



Permaculture to monoculture in shifting cultivation landscape of Mizoram, Northeast India: Are agrobiodiversity and happiness waning?

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The status of agrobiodiversity and perceived well-being of one indigenous community, namely the Mara tribe, was assessed in a pilot study of 150 households sampled at random from two blocks in Saiha district, which lies at the south-western corner of the state of Mizoram. A subsample of 50 households was chosen, based on a set of predefined criteria, for data collection using mix methods approach. The study documented 30 species of plants being cultivated by the respondents. The species comprised ten vegetables, nine fruit plants, seven field crops and four species of spices and condiments and their cultivation was supplemented with five species of domesticated livestock. The plants other than field crops were identified by the respondents as top three choices for the diversification of farming. The growing transition to monoculture is taking its toll on the respondents' sense of subjective well-being. Most of them (92%) reported a moderate level of well-being or fluctuating levels of well-being: they are struggling now and expect to struggle even more in the future, to continue their way of life. We urge caution in the drive towards modernization lest the change should threaten the well-being of people and the ecological-economic trade-offs of monoculture.

Keywords: Agrobiodiversity, Cash crop, Jhum, Monoculture, Permaculture, Well-being

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Shifting cultivation (SC) is considered the most ancient system of agriculture; in SC, soil fertility is restored after taking a crop by leaving the land fallow for long periods instead of using chemical fertilizers and other soil amendments. Diverse and complex cropping systems facilitate the recycling of nutrients between natural vegetation and crops, thereby maintaining ecological balance¹. Modern farming, on the other hand, focuses on monoculture, or growing a single crop over the entire area, which is prevalent in the industrialized nations of the world. Although monoculture is more efficient in economic terms, many researchers have pointed out its shortcomings in terms of the many and various adverse social and environmental impacts^{2,3} a criticism supported by the observation from many studies that biodiversity in monoculture plantations is much lower than that in native forests that surround those plantations.

Some researchers have described exotic monocultures as 'biological deserts'⁴⁻⁷. One example of the adverse social impacts of the introduction of

plantation crops is the change of ownership of land from local communities to large private corporations. Such change amounts to loss of traditional goods and culture, customary rights, and livelihoods, all related to forced resettlement and unequal distribution of resources^{8,9}.

In contrast to monoculture is permaculture (a term coined by Bill Mollison), a portmanteau word that combines 'permanent agriculture' with 'permanent culture' to mean 'the conscious design and maintenance of agriculturally productive ecosystems which have the diversity, stability, and resilience of natural ecosystems'. Permaculture is, in effect, a sort of reversal of monoculture to promote biodiversity by growing different crops. The co-originator of permaculture, David Holmgren¹⁰, defines it as '*consciously designed landscapes, which mimic the patterns and relationships found in nature, while yielding an abundance of food, fibre, and energy for provision of local needs*'. Permaculture seeks to make an ecosystem robust and sustainable by growing several plant species together for managing the land and making it more productive. Permaculture has also

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been described as an international sustainability movement and agroecological design system¹¹ and emphasizes adopting eco-friendly management practices and locally adapted solutions to obtain several ecosystem services. Such an approach is useful because it ensures yields from a variety of crops (and thus avoids putting all the eggs in one basket as it were), regulates the hydrological cycle, stabilizes soil quality, promotes the conservation of wildlife, and manages pests, diseases and weeds effectively through biocontrol options¹².

In India, permaculture is viewed as a mix of India's indigenous farming methods, which were in vogue before the Green Revolution and encompasses a few principles taken from those traditional methods of cultivation. Permaculture discourages monoculture and serves to open up the possibility of growing a wide range of food grains, fruits and vegetables and thereby expanding the food basket; thus permaculture also contributes to community health. Permaculture is different from SC in that land is not cleared by burning and it is not land that is rotated but crops. Moreover, plant roots are left in the ground to decompose and thus add organic matter to the soil. However, the primary motto of both the farming systems is the same, namely biodiversity.

Biodiversity impacts human health and well-being in many ways, but the mechanism by which biodiversity delivers these benefits is attracting increasing attention¹³. Psychological well-being of an individual has been positively linked to the number of species that the individual perceives in his or her surroundings^{14,15}. Although a substantial body of literature reports the beneficial effects of experiencing nature and of green spaces on health and well-being, how the various characteristics of the natural environment, including biodiversity, influence mental health and well-being is not clearly understood. Until recently, only one systematic review has explicitly examined the advantages of contact with biodiversity for health and well-being¹⁶.

It was against this background that the present research sought to assess agricultural biodiversity and to relate it to the native peoples' self-reported psychological well-being in the midst of the shift to monoculture of cash crops and oil palm plantations in Mizoram in north-eastern India.

Study Area

Saiha district in Mizoram (Fig. 1), at the south-western corner of Mizoram, is predominantly

inhabited by the Mara tribe. The district is divided into two blocks. Similar to the inhabitants of other districts of Mizoram, the staple of people in Saiha is rice and maize, supplemented with generous quantities of meat. Other food items include freshwater fish and many locally grown vegetables. Saiha has a low population density, 40 people per square kilometre, compared to the state average density of 52. Pala Tipo is the largest natural lake in Mizoram and is surrounded by thick forest. The forest and the lake are rich in fauna and flora¹⁷. The Mawma Tlah, or the Mawma mountain, in the south-eastern part of the district, is the tallest mountain

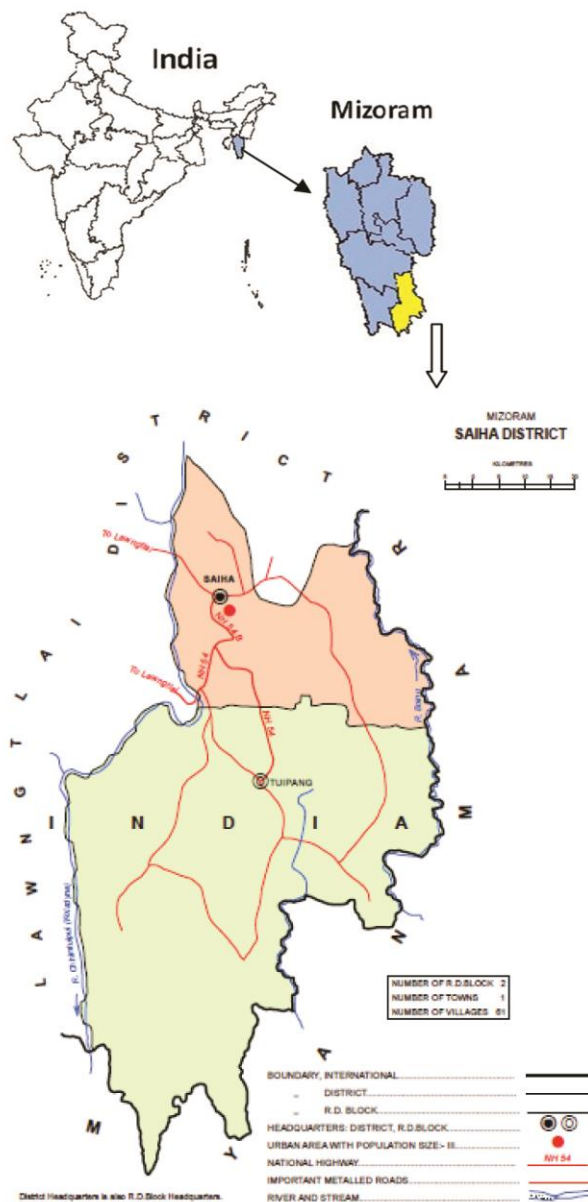


Fig. 1 — Mizoram state map showing the study area (Saiha district)

(approximately 2033 m) in the district. This mountain is part of the rich history of the Mara people and is revered by them; it also attracts a large number of tourists, especially in winter. Another tourist attraction is the Kaopi waterfall on the river Tisi, close to the village of the same name. The waterfall consists of a rocky cliff and, as with the mountain, is part of the history and also regarded by visitors as well as the locals as ideal for adventure tourism. Indeed, several empirical studies proposed that exposure to natural landscape enhance human health and wellbeing.

Methodology

Based on the concentration of indigenous tribes, their dependence on SC and accessibility of the location, six ethnic villages were chosen from the two tribal development blocks, namely Saiha Sadar and Tipa, of Saiha district. We also conducted a pilot survey of 150 households (HH) in both the blocks (75 HH in each) and, based on some characteristics and the potential to meet the objectives of the study, selected a third of the sample, or 50 HH, for further study. We used such criteria such as the number of years of experience with SC, extent of impact of monoculture, and the level of social participation (involvement in community decision-making related to the choice of the crop(s) for the community-owned land SC land, farming being primarily a cooperative venture on such land in the region). Heads of the chosen 50 HH were interviewed in-depth with particular reference to agrobiodiversity in the SC landscape comprising cultivated as well as fallow patches and their subjective feeling of well-being. A structured survey schedule coupled with a checklist of cultivated plants was used for examining the prevailing diversity. To encourage bottom-up participation and consultation, free, prior and informed consent was taken from the Village heads and respondents. The survey was followed by focus group discussions and transects walks with SC practitioners and key informants to triangulate such matters of common concern as the impact of monoculture on agrobiodiversity and socio-cultural services.

For measuring subjective well-being of respondents, we used Cantril's self-anchoring scale¹⁸ (SAL; Cantril 1965), because there is no single right technique for evaluating subjective well-being across all research situations and purposes¹⁹; also, SAL is the most enduring and commonly used single-item measure, shows excellent reliability²⁰ and often deployed in large-scale surveys, including those

undertaken by the Gallup Organization²¹. For interpretation of results, the categories, namely suffering, struggling, or thriving, formed by Gallup²², were used. Taking into account the ladder-of-life scale developed by Cantril and his peers, the respondents were profiled based on how they viewed their current situation as well as their situation in near future (five years from now). The respondents were categorized as 'thriving' if they express satisfaction with the present situation and view the near future with great deal of optimism; as 'suffering' if they perceive the current situation as weak and express little hope for the future and as 'struggling' if they seem to be intent on merely getting by. For proper interpretation and valid conclusions, the data were subjected to need-based statistics and analysis.

Results

Crop diversity

Table 1 lists the most frequently recorded species or breeds in shifting-cultivation landscape. Field crops were the principal crops grown by the upland tribes in Saiha district.

Table 1 shows that in the shifting-cultivation landscape within the study area, the respondents grow thirty species of plants and raise five breeds of livestock. The plant species comprise 10 vegetables, 9 fruit crops, 7 field crops and 4 spices and condiments: the most commonly grown among each category, respectively, are mesta (roselle, or *Hibiscus sabdariffa*), pumpkin and cabbage; banana, lemon, and orange; finger millet (*Eleusine coracana*), rice and maize and chili and coriander. Among livestock, poultry and pigs are the most common animals.

Preferences for agricultural diversification

Based on a thorough review of relevant literature, we prepared a list of technological options for better management of SC-practices recommended by different research institutes and similar sources—and requested the respondents to rank their preference for each practice on a 5-point Likert scale. We then validated these responses from individuals through focus group discussions (Table 2).

The top three choices for crop diversification, in descending order, were spice crops ($x=4.30$), vegetables (4.26) and fruits (3.94). The two remaining options, namely integrated farming (average rating of 3.92) and protected agriculture- cultivation of high value horticultural crops, could be viable options for diversification and can contribute to increasing the

Table 1 — Percentages of the most frequently recorded plant & livestock species in the sample area

Field crops		Frequency Percentage	Vegetable crops		Frequency Percentage
1) Finger millet (<i>Eleusine coracana</i>)	66	1) Mesta (<i>Hibiscus sabdariffa</i>)	75		
2) Rice (<i>Oryza sativa</i> L.)	61	2) Pumpkin (<i>Cucurbita pepo</i>)	68		
3) Maize (<i>Zea mays</i> L.)	49	3) Cabbage (<i>Brassica oleracea</i> var. <i>capitata</i>)	61		
4) Cowpea (<i>Vigna sinensis</i> L.)	17	4) Drumstick (<i>Moringa oleifera</i>)	35		
5) Pigeon Pea (<i>Cajanus cajan</i>)	7	5) Mustard (leaf) (<i>Brassica</i> spp.)	19		
6) Soybean (<i>Glycine max</i>)	5	6) Ash gourd (<i>Benincasa hispida</i>)	13		
7) Black gram (<i>Vigna mungo</i>)	2	7) Squash (<i>Sechium edule</i>)	9		
Fruit crops		8) Carrot (<i>Daucus carota</i> subsp. <i>sativus</i>)	5		
1) Banana (<i>Musa</i> spp.)	27	9) Brinjal (<i>Solanum melongena</i>)	7		
2) Lemon (<i>Citrus limonium</i>)	23	10) Potato (<i>Solanum tuberosum</i>)	3		
3) Orange (<i>Citrus aurantium</i>)	25	Condiments & spices			
4) Strawberry (<i>Fragaria ananassa</i>)	19	1) Chili (<i>Capsicum</i> spp.)	79		
5) Pineapple (<i>Ananas sativus</i>)	13	2) Local coriander (<i>Eryngium foetidum</i>)	54		
6) Grape (<i>Vitis vinifera</i>)	7	3) Ginger (<i>Zingiber officinale</i>)	33		
7) Tamarind (<i>Tamarindus indica</i>)	7	4) Turmeric (<i>Curcuma longa</i>)	3		
8) Papaya (<i>Carica papaya</i>)	5	Livestock			
9) Jackfruit (<i>Artocarpus heterophyllus</i>)	3	1) Poultry (<i>Gallus gallus domesticus</i>)	87		
		2) Pig (<i>Sus scrofa domesticus</i>)	83		
		3) Goat (<i>Capra aegagrus hircus</i>)	11		
		4) Fishery (local spp.)	13		
		5) Buffalo (<i>Bubalus bubalis</i>)	12		

Table 2 — Ways to promote crop diversification as rated by respondents

Items	Average score	Standard deviation	Rank
Spice crops	4.30	0.71	1
Vegetables cultivation	4.26	0.90	2
Fruits orchard	3.94	0.59	3
Integrated farming system	3.92	0.75	4
Protected cultivation of high value horticultural crops	3.82	0.60	5

income, as reported by the respondents. These preferences are understandable and only to be expected, given the rich natural resources and a climate and soil conducive to growing vegetables, fruit and spices.

Most respondents (92%) reported experiencing moderate or inconsistent levels of well-being (Fig. 2): they find their present situation a struggle and expect more struggle in the future. They are more likely to indulge in drinking and smoking but are less likely to consume wholesome food. However, a small proportion (about 5%) of the respondents did report a strong, consistent and progressive feeling of well-being. These respondents look upon their current situation as favourable and expect that in the next five years the situation will be even better, enabling them to enjoy a higher quality of life. A small minority (3%) perceived their well-being to be at high risk. Their access to basic needs— food, shelter, and

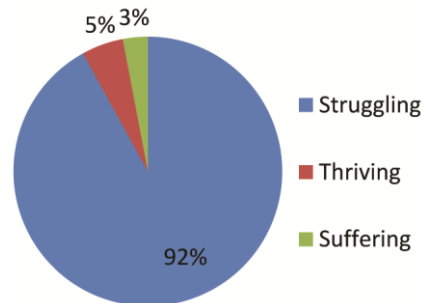


Fig. 2 — Distribution of respondents according to self reported well-being

clothing — is limited, which made them rate their current situation as poor and view the future as dismal (a rating below 4 on a scale of 0–10 on both counts).

Discussion

A major advantage of the rich agrobiodiversity in Saiha district is dietary diversity, which contributes to food security (adequate calories) and nutritional security (required vitamins and minerals) of the Mara tribe. Developmental literature reports that food intake, particularly that of fruits and vegetables, is associated with higher levels of the components of well-being²³. Furthermore, many cultivated and wild edible plants on such a landscape ensure round-the-year availability of food, in which the traditional fermented foods also play a part. One study enumerates the variety of fermented foods consumed by the indigenous people of Mizoram²⁴. These foods

include *sa-um* (fermented pig fat preserved in dried bottle gourd (*Lagenaria siceraria*), *bekangum* (fermented soybean), and *tam-um* (fermented mustard), which are among the most popular foods of the Mizos. For the latter, *ɽampui*, a local cultivar of mustard (*Brassica rapa* or *B. juncea*) is used. *Dawlɽawm* refers to the dry leaves that cover the bulbous root of taro (*Colocasia esculenta*). *Bai* is a mixed vegetable; *behlawibai* is a dish made from fresh leaves of cowpea, which are added to pre-boiled water and *maian bai* are fresh leaves of pumpkin. *Chhangban* is a sticky form of bread made from several varieties of rice, including *buhtawi*, *ɽaibuhban*, *i-daw*, *buhbansen*, *zakeuva*, and *fazu* (all these are local names). *Sarep* is smoked meat; *dawlrep* is dried taro; *behlawirep* is dried or smoked cowpea and *sawhchiar* is pork or chicken porridge. These dishes are supplemented with such produce from fallow lands and surrounding secondary forests as wild edible mushrooms, medicinal plants and, more important, bamboo shoots.

Although SC is perceived as a multifaceted and the most complex form of agriculture or agroforestry in the world²⁵, a comprehensive understanding of this type of agriculture is lacking. This age-old agroforestry system displays an astute ecological rationale coupled with in-depth use of indigenous knowledge and natural resources. This approach embodies the management of agrobiodiversity in the form of diversified agricultural systems and is very similar to permaculture in many aspects. Between 1985 and 1992, the state government of Mizoram embarked on a pilot-scale implementation of a new land use policy (NLUP) that sought to put an end to the practice of SC by offering the farmers alternative land-based activities. Large-scale implementation of this policy began in 2011. A very recent study indicates that even after the NLUP, bamboo forests are allocated for SC. Further, these abandoned lands are then promoted by the state agricultural department as suitable for oil palm plantations, a form of land use that also affects the gender dynamics adversely, because the role of women becomes more submissive – mostly, they work on daily wages – in the settled cultivation of oil palm, whereas their role in SC is greater and more active. Private oil palm companies do not collect fruit from farmers living in remote villages away from motorable roads, which pushes men to work on daily wages and women to work on extracting palm oil at home²⁶. Promotion of vegetable cultivation was a component of the NLUP because it was the people's choice, as is also reflected in the present study (Table 2), along with the development of

marketing infrastructure. However, marketing infrastructure continues to be inadequate. In this scenario, more than 90% of the respondents were categorized as 'struggling' or merely getting by (Fig. 2). This scenario can be compared with that of the Government interventions led to the situation like post green revolution effects in the country. In other words, most of them consider their current situation to be unsatisfactory and seek individual happiness increasingly in cultural values²⁷—SC is integral to indigenous culture, which often involves applying sophisticated indigenous technical knowledge. Many indigenous cultures worldwide have spiritual beliefs, ethical values and traditional practices that are directly linked to the environment²⁸⁻³¹. For example, nearly all the Mizo festivals are associated with the tilling of land. *Mim Kut*, *Chapchar Kut*, and *Pawl Kut* are the three major agrarian festivals in Mizoram, all of which are in one way or the other connected to farming. *Chapchar Kut*, which is celebrated during spring after the harvest, is perhaps, the most joyous of the Mizo festivals³² whereas the shift away from SC to monoculture (Fig. 3) influences all these aspects adversely, eroding the happiness of the indigenous community and also shrinking the diversity in their diet and thereby

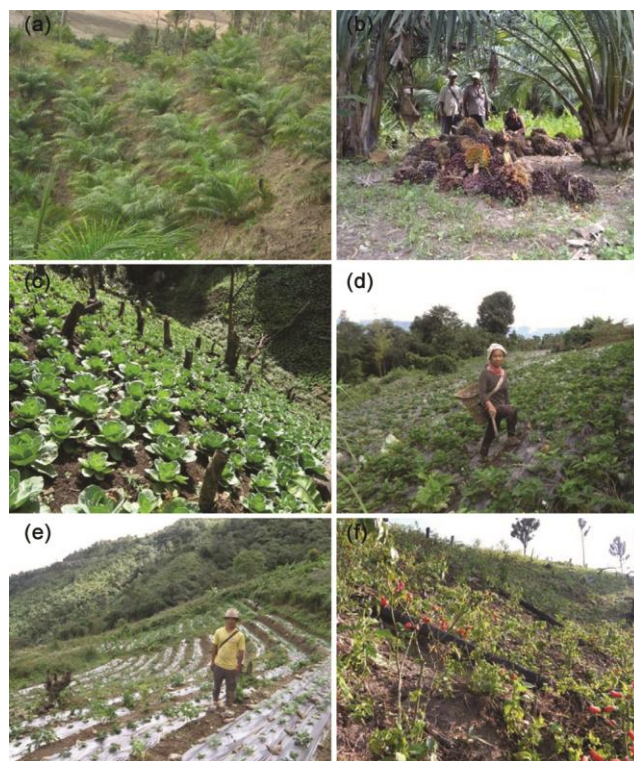


Fig. 3 — (a) and (b), Oil palm plantation in Saiha; (c), monoculture of cabbage; (d) and (e), monoculture of strawberry (a crop exotic for the region); (f), monoculture of chili as part of shifting cultivation

affecting their health. Indeed, previous researches conducted in the study area has also indicated the threat to people's livelihoods and bicultural diversity thereby suggested for sustainable conservation of species used in food systems of the indigenous people^{33,34}.

Conclusion

To quote Vandana Shiva, "We've moved from wisdom to knowledge, and now we're moving from knowledge to information and that information is so partial that we're creating incomplete human beings." The loss of our cultural and epistemological diversity to the Western monocultural mindset is as much a threat to our continued existence as climate change or any other of the numerous perils we collectively face. Through focus group discussions with tribal people, we showed that diversity – different species in a land-use system boosting the resilience of ecosystem services – contributes to human well-being—and ensuring the integrity of ecosystems is the bottom line when it comes to promoting and sustaining that well-being. Because both biodiversity and subjective well-being are influenced by multiple factors, it is difficult for the research community, ecologists and psychologists in particular, to find the precise and direct links between biodiversity and subjective well-being. However, we as scientists need to trace those links and appreciate the benefits that accrue from nature. Upon understanding these links, we need to share that understanding with the wider community and describe the dynamics of these links if decision-making is to take into account biodiversity as well. Based on the findings of the investigation, a clear picture emerges, showing that the lives of forest-dwelling communities are greatly affected by the transition to monoculture that brings in its wake drastic socio-economic and technological changes.

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Conflict of Interest

All the authors here declare that they have no conflict of interest in this publication.

Authors Contribution

D K P compiled the data and prepared first draft of the manuscript, P A, H K D & B N H reviewed and edited the manuscript.

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