DIVERSITY IN SHIFTING CULTIVATION SYSTEM AND CROP SPECIES

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Contents

Summary

Indigenous foods and local farming systems were overlooked and their ill effects on indigenous populations often highlighted. Shifting cultivation (SC), also known as swidden or slash-and-burn agriculture, is one such system which is also the most debated among traditional agroforestry systems. Shifting cultivation, one of the oldest farming systems in the world, is the dominant land use in mountainous regions of South Asia and South East Asia. Many scholars have defined the system from different perspectives but maintaining the common thread of its location specificity and its indigenous nature. The history of SC can be traced back to about 8000 BC during the Neolithic period. There are various local terms used in different countries for SC. The practice of SC consists of an alternating cycle of clearing a patch of either private land

or community-owned natural forest by slashing the existing vegetation and burning it and then growing a crop on it. The six steps or stages of SC are delineated in this chapter, and the typical agricultural calendar of shifting cultivation is illustrated. Another important component of SC is involvement of women. Involvement of women for sustainable resource management in this system ensures food security of the family and community. Women are responsible for selecting seeds, sowing, weeding, gathering, processing, and selling the surplus. The traditional wisdom and diversity of crops in SC are two more interesting areas. Lastly, the chapter gives details of SC as practised in north-eastern India.

1. Introduction

Climate change is bound to affect every aspect of sustainable development, and if the United Nations Sustainable Development Goals (SDGs) are to be achieved, we need to understand the pathways through which climate change will either complement or compete with that effort. A part of this understanding relates to the knowledge systems of local communities including those who are custodians of traditional or non-formal knowledge and especially of communities practising farming using methods developed over centuries. That knowledge can be used for developing sustainable methods of farming when judiciously supplemented with methods modern and scientific but neither intensive nor demanding in terms of external inputs. Fruitful sharing of such wisdom requires interactional expertise for capturing relevant feedback from such communities and integrating diverse viewpoints with mainstream knowledge systems. More specifically, such integration requires collecting detailed information from practitioners including local peasants, artisans, indigenous groups, and community leaders and then collating and synthesizing it with mainstream approaches to set up a high-quality and sustainable knowledge base. However, at the local and global level, the empirical leanings and evidence establishing the relationship of sustainable development with climate action are usually spread across institutions, locations, and disciplines. Such situations are critical hindrances to holistic and integrated comprehension of the socio-environmental systems ingrained in the SDGs.

Our critical response to climate change at this time should be to explore and promote alternative ways of farming using a mix of modern and traditional methods. This response will help not only in maintaining but also enhancing biodiversity and ecosystem productivity in landscapes in which people share an intimate relationship with nature. Indigenous agro-ecosystems have farm- and landscape-level diversity and they are usually safeguarded by natural elements such as forest patches and streams. Such traditional subsistence or family-run farms are usually resilient and serve as a cushion against any pandemic. In the past, such indigenous foods and local farming systems were overlooked and often disparaged, and their ill effects on indigenous populations were often highlighted. One such system is shifting cultivation (SC), also known as swidden or slash-and-burn agriculture, one of the most debated traditional agroforestry systems. This system, comprising diverse indigenous or traditional crops, their wild relatives, and appropriate methods of cultivation, has the potential to contribute new approaches to cope with climate change. This article is an attempt to convince readers worldwide that the much-vilified system in fact has much to offer once it is explained in clear terms, backed by first-hand evidence and recent knowledge.

1.1. Definition and Features

Shifting cultivation, one of the oldest farming systems in the world, is the dominant land use in mountainous regions of South Asia and South East Asia. The practice is referred to variously as swidden, slash-and-burn farming, rotational bush fallow agriculture, and, especially in North East India, as 'jhum'. These terms are often used interchangeably in scientific literature. Shifting cultivation is also a traditional agroforestry system. So far, no single and suitable definition widely accepted by the scientific community has emerged. The term 'swidden' was first proposed by the Swedish anthropologist Izikovitz in 1951 to describe patches of land cleared by burning or plots of burnt woody vegetation. However, the term did not prove popular within the scientific community because scholars considered it as a term from old English. Shifting cultivation (SC) refers more broadly to growing rice and others crops on a given piece of land and then leaving it fallow or raising the next crop after the harvest. Thus, SC encompasses the entire system of swidden (cultivated) plots and fallow plots often practised by shifting or semi-nomadic people on plots that are not permanently under cultivation and even by those with relatively fixed settlements. Conklin (1957) distinguished swidden from SC as the method of farming by clearing fields by burning of existing vegetation then utilizing it for short periods (2–3years), and then keeping it fallow. Swidden is a "land use system that employs a natural or improved fallow phase, which is longer than the cultivation phase of annual crops, sufficiently long to be dominated by woody vegetation, and cleared by means of fire". This definition also highlights the use of fire to associate swidden with SC. McGrath (1987) defined SC as follows: "A strategy of resource management in which fields are shifted in order to exploit the energy and nutrient capital of the natural vegetation – soil complex of the future site". In short, the term swidden is perfectly appropriate for describing the farming system in South East Asia including north-eastern India because it includes such unique attributes as cultural identity and the use of fire. Traditional swidden or SC thus comprises slashing and burning followed by a period over which the plot thus cleared is cultivated.

1.2. History

Shifting cultivation has a history going back over millennia, especially in humid tropics, which is usually characterized by less densely populated areas. The beginning of SC lies in the Neolithic period (about 8000 BC), and SC was a revolutionary shift in humankind's mode of food production. This shift transformed people from hunters and gatherers to food producers. Shifting cultivation involves rotation of fields against rotation of crops, using human labour exclusively, not using draught animals and manuring, sowing of seeds using dibbler or hoe, with short periods of land engagement alternating with long fallow periods for regeneration of vegetation in secondary forests.

With reference to Mayan swidden farmers of Mesoamerica and early Danubian swidden agriculturalists of Europe, the archaeologist Richard Adams observed similarities in the nature of their settlement patterns and the distribution of artefacts between them. Adams (1969) observed the expansion of Danubian farmers into Western Europe around 5000 BC resulting into rapid and extensive spread of Danubian settlements and traditional arts and technologies across the vast area. Adams attributed this pattern to the practice

of slash-and-burn (swidden) agricultural systems in the primeval forests of Europe. Such pattern resulted in rapid establishment, abandonment, and reoccupation of villages over vast areas comparable with swidden farmers the world over. According to Minnich (1997), similar demographic and cultural patterns were noted with swidden initiated by the Slavs to the eastern Alps and northern Balkans in the sixth century. This practice further persisted even in the twentieth century in the hilly and forested regions of Slovenia. Similarly, Myrdene Anderson (1996) documented the practice of swidden into Norwegian Lapland from Finland during the eighteenth century. In fact, the extensive review of swidden-related practices is documented in eHRAF Collection of Ethnography (the online version of the Human Relations Area Files) highlighting forty-eight societies over the globe, the cultural histories of which centres around swidden or similar forms of farming intensification. Those societies range across Africa, Asia, Europe, Central America and the Caribbean, North America, Oceania, and South America.

1.3. Geographical Distribution

As SC mostly revolves around using a piece of land for a shorter period followed by keeping it fallow for a longer period, data on the extent of coverage of SC are scarce. Hence, it is difficult to capture SC on land-use maps or to maintain the statistical records of it. Therefore, the number of people associated with SC at any given time is hard to capture even globally. Such data are crucial to successful implementation of any programmes or initiatives such as Reducing Emissions from Deforestation and Forest Degradation (REDD), biodiversity conservation, and improvement of local livelihoods. However, a recent conservative estimate is that swidden is practised, directly or indirectly, in more than 60 countries globally, involving almost 300–500 million people and covering roughly 280 million hectares, including both cultivated fields and fallows (Heinimann et al., 2017). The mountainous and hilly parts of Latin America, Central Africa, and South East Asia which also include north-eastern India are dominated by swidden cultivators. Shifting cultivation is practised along hill slopes, slopes up to 20 degrees being ideal, and is known by many region-specific terms (Table 1). In North-East India, the commonly used term is ‘jhum’ cultivation.

Country or region	Local term
Bhutan	Tsheri
Brazil	Roka or Roca
Congo (Zaire river valley)	Masole
Equatorial African countries	Fang
Guadeloupe	Echalin
India (north-east)	Jhum
Java and Indonesia	Ladang or Humah
Madagascar	Tavi
Mexico	Comile
Mexico and Central America	Milya
Myanmar	Taungya
Philippines	Caingin
Sri Lanka	Chena

Tanzania	Kilimo cha kuhamahama
Thailand	Tamrai
Uganda, Zambia and Zimbabwe	Chetemini
Venezuela	Konuko or Conuco
Vietnam	Ray
Western Africa	Logan
Yucatan and Guatemala	Milpa

Table 1. Local terms for shifting cultivation around the world

2. Shifting Cultivation: Systems and Practices

The practice of SC comprises an alternating cycle of clearing a patch of either private land or community-owned natural forest by slashing the existing vegetation and burning it. The patch thus cleared is used for growing food crops. After 2–3 years of cultivating the patch, farmers move on to a fresh patch of land, leaving the earlier patch fallow to allow vegetation to regenerate. The system keeps the landscape dynamic because it simultaneously harbours a mosaic of cultivated fields, patches lying fallow over varying durations, and natural forests (Figure1), all of which are subject to change. The duration over which a patch of land is kept fallow varies greatly depending on the village, the household, or even on the part of the field managed by a single household. All cultural operations in SC are carried out manually, using simple tools such as a machete, a sickle, an axe and a spade of local design, or even sticks sharpened to a point. Seeds are seldom bought; rather, part of the previous harvest is usually used as seed for the next crop. Also, while clearing the land for cultivation, large fruit-bearing trees are retained. The stumps of trees are left in the field to decompose and thus release organic matter and nutrients into the soil. Some tree stumps also develop fresh shoots, making regeneration of the fallow vegetation faster. The abandoned patch, which is kept fallow for several years, allows the original vegetation to regenerate. By dispensing with tillage, SC offers several ecosystem services, including sequestering carbon, maintaining biodiversity, recycling nutrients, and building resilience against natural and anthropogenic disturbances—all of which contribute to enhancing food security. The complete cycle of SC consists of six stages (Figure 2 and 3), each of which demands crucial decisions concerning location, scheduling crops, and labour inputs by practitioners. The six stages include site selection and clearing, burning, sowing, weeding and protecting, harvesting, and succession. A poor decision at any of these stages might lead to poor harvests or even no harvest at all.

Swidden agro-ecosystems may vary also within the same regions, albeit with emphasis on different subsistence subsystems. Whereas “shifting cultivation refers to one of the undetermined number of agricultural systems” (Conklin, 1966), swidden, on the other hand, is not one system but many hundreds or thousands of systems. For example, a total of 18 distinct types of shifting agriculture are known even within South East Asia itself. Some of the swidden systems may have fishing as an important element, whereas in others it may be food gathering.

Figure 1. Shifting cultivation in Saiha, Mizoram, India: the landscape is a mosaic of cultivated fields, regenerating fallows, and forests

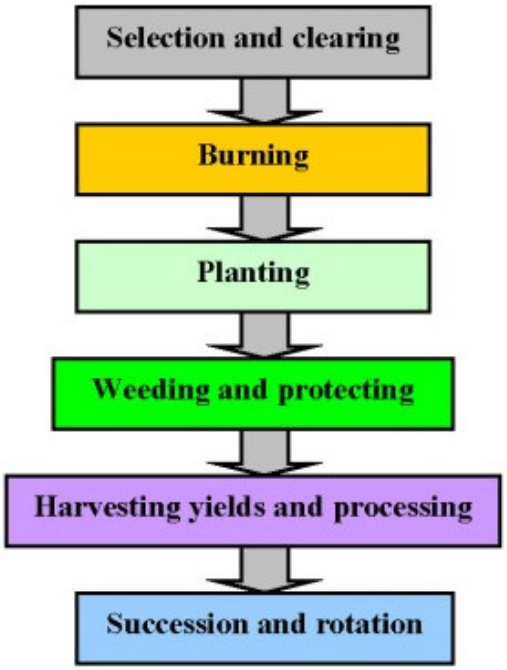

Figure 2. Stages in shifting cultivation

Whereas a case has been made to limit the term 'shifting cultivation' to cropping sequences of which extended fallows form a part, the term is often extended to include

any system of farming that involves fallows and sifting the site of cultivation. Although swidden systems are grouped based on a number of features, the present discussion focuses on two major features, namely, (1) the extent of socio-economic integration and (2) the intensity of land use and labour. Socio-economic integration with shifting cultivation can be either in part or in full: if it is in part, it reflects "predominantly only the economic interests of its participants (as in some kinds of cash crop, resettlement, and squatter agriculture)"; if it is fully integrated, it originates "from a more traditional, year round, community-wide, largely self-contained, and ritually-sanctioned way of life" (Conklin, 1957). Shifting cultivation in India, Nepal, Bhutan, and Myanmar shares many common features. For example, in Bhutan one type of shifting cultivation, referred to as *tsheri*, is seen mostly in subtropical and tropical broad-leaved forests whereas the other, *pangshing tsheri*, is seen mostly in subtropical and tropical grasslands: in the former system, all vegetation –trees, shrubs, other perennials, and annuals – is cut in the dry season, left to dry, and then burnt before sowing (either dibbling or broadcasting) the next crop; in the latter, crops are grown without any external inputs in the form of chemical fertilizers. All these systems share the following features.

- Cultivators do not move their home base, which is typically close the land that is cultivated permanently, but erect a makeshift dwelling and a small store close to the site of *tsheri*.
- Typically, only one crop intervenes or breaks the extended fallow that lasts over 5–12 years: the duration varies directly with elevation, the periods at higher elevations being longer than those at lower elevations.
- The density of population governs how intensively SC is practised: a higher population density requires more intensive cultivation.

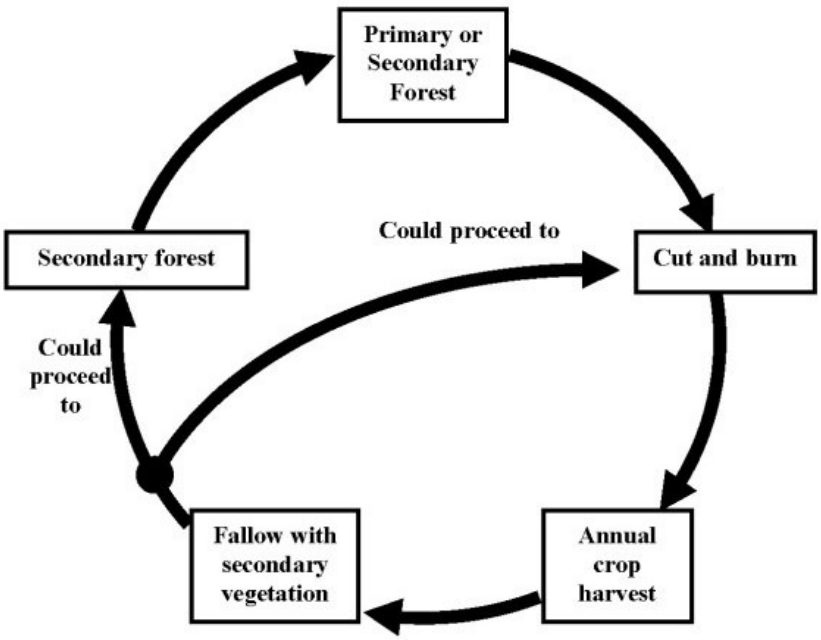

Figure 3. Shifting cultivation cycle

Bun, a version of SC practised by the Khasi and Jaintia tribes of Meghalaya in north-eastern India, exploits the traditional ecological knowledge to ensure that lands are

farmed sustainably. Many crops are cultivated on hill slopes and on terraced plots on raised beds (*bun*) consisting of dry vegetation covered with soil, which is then set on fire before sowing. Several crops are grown on a given piece of land for 1–3 years, which is then left fallow for 3–5 years, although the latter has now been shortened to 1–3 years as cultivable land becomes increasingly scarce.

Home and tree gardens and livestock are also important components of such agricultural system. Home gardens are raised for growing vegetables, fruits, herbs, and ornamental plants for household use. Fruit trees such as plum and apricot are planted for capturing recent market opportunities. Tree gardens are raised on slopes at elevations higher than those used for settlements in swidden systems involving cassava. Cattle are allowed to graze in harvested paddy fields, along roadsides, and in fallows and secondary forests. The cattle also facilitate flows of materials including nutrients between different components of an agroecosystem. Similarly, home gardens might range from highly productive to virtually non-existent. Despite such variations, all share the strategy of having potential subsystems that can be intensified as needed. The prominent subsystems may only be used when other subsystems fail to deliver, e.g. gathering from the forest may be a common subsystem, but the intensity of gathering may vary as needed, and if the harvest from cultivated fields is good, food gathered from the forest may be restricted and confined to favoured fruits, vegetables, or ‘snacks’ whereas if the harvest is inadequate, gathering is intensified to include staples (wild roots, sago, etc.) as well as more fruit and vegetables to support the group until the next harvest. Swidden is basically a rotational and dynamic agroforestry, with land cover changing from natural forests to newly-cleared swiddens to fallows of different ages. Fallow, in this context, refers to the duration over which a piece of land is left to recover by allowing its vegetation to regenerate on its own and no crops are raised. Therefore, a fallow is not ‘abandoned’ land that the swidden farmers do not intend to use again; instead, it is land left without a purposeful crop, and the farmers use it to raise another crop in future, which may serve as a source of food, timber, and non-timber forest products to the extent to which they are available.

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Operations or activities	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Clearing the forest for cultivation and felling trees for house construction												
Burning of fallen biomass along with weeds: the ash adds nutrients, especially potassium, to the soil												
Sowing or planting potato, maize, cassava, 'jaïing' (a wild edible vegetable), sesame, mustard, and bean												
Sowing millet, Job's tears, and sesame; also, planting 'shken' (a variety of bamboo) and banana												
Sowing cucumber												
Harvesting potato and planting its next batch; also sowing maize												
Planting sweet potato												
Cleaning and weeding												
Millets begin to flower; Job's tears, sesame, and rice bean (*Vigna umbellata*) reach full maturity												
Harvesting yam, millet, Job's tears, and sesame												
Mustard (for leaves), pea (*Pisum sativum*), 'phantlang' (winter potato), 'kubi' (*Brassica oleracea*, cabbage) and lettuce (*Lactuca sativa*) grown during winter												

Cool and moist weather
Cold and moist weather
Rainy and humid weather
Warm and humid weather

Table 2. Agricultural calendar of shifting cultivation (a typical case of Nongtraw village, East Khasi Hills district, Meghalaya)

Although SC is, debatably, considered detrimental to forests, it must be noted that farmers in fact contribute to afforestation by planting fallow areas with trees that provide a variety of products. Such secondary forests contribute to the well-being of people and offer a range of ecosystem services. Unlike forests that are cleared for commercial farming, those that are cleared as part of SC regenerate quickly and maintain their species richness, become highly productive, and are better equipped to counter the adverse effects of climate change and other calamities. Matos and co-

workers (2020) showed recently that such patches of secondary forests offer several related benefits, or 'co-benefits', being eligible for payments under forest and landscape restoration schemes and other carbon-credit-based services such as reducing emissions from deforestation and forest degradation, plus sustainable management of forests ($REDD^{+}$). Such patches of secondary forests, even when isolated, can mitigate the adverse effects of climate change; reverse the process of species extinction by allowing space for endangered species to recover; and facilitate the movements of living beings and the expansion of gene pool—functions critical to the health of ecosystems and the conservation and enhancement of biodiversity. Shifting cultivation is thus essentially a system to share the land with nature whereby smallholders contribute to species conservation within a much larger upland landscape.

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Biographical sketch

Dileep Kumar Pandey was born in 1972. He received his bachelor's degree in agriculture and animal husbandry and his master's degree in agricultural extension from Chandra Shekhar Azad University of Agriculture and Technology, Kanpur, Uttar Pradesh, India, in 1995 and 1997, respectively, and his doctorate degree in extension education from Banaras Hindu University, Varanasi, Uttar Pradesh, India, in 2001.

In 2001, Dr Pandey was appointed as Assistant Professor in the Central Agricultural University, Imphal, Manipur, India, and later as Associate Professor and Professor in the same university, where he headed the Social Sciences Department. In 2018, he was posted to the College of Horticulture and Forestry, Pasighat, Arunachal Pradesh, a constituent college of the Central Agricultural University. He was Head of the Department of Social Science from 2018 to 2021. This posting helped him to augment his expertise on traditional culture, indigenous food systems, and shifting cultivation, especially in north-eastern India.

Apart from undergraduate and postgraduate teaching and technology transfer, Dr Pandey is actively engaged in research. As a Principal Investigator, he successfully completed two research projects, namely (1) Mapping of Socio-economic and Livelihood Patterns of Jhumias in North East Hill Region of India and (2) Impact of Information and Communication Technologies in Agricultural Education in India, funded by Indian Council of Agricultural Research, New Delhi. In addition, as a Co-Principal Investigator he contributed significantly to two more research projects, namely (1) Value Chain Analysis of Ginger in North East Hill Region of India and (2) Socio-Economic Aspects of Value Chain Analysis of Dry Fish in North Eastern Region of India. Currently, Dr Pandey is working on agrobiodiversity and ecosystem services and diversity in indigenous foods and well-being. His notable contribution was to examine the continuance of shifting cultivation using the concept of place attachment, Agrobiodiversity and food security in Jhum (recently published in *Forest Policy and Economics*), a leading international peer-reviewed journal. As a lead author, Dr Pandey has more than 65 scientific articles, 4 of which were published in *Current Science*, century-old journal published by the Current Science Association, Bengaluru, India. In the year 2022, his three papers published in reputed journals namely; *Landscape and Urban Planning, Food Security,* and *Biodiversity and Conservation* respectively.

Shantanu Kumar Dubey was born in 1971. He has graduated from the erstwhile Bihar College of Agriculture, Sabour (a constituent college of Rajendra Agricultural University, Pusa, Samastipur, Bihar, India) in 1993 and obtained his Master's and Doctorate from the National Dairy Research Institute (NDRI), Karnal, Haryana, India, in 1995 and 1999, respectively. He earned merit scholarship, university gold medal and senior research fellowship during Graduation, Masters and Doctoral programmes respectively.

In 1999, Dr Dubey joined the Agricultural Research Services at Central Potato Research Institute, Shimla, Himachal Pradesh, India, and served its regional station in Meghalaya from 2000-2006, where he had ample opportunity to work with indigenous tribal and non-tribal peoples of north-eastern states. Dr Dubey also served at Indian Institute of Pulses Research, Kanpur (2006–2009) and Indian Agricultural Research Institute (2009–2013) and from then onwards is with the Indian Council of Agricultural Research's Agricultural Technology Application Research Institute, Kanpur, Uttar Pradesh, India.

Dr Dubey was involved in teaching, research and extension as well as monitoring of the frontline extension programmes in India. As a researcher, he has executed 12 in-house research projects and *adhoc* studies which mainly focussed on documenting and analyzing the traditional potato production practices among the tribals of north eastern states, adaptation and integration of modern production technologies with the traditional wisdom, marketing system dynamics in the NEH region as well as the impact of the technologies with reference to the region. Likewise, in pulses production, research studies on impact of different participatory projects for dissemination of pulses technologies, stakeholders' analysis in pulses research and extension, gender differentiated roles in pulses production, protection and post harvest handling to name a few which were planned and executed by Dr Dubey. He has also worked on the action research projects leading to technology dissemination models which included institute-post office linkages for reaching the unreached and partnership based innovative experiments by involving voluntary organizations of India and ICAR research institutes and state agricultural universities of the country. Similarly, Model village concept was experimented in farmer participatory orientation with the aim to improve the efficiency of farming systems, institution building and marketing and value chain dynamics. Like-wise, he was also associated in several externally funded research projects (15) supported by many national and international institutions.

Dr Dubey was also engaged in teaching and guiding the post-graduate students in Extension Education for the period from 2009-10 to 2013-14. With this capacity, he was associated in teaching the important courses like Training for Human Resource Development, Fundamentals of Research Methodologies and Basics of Extension Education. He has co-guided five Maters and three PhD students.

Dr Dubey has to his credit 105 research papers in journals of national and international repute, several books and book chapters, technical bulletins, etc. He is also the Honorary Fellow of few professional societies besides being awarded by many organizations.