite farming systems*, *Nagaland*, *pluriactivity*, *Southeast Asia*, *swidden*, *wet rice*

Introduction: composite farming systems

Composite systems, as we abbreviate the 'composite swiddening agroecosystems' defined by Rambo (1996, 2007), are those in which radically different technologies such as swidden agriculture, permanent wet-rice farming, home gardens, perennial-crop farming and enduring tree-crop cultivation are found together within the farming complex of one community. Composite systems are not new and are not all that uncommon in Southeast Asia, but little integrated discussion occurs in the literature. Rambo himself, Menzies (1996), Yin (2001) and Menzies and Tapp (2007) are among the few who review the interrelations that make such mixed systems successful. There have, on the other hand, been several studies on the productivity of swidden cultivation, and in some cases a comparison with wet-rice cultivation (e.g. Padoch, 1985; Cramb, 1989; Conelly, 1992; Hunt, 2000; Mertz, 2002). The most recent of those that dealt with a composite system looked only at the swidden element (Nielson *et al*., 2006). Until now no one has attempted to quantify in detail the manner in which farmers manage their inputs into the distinctive sub-systems of composite farms, or has comparatively measured the total outputs thus obtained. This paper pioneers such quantitative measurement.

We present data on the operation of the principal sub-systems, wet-rice terraces and swidden found in two Nagaland villages in the years 2000 and 2001. This was in a period of rapid economic and social change in Nagaland, and the 2000–2001 situation was a stage in a transition that we also discuss. The data rest principally on two years of supervised day-by-day diary keeping by groups of men and women

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farmers in support of Cairns' field work in Nagaland. The accompanying tables and diagrams, and the plates, all relate to 2000–2001, and all statements referring to this time of fieldwork are placed in the past tense, even though some conditions described may well remain unchanged. The compelling priority of other work, and severe illness, delayed the writing of this paper so that its central data are already historical although hopefully interesting methodologically despite the delay.[1] To discuss change, it becomes necessary to view the 2000–2001 situation in perspective, involving us in challenging problems of interpreting trends both within and since the date of Cairns' field material. We tackle these problems toward the end of this paper.

Relevant aspects of the modern debate regarding swidden cultivation

Locating our material in the literature is not easy because most writing on wet rice concerns regions that have experienced the Green Revolution; Nagaland has not. The swiddening literature has greater relevance. Writing on swidden cultivation in Southeast Asia has undergone a major recent shift. Until lately, impending collapse of unimproved systems, because of the imposition of shorter and shorter cycles of clearing, burning, and cultivation on sensitive forest ecosystems, was a recurrent theme (Cairns, 2007a). On the evidence presented by Schmidt-Vogt *et al*. (2009) there are now few ongoing shifting cultivation systems in Southeast Asia in which 10 years fallow, the minimum suggested by Ramakrishnan (1992), is still achieved. Yet the predicted disasters have not occurred.[2]

Other forces instead have hit shifting cultivation. Writers nowadays are principally concerned with its rapid replacement by other forms of land use. Padoch *et al*. (2007) focused attention on this issue and were followed by a set of papers presented at a symposium held at Hanoi, Vietnam, in 2008, published in a special issue of the journal *Human Ecology* in 2009. While new livelihood strategies are sometimes adopted voluntarily, the reasons given for change are often in the category of external forcing: heavy advice, prohibitive legislation, land alienation or exclusion from land by conservation zoning. Fox *et al*. (2009) describe how shifting cultivators have been marginalised as members of ethnic minorities, deprived of access to land or brought almost forcibly into the commercial economy in a subordinate status. In a recent book, Scott (2009) echoes this argument by describing the events of the past half-century as the 'last enclosure' in the uplands, meaning the capture by state control of the last major farming regions in which people could organise their social and productive systems in diverse ways of their own choosing.

Scott (2009) says more. Most recent writers seem at least tacitly to accept the traditional stance that shifting cultivation is the most ancient of all farming systems, and therefore that it is primitive. Yin Shaoting (2001) had earlier denied this and points out that farmers who use knife, fire, and dibble-stick in swiddens are fully aware of the use of the hoe and plough and of irrigated terracing; in some instances they combine these very different technologies in their management repertoire. Scott goes much further and argues that shifting cultivation has been a political choice taken in historical times. Swidden agriculture offered few opportunities for appropriation of agricultural surplus by tax-gathering governments, their police and armies. Swiddening, he says, is footloose and an 'escape agriculture'. Brookfield (2011a, b) has written critically on these generalisations, but in this paper we allow Cairns' data to tell their own different story.

Introducing the Angami Naga, the research and the two villages

The Naga of northeastern India and adjacent areas of Burma (Fig. 1) are a warrior-like people famous for their headhunting (von Fürer Haimendorf, 1946; Saul, 2005). The majority practise swidden farming with few wet-rice patches or none, but the Angami of southern Nagaland are different in that they depend primarily on wet rice grown in elaborate systems of irrigated terraces. Shifting dry fields – jhums as swidden fields are known in India – are for them a subsidiary source of livelihood. Because the rest of this paper is about Nagaland, we use the Indian term jhum from this point forward. Some Angami jhums are terraced but not levelled, and

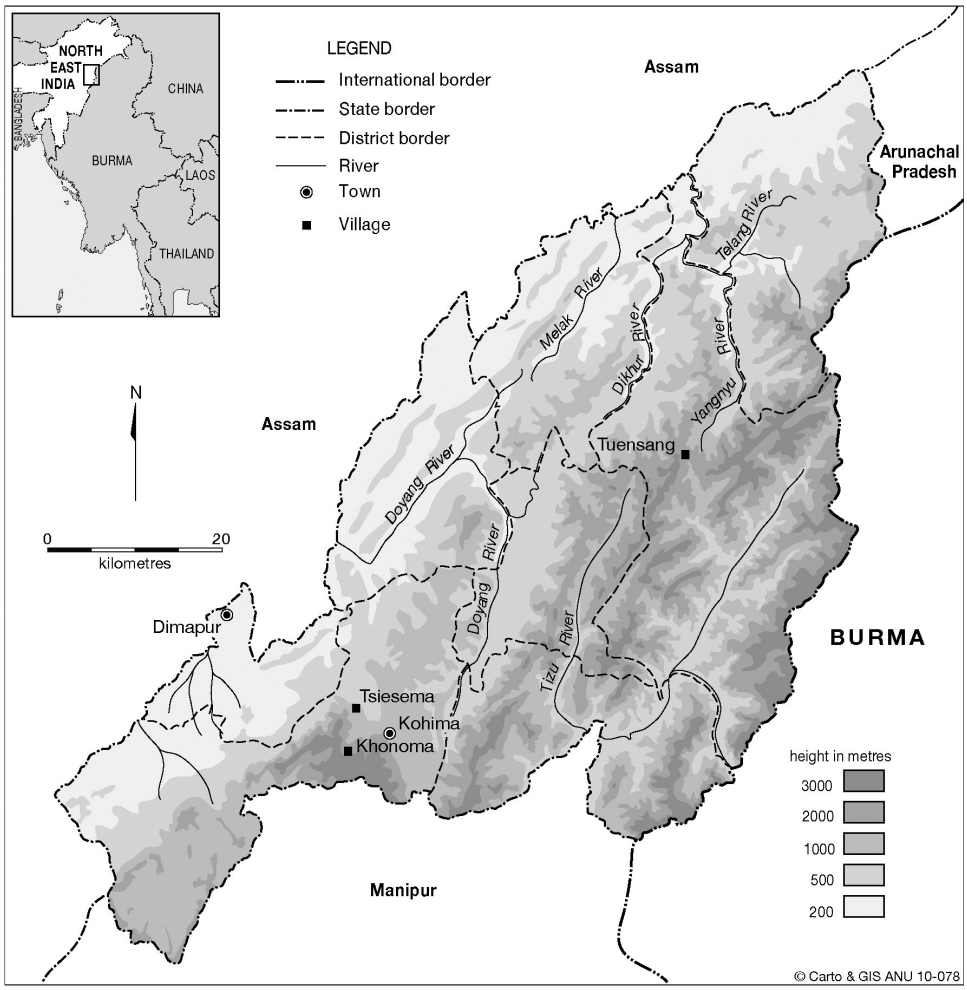

Figure 1. Nagaland

where we use the term 'terrace' alone it always means the wet-rice terraces only.

The Angami Naga were first comprehensively described by Hutton (1921). Because of the events briefly recounted below, rigorous description of them suffers a long gap after his writings and those of other British administrators. Cairns (2007b), in the still-unpublished doctoral thesis on which most of this paper is based, provides the first comprehensive ethnographic account since Hutton (1921). Cairns' first interest was agronomic. He was impressed by the use of nitrogen-fixing, heavy-littering Nepalese alders (*Alnus nepalensis*) as a sole fallow species in the jhums of a leading Angami village, Khonoma (Cairns *et al*., 2007). It was this distinctive use of soil-improvement trees in the jhum component that attracted his attention to the village. His research there eventually expanded to become a wider analysis of the dynamics of Khonoma's cultural ecology, but from early on it was decided also to study a second village with a composite system that lacked the use of alders in the jhum fields. Selection fell on Tsiesema, which turned out to be fortunate because substantial contrasts are exhibited.

The highly elaborated alder-jhum system remained one of Khonoma's major claims to distinction. *A. nepalensis* is a pioneer colonist of open spaces, and Khonoma farmers actively propagated it so that it became almost a pure stand in their fallows. When the land was to be cultivated the alders were not burned or cut

Plate 1. Pollarding alders at Khonoma
Note: Photograph by M. Cairns, 1999–2002.

down but were skilfully pollarded (Plate 1). Only the trash was burned. Pollarding, a woodmanship practice encountered with several tree species in scattered localities all the way from western Europe to China, makes use of the self-renewing power of trees. The tree is cut two metres or so above the ground, leaving a permanent trunk from which shoots grow up to become poles that are cut for firewood or other use at intervals of years.[3] Under conditions of severe land shortage in the recent past, a fallow period under managed alder of only two years' duration was sufficient to restore soil fertility for a further two years of cropping and to go on doing so, cycle after cycle. Khonoma and some other Nagaland villages seem to have been almost unique in this respect within India. Indeed to our knowledge, in all of South and East Asia these pollarding methods find close observed parallel only in the treatment of *Cassia siamaea* and *Quercus* for firewood production in southwestern China.

Yet the jhums remained subsidiary to the wet-rice terraces. Khonoma's foundation stories strongly emphasise the potential of the adjacent valley for wet-rice cultivation, and although there is no written history before the 1830s we can be reasonably confident that rice intensification came before jhum intensification.[4] The valley below the village is terraced and irrigated in a manner that has drawn comparison with the famous Ifugao terraces in the Philippines, and oral history indicates that the terraces were completed at least 250 years ago. The village site itself, on a sharp ridge, was eminently defensible. By the nineteenth century, when the population of Nagaland had grown substantially and warfare between villages had become endemic, the village was strongly fortified. Khonoma became powerful, influential and feared over a wide area (Hutton, 1921). It was never conquered by other Naga but was unable to resist the more heavily armed British who seized the village in 1879 in the course of campaigns to pacify the Naga hills. Nor was Khonoma able to resist the Indian army that for a second time destroyed and depopulated most of the village in 1956 early in a prolonged

struggle to put down a movement, based initially at Khonoma, for Naga independence. Two of Khonoma's three major clans dispersed almost completely into the forest and to other communities. Some individuals bought land in the lower hills mostly in what is now Dimapur District (see Fig. 1), land that they still retain. Tsiesema was less directly involved in these hostilities.

The war ended in stages between 1964 and 1975, but it was not until the 1990s that peace became more or less permanent.[5] Meantime in 1963 Nagaland became a state within the Indian union, with one distinctive condition that is important to this discussion. Land, and the forests in particular, remain under local control, 88% of forest in contrast to only some 10% in India as a whole. There has been no alienation to create externally controlled forest reserves. Peace reopened trading links with the Assam lowlands, but although many of the wartime refugees returned to Khonoma, the modern village remains smaller than it was before 1956. Trade and emigration have relieved the severe population pressure on local resources that had earlier driven a remarkable intensification of its agriculture.[6]

For Nagaland as a whole, transfer funds from national government provide much the largest part of a state budget that has risen almost year by year, rapidly since 1980, and now exceeds the equivalent of half-a-billion US dollars annually. Most of this supports a greatly enlarged civil service. Smaller funds are directed to Village Development Boards in each registered village, under a scheme begun in the 1980s. Sundry other national poverty-reduction supports also reach Nagaland communities. This national support is without specific 'strings'. It needs to be stressed that despite the trauma in the third quarter of the twentieth century, the Angami Naga villages have lost neither land nor control over its use. Official and semi-official documents describe efforts to persuade Naga farmers to adopt 'modern' agricultural methods, and there have been inputs in provision of infrastructure, germplasm, and (at Tsiesema) machinery. But decision-making has not been taken out of local hands. External forces have been strongly influential under both British and Indian rule, but the changes reported below were determined ultimately only by the villagers themselves.

Researching the basis for a comparison

Because of continuing low-level unrest in Nagaland, Cairns was permitted to visit only for short periods of one to three months, totalling about one year over more than three years in 1999–2003. Intervening periods were occupied in documentary work, data tabulation and GIS analysis. Sustained participant observation was therefore not an option. To obtain continuous data through the whole of 2000 and 2001, two groups each of 10 collaborating farming families in Khonoma and Tsiesema agreed to keep diaries of their activities on selected fields, guided by research assistants resident in the two villages. In each village a 'farmer coordinator' was selected first, and in consultation with Cairns, he then chose his nine collaborating families. While hopefully reasonably representative, therefore, the twenty families were in no sense random samples of the village populations; the very poor escaped inclusion. Diary keeping became a family activity, and children were often involved. Separate records were kept of labour inputs and of all material inputs and outputs, facilitating cross-checking.[7]

Standard lists of field operations were developed for both wet-rice terrace and jhum cultivation, and divided into six sequential categories: (i) wood harvest; (ii) nursery management; (iii) field preparation; (iv) planting; (v) plant management; and (vi) crop harvest. Cairns and his assistants reviewed each family's activities with them, line by line, to clarify what exactly was done, then inserted the activity code that fitted best. This made possible the reduction of all text into simple numbers that could be manipulated for statistical analysis. Farmers recorded their labour in hours because, especially during non-peak times, much work was done in small instalments of only a few hours here and there.

Material inputs and outputs were all recorded not as quantities but in terms of their local price (in Indian rupees), whether or not they were bought and sold. Often germplasm had been saved rather than bought, and a high proportion of crops was used domestically and not sold. The 'values' given in the text and tables are

therefore imputed values, and not necessarily either actual expense or income. This is shown in the tables, but to avoid circumlocution in the text they are treated as though they were real when discussing findings from the diary information.

The selected fields, 40 in total (10 wet-rice terraces and 10 jhum fields in each village), were carefully measured and located. The diaries provided data at field level. The area (m^2) of these monitored fields had to be measured in order to be able to convert the findings to a more meaningful per hectare of land.[8] The data also needed to be examined in terms of what it meant to the average village household because it was here that most decisions were made on how agricultural lands were managed. The Angami patrilineal system of inheritance fosters considerable disparity in land ownership. The research thus needed to look beyond the monitored fields, at the total land holdings of each of the collaborating farmers. For the wet-rice terraces, it was a straightforward matter of surveying all the additional plots – beyond the one monitored – that each collaborating farmer owned. This showed the total wet-rice land cultivated by each farmer, and allowed the diary findings to be scaled up to household level.

The extent of jhum land was less easy to measure, and an indirect proxy method was used to estimate the area of additional jhum holdings of each of the collaborating farmers beyond the single field that was being monitored. Villagers themselves measured land by how much seed it took to plant it or by the expected yield. By applying these widely understood equivalences to the monitored fields that were of a known hectarage, farmers' reported planting rates and expected yields could be calibrated on a per-hectare basis.[9] This, in turn, allowed estimation of the approximate area of their additional jhum fields.

The organisation of production

Angami villages, and even the major clans within them, governed themselves without chiefs, important decisions being taken by an informal council formed of prominent seniors. There was no heritable ranking, either of descent groups or individuals.[10] Each major clan held blocks of land within and around the villages. Only land beyond the normal limits of cultivation was regarded as the domain of the village as a whole. Within the clan territories, individual male-headed families held effectively private claim to regularly utilised land, including all the wet-rice fields and most of the jhums.

Most agricultural labour was performed by household members working in their own fields. This was particularly true in Khonoma where fields tended to be smaller. In Tsiesema's larger fields, groups of often related farmers banded together and worked in turn in each member's fields in preparing the seedbeds, transplanting, and harvesting. Between these times of peak demand, labour reverted to household sources as each family tended its own fields. Most of the labour recorded was performed by women. Gender aspects of work are discussed in full in Cairns (2007b). Historically, the principal role of men was to defend the villages and their people from the danger of headhunting raiders. Although these dangers were long in the past, men still contributed only a minority share of the field work, especially at Khonoma. Only the actual pollarding of trees was almost exclusively a male task. The data often showed village women performing two or three times as much agricultural labour as their menfolk. It was solely in field preparation and in the wood harvest at Tsiesema that male labour input exceeded that of women. In Khonoma female labour input preponderated in all categories of activity.

Wage labour was found most frequently when relatively affluent households, often with more lucrative off-farm sources of income, hired their least prosperous neighbours to work in their fields. These neighbours often had little land of their own to cultivate, and some lacked even the means to rent land. It was thus usually a transaction between the most and the least affluent strata of the village. During the period of field research, the standard wage rates for hired labour were Rs 100/day[11] for men, Rs 80/day for women, and Rs 60/day for children (<15 years of age).[12] Some of Khonoma's wet rice was produced under share-cropping arrangements. When wet-rice fields were rented, the usual terms were for the harvest to be evenly divided between the cultivator and

Plate 2. Part of Khonoma village, looking northeast
Note: Photograph by M. Cairns, 1999–2002.

the land owner. This was also the arrangement by which Khonoma villagers used all of the wet-rice land that they bought down in the lower hills during the Indo–Naga war. Owners contracted lowland families to manage them on a share-cropping basis. About 15 truckloads of bagged paddy arrived in Khonoma each autumn from these outside fields.

Chicken and also pigs, though fewer than in earlier times, were kept by most households. Cattle were now little managed by village families. Migrant Nepali families, usually staying in ramshackle accommodations on village outskirts, tended the cattle in return for a share of the milk and calves. Their standard of living was far below that of their Angami hosts. Mithun (*Bos frontalis*) were still highly prized at Khonoma. They wandered in the forests in communal herds and received little human handling until it was time to capture them for slaughter or sale, in modern times usually to celebrate a wedding. The little attention that they did get was from herders who camped in outlying sheds and, from time to time, blew on buffalo horns to summon the mithun for inspection, rewarding them by sprinkling salt on convenient rocks.

The two villages and their land

Khonoma occupies a rugged basin backing onto the forested Barail range of mountains, cresting at over 2700 m. The valley is terraced up to 1800 m, but rice was cultivated only below 1520 m. The adjacent hillslopes carried jhum fields up to 2100 m. Using GIS analysis, Cairns found that only 41.5% of the total village territory lay below 2000 m and had less than 30% slope, thus being readily cultivable by Angami technologies. The total population of Khonoma, not including the herders who lived on the outskirts, was 2145 in 2001, lower than before 1956 (Plate 2). Over 3600 people of Khonoman origin lived elsewhere. The first British observers to see Khonoma in the nineteenth century were struck by the shortage of agricultural land, and during the period of British rule (1879–1946) the effective population density on cultivable

land probably exceeded 250/km^2. Disregarding the purchased land towards the Assam border it was around 160/km^2 in 2000–2001. It was under high population density in the two or three centuries before 1956 that the alder-jhum system was fully elaborated at Khonoma with fallow periods as short as two years on the most intensively used jhum land. Around 2000 the normal fallow length in the alder-jhums was seven years.

Tsiesema, by contrast, is on a less mountainous but dissected terrain at a lower altitude, and almost all its land is cultivable.[13] Its full altitudinal range is from 522 to 1460 m, and the village occupied the highest land. Tsiesema had 788 people in 2001, and there had been no major reduction as at Khonoma. Population density at the time of fieldwork was only 52/km^2. Tsiesema's wet-rice lands are in small valleys, whereas most of Khonoma's are in a single large block (Plates 3 and 4). Almost all of Khonoma's rice was grown in this block with only a minor contribution from the jhum fields. In Tsiesema, by contrast, a large part was grown in the jhum fields, making this village more representative of Nagaland as a whole. The normal fallow period at Tsiesema was around 13 years, and earlier it was longer. Tsiesema is too warm for alders to flourish, and the woody fallow was made up of a wide range of tree species.

The wet-rice terrace systems in 2000–2001

In 2000–2001 both villages grew a single crop of wet rice in each year, grown from farmers' seed with no use of either high-yielding varieties or the external inputs that characterise Green Revolution systems. Tsiesema made some use of oxen and there was a single hand tractor, but most labour and all at Khonoma was performed by hand. The monitored fields in both villages were worked only by hand.

The entire Angami agricultural calendar has been built around wet-rice cultivation, and in 2000–2001 its demands took priority at all times. The first hoeing was done individually during the winter months. Thereafter, all activities were synchronised.[14] When work was required on the wet-rice crop, everything else was set aside. Particularly at Khonoma, there was a palpable sense of competition and nobody wanted to be seen finishing last or doing a less admirable job than his or her neighbour.

Khonoma

The very similar rhythm of inputs into both villages' wet-rice terraces is shown in Figure 2. At Khonoma, the first tillage was completed over December to February. The rice nurseries were established in March, but otherwise there was a relative lull in March and April There was a major spike in activity over late May and June as the fields were puddled and transplanted, the busiest period of the year. Then there was only light work tending the crop from July to September. A final surge at harvest time, mostly in October, ended the crop year. This was the sequence of activities that has kept the Angami fed for as long as they can remember.

Tsiesema

The pattern shows minor differences related mainly to the altitudinal spread of the Tsiesema fields (760–1355 m), compared with those monitored at Khonoma (1331–1527 m). Tsiesema began its first tillage about a month later and did less of it.[15] We see a dispersed pattern with, most notably, rice transplanting continuing into July and even August. Table 1 additionally shows that the collaborating farmers in Khonoma invested one-third more labour hours than their counterparts in Tsiesema, who worked a significantly larger area of wet-rice land.

Material inputs and outputs

The material flows into and out of the wet-rice terraces are presented in Figure 3. It is here that we first encounter the major changes that had already taken place. During the British period government officers had introduced potatoes and other cool-climate vegetables to the northeast Indian hills. These were largely lost in the wartime period after 1942 but were reintroduced around 1980 and have been adopted both in the wet-rice terraces and in the jhums.

Khonoma The first thing that stands out from Figure 3 is that the wet-rice terraces were being

Plate 3. Part of the Khonoma wet-rice terrace system
Note: Photograph by M. Cairns, 1999–2002.

Plate 4. A Tsiesema valley, with wet-rice terraces and secondary forest (jhum fallow)
Note: Photograph by M. Cairns, 1999–2002.

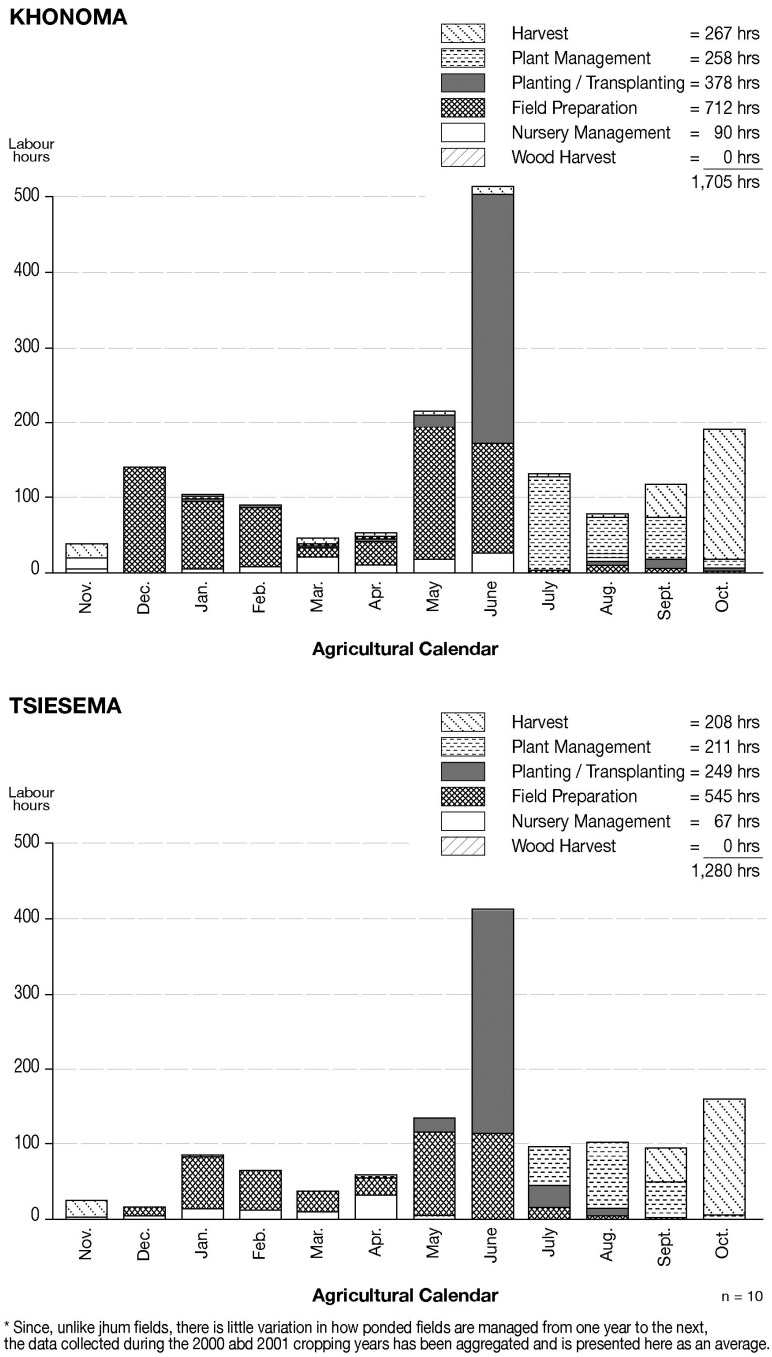

Figure 2. Labour inputs into wet-rice terraces in Khonoma and Tsiesema, broken down into category of field operations, 2000 and 2001 average

planted to much more than rice. There was a seemingly expanding trend for terraces to be converted into intensively managed vegetable gardens. This was particularly so on upper terraces that were close to the village. Above 1520 m conversion to dry fields had been completed since around 1990. While rice continued to be the major output from all other terraces, garlic and potato were gaining importance as cash crops in addition to a wide variety of greens and other vegetables. This was happening under two distinct patterns. In the first,

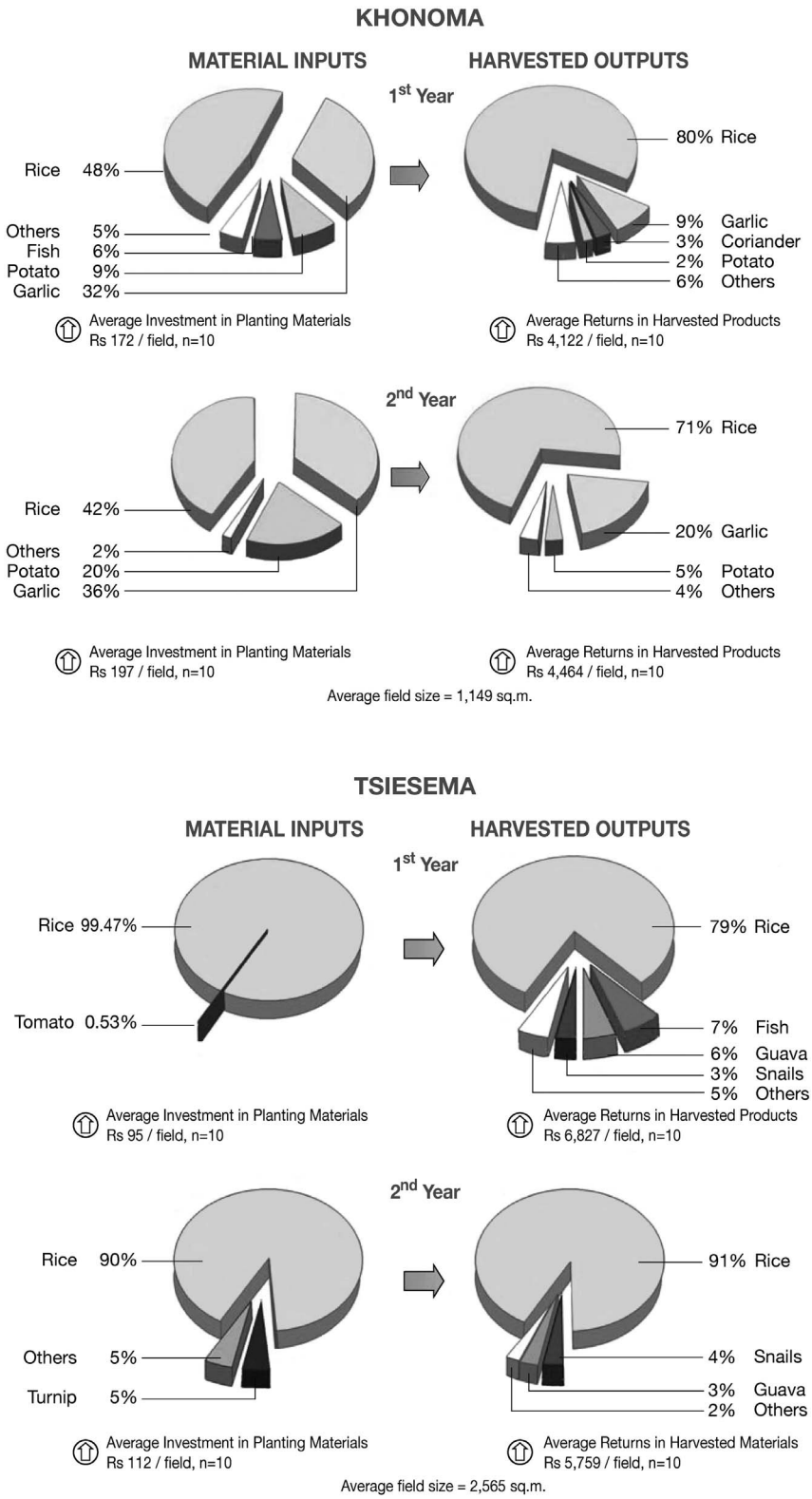

Figure 3. Material inputs to and returns from wet-rice terraces in Khonoma and Tsiesema during the first (2000) and second (2001) cropping years

Table 1. Data from monitored wet-rice terrace fields, 2000–2001

	Khonoma	Tsiesema
Av. altitude of fields (m)	1 427	1 093
Av. area of fields (sq.m.)	4 183	5 568
Per household		
Labour inputs (hrs)	1 705	1 280
(Imputed) planting materials (Rs/ha)	672	225
(Imputed) gross harvested outputs (Rs)	15 628	12 861
(Imputed) net harvested outputs (Rs)	14 956	12 636
(Imputed) net returns to labour (Rs/day)	70	79
Per hectare		
Labour inputs (hrs/ha)	4 076	2 299
(Imputed) planting materials (Rs/ha)	1 606	403
(Imputed) gross harvested outputs (Rs)	37 361	23 097
(Imputed) net returns to land (Rs/ha)	35 755	22 694

Notes: Net harvested outputs = gross outputs – planting materials; net returns to land = gross outputs/ha – planting materials/ha; 1 working day = 8 hrs; Rs = Indian Rupees, which are officially represented by ₹.

selected terraces were set aside from the standard flooding procedures, and vegetables were planted as a summer crop instead of rice. In the second, after the rice crop was harvested, the soil was quickly turned over again and the vegetables were planted as winter crops. They were harvested the following spring in time to prepare the land for the usual summer crop of rice. This second pattern made more intensive use of the land because the winter vegetables were an adjunct to the usual rice crop, not a replacement. This diversification of cropping patterns also shows up in the labour graphs and somewhat clouds the pattern of activities relating strictly to rice. Labour spent planting in the autumn months (see Fig. 2), for example, was for potatoes and garlic planted in the terraces as winter crops.

This reveals a changing strategy that we will also see in the Khonoma jhum fields. Colder conditions that were once a liability for growing subsistence cereals had been transformed into an asset by converting to semi-temperate vegetables that prosper in cooler environments and enjoy high market demand among the growing middle classes on the plains and in India's cities.

Tsiesema Conversion from subsistence cereals to vegetable cash crops had not happened in Tsiesema's wet-rice terraces where hotter conditions offer fewer advantages for producing cool-climate crops.[16] Although the terraces themselves continued to be planted almost exclusively to wet rice, Tsiesema did diversify its production with subtropical fruit (guava, oranges, bananas, peaches, pomelo) harvested from the terrace bunds or from the vicinity of the field huts.

In imputed terms, the diary-keeping group of farmers in Khonoma was spending nearly three times as much on planting materials for their terraces as their counterparts in Tsiesema. This was primarily because of the higher costs of potato sets (Rs 12/kg) and garlic cloves (Rs 10/kg) that were increasingly supplementing rice (Rs 4.6–5.8/kg) in Khonoma's terraces. But these costs were cushioned in so far as planting materials could be set aside from the previous year's harvest. In return for their investment, the 10 Khonoma farmers were reaping harvests averaging an imputed value of Rs 37 361/ha from their terraces (Table 1). Of the harvested output 71–80% was rice and the remainder mostly garlic, potatoes, and coriander. Despite their larger size the Tsiesema terraces were earning somewhat less at Rs 23 097/ha. Rice comprised 79–91% of the value, and the balance was mostly fish, guava, and snails.

Cost–benefit analysis for wet-rice terrace cultivation

The diary-keeping farmers in both villages were, on average, each cultivating in the vicinity of a half-hectare of wet-rice land, Khonoma somewhat less and Tsiesema a bit more. Khonoma was managing its smaller land area much more intensively, both in labour and in planting materials. These extra inputs enabled Khonoma to coax about 18% more harvest value from its limited land. Significantly, almost 25% of the harvest value per household (Rs 3858) came from vegetable cash crops that were relatively new introductions. This intensified management was providing Khonoma with returns of close to 60% more harvest value from a hectare of land than was reaped in Tsiesema. But the same was not true of the productivity of labour. Despite Khonoma's increasing adoption of high-value

Plate 5. Khonoma farmers planting rice
Note: Photograph by M. Cairns, 1999–2002.

crops, Tsiesema farmers were still managing to earn almost 13% more for every day that they spent working in their fields.[17]

The picture that emerges fits with Khonoma's history as a village short of agricultural land. It had to prioritise returns to land as opposed to labour. This intensification was further encouraged by the closeness of Khonoma's terraces to the village residential area (walking times to/from fields averaged 22.5 min) so fields could be visited often without wasting much time in transit (Plate 5). But in Tsiesema where population had never grown so high, the terraced fields were widely scattered across the landscape (walking times to/from fields averaged 61 min), and there had been less pressure to intensify land use.

Jhum cultivation in 2000–2001

With terraces supplying most of the villagers' rice needs, the role of Angami jhums was of a supplementary nature, providing firewood and additional grains and a wide range of dryland crops to add variety to the diet. Jhum management was thus fitted around the exigencies of wet-rice cultivation – spatially in terms of where the fields were located, temporally in terms of the flow of labour inputs, and the crops that it was expected to produce. This might also be true for most Angami villages, but we cannot say that the primacy of wet rice would characterise all composite systems in Southeast Asia. Rambo's (1996) seminal report on the Tay system in Hoa Binh province, Vietnam, gives no indication of such priority. The Tay system combined wet rice with jhum rice and other elements, and obtained much higher rice yields from its small wet-rice terraces, although each system gave a closely comparable return to labour inputs. Each provided about half of the total rice production. More widely in the region, enduring cropping has occupied only a small area before recent changes.

First-year jhums

Khonoma The new jhum cycle began with reopening the fallow and harvesting the firewood obtained in the process of pollarding the alder trees from November to February (Fig. 4). Field preparation followed directly, gaining momentum in February and March; the fields were then planted in March; management of the crops dominated over the next four months, interrupted by the peak season for planting rice in the irrigated terraces. It was only in July that a similar amount of labour again went into the jhums as into the wet-rice terraces. Harvest began in June and extended into November. Although these were the rough contours of the graph, it was also clear that small amounts of soil tillage and replanting continued throughout the summer months, representing Khonoma's

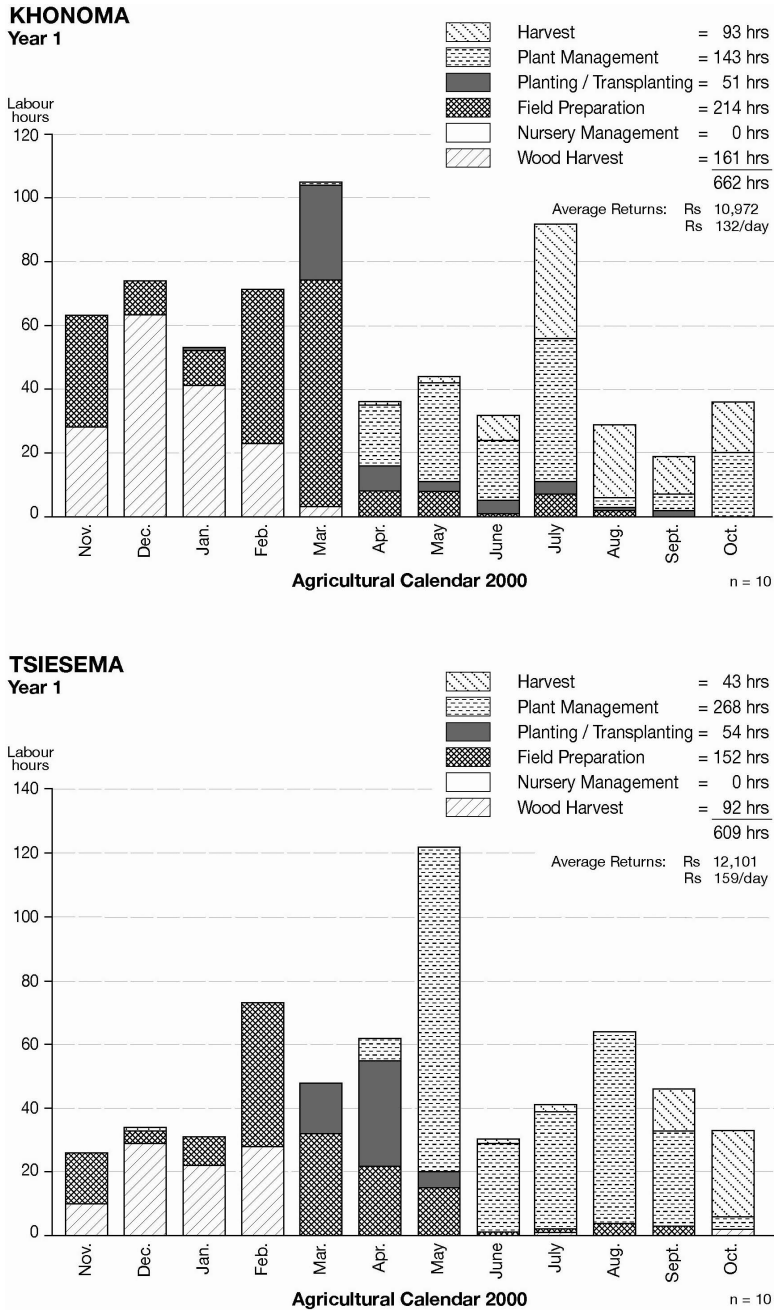

Figure 4. Labour inputs into first-year jhum fields in Khonoma and Tsiesema by household. Data presented by category of field operations

use of intercropping, relay-planting, and crop rotations as it planted faster-maturing vegetables in intensified cropping patterns.

Tsiesema Jhums continued to be rice based. Activities in Tsiesema's jhums tended to be done once and were then finished for the year. There was not the continual retillage and replanting that was found in Khonoma jhums as one crop was harvested and that piece of ground became available for another. Jhum cultivation in Tsiesema began with wood harvest

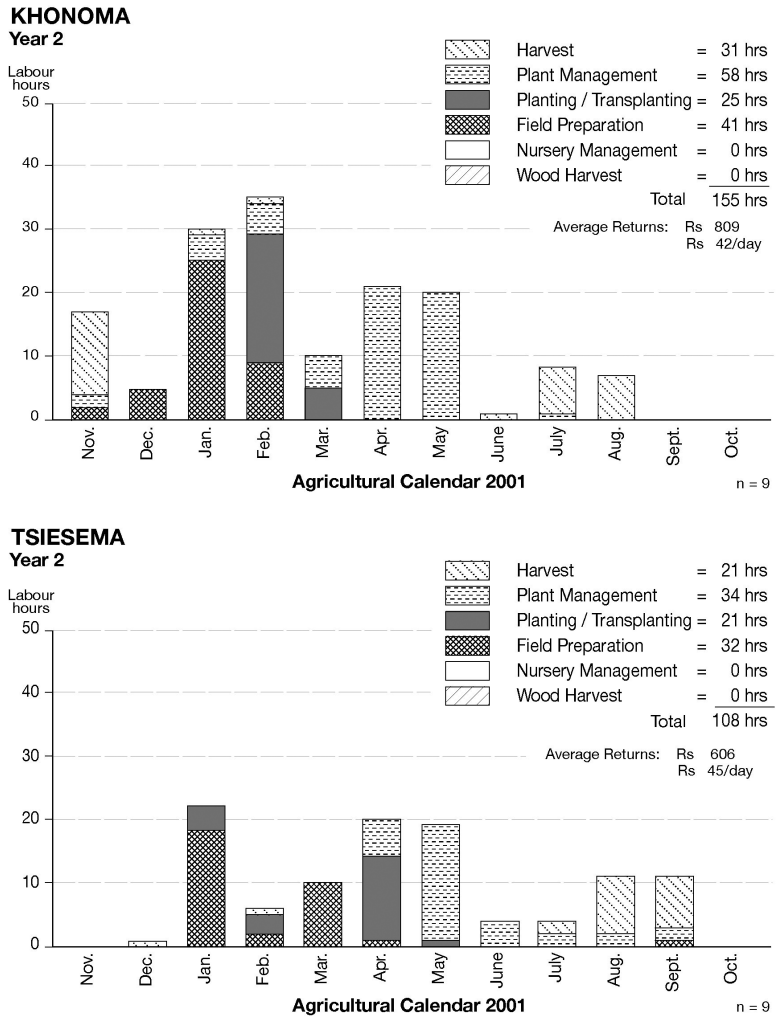

Figure 5. Labour inputs into second-year jhum fields in Khonoma and Tsiesema by household. Data presented by category of field operations (n.b. scale 2× exaggeration vv Figure 4)

over the winter months of November to February; field preparation started in tandem with removal of the wood, peaked in February and March, and was completed by May. Planting began in mid-March, peaked in April and spilled over into May; plant management got underway in April, became busiest in May (when the rice was tilled early in the month and then weeded again at the end), and continued until September. The busy time concluded with harvest in September and October. As was the case with Tsiesema's wet-rice terraces, the significant range in altitude among the monitored jhum fields (967–1453 m) stretched out the time frame under which each field operation continued. Planting in the lower jhums could still be going on months after completion of the last upper jhum.

Second-year jhums

In the second cropping year there was a dramatic reduction in labour inputs in both villages (Fig. 5). Wood now came from first-year jhums opened elsewhere. The residues from the previous year's crop needed only to be cleared away and the soil tilled lightly to get the seedbed into shape for replanting. This much-reduced field preparation was done mostly in January followed by planting in February. Modest labour

inputs continued as the crop was cared for over the next four months and finally came harvesting in July and August. As autumn approached in Khonoma, the alder poles were already beginning to form a canopy and the yellow crop residues quickly disappeared under a flush of weeds that marked the first stages of fallow succession. Although the succession of field operations over the two cropping years was still quite clear, it was more dispersed, with more activities going on concurrently than would have been the case earlier when Job's tears were the main crop of first-year jhums with a millet-perilla intercrop during the second year.

The second cropping year in Tsiesema had even less importance than that in Khonoma and sometimes did not happen at all. Some crops were more tolerant of second-year cropping. Chilli yields usually improved in the second year (assuming the original plants persisted), sometimes even doubling. Maize, millet, cucumber and yam would still yield satisfactorily, but not the rice staple. There was one particular non-glutinous variety that was normally used when a Tsiesema jhum field was replanted with rice in a second successive year. Farmers' attitude towards second-year fields appeared opportunistic; the soil was still sufficiently fertile and weed populations were not yet out of control, so they tried to harvest whatever they could with minimal inputs. But at Tsiesema it was not uncommon for less satisfactory fields to be returned to fallow after only a single cropping year.

Material inputs and outputs in the jhums

Khonoma Crop data for 2000–2001 show a system in transition, in which traditional subsistence crops lingered alongside new introductions aimed at outside markets. This was most obvious in the first cropping year (Fig. 6). The Job's tears that had long been the forte of first-year jhums had been largely pushed aside by potatoes, now constituting almost three-quarters of total planting material costs.[18] Soybean, taro and Job's tears each added another 4%, and another 36 minor crops combined for the balance (Plate 6).

The output data show that a massive 46% of the total yield value came from the firewood harvested when the fallow was opened; potatoes, maize and soybeans were the main harvested crops, but a wide range of minor crops was grown in small amounts for kitchen consumption. This latter category included small quantities of wild flora (perennial buckwheat and other wild vegetables) and fauna (birds, crabs, grasshoppers) that farmers collected as they worked in their fields.

The second-year reduction in labour inputs was accompanied by an equally dramatic narrowing of agrobiodiversity (average 17.9 crops/field (first year): 4.8 crops/field (second-year)). Cash crops had made fewer inroads here, and the millet-perilla intercrop that traditionally occupied all second-year jhums still represented more than half of expenditure on planting materials. But a trend towards conversion from such subsistence crops to higher-value cash crops was evident in the shares of potato sets and garlic. The bulk of the harvest value still came from foxtail millet and perilla.

Tsiesema Compared with Khonoma, this village showed a lower level of agrobiodiversity in its jhum fields (53 species (K): 40 species (T)),[19] but the nature of the fields was strikingly different from the intensively managed market gardens, terraced and scattered with alders, found in Khonoma (see Plates 6 and 7). Tsiesema's jhums remained more typical of the region: rice based, with a sprinkling of maize, chillies, tomatoes, and other crops throughout, with yams and cucumbers targeted at heavily ashed spots where unburned debris was piled and reburned (Plate 7). Field boundaries were often marked by rows of maize or taro, and there were small patches of vegetables near the field huts for preparing noon meals. Rice was the largest single expense in planting for the first cropping year, followed by root crops (taro, ginger and garlic). The remainder comprised a wide array of minor crops.

Even more than at Khonoma, firewood dominated the list of harvested products from Tsiesema's first-year jhums (55%). At Tsiesema, the older fallows contained oak and other high-value tree species. The trees were cut low rather than pollarded, and firewood of higher average value was yielded.[20] In the limited cropping that Tsiesema did in the second year, emphasis was shifted from cereals to root crops that were more nutrient efficient under conditions of

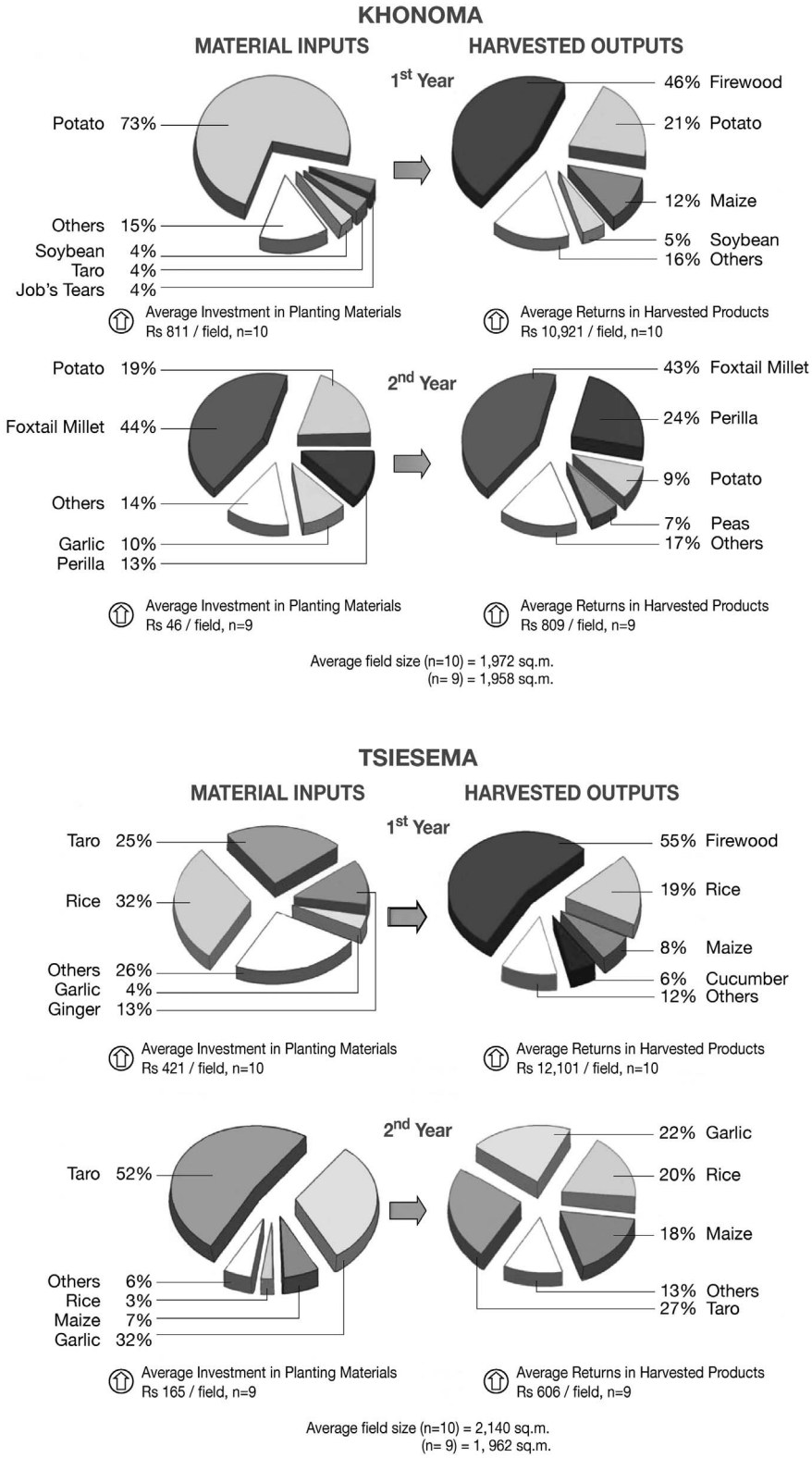

Figure 6. Material inputs to and returns from monitored jhum fields in Khonoma and Tsiesema (2000 and 2001 cropping years)

Plate 6. A Khonoma jhum in crop
Note: Photograph by M. Cairns, 1999–2002.

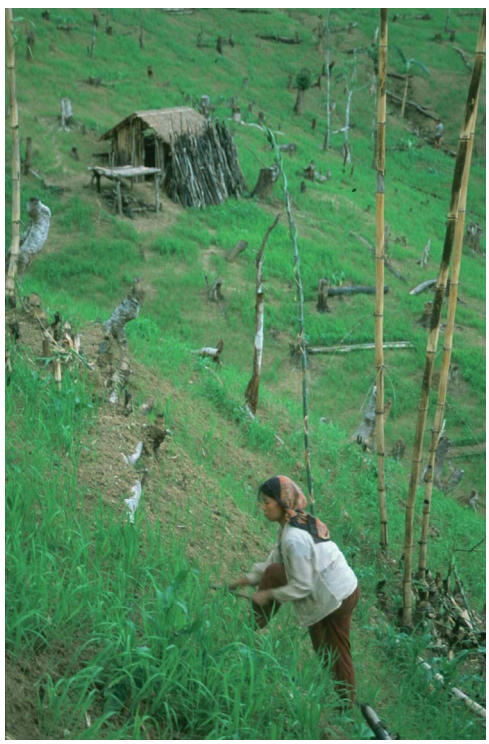

Plate 7. A Tsiesema jhum growing rice
Note: Photograph by M. Cairns, 1999–2002.

declining fertility. The major planting-material costs were for taro and garlic, but the total cost per field was very small.

Cost–benefit analysis of jhum cultivation

A distillation of the findings from the jhum diaries is presented in Table 2. Angami jhums were small compared with those of other Naga subgroups that relied on jhum cultivation for virtually all of their food needs. Keitzar (1998) reported that the jhum area cultivated by Nagaland households varied from 0.5 to 2.5 ha, but the diary-keeping farmers in Khonoma and Tsiesema each opened up only around one-fifth hectare of new jhum land in 2000 (Fig. 6). There were important differences between the two sets of sampled fields. The 10 monitored jhum fields in Khonoma had an average altitude of 1671 m with a northern exposure – too cold for rice but ideal for potatoes and other cash crops grown for lowland markets. The Tsiesema fields averaged an altitude of 1264 m with a predominantly western aspect, too warm for the semi-temperate jhum crops that Khonoma then grew but quite satisfactory for rice. The jhums sampled in Khonoma were also more uniformly clustered, from 25 to 40 min walk from the village; those in Tsiesema were strung out from the village edge (5 min walk to 1453 m) down the slope midway to its most distant boundaries (110-min walk to 967 m).[21] The more distant jhums had higher costs, most significantly in terms of daily transit times but also from the increased danger of predator damage. Often the farmer would need to sleep over in distant jhums both to cut down time spent walking and to guard the crop against wild boar and other nocturnal visitors.

The data in Table 2 parallel the general dynamics already seen in the terraces (see Table 1). Khonoma was investing more, both in terms of

Table 2. Data from monitored jhum fields over 2000 and 2001 cropping seasons

Per household	Khonoma	Tsiesema	Per hectare	Khonoma	Tsiesema
First-year cropping			First-year cropping		
Actual and imputed costs			Actual and imputed costs		
Labour inputs (hrs)	662	609	Labour inputs (hrs)	3 357	2 846
(Imputed) planting materials (Rs)	811	421	(Imputed) planting materials (Rs)	4 113	1 967
(Imputed) benefits			(Imputed) benefits		
(Imputed) gross harvested outputs (Rs)	10 921	10 058	(Imputed) gross harvested outputs (Rs)	55 380	47 000
(Imputed) net harvested outputs (Rs)	10 110	9 637			
(Imputed) net returns to labour (Rs/day)	122	127	(Imputed) net returns to land (Rs/ha)	51 267	45 033
Second-year cropping			Second-year cropping		
Actual and imputed costs			Actual and imputed costs		
Labour inputs (hrs)	155	108	Labour inputs (hrs)	786	505
(Imputed) planting materials (Rs)	46	165	(Imputed) planting materials (Rs)	233	771
(Imputed) benefits			(Imputed) benefits		
(Imputed) gross harvested outputs (Rs)	809	608	(Imputed) gross harvested outputs (Rs)	4 102	2 841
(Imputed) net harvested outputs (Rs)	763	443			
(Imputed) net returns to labour (Rs/day)	39.4	32.8	(Imputed) net returns to land (Rs/ha)	3 869	2 070

Notes: Net harvested outputs = gross outputs – planting materials; net returns to land = gross outputs/ha – planting materials/ha; 1 working day = 8 h; Rs = Indian Rupees, which are officially represented by ₹.

labour and in terms of planting materials, in its smaller land area. This was earning it about 8.6% more gross harvest value than Tsiesema's fields. But the labour that Khonoma used to achieve those gains received lower returns than did Tsiesema's less intensive management. Second-year jhums in both villages provided meagre outputs and abysmal returns to labour. Of all activities supporting the livelihood of Angami villagers, planting second-year jhums was the least remunerative use of their time.

The major role of Tsiesema's jhums remained subsistence – supplementing yields from the terraces to create a position of assured rice security. Khonoma farmers, on the other hand, were exploiting their comparative advantages. The role of Khonoma's cooler jhums thus became cash generation to pay school fees and electrical bills and to buy clothing and kitchen supplies, while families relied on their wet-rice terraces (and often the additional land bought at lower altitudes) for their rice needs. Supplementary rice could easily be purchased from the market in Kohima.

The most complete contrast between the two villages was in the length and treatment of the jhum fallow. On the normative basis that farmers married and assumed full responsibility for their own farms before the age of 25 and continued active farming until almost the age of 70, it follows that during a working life of, say, 45 years, a Tsiesema farm family would cultivate a particular jhum plot three times whereas their Khonoma counterparts would do so five times. The contrast is clear in Figure 7.

Condensing a detailed analysis in Cairns (2007b), the averaged annual imputed product of a family's jhums over 45 years, on a per-hectare basis, would be Rs 3976 for Tsiesema but Rs 6613 for Khonoma. The contrast in long-term land productivity would have been even more marked when Khonoma fallows were shorter in the century or more before 1956. It remained significant in 2000–2001. Investment in managing *A. nepalensis* by pollarding and maintaining almost pure stands had converted these stands into landesque capital with ongoing value that could be realised on a regular and quite frequent basis. On a scale of capital valuation over time, the Khonoma alder-jhums were of considerably higher worth than the more natural fallows of Tsiesema.

The alder-jhum system at Khonoma, with its alternating wood-crop and field-crop use of

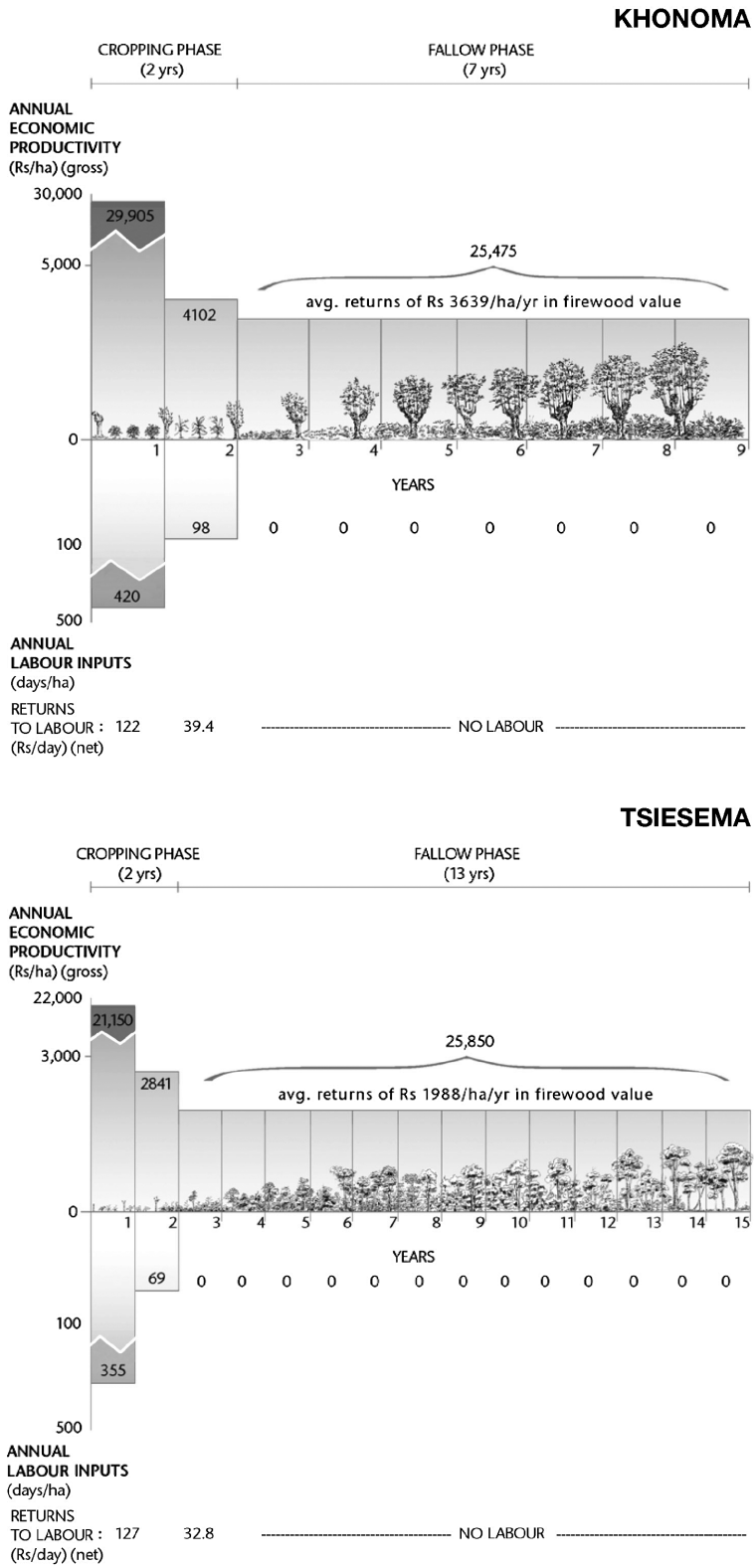

Figure 7. Labour investment over a working lifetime and economic returns from contrasted jhum systems at Khonoma and Tsiesema

the land, was a composite element different from classic swiddening in an important quantitative as well as qualitative sense. Both of us (Brookfield, 2001; Cairns, 2007a) and others cited above (e.g. Menzies, 1996; Yin, 2001; Rambo, 2007) have insisted that shifting cultivation should be thought of not as a single system but as a diverse set of dynamic systems. In this perspective, the alder-jhum system should be regarded as representing an unusually intensive form, highly sustainable as well as uncommonly productive.[22]

Complementarity and a contradiction in the composite systems in 2000–2001

We have seen how the labour demands of wet-rice terrace cultivation dominated the allocation of inputs in 2000–2001, and by all accounts had done so for generations. Yet the technology itself had remained stagnant, benefiting from none of the innovations brought elsewhere by the Green Revolution. The improvements in income came entirely from the new crops and the markets they commanded. More dramatic changes had taken place in the jhums, especially when viewed in terms of returns to labour. The 2000–2001 data in Tables 1 and 2 show that in imputed-value terms, first-year jhum cultivation provided between 1.6 and 1.8 times the returns to labour invested in the wet-rice terraces. The margin of superior returns from jhum cultivation had grown as farmers substituted high-value commodity crops for the food grains that they had planted in the past, and in a more comprehensive manner than on the terraces.[23]

Operation of two complementary subsystems had given Angami farmers both security and scope for flexibility.[24] These strategies enabled both villages to roughly quadruple the imputed value of their first-year jhum harvests per hectare compared with what Cairns (2007b) estimated for the pre-market era when they planted only food grains for subsistence use. They were able to do this while using the terraces to preserve the goal of rice self-sufficiency imposed on them by persistent insecurity in the past, continuing almost to the end of the twentieth century. Despite the absence of high-yielding varieties they obtained reasonable yields, estimated by the State Department of Agriculture to average 2.5 t/ha on the Khonoma terraces, 2.0 t/ha on those of Tsiesema (Dr S. Keitzar, pers. comm. to Cairns 6 November 2010). Calculating on the basis of production reported by the two groups of collaborating farmers on all their terrace plots gave higher yield values, suspiciously high. We rejected these because of potential errors in the data, even though the same methods gave an entirely credible 1.3 t/ha for the Tsiesema first-year jhum crop of upland rice (Cairns, 2007b).[25] The best we can firmly conclude about wet-rice terrace yields is that they remained rewarding and, as we shall see below, apparently still do.

We took a long-term perspective of the jhums in Figure 7 and the associated discussion. If we take a similar perspective of the wet-rice terraces, we recall that they require no fallowing and, with only modest inputs mainly of green manure, can be productive every year. At 2000–2001 costs and prices they were capable of yielding produce valued close to an annual imputed Rs 12 900 for a Tsiesema family and Rs 15 000 for a family in Khonoma (Table 1). Although this is much less than the imputed product of first-year jhums, these yearly available values were, respectively, more than 3.25 and 2.25 times the annual productivity of jhum sites averaged over 45 years of cultivation and fallow. Taking this perspective, they were easily the most productive part of the total space cultivated by the two villages. What Angami Naga composite-system farmers had done in the past was to manage different parts of their ecological environment so that each part yielded its optimal returns for subsistence objectives. But when the objectives began to change a new pattern of responses emerged.

Signs of its emergence were visible at Khonoma in 2000–2001, but in a puzzling manner. Although vegetables had come to dominate first-year jhum production, maintenance of some jhums was lagging and by 2002 the opening of new jhums had become patchy. Only about a third of one particular jhum block that was due to be opened was actually cleared in that year. A survey of all Khonoma families revealed that fully one-third of them had opened no first-year jhums at all in 2002. Reinspection of the data uncovered what seemed, on *prima facie* grounds, to be illogical behaviour.

Table 3. Per-household (H/H) distribution of labour and imputed returns in 2000–2001

	Khonoma	Tsiesema
Imputed returns to labour per H/H	Rs/day	Rs/day
Wet-rice terraces	70	79
First-year jhums	122	127
Second-year jhums	39	33
First-year jhums as % of terraces	174%	161%
Actual inputs of labour per H/H	Hours	Hours
Wet-rice terraces	1705	1280
First-year jhums	662	609
Second-year jhums	155	108
First-year jhums as % of terraces	39%	48%

Notes: 1 working day = 8 hrs; H/H = Household; Rs = Indian Rupees, which are officially represented by ₹.

The summary Table 3 presents a stark contradiction between the advantages obtained by working on first-year jhums rather than on the terraces and the fact that actual inputs still went mainly into the latter. Given that farmers have not been slow to change their cropping patterns in response to modern opportunities, it was surprising that they seemed to be using the jhums less while at the same time sustaining efforts on the wet-rice terraces. At the end of fieldwork directions were uncertain, and in writing his thesis conclusions three years later Cairns was inevitably ambiguous. He praised the success of the alder-jhum system and saw it as a model that others might copy or – using other soil-improving trees – adapt in the transition from swiddening to more continuous farming (see Cairns, 2007a). Yet at Khonoma he feared that it would vanish within 25 years (Cairns, 2007b).

Seeking to understand the pathway of change

Although we have no hard data beyond 2002, and there has been no opportunity for new fieldwork, we have a useful body of information on subsequent change. Cairns has been kept well *au courant* with events in Khonoma, although not at Tsiesema. What we know is outlined below, and it all follows from what was observable by 2002. To explain change means in effect that we must be able to predict the present from the past, but because of the contradiction discussed above we have a classic uncertainty situation. The determinants of what was observed in 2000–2001 were not fully understood. Logically, confident prediction is impossible in these circumstances (although one might not guess this from the many confident predictions that are written). It became essential to reduce the uncertainty. We therefore re-examined the data for clues and tested suggestions in correspondence between Cairns and his best Nagaland informants, learning more about events in the process.

Four suggestions could be offered. First, the high seed costs of the profitable new jhum crops – potatoes and garlic – have been noted above; might they alone be capable of excluding the less affluent from participation? This explanation appealed to certain informants. But Cairns' data did not encourage the belief that this would be relevant except to the very poor. The two groups of collaborating households had additionally kept financial diaries from April 2001 to March 2002, and their records unmistakably showed that agricultural inputs were only a minor element among recorded expenses (Cairns, 2007b). But might unequal access to suitable land also be an element? Many villagers laid claim to little land. Among the Tsiesema farmers who kept diaries, claims to jhum and fallow land ranged from over 5 ha down to 0.06 ha, and the range was similar though smaller at Khonoma with 4 of 10 farmers claiming less than 0.6 ha. But land shortage was not necessarily an obstacle, at least not 10 years ago. Five of the 10 jhum fields monitored at Khonoma (48.25% of the total area opened in 2000) were on rented or borrowed land. Two of the 10 at Tsiesema were on borrowed land.

A third possibility arose from the observed conversion of wet-rice terraces to permanent commodity-crop fields in the decade before Cairns' fieldwork. Perhaps the 2000–2001 survey had caught an early stage in an ongoing transformation of many more wet-rice terraces into vegetable fields? Terrace land is much easier to work than jhum land, and the terraces lying below the unsewered village receive abundant nutrients via stormwater. Intuitively, it seemed likely that these would follow the higher-altitude terraces into conversion, especially if more families were now willing to depend on buying cheap rice imported from the plains. Could this be why many families were losing interest in the first-year jhums? This hypothesis quickly bit the dust. In late-summer

Table 4. Jobs and their value in the two villages in 2002

	Khonoma	Tsiesema
Number of government jobs in village	80	82
Number of private jobs in village	36	7
Total wage-earners in village	116	89
As % of total village population	5%	11%
Total wages per month (Rs/month)	517 900	450 500
Average wage of employees (Rs/month)	4 465	5 062
Imputed values of agricultural production:		
Mean H/H wet-rice terrace production per month (Rs)	1 302	1 072
Mean H/H first-year jhum production per month (Rs)	910	838
Mean H/H second-year jhum production per month (Rs)	67	51
Total imputed value per month per mean H/H (Rs)	2 280	1 961

Notes: Jobs information from surveys by Cairns in 2002. Agricultural information calculated from Tables 1 and 2 by dividing annual gross values by 12. H/H = household; Rs = Indian Rupees, which are officially represented by ₹.

2010 the very terraces in question, close to the village, were described by a highly reliable informant as producing a bountiful crop of rice (Dr V. Meru, pers. comm. to Cairns, 27 August 2010). Clearly, rice production continues to flourish.

The fourth suggestion was more far-reaching. Was the emergence and growth of a non-farm economy the reason for the seeming disinterest in good agricultural opportunity? Together with education for young adults as well as children, non-farm activities absorbed a growing share of the potential workforce by 2000–2001, especially but no longer only the men.[26] Employment in the villages themselves was surveyed in 2002 and reported in appendices to Cairns (2007b). Results are summarised in Table 4. In terms of numbers in relation to village population, and average wage, these jobs were more significant in Tsiesema than in Khonoma. In both villages the mean monthly wage of these employed people amounted to fully twice the per-month imputed value of an average diary-keeping family's production from its terraces and jhums together. Nor was this all. In addition to these within-village employees there were also weekly commuters to jobs in Kohima, the state capital, whose wages were not recorded. Some villagers with well-placed patrons obtained significant incomes from government contract work, and many others earned irregular incomes from skilled artisanal work in stone masonry, basketry, weaving, and carpentry.[27]

The 2001–2002 financial diaries underscored the importance of these cash incomes. For these village families most farm produce was still used mainly for consumption. The average on-farm component of total money income, even including firewood, came to only 13.3% at Khonoma and 35.9% at Tsiesema. Members of most cooperating households earned wages which, together with income from skilled artisanal work and contracts, were the principal family sources of cash (Cairns, 2007b). All these were active farming families, selected as such. In the villages as a whole, the most financially hard-pressed households were those that had not been successful in tapping into one of the new income niches and continued to rely solely on agriculture. For those who were successful, off-farm work constituted a livelihood element in strong competition with both forms of agriculture. Nothing we have learned suggests that the significance of off-farm incomes has diminished in the subsequent eight years. Here we seem to come closest to a satisfactory explanation of our 2000–2001 contradiction. Pluriactivity had come to southern Nagaland and was profoundly modifying family priorities. This was the more so as rewarding alternatives to jhum cultivation were emerging.

The events can be briefly outlined. In addition to the market-garden opportunity that people had discovered for themselves, the state agricultural authorities were pressing a small number of permanent crops on Nagaland's farmers. So also was the one major international project that has worked in Nagaland agriculture.[28] The bushy spice-crop *Amomum subulatum* (called 'large cardamom' or sometimes 'Nepalese car-

damom') was the principal of these; others were tea and sometimes passion fruit. They were being planted in the jhum areas; in some of those mature jhum fallows that were not being opened in the early 2000s the alders were instead being under-planted with these crops, mainly *A. subulatum*. Some farmers have chosen timber as a cash crop. At its simplest, some are doing this just by leaving fields in fallows of indefinite length and thus allowing selected alder pollard-poles to reach more marketable girths as timber.

On the report of informants the new agroforestry pattern has become more common, permitting many now-pluriactive families to retain control over their land and its produce with quite minimal labour inputs. Sale of *A. subulatum* is not to volatile international markets but is within India, and prices continued to increase into 2010. But prices are at risk from competitive variation, and the security that came with diversity in subsistence cropping patterns could be lost. There are also dangers of vulnerability to disease.[29]

It would seem that new long-term crops are taking the place of the jhums, and we can now confirm Cairns' (2007b) tentative prediction. Whether alder becomes a plantation cover or a timber crop, it is probable that its long historical role as fallow improver in Khonoma's jhums is coming towards an end. The pace of change accelerated after a long delay imposed by the period of insecurity between the 1950s and 1990s.[30] The patterns of change include transformation of a jhum system that had been remarkably successful both ecologically and economically. Rice, on the other hand, has not yet been either displaced or revolutionised. The changes are comparable with but not identical to those experienced in most other parts of the larger Southeast Asian region, and they have happened without the negative external forcing commonly reported in other areas. Partial transformation of the system into cash-crop farming is based on exploitation of regional market opportunities and is thus economically less vulnerable than transformations that rely on specialisation for international markets. This is still a composite system, but of an increasingly different content from that observed and quantified only a decade ago.

Concluding remarks

Rambo (1996, 2007) described composite systems as robust by comparison with unmixed shifting cultivation systems, and we endorse this view. Composite-system farmers have an advantage that the pluriactive farmers in developed countries also have: they can shift their inputs between different forms of activity in an efficient manner (Brookfield and Parsons, 2007). The successful management of both natural and human resources was central to the old composite system in these Angami villages and now the creation of a large non-farm sector creates new management challenges. Part-time farming was, in an embryonic form, already present in the days when men were primarily warriors. It was common in 2000–2002. We do not know if it will now become general or if there will instead be a growing neglect of agriculture as a whole when the presently adult generation is replaced by a better-schooled generation with its known preference for non-farm work. Nagaland is now a small and peripheral part of a large country that is undergoing accelerating change, most of it in the direction of expanding its manufacturing and tertiary sectors. That is the context of the future.

Returning finally to the historical debate, a better understanding of composite systems should help dispose of notions that upland agriculture is 'footloose'. Where farming systems involve substantial investments in landesque capital, such investment tends to fix them in place. In Nagaland, Khonoma is very clearly a land-bound polity of some antiquity. Its jhum innovations reflected the land-bound status initially conferred by the long flights of terraced rice fields. Khonoma had to remain where it was, building up strong defences, becoming powerful regionally and intensifying all elements of its farming. When, half a century ago, much of the village was destroyed and depopulated, many of its people returned as soon as they could to care for their largely undamaged investments in land and trees. We suggest, in conclusion, that greater attention to the composite systems of the region might itself diversify an argument that has been too strictly focused on an oversimplified shifting cultivation model, in regard to external forcing that has also been oversimplified (Brookfield, 2011a). The case of

the Angami Naga is not typical, involving a traumatic historical experience that in the end has left them with more autonomy than is enjoyed by many of the region's upland minorities. But it does demonstrate the resilience of farming people who develop multiple skills and quickly adapt to changing conditions.

Acknowledgements

The research detailed in this paper was made possible by the generous assistance of Canada's International Development Research Centre, while Cairns himself was supported by a PhD scholarship awarded by the Australian National University. Local research assistants in each village, Carolin Meru in Khonoma and Koulie Mere in Tsiesema, were pivotal in undertaking fieldwork. The people of the two villages, and especially the collaborating diary-keeping farm families, provided invaluable support. At the fieldwork 'base camp' in Chiang Mai, Thailand, Tossaporn Kurupunya played a highly important role in collating field data and organising them into easily understood figures. Kittima Kidarn assisted with the mapping and GIS components of the research. Jenny Sheehan (ANU Cartography) skilfully either drew or redrew all the diagrams and the map. Both authors gratefully acknowledge the assistance of Nicholas Tapp, Bob Hill, and Muriel Brookfield in reading and commenting constructively on drafts of this paper. We are also grateful to two anonymous referees for valuable suggestions on better presentation of our argument.

Notes

1 An extended period of fieldwork created a large body of data that had to be analysed and presented in a PhD dissertation within the limited time allowed. There was also heavy editorial work on Cairns (2007a). Not long after these tasks were completed, Cairns suffered a severe stroke for which in 2011 he remains under treatment. Brookfield, who had been one of Cairns' principal supervisors, joined him in writing this paper in 2010.

2 It is perhaps too early for a well-considered and strongly supported conclusion by Mertz *et al*. (2008) to have been fully absorbed into the argument. Finding no consistent relationship between crop yield and the length of fallow in a range of systems, they concluded that swidden systems do not necessarily self-destruct when fallow periods are shortened. There remains scope for fallow-improvement innovations even at a late stage in the fallow-shortening process.

3 The principle is the same as with coppicing except that coppiced trees are cut close to the ground. Both practices rejuvenate the tree. Some Angami alders are well over 100 years old.

4 The foundation stories place Khonoma's origin as in the fourteenth century, by a group from western Burma who came to the site from a previous location on the edge of Manipur. By this period, wet rice was widely being managed in incipient valley states throughout Southeast Asia and northeastern India. Manipur was one of several small-valley states in the region.

5 The Naga independence movement split into mutually hostile factions and some low-level violence continued into the past decade. Problems continue in adjacent Manipur, where there is a substantial Naga population. The question of Naga nationalism in relation to the modern states is far from resolved (Baruah, 2003; *The Economist*, 2010).

6 The agricultural history of Khonoma is a demonstration, not just a test, of the Boserup (1965) hypothesis regarding intensification driven by population pressure.

7 A combination of close farmer supervision as the diaries were being kept, followed by careful verification at the end of each cropping year, was aimed at maximising data accuracy to the extent possible. Irregular group meetings were held throughout the fieldwork to discuss any problems and make needed adjustments.

8 Farmer collaborators were trained in using a compass, altimeter and clinometer that, together with a 30-m measuring tape, allowed them to survey quickly the 40 monitored fields. After adjustment, coordinates were imported into ARCinfo to create polygons representing each field. The boundaries were also entered into a GPS and overlain on electronic base maps of the villages.

9 The measures involved a number of local containers, the capacity of which had to be measured for conversion to kilograms. Results confirmed that this worked well in all the monitored fields.

10 This republican form of government would seem to correspond to the 'gumlao' polity of many Kachin in adjacent Burma, as described by Leach (1954). There seems never to have been a time when Angami villages had hereditary chiefs, but Sema Naga to their northeast did at least until lately (Bouchery, 1988). Angami political equality does not imply economic equality. In the past wealthy individuals could acquire status by giving large merit feasts that were recorded by stone monoliths in the rice fields; some are to be seen in the background on Plate 5. Status has more recently been shown by prominent display of prestigious possessions.

11 US$ 1 = 48.044 Indian Rupees, as of December 31, 2002, toward the end of the fieldwork.

12 These modern rates downgrade the relative value of women's work. Before the British abolished slavery in the later nineteenth century, a female slave was worth two or three times as much as a male slave.

13 Tsiesema is a more recent village than Khonoma and lacks the oral history detail that is remembered at Khonoma. As 'Chiswema', Hutton (1921) placed it within the 'Kohima group', the old Kohima village itself being possibly roughly contemporary with Khonoma. Over time the early Angami villages spawned offshoot settlements, some of which themselves grew large.

14 Rice planting began first in the cooler ecology of the uppermost terrraces and then 'rippled' down to lower altitudes where warmer temperatures nurture faster rice growth.

15 As part of its field preparations, Tsiesema often had the added labour costs of repairing terraces and irrigation canals that had been damaged by landslips. Unlike Khonoma, Tsiesema does not have stone walls to stabilise the terraces and keep them from slipping down the slope. Repairing such slips was an annual chore, and damage could be so bad and so frequent that terraces were abandoned.

16 Agrobiodiversity in the Khonoma terraces was highly variable, depending on the basket of resources that each farmer had at his disposal and his strategy for managing them. Some continued the old tradition of planting only rice, but other monitored fields were planted with up to a dozen crops in addition to the main rice crop. This was not happening in Tsiesema. The warmer terraces continued to be planted primarily to rice, with occasional small amounts of maize, chilli or tomato. Some Tsiesema farmers who were unable to produce all their rice needs planted higher-priced glutinous rice (Rs 20/kg) with the intention of selling it in the Kohima market (for making rice beer) and using the revenue thus earned to buy the non-glutinous rice they needed at Rs 12/kg. Many households also relied on sales of sticky rice to generate the money needed to pay their children's school fees. Glutinous rice was grown at a cost. Yields were roughly 25–33% lower than those from non-glutinous varieties.

17 Throughout this discussion a working day is taken to consist of 8 hrs. All data were recorded in hours.

18 Root crops were relatively more expensive to plant than cereals because the planting materials cost more per kilogram and were planted at more kilograms/hectare. It is likely that higher planting costs prevented some poorer households from planting potatoes, especially if the seed potato had to be imported from Simla. While their more prosperous neighbours earned good returns from potato sales, the poorer sector remained stuck in a subsistence economy.

19 Inventories of crops grown in each subsystem suggested that the lower agrobiodiversity of Tsiesema's jhums might be because they were planting some of these other crops in small permanent home gardens close to the village. Cairns and his collaborators found a total of 75 crop species in the permanent gardens sampled in Tsiesema ($n = 10$) compared with a more modest 42 in Khonoma ($n = 9$). Tsiesema managed these gardens relatively intensively, applying cattle dung and continually planting new crops as old ones were harvested. Villagers could harvest something to eat from their permanent gardens throughout the year, as well as feedstuffs to include in the mash that they boiled for their pigs every evening. Surpluses were sold.

20 Although Tsiesema did not manage the content of its jhum fallows anywhere nearly as intensively as Khonoma, it nevertheless had less obvious ways of manipulating fallow vegetation to favour desired species. *Melia*, a valued timber species, provides one such example. As Tsiesema's jhum fields were left fallow, free-ranging cattle followed behind to graze the crop residues and fallow regrowth. These cattle were particularly fond of eating any *Melia* fruit that they could find, and in this case were playing a very important role in seed dispersal. When the land was later reopened for cultivation, the *Melia* seed germinated in tandem with the jhum crops and was then protected during subsequent weeding operations. With no extra labour costs, this valued species thus had a high frequency in the subsequent fallow regrowth, constituting a form of improved fallow in its own right.

21 These sample biases, which they indeed are, were to some degree a product of having had to select the farmers before the fields. In Khonoma, there was a more intentional bias toward farmers in one of the three major clans, in which the alder-jhum system was more highly developed than among the other two major clans.

22 The share of firewood sale in this productivity needs a brief further comment. Closeness to the state capital Kohima created a particularly strong market for firewood from Khonoma and Tsiesema, but it was an important jhum crop even in remote areas. Chingmei village near Tuensang in eastern Nagaland (Fig. 1) also grew alder in its jhum fields, its methods often compared with Khonoma. Informants there explained that when they opened a fallow, they earned more from the harvest of alder wood than from the food crops that were then planted. Alder firewood was sold at Rs 200/stack, each stack measuring about $0.9 \times 1.2 \times 0.9$ m. One villager noted that beyond satisfying his own firewood needs, he was able to sell another 28 stacks, earning him Rs 5600.

23 Farmers participating in the research were learning from and responding to data as they became available. Analysis of their diaries, for example, confirmed that planting potatoes and other vegetable crops was far more profitable than traditional staples such as Job's tears or millet. The following year (2002) witnessed a large surge in potatoes planted in jhum fields. Better information was improving the capacity to make informed decisions.

24 In explaining why jhum cultivation was valued, farmers frequently pointed to the many months over which successive crops are harvested. There was flexibility in the system. Jhums could be managed with a minimalist strategy – such as near monocultures of maize or Job's tears – in which labour inputs were few. Alternatively, they could be managed extremely intensively, incorporating a wide menu of crops interplanted in combinations of crop rotations, intercropping and relay-cropping patterns. This in turn also provided flexibility in producing either enough for home consumption only or for the market also.

25 Conversion from local containers to kilograms, described in note 9, worked well on the monitored plots, but in this calculation there were two additional sources of potential error. Reported total production was related to total terrace area owned, including the unmonitored plots. These latter were surveyed but, being often of irregular shape, there may have been errors. In addition, some farmers might have exaggerated their remembered total production of wet rice. It was therefore decided to reject what were suspiciously high results.

26 A comprehensive village census in Khonoma in 2001 found more than 1000 fewer people than did the national census of the same year. The missing people were living and working elsewhere but still gave Khonoma as their place of residence in the national census.

27 Stonemasonry, involving the making of stone blocks from the numerous sandstone outcrops in the hillsides, is an ancient skill at Khonoma. It built the terrace walls and the formidable fortifications of the old village. At the time of fieldwork it earned money by supplying the building boom in the nearby state capital.

28 NEPED, now 'Nagaland Empowerment of People through Economic Development', was at the time of fieldwork a Canadian-funded project concerned principally with the improvement of shifting cultivation from within. Now it is supported by state and national funds. Beginning in 1995 it was involved in the promotion of Khonoma's alder-jhum system elsewhere in Nagaland, and more recently has been concerned with the stabilisation of shifting cultivation by plantation crops, especially *Amomum subulatum*. It was through NEPED that Cairns first visited Khonoma in 1995.

29 Khonoma experienced this problem when, early in its conversion of jhum land to *A. subulatum* plantations, an unidentified disease swept through the *A. subulatum*. Diseased planting material had been brought from Sikkim in the Himalayan middle hills.

30 The expansion of roads was central to these changes. In the case of Tsiesema, the response included the construction of a new village away from the hilltop site and more accessible by road. In 2000–2002 Khonoma had daily bus services not only to Kohima but also to the larger town of Dimapur on the edge of the Assam plains (Fig. 1). The buses were heavily used for the transportation of low-bulk produce for sale in the towns. Bulkier produce, including firewood, went by truck.

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