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Farmers' Income and the Driving Forces for the Switch from Shifting Cultivation to Settled Agriculture in Meghalaya, India

Mebaaibok L Nonglait, Nicholas Khundrakpam and Pratibha Deka*

Department of Environmental Science, Tezpur University, Tezpur, India

*Corresponding author: pratibhadeka@gmail.com

Abstract

This study assesses the dependence of farmers on semi-settled (a combination of shifting and settled cultivation) and settled agriculture as a source of family income. The farmers residing in the hilly tracts of West Garo Hills mostly adopt semi-settled cultivation. Farmers are also transitioning from semi-settled to settled agriculture. This study was conducted to investigate the factors influencing the transition and the socioeconomic conditions of farmers practicing semi-settled and settled agriculture. The researchers surveyed 119 randomly selected households in West Garo Hills, a district of Meghalaya, India, using a structured questionnaire. Exploration of influencing factors for transitioning is important to provide insights into how factors interact, thereby facilitating the development of effective adaptation strategies and policies that will ensure farmers' future well-being. Results showed that settled farmers generate more income and possess more land area than semi-settled farmers. Besides available land area, a stable source of income for a family is a strong determinant for abandoning shifting cultivation and transitioning to settled agriculture to boost income with less time investment and labor. The farmers found that shifting cultivation helped meet their dietary needs and some income during the COVID-19 lockdown. Alongside efforts to boost commercial agriculture, the government should also assist farmers with limited resources in transitioning to settled agriculture by building market networks for the goods produced from shifting cultivation.

Keywords: agricultural transition; cash cropping; livelihood; livestock rearing; risks and opportunities

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INTRODUCTION

Shifting cultivation, or swidden, is an old farming system that is widely practiced in the hilly tropics of South and Southeast Asia. The practice generally involves a cycle of land selection, clearing, burning, cultivation and abandonment phases. It is carried out on gentle to steeply sloping terrain covered with vegetation and soil that can be characterized as nutrient-poor, low-depth mountain soil (Coomes et al., 2000; Bruun et al., 2009). This practice is labor intensive and involves the use of basic tools and techniques, community participation, and minimal input sufficient for subsistence-level production (Rasul and Thapa, 2003). Shifting cultivation was considered to be ecologically viable when enough land (10 to 20 years) was available to allow cultivated lands for a long restorative fallow period and crop yield demands were low (Lal, 2005). However, population growth and governmental control over forest areas have led to a scarcity of land for cultivation (Rasul and Thapa, 2003). This has led to a reduction in the fallow period, putting more pressure on land resources, resulting in the loss of soil nutrients, and biodiversity, increasing susceptibility to soil erosion, and accelerating the conversion of

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virgin and secondary forests to agricultural land. While the majority of the scientific community views shifting cultivation as an unsustainable agricultural practice, others argue for the importance of the practice in social cohesion, and maintaining indigenous culture and identity (Punitha et al., 2018; Thung, 2018).

In India, shifting cultivation is mainly confined to the hilly region of Northeast India (Bhuyan, 2019). The government of India has been introducing different developmental schemes and policies to reduce the dependence of *Jhumias* on shifting cultivation. One approach is encouraging farmers to switch from conventional shifting cultivation crops to high-value cash crops while incorporating additional off-farm activities like dairy farms, poultry farms, beekeeping operations and fisheries to increase revenue (Deka and Sarmah, 2010; Datta et al., 2015; Teegalapalli and Datta, 2016). Despite the attempts to eradicate shifting cultivation, the practice continues to be an important farming system among the indigenous people of Northeast India. Previous studies from Northeast India have attributed culture, tradition and the lack of viable alternatives as factors for the persistence of shifting cultivation (Teegalapalli and Datta, 2016; Punitha et al., 2018; Shangpliang, 2019).

Published literature from India and abroad had focused on pedological impacts of shifting cultivation on soil physicochemical properties (Prasad et al., 2001; Ouattara et al., 2006; Terefe and Kim, 2020), soil microbial communities (Ralte et al., 2005; Miah et al., 2014) and soil macro-faunal communities (Ibrahim et al., 2016; Zodinpui et al., 2019). There are also works on Land Use and Land Cover Change (LULCC) in shifting cultivation areas (Lele and Joshi, 2008; Kurien et al., 2019; Assaf et al., 2021), agronomic problems of shifting cultivation and alternatives to improve the practice (Prakash et al., 2017), effects of shifting cultivation on climate and air quality (Tinker et al., 1996; Prasad et al., 2000; Gupta et al., 2001; Prasad et al., 2002), vegetation recovery patterns in shifting cultivation fallow areas (Gomes et al., 2020; Thong et al., 2020), alternatives to shifting cultivation (Harwood, 1996; Bhatt et al., 2010) and socio-cultural aspects of shifting cultivation (Misbahuzzaman, 2016; Punitha et al., 2016; 2018). There are, however, relatively fewer studies that look into drivers of change from shifting cultivation to other agricultural practices and the consequences of the changes made (van Vliet et al., 2012; Teegalapalli and Datta, 2016).

According to sociological surveys and geographic data from the last decade, fewer people now practice shifting cultivation in India and less land is covered by shifting cultivation than it was in the past (Wastelands Atlas of India, 2005; 2010; 2019). Figure 1 shows the decreasing land areas under shifting cultivation of Northeast India over the years. There has been a growing number of people switching from shifting

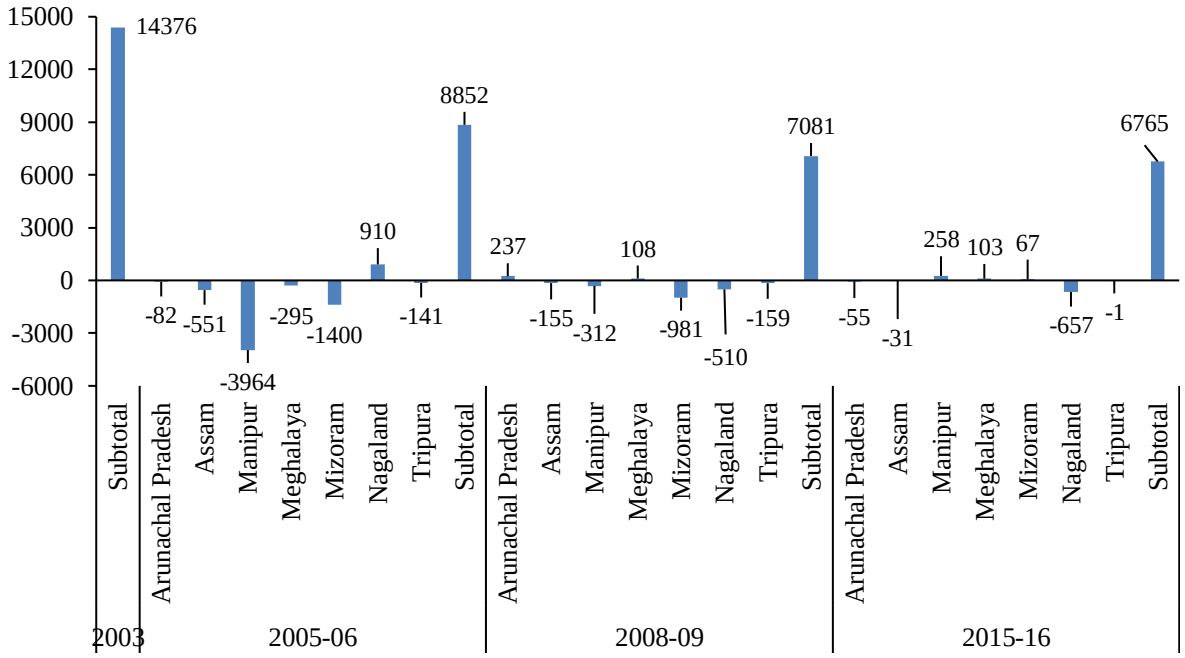

Figure 1. Area change under shifting cultivation in north-eastern states of India from 2003 to 2015-16 (Adapted from the Wasteland Atlas of India, 2005, 2010 and 2019)

cultivation to permanent or settled cultivation, or at the very least combining the two (Teegalapalli and Datta, 2016; Sati, 2022).

This makes it important to understand the factors behind the transition from shifting cultivation to settled or semi-settled cultivation. While van Vliet et al. (2012) discovered that conservation policies, market development, economic structure and population growth led to the abandonment of shifting cultivation on a larger scale, others who looked at the household level scale discovered that labor availability, economic status and cultural affinity were drivers of change (Teegalapalli and Datta, 2016). Socioeconomic status has a significant impact on the well-being of a family (Alegria et al., 2018). Lower socioeconomic position, which correlates with lower educational attainment, poverty and ill health, will eventually undermine societal well-being (American Psychological Association, 2022). On the other hand, a higher socioeconomic level generally leads to an increase in human development parameters and human development has been linked to improvements in sustainable development (Mukherjee and Chakraborty, 2013). Because the majority of the Garo people are Christians, the traditional rites and rituals associated with shifting cultivation forming the people's cultural identity are no longer practiced (Marak, 2014). It is now viewed solely as a practice of supplying additional food and firewood to homes.

This study is an attempt to look at household-level socioeconomic attributes along with economic status and labor availability that serve as constraints or leeway for families in a community without cultural restraints to move away from shifting cultivation to commercial-based settled agriculture. Exploration of influencing factors for transitioning is pertinent to developing effective adaptation strategies and policies that would ensure better livelihood for farmers in the future. With this background, the present study was designed to study 1) the scenario of shifting cultivation in the West Garo Hills District of Meghalaya, 2) the livelihood and economic dependency of people on shifting cultivation and 3) the reasons behind the transition from shifting cultivation to settled agriculture.

MATERIALS AND METHOD

Study area

The study was conducted in West Garo Hills district (WGHD from here onwards), Meghalaya (90°13'28.08" E and 25°34'4.57" N), India. Shifting cultivation is a very common practice in the WGHD of Meghalaya of Northeast India. It is also called "*Aba*", "*Aba-oa*" or "*Jhum kheti*" in Garo, a Sino-Tibetan language spoken in India and mostly in the Garo Hills districts of Meghalaya state. WGHD is characterized by flowing rivers and sloping green hills dominated by secondary forests, plantations and virgin forests. Temperature is hot, humid during summer, cold and dry during winter. Secondary forests are a result of shifting cultivation left fallow for regeneration. In the past, shifting cultivation was the main source of livelihood for the Garo people inhabiting the district (Riahtam et al., 2018). At present, many farmers are transitioning to a settled form of cultivation. Nevertheless, shifting cultivation is still widely practiced in many parts of West Garo Hills and is still the most extensive land use in the district (Kurien et al., 2019). The effect of shifting cultivation is conspicuously seen in the WGHD as most of the Garo tribes depend on the shifting cultivation and forest resources for their livelihood and source of income (Pandey et al., 2021). This is why the region was given priority for the study. The study was conducted in ten villages in the WGHD (Figure 2).

Household survey

The procedure of selecting survey sites includes identifying villages within the district that have engaged in shifting cultivation in the past but predominantly practicing settled agriculture at present. Additionally, villages where shifting cultivation is still actively practiced are also included in the selection process. Due to rugged terrain, inaccessible roads to villages, unavailability of respondents as members usually spending daytime in their farmlands and in some instances, unwillingness of households to participate in the survey, researchers utilized the non-probability convenient sampling technique for selecting households for the survey. The survey involved the interview of the headman (*Nokma* in the Garo language) from every village, followed by interviews with households that were randomly selected. The structured questionnaire, consisting of open-type questions (Teegalapalli and Datta, 2016; Dasgupta et al., 2021) was conducted in 119 households between October 2021 and April 2022 with the help of two local translators who were graduate students. Key informant interviews and focus group discussions were also conducted.

The key informant (headman) interview was focused on gathering information about surveyed villages (e.g., number of households, amenities available and common agricultural practices). Information on socioeconomic background and the agricultural practice of the households with an emphasis on shifting cultivation was obtained during the household surveys. Focus group discussions were aimed at gathering the general outlook of the people regarding their farming practices and shifting cultivation. The period of data collection for the survey also coincided with a reduction in the number of COVID-19 cases in the state of Meghalaya. Therefore, researchers tried to examine the coping strategies of the farmers at a time during the pandemic.

Data analysis

Socioeconomic characteristics such as income, stable income sources and area of cultivation were assessed using the student t-test. Following Islam et al. (2020) and Bui and Nguyen (2022), researchers used the logistic regression (LR) model to find out the factors that influence the farming choices of the farmers in Meghalaya. LR was used to predict the probability of a binary outcome categorical variable, which in this case is the farming mode "settled" and "semi-settled", based on the set of socioeconomic variables. In this study, farming mode (settled/semi-settled) was selected as the dependent variable while socioeconomic information viz., area of cultivation, number of income alternatives, members working as laborers, family size and presence of stable income in a household were selected as socioeconomic explanatory variables. These variables were selected based on area of cultivation, number of income alternatives, presence of members working as laborers, family size and number of stable incomes. In terms of area of cultivation, farmland area affects a farmer's decision to choose the type of land use and land management (Saguye, 2017). An underlying hypothesis for this variable is that households with larger land areas are in a better position to experiment with their land with cash crops along with some areas to ensure food security. In terms of the number of income alternatives, an underlying hypothesis for this variable is that households with more sources of income are in a better position to experiment with different types of crops in their farmland, particularly with cash crops (Bhatta et al., 2016).

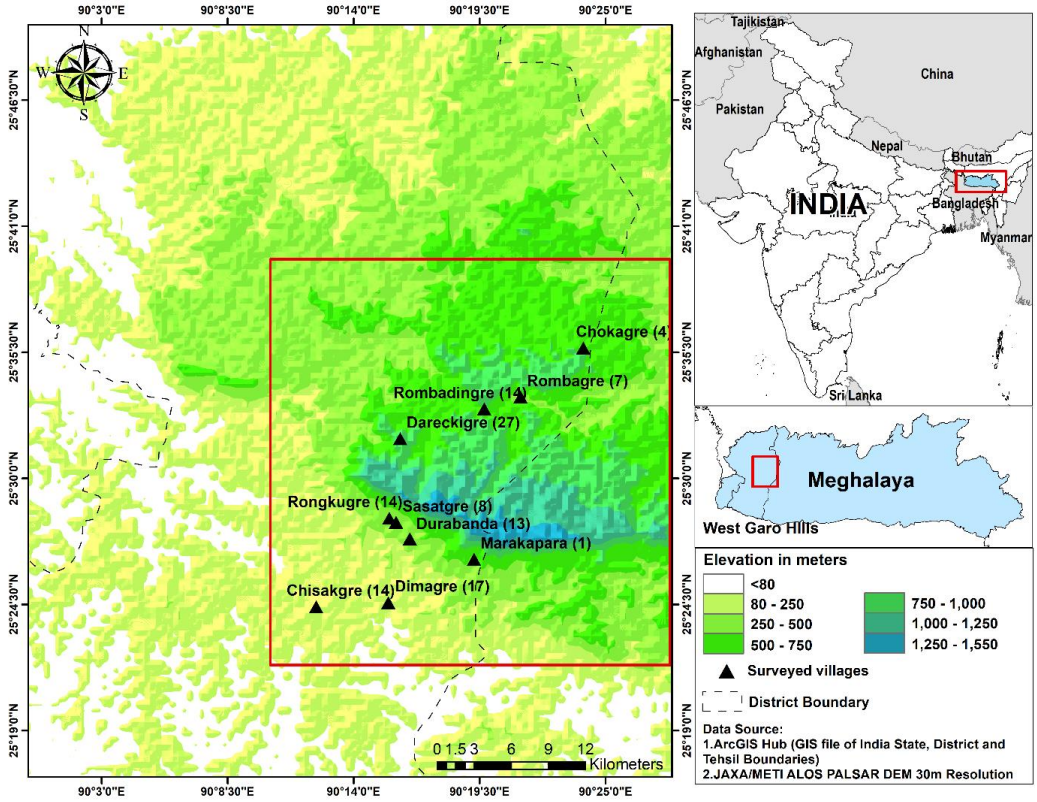

Figure 2. Study map showing surveyed villages (represented by black triangles) in WGHD, Meghalaya

Note: Number of surveyed households is given in brackets

Table 1. Surveyed villages, total number of households in each village and sampled households from villages

Villages	Total households	Sampled households	% Surveyed
Chisakgre	66	14	21
Chokagre	36	4	11
Darechikgre	197	27	14
Dimagre	47	17	36
Durabanda	79	13	16
Marakapara	31	1	3
Rombadingre	117	14	12
Rombagre	79	7	9
Rongkugre	66	14	21
Sasatgre	36	8	22
Total	754	119	16

More alternative sources of income mean there are more ways to earn and provide for food requirements instead of simply relying on farmland for food security. Dealing with the presence of members working as laborers is an indication that those households are more likely to engage in shifting cultivation. The practice's low payoff forces families to seek alternative sources of income, of which daily wage labor is the most prevalent (Teegalapalli and Datta, 2016; Saguye, 2017). Dealing with the family size, the fundamental assumption behind this variable is that homes with more family members would have more mouths to feed, which would motivate the household to engage in shifting cultivation because it is an easier way to guarantee food security. Additionally, it is customary in villages practicing shifting cultivation to assign larger plots to households with more members than to households with fewer members. In terms of the number of stable incomes, stable income refers to income sources available in the area that generate a regular and consistent flow of income for the households. Stable income is an asset that guarantees farming households with income to explore innovations and changes in their agricultural practice (Teegalapalli and Datta, 2016). Concerning WGHD, jobs such as government servants, teaching, shopkeeping and commercial driver could be considered as stable income sources.

Cultural practices, education of the household heads and livestock income were not considered in this model. Almost all of the household heads hold the same education, below the 10^{th} standard, and a significant proportion of the respondents could not provide any information on the income generated from selling livestock.

The general form of the LR with n-independent predictor variables can be written as Equation 1.

$$P(Y) = \frac{1}{1+e^{-(\beta_1+\beta_2+\beta_3+\beta_n x_n)}} \quad (1)$$

Where, P(Y = j) represents the probability that a household chooses farming mode j (settled/ semi-settled), x_1, x_2,...x_n represent the explanatory variables, and β_1, β_2,... β_n are the regression coefficients that are linearly related to P(Y), the probability of choosing settled cultivation or semi-settled cultivation.

RESULTS AND DISCUSSION

The surveyed villages are located in remote places in the district with poor road conditions. The residents have to travel more than 20 km for marketing and banking needs. There are only lower primary and upper primary schools. Transportation services generally include auto rickshaws. Drinking water is drawn from streams using PVC pipes. The women of these surveyed villages have formed Self-Help Groups (SHGs) where they pool money and support each other by providing loans with the money collected from members. The presence of this SHG has been instrumental to these participating women, as they mentioned that they were able to buy livestock as well as other necessities to support their livelihoods through the loans that they availed from the SHG. A few villages have access to health centers and common agricultural machinery, such as rice mills and power tillers in their villages. Others have to travel more than 8 km to avail of such amenities. Although these amenities do not indicate their direct influence on income, they are suggestive of the standard of

the basic welfare and infrastructure available in the surveyed villages. Since all the people in the surveyed villages are Christians, they no longer practice any rituals related to their agricultural practices. Christianity prohibits the practice of traditional rituals that involve the sacrifice of animals or offering prayers to traditional deities. This suggests that shifting cultivation no longer has much cultural significance for the Garo people.

Agricultural practices among the villagers

Households adopting semi-settled or settled cultivation do so in community land areas under the jurisdiction of the *Nokma* (village head). *Nokma* distributes the land among the households based on the family size during the land selection period of shifting cultivation. Farmers wishing to carry out cash cropping have to get permission from *Nokma* to provide the available land. Residents are permitted to carry out cash cropping in the allocated area as long as they need. However, the land still belongs to the clan and the *Nokma* has the right to reclaim it. With a sharp increase in permanent cultivation in the hilly areas, the Garo Hills District Council has imposed the Act of 1960 to regulate and collect land fees from those who use the land for agriculture. According to the Act of 1960, 25% of the fees go to the *Nokma* and the remaining 75% to the council fund. The size of land that a resident can take for cash cropping is also under the discretion of the *Nokma*. Although *Nokma* is a custodian of the land, he does not possess autocratic power because decisions are made in consensus with the elders that constitute the village council (Fernandes and Barbora, 2009; Momin and Mawroh, 2020).

A majority (69.75%) of the farmers in the WGHD adopt a semi-settled agricultural practice, while the rest (29.41%) adopt a settled agricultural practice. Semi-settled cultivation is a combination of settled or permanent cultivation and shifting cultivation. Areca nut, cashew nut, oranges, tea and rubber were a few of the crops grown exclusively for commerce in settled cultivation (Table 2). The crops are grown and maintained for many years, as long as the benefits accrued from the proceeds can sustain the farmer's livelihood. The majority of households (85%) among the *Adis* of Arunachal Pradesh (another hilly state of Northeast India) were also found to be engaged in semi-settled agriculture, followed by 10.63% engaged in settled agricultural practice. The remaining surveyed population relies only on shifting cultivation (Teegalapalli and Datta, 2016). Other countries in Southeast Asia are already undergoing rapid transitions from subsistence agriculture to commercialized-oriented agriculture (Diez, 2016; Ashraf et al., 2017). The semi-settled cultivation among the *Jhumias* of Meghalaya was reported in the late thirties due to the low economic return from shifting cultivation (Deb and Binu, 2016).

A variety of factors based on household resources drive these shifts, which are highly complex and result in different agricultural landscapes (Burra et al., 2021). Because of the ongoing transition, it is common to find the coexistence of subsistence shifting cultivation and commercial-oriented settled cultivation in villages (Milne, 2013). Market-oriented agriculture often increases farmers' income, but this type of agro-economic system is considered risky due to unforeseen events like crop failure, price fluctuations and shifts in market demands (Jamir, 2014; Burra et al., 2021). A multi-crop system like shifting cultivation's subsistence agriculture ensures better food security. This has led to the predominance of dual agricultural systems because subsistence farming can provide a safety net for food provisioning in case market-oriented agriculture fails.

Agriculture for income generation

In this survey, the majority of the respondents (88.2%), both from settled and semi-settled cultivation, took up areca nut cultivation as the main crop for income generation. Other cash crops are cultivated for additional income (Table 2) while crops from shifting cultivation are mostly for food security. Residents of Sasatgre,

Table 2. List of agroforestry crops commonly cultivated by households in the district

Agroforestry crops	Number of households (n = 119)	Households planting the species (%)
Areca nut	105	88.2
Orange	39	32.8
Cashew	28	23.5
Pineapple	13	10.9
Rubber	3	2.5
Other	11	9.2

Rongkugre, Durabanda and Dimagre engage in considerable areca nut cultivation, and researchers found that the proportion of settled to semi-settled farmers is highest in these villages. Superior quality areca nut was produced in Sasatgre and Rongkugre, and therefore, the areca nut from the area fetches a high price in the export market, selling at INR 3,000 to 6,000 per bag (~50kg) before the COVID-19 pandemic. Cashew nuts, which were usually sold at INR 300 per kg, do not have as much export potential as areca nuts, and therefore, areca nuts may be the main determinant for transitioning from semi-settled to settled farmers in the district. Mathur and Bhattacharya (2022) also found that areca nut is the most dominant agroforestry crop amongst settled farmers of two shifting cultivation districts of Tripura, north-eastern India. The authors

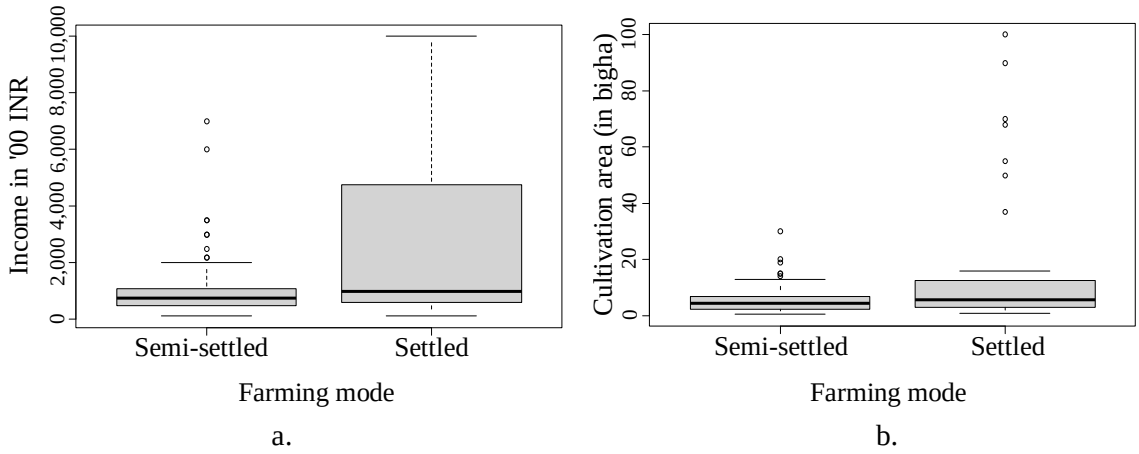

Figure 3. (a) income with farming mode (settled vs semi-settled cultivation); (b) cultivation area of farmers with farming mode (settled vs semi-settled cultivation)

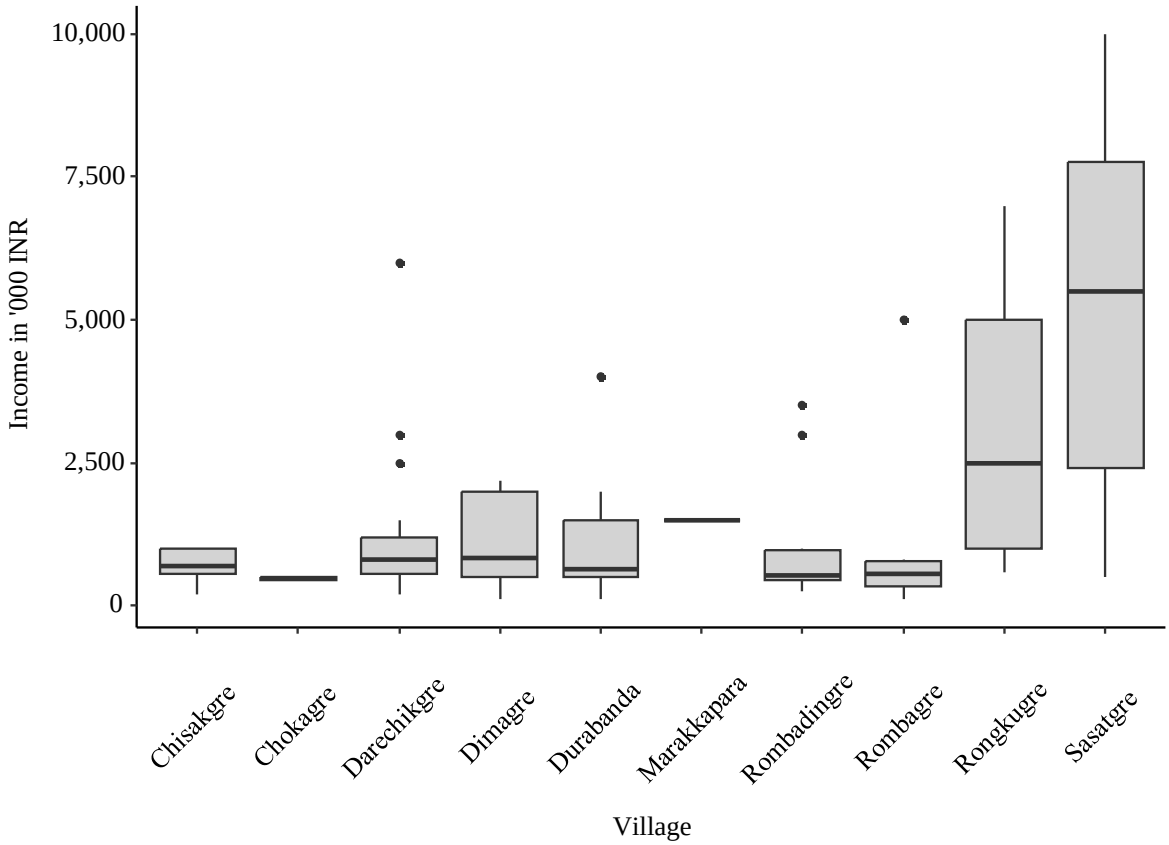

Figure 4. Village-wise average income of households

attributed the dominance of areca nuts in the study area to their low maintenance and high economic returns.

A comparison of the mean annual income and mean area of cultivation of semi-settled vs settled farmers showed that settled farmers generate more income (semi-settled = INR 1,08,646 per year, settled = INR 2,64,157 per year, $p < 0.01$**) and possess more land area (semi-settled = 5.8 bighas, settled =18.5 bighas, $p < 0.05$*) than semi-settled farmers and these differences are statistically significant (Figure 3a and 3b). The income per land area was also found to be higher amongst settled farmers (INR 30021 per bigha) than in semi-settled farmers (INR 27201 per bigha). However, the differences are not statistically significant (p value = 0.61). Lalengzama and Easwaran (2014) also reported similar results in terms of income and area of cultivation. Settled farmers had significantly more income and area of cultivation than semi-settled farmers.

Village-wise income showed that households from Sasatgre followed by Rongkugre had the highest annual income, whereas households from Rombadingre and Chokagre had the lowest annual income. The majority of the respondents of Sasatgre (87%) and Rongkugre (71%) practiced settled cultivation of areca nuts as their main source of income (Figure 4). Also, as per the respondent's information, these two villages are the main suppliers of exported areca nuts in the WGHD. Low-income villages were largely dominated by semi-settled farmers. Possibly, for the same area, settled farmers would make more income as they are maximizing the usage of their available land for cash cropping and nothing else. Whereas, semi-settled farmers may be optimizing their usage of their land for adequate income generation as well as for securing the nutritional needs of the households (Bhuyan, 2019; Pandey et al., 2022).

Family size bears an influence on the amount of food consumed by the family. Thus, there is higher likelihood that households with more family members would involve in subsistence agriculture in order to ensure food security (Siphesihle and Lelethu, 2020). In this study, family sizes are comparatively similar among the two population groups (Semi-settled = 6.8, Settled = 6.3, p value = 0.37). In developing countries, members of a family generally pool their efforts together in their struggle for survival. Thus, family size also has an influence in overall family income when family members in addition to the household head contribute to the family income (Safllios-Rothschild, 1980). However, in this study the results showed that there is no correlation between income and number of family members (r = 0.041).

Education of the household head often correlates with income of the households, wherein higher income was reported from households having more educated household heads (Bilenkisi et al., 2015). However, in this survey, almost all household heads completed lower primary education only without completing the 10^{th} standard, making it less important to include as a study variable. Low levels of education have also been associated as a factor for continuing the practice of shifting cultivation (Rahman et al., 2012). All of the children from the surveyed households pursued education of various standards with no school dropouts reported. However, some families (n = 14) engaged their children in agricultural practice. About 66.7% of households with stable income fall in the settled cultivation group and 33.3% belong to the semi-settled group ($p < 0.01$**). This may be due to the financial ability of stable-income households to afford the investment and labor costs needed for settled agriculture. Shifting cultivation on the other hand is laborious and time-consuming.

Livestock rearing among the farmers

Livestock is an important component among rural communities to earn extra money whenever a need arises. It is also an important asset in providing dietary needs for family nutrition, social gatherings, and manure to enhance soil productivity (Bettencourt et al., 2015). Livestock is a common feature among the farmers of the district because the majority (87.4%) of the households take up livestock rearing. A total of 82.4% of respondents provided details of the kinds of livestock that they rear and among this group, chicken (68.8%) was found to be the most common livestock, followed by cows (50.4%), pigs (36.1%) and goats (9.2%). Livestock rearing is not a specialized activity for livestock production but is only a supplement to their livelihood. Only 48.1% of the group that raised livestock provided estimates of the income generated from selling their livestock, for which most of the households earn around INR 2,000 to INR 10,000 per annum. About 19.2% of the group rear livestock for self-consumption and occasional community gatherings during celebrations and funerals as a custom for villagers. The remaining 32.7% of respondents claimed to be unaware of the amount of money made from

selling livestock. Although livestock rearing has great potential to boost farmers' income, the surveyed villages seem to lack intensive livestock production. The reasons may be insufficient feed to offer their animals, the high cost of commercial feed, the risk of mortality, and longer return periods. Nevertheless, the government of Meghalaya through the Animal Husbandry and Veterinary Department has been putting efforts into alleviating poverty and raising the standards of farmers in the state through livestock production by introducing programs with loans and subsidies along with technical support and guidance to ensure the success of these livestock ventures.

Role of shifting cultivation during the pandemic period

The COVID-19 pandemic has caused the world to pay a high toll in terms of human lives and the economy. The pandemic has also disrupted agricultural activities and commerce of agricultural goods, thereby, affecting nutritional security and farmer's livelihood (Rasul, 2021). Nevertheless, when most sectors of the economy are under stress, livelihood generated from agriculture has served as a cushion against urban job loss for some workers during the peak of the pandemic (Halimatussadiah et al., 2022). Khatri et al. (2023) reported that subsistence farming played a key role in serving as a critical safety net as there was an increased reliance on locally produced food during the pandemic. This survey was started in October 2021, when the second wave of the pandemic slowed down and most protocols restricting movement and marketing were lifted. Researchers were interested to know if the peak season of COVID-19 in Meghalaya had any effect on the agriculture businesses of the respondents. About 94% of the respondents mentioned that their business was indeed affected during the pandemic, as there was a lack of labor, marketing opportunities and customers to purchase goods produced in their fields.

People practicing semi-settled cultivation (95%) were in a better position to meet their dietary requirements than settled farmers. Semi-settled farmers were able to procure vegetables and cereals from their farmlands. Settled farmers had to depend on the market to acquire these food items. About 53.7% of semi-settled farmers stated that shifting cultivation helped to procure vegetables and cereals, and 4.9% stated that shifting cultivation helped to procure vegetables only. About 36.5% of the respondents informed that the produce from shifting cultivation had helped them to fetch some income during the COVID-19 lockdown (Figure 5). Both groups acquired daily rations (e.g., rice, dal and sugar) from the public distribution system. Due to lockdowns and restrictions on the movement of non-essential goods, settled farmers may have experienced more resilience issues than semi-settled farmers because of the COVID-19 pandemic. Furthermore, compared to semi-settled growers, settled farmers have less access to fresh vegetables and cereals. A study conducted in East Kalimantan on community resilience to the impacts of the COVID-19 pandemic revealed that communities that had more access to shifting cultivation areas and autonomy in terms

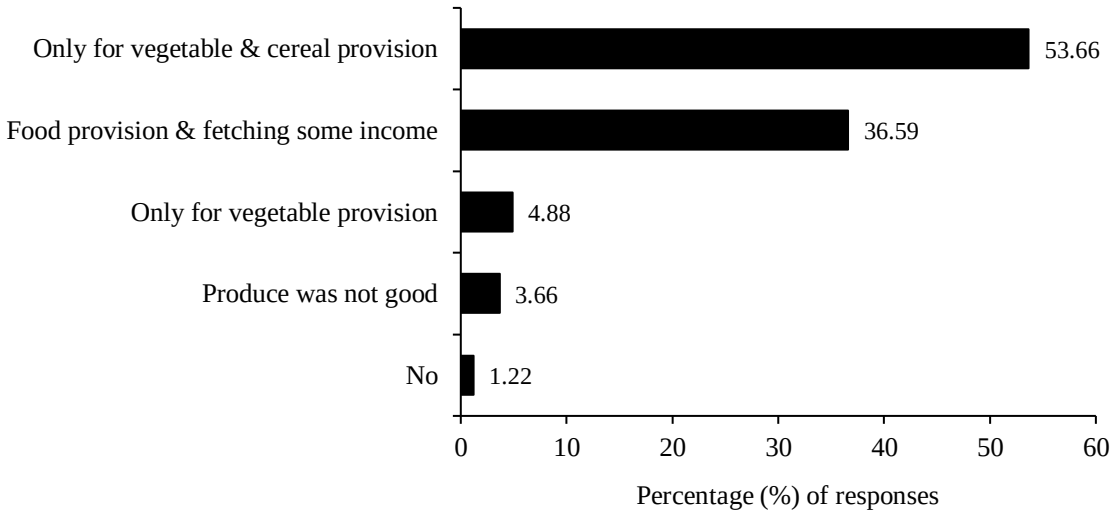

Figure 5. Role of shifting cultivation during COVID-19 lockdown. The responses were gathered from semi-settled farmers only

of forest resource utilization had better resilience (Wahyuni and Wiati, 2021). These communities were able to acquire a livelihood, generate economic activities, and invest in health care during the pandemic.

Factors behind the transition from shifting to semi-settled cultivation

The results of the LR model are presented in Table 3. The results revealed that socioeconomic factors viz., area of cultivation, stable income and the number of members working as laborers were variables that significantly influenced the farming choice of households. As mentioned earlier, the student t-test results showed that settled households hold significantly larger cultivable land areas than semi-settled households. The odds ratio (OR) indicates that a unit increase in the area of cultivation increases the odds for settled cultivation by 1.05 times. A large area of cultivation may influence farmers in choosing settled cultivation. Large areas give room for farmers to take risks in experimenting with cash crops. The success may have eventually motivated the farmers to convert all their available land for cash cropping. In addition, switching to settled agriculture, which is often a mono-cropping system, may incur a higher risk to the farmer in case of crop failure. Mixed cropping systems on the other hand reduce the risk of complete crop failure, as pests and diseases do not equally affect different species of crops (Azam-Ali, 2003).

The results showed that a unit increase in the number of stable income sources raises the odds of practicing settled cultivation by 4.5 times. Households with stable income sources were more likely to abandon shifting cultivation, as shifting cultivation is labor-intensive with low economic output. Researchers found that households with stable income sources had fewer financial constraints in hiring labor needed for initial investment during the transformation of shifting cultivation areas for agroforestry-based cash cropping areas. Teegalapalli and Datta (2016), in a study among the Adis in central Arunachal Pradesh, reported that households with stable income sources (high-income households) mostly practice settled cultivation. They also reported the prevalence of semi-settled cultivation among low-income households. Sati (2022) also pointed out that conversion to settled cultivation is a cost-intensive operation. As the majority of *Jhumias* of Mizoram are generally poor farmers who cannot afford the cost of conversion, only a little expansion in settled cultivation has occurred in the state (Sati, 2022).

The presence of members working as daily wage laborers lowers the odds for settled farming mode by 0.37 times. The reason may be the low payoff from their agricultural activity or that daily wage just helps in fetching an extra income during months where low involvement in shifting cultivation is required. Teegalapalli and Datta (2016) also found a higher degree of practicing shifting cultivation among households with higher labor availability (members who are engaging in shifting cultivation activities).

The two factors (area of cultivation and stable income source) and their coefficients that significantly influence the transition from shifting cultivation to settled agriculture collectively point to the fact that high economic status provides more leeway for farmers to shift from shifting cultivation to settled agriculture. Households with larger land holdings and higher incomes are less constrained by labor costs and the cost

Table 3. Results of the logistic regression model

	Coefficients	Std error	z	P>|z	95% CI		Odds ratio
Constant	-0.154	0.759	-0.203	0.839	0.193	3.796	0.857
Area of cultivation	0.046	0.023	1.998	0.046*	1.001	1.094	1.047
Number of alternative incomes	0.106	0.208	0.506	0.613	0.739	1.672	1.111
Presence of members working as laborers	-1.003	0.473	-2.120	0.034*	0.145	0.927	0.367
Number of family members	-0.125	0.095	-1.317	0.188	0.733	1.063	0.883
Presence of stable income	1.510	0.763	1.980	0.048*	1.015	20.172	4.526

Note: Socioeconomic inputs viz., area of cultivation, number of alternative incomes, number of laborers, number of family members, and stable income in the family as predictors, and settled cultivation is selected as the target group. * Represent 95% statistical significance

of seedlings associated with starting the transformation of shifting cultivation areas and planting cash crops. Generally, the crops that the farmers of WGHD adopt for cash cropping take a minimum of 5 years to mature and be ready for commercialization (interaction with farmers during the survey). Farmers who invested in the transformation of their shifting cultivation farms would have to rely on their remaining shifting cultivation farms for food security and other sources of income during this waiting period. As a result, transformation is challenging for households with limited landholdings and no additional sources of income besides daily wage labor jobs and shifting cultivation. Bhatta et al. (2016) reported that farmers with farm sizes of 1 ha and above made significantly more changes in their agricultural practices compared to farmers with farm sizes below 1 ha area. Food sufficiency was also found to be an important variable influencing farmer in changing their agricultural practices. Bhatta et al. (2016) also revealed that in addition to farm size, lower productivity and fewer sources of income contribute to less food sufficiency, suggesting that these variables may restrict the farmers from changing their agricultural practices.

The limitation of this study is that researchers did not survey the cultivation area of the *Jhumias* to tie the geographical information of the area with the degree of transition of the respondents. A closer look into the geographical conditions of the cultivation area would ensure the degree of success in adopting any cash crop in shifting cultivation sites. Geographical information including the edaphic, topographical and climatic information would serve well in assessing the viability of the crop of interest with the land area. Such information can also help in developing adaptation strategies and land transformation that would be conducive for the crop to thrive. In the district, the abandonment of shifting cultivation seems to be strongly tied to the success of areca nut cultivation. Researchers observed that people were practicing settled agriculture in those areas (Sasatgre, Rongkugre and Durabanda) where superior quality areca nut is produced. Farmers of Rombagre had tried settled cultivation with cash crops (tea and areca nut) as trials in the areas where shifting cultivation was practiced earlier. However, tea productivity and quality were low due to the land's unfavorable topography and climatic patterns. Farmers eventually abandoned tea cultivation. The farmers also stated that the same topographical and climatic condition of the land results in the delectable quality of areca nuts; but the yield of the crop in this particular region was low. Farmers are still practicing settled cultivation of areca nuts with the hope of getting more economic return. Future research can be planned to see the effects of edaphic, topographical and climatic factors on areca nut cultivation. This could serve as an adaptation strategy for the farmers that have tried to adopt this (areca nut) cash crop.

This study indicates that shifting cultivation is still an important component for supporting the needs of households in WGHD. It also indicates that settled cultivation does alleviate the income and status of farmers. Interactions with local farmers who are still engaged in shifting cultivation informed the researchers of their willingness to use cash crops as a way to boost income. Therefore, researchers see the prevalence of semi-settled and settled farmers in WGHD, which represents an ongoing transition from shifting cultivation to semi-settled and finally from semi-settled to settled cultivation in WGHD. This ongoing transition may eventually lead to the disappearance of shifting cultivation from WGHD as more farmers adopt settled forms of agriculture to acquire higher economic returns. Heinimann et al. (2017) expected that shifting cultivation will decrease significantly in all regions of the world in the next 20 years, and shifting cultivation is expected to be left by farmers in India by 2030. However, shifting cultivation may persist if the terrain and topography still pose an obstacle to the adoption of alternatives to this practice in the WGHD.

CONCLUSIONS

A majority (69.75%) of the farmers in the WGHD adopt a semi-settled agricultural practice, while the rest (29.41%) adopt a settled agricultural practice. Income levels showed that settled farmers earn more than semi-settled farmers. While settled farmers devote their time and resources solely to cash cropping for income, semi-settled farmers place their efforts in cash cropping and daily wage labor for income but are dependent on shifting cultivation for food security. Semi-settled farming was also helpful during the pandemic time to get fresh and variety of vegetables. Farmers are also transitioning from semi-settled to settled cultivation for more economic return. The study revealed that the transition mainly depends on the stable income of the family and land available for cultivation.

Along with ongoing efforts to boost settled agriculture in the region, the government should also assist farmers with limited resources in transitioning to settled cultivation by building market networks for the goods produced from shifting cultivation.

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