

## Article

# Tobacco Farmers' Perceptions of Unsafe Tobacco Cultivation and Its Effect on Health and Environment: A Case of Chittagong Hill Tracts, Bangladesh

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**Abstract:** As the environment is severely harmed by tobacco (like growing, processing, production, and disposal), the study was set forth to determine the tobacco cultivation status and perceptions of the tobacco farmers toward the environmental and health hazards of tobacco farmers due to tobacco cultivation. We conducted the study in Lama Upazila, Bandarban Hill District, Bangladesh. The survey method was applied to collect the necessary data, utilizing a pre-structured interview schedule, from 242 tobacco farmers who were selected randomly. The study's results portrayed that the average tobacco cultivation farming experience of the farmers was about 10 years, and the farmers occupied about 0.97 acres of land for cultivating tobacco, while 81% of the tobacco farmers utilized the plain lands for cultivating tobacco, although the study area was a hilly one. A huge amount of fuel wood (average 5390 kg) was required for the curing of tobacco leaves. The farmers produced about 2 MT of tobacco per year and earned about BDT 89,066 (USD 810) from this production. Given that 77% of the tobacco farmers in the research area felt that tobacco production increased the risks to the environment and tobacco farmers health, their opinions ranged from somewhat to highly favorable, which meant they were concerned about the environment and health hazards. The research's findings provide useful background knowledge on the detrimental effects of Bangladesh's tobacco farming.

**Keywords:** tobacco cultivation; perception; environmental degradation; Bandarban; Bangladesh



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## 1. Introduction

Bangladesh is predominantly an agrarian nation with a densely populated country [1,2], with an approximate 39.46 percent labor force employed in agriculture, which accounts for 13.07 percent of the GDP [3]. The sole hill region in Bangladesh, commonly referred to as the Chittagong Hill Tracts (CHT), is located in the southeast of the country. The three hill districts of Bandarban, Rangamati, and Khagrachhari make up the CHT. CHT spans an approximate area of 13,295 km<sup>2</sup> [4].

The items derive from the cured leaves of the plants, namely, *Nicotiana*, which belongs to the Solanaceae family, and are referred to as tobacco. *N. tabacum* is the most common commercial crop out of more than 70 species of tobacco [5]. For smoking, dried tobacco leaves are primarily employed in pipes, shishas, cigars, and cigarettes. Additionally, they

come in snus, chewing, dipping, and snuff variants [4]. Despite the acknowledged negative effects on the environment and health of human beings, tobacco leaf is nevertheless a major agricultural crop in many nations. Tobacco farming is becoming more popular in emerging countries, such as Bangladesh [6,7]. Food crops were grown on Bangladesh's fertile lands in the 1960s, but American tobacco companies began growing tobacco in Teesta, Rangpur, after the country gained independence in 1971. And tobacco farming has become a component of Bangladeshi agriculture since the country's freedom, due to the British American Tobacco Company's promotion. The environment, crop agriculture, and human health are all at risk due to the nationwide proliferation of this unconventional agricultural product [8]. It is grown in several parts of the country, but predominantly in the north- and south-western areas, such as Rangpur and Kushtia, and in the eastern mountainous region, such as the CHT. Because there was an abundant supply of fuelwood in the CHT, especially in Bandarban district (more specifically in Lama and Ali Kadam Upazilas), tobacco production increased dramatically in 1984 [8].

Nevertheless, there have been many severe health, environmental, and social consequences of tobacco production, and it is increasing in popularity in developing and underdeveloped countries. Degradation of soil and loss of forests are among the most documented and widely acknowledged environmental effects of tobacco production [9]. A few effects include lower production of other forest products essential to low-to-middle-income countries, severe shortages of lumber for construction, degradation and decrease in food crop soil yield, and scarcity of cooking wood. Moreover, the depletion of groundwater supplies, the sedimentation of reservoirs, rivers, and irrigation systems, and the alteration of the climate as a result of habitat fragmentation and overexploitation are all possible consequences of tobacco farming [10].

Bangladeshi farmers usually turn to tobacco farming due to commercial inspiration. Although tobacco farmers receive some early cash from tobacco farming, they are unaware of potential future issues such as a deterioration in soil fertility, a decrease in plant diversity, the loss of animals and poultry, and ultimately health issues with themselves [8]. Tobacco cultivation, processing, production, and disposal have a significant negative impact on the environment [11]. Tobacco farming has a variety of harmful consequences. Tobacco production has resulted in significant deforestation. One of the primary reasons for greenhouse gas emissions and climate change is deforestation [12]. One more outcome is biodiversity loss, which has been linked to tobacco-driven habitat fragmentation in Bangladesh [13], Brazil [14], Cambodia [15], Tanzania [16], Uganda [17], and Zimbabwe [18]. It is also linked to land degradation or desertification, which includes soil erosion, lower soil fertility and production, and water cycle disruption [19]. Desertification caused by tobacco growing, on the other hand, has been reported in several Miombo zone countries [20]. Willcock and his colleagues [21] found that from 2008 to 2000, forest cover was replaced by both tobacco and maize cultivation (2.8 million hectares) in eastern Tanzania [21], implying that tobacco cultivation is partly responsible for the greenhouse effect [19]. Tobacco, on the other hand, is typically grown as a monoculture, requiring significant amounts of agrochemicals (such as pesticides, fertilizers, and herbicides) to defend against pests and diseases.

Due to its sensitivity to different diseases, tobacco necessitates the use of up to sixteen pesticides, some of which are illegal to use, like DDT, Aldrin, and Dieldrin [10]. The World Bank announced in 1991 that they would halt financing or explore loans for tobacco-related activities, including the production, processing, or marketing of tobacco products, due to the toxic effects of tobacco on the environment, forests, and public health generally [10]. Growing and curing tobacco in low- and middle-income countries has the greatest negative environmental effects [15]. Meanwhile, some previous studies also identified the detrimental effect of tobacco farming on public health and the surroundings [22,23].

The CHT is basically a hilly and forestry area that is home to thirteen ethnic communities, and subsistence agriculture in the form of 'Jhum' cultivation is the cornerstone of the hill economy. This 'Jhum' cultivation is characterized by 'slash and burn' type shifting farming [24]. This agro-practice is currently struggling to survive because of low

yields, a shortage of cultivable land, and mounting population pressure [24]. Meanwhile, in CHT, one of the most ecologically vulnerable areas, tobacco growing is booming [8]. Despite its detrimental effects, relatively little research has been performed to examine tobacco farmers' perceptions of the effects of CHT tobacco production on the environment and their health [8]. Sultana and her colleagues also studied the spatiotemporal land-use change brought on by tobacco farming. As a result, the current study examined the present situation of tobacco farming and farmers' perceptions of how tobacco production affects both farmers health and the environment in the Lama Upazila of the Bandarban area. Moreover, through this study, we also tried to ascertain the sociodemographic status of tobacco farmers and to sketch the important factors affecting tobacco farmers perceptions toward environmental and health hazards due to tobacco cultivation.

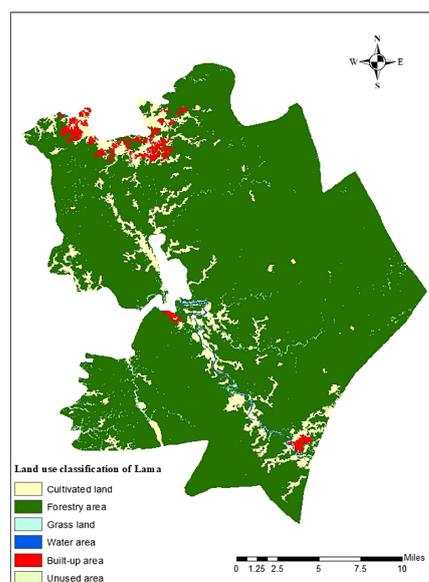
The interpretation of the research methodology, including the variables and methods of measurement, the research site, and the sampling procedure, will be addressed in the next section of the current article. After that, we continue by presenting significant findings. We conclude by discussing the results' significance.

## 2. Materials and Methods

It was a descriptive survey type of study, with the goal of determining the perceptions of tobacco farmers in the CHT toward the environment and health hazards. We also determined the current status of tobacco farming, along with several social and economic aspects of the tobacco farmers and their contribution toward perceptions, and accordingly, we selected one of the tobacco-cultivated areas, namely, Lama Upazila of Bandarban district, as the study area.

### 2.1. Study Area

We purposively selected three unions (the lowest tier of regional administration of Bangladesh), namely, Soroi, Lama Sadar, and Rupshipara of Lama Upazila (the second lowest tier of regional administration of Bangladesh) of Bandarban district, due to extensive tobacco cultivation in these areas. We also took six villages from the three unions, namely, Pulang Para and Aung Keojarpara (Soroi Union), Morakhola Marma Para and Morakhola Muslim Para (Lama Sadar Union), Hafez Para, and Shelartua Para (Rupshipara Union), to collect data from the respondents. The map of Lama Upazila is shown in Figure 1 below:



**Figure 1.** Map showing Lama Upazila of the Bandarban district, Bangladesh.

## 2.2. Population, Sample, and Sampling Technique

The Soroi, Lama Sadar, and Rupshipara unions had a total of 205, 237, and 203 tobacco farmers, respectively. This meant that 645 tobacco farmers overall from these three unions were taken into consideration for the study's population. Meanwhile, using a random sampling technique, we selected 242 tobacco farmers in total (38% of the total population; 73, 95, and 74 from the Soroi, Lama Sadar, and Rupshipara unions, respectively). The sample size calculation process was explained at <https://fr.surveymonkey.com/mp/sample-size-calculator/> (accessed on 21 March 2020), and, using that information, we applied Formula (1) to establish the study's sample:

$$n = 1 + \left( \frac{z^2 \times P(1 - P)}{e^2 N} \right) \quad (1)$$

where  $n$  is the sample size taken into consideration,  $N$  is the total number of respondents, and  $z = 1.96$ , a constant established by convention based on the accepted error. A 95% confidence level and a 5% margin of error might be obtained with the sample size at  $p = 0.5$ .

Then, in order to obtain crucial information from the respondents, a face-to-face personal interview was performed using the structured interview schedule. The interview schedule contained both closed and open forms of questions.

## 2.3. Various Independent Variables and the Methods Used to Measure Them

Farmers' perceptions are actually influenced by several factors. As noted by Jha and Gupta [25], farmers found it challenging to execute adaptation methods against climate change in the absence of accurate perceptions. Additionally, they found that a greater perception of climate change promotes the application of appropriate adaptation techniques and increases adaptability. However, they came to the conclusion that people's perceptions were very subjective, location-specific, and impacted by a number of factors. Among these were the farmers' cognitive abilities, which differ throughout households and are influenced by demographic characteristics including age, gender, educational attainment, place of residence, and ethnicity, with more sociodemographic aspects [26,27]. Accordingly, several factors were responsible and related to the tobacco growers regarding health risks and environmental hazards due to tobacco cultivation. We selected eight factors as independent variables for the study and measured each one in accordance with its characteristics.

(i) The age of the respondents was calculated in years based on their responses, and a score of one was assigned for each year of age. (ii) When measuring family size, we assigned a score of one to each member of the household (including the couple, their children, and other dependent members). (iii) A respondent's educational qualification was measured in terms of degree attainment from formal education systems (i.e., primary school, high school, etc.), and accordingly, a respondent was provided a score of one for each year of schooling. (iv) A respondent's total earnings from a variety of sources, including business, services, and agriculture, were used to determine their annual family income. The currency used was the US dollar. (v) The total number of days a respondent spent receiving various agriculture-related training over the course of their life was used to calculate the amount of agriculture-related training they had received. (vi) Meanwhile, we calculated the total land holding by means of the sum of all areas (homestead area, own land under own cultivation, land taken from or provided to others on lease). It was expressed in acres. (vii) Tobacco land holding was estimated as the respondents' entire land area, which was used solely for tobacco cultivation and measured in acres. (viii) The entire earnings from tobacco cultivation in a year were used to compute a respondent's tobacco income, which was also stated in USD.

## 2.4. The Dependent Variable and the Method of Measurement

Perception is the term used to describe the sensory perceptions of the world. It requires both the recognition of environmental cues and the execution of responses to

those cues. Through the perceptual process, we obtain knowledge of the characteristics and components of our environment that are essential to our existence. Perception not only shapes our perspective of the environment, but it also makes it possible for us to engage with it [28]. Tobacco farmers’ perceptions toward the environment and health hazards were perceived as the dependent variables for the present study. To recognize this, we requested feedback from the participants regarding 15 statements pertaining to health and environmental risks. Accordingly, a 5-point Likert-type scale (strongly agree, agree, uncertain, disagree, and strongly disagree) was used to evaluate the respondents’ perceptions. The scores were strongly agreed (5), agreed (4), uncertain (3), disagreed (2), and strongly disagreed (1). A similar type of measurement technique was also followed by [29].

Additionally, we evaluated the reliability of the perception statements in the interview schedule using Cronbach’s alpha test. The alpha coefficient of this test, which ranges from 0 to 1, is used to assess the validity of the statements used in the Likert scale [30]. Cronbach’s alpha was computed using the following Formula (2):

$$\alpha = \frac{K\bar{C}}{\bar{v} + (K - 1)\bar{C}} \tag{2}$$

where for the present sample of farmers,  $c$  is the mean of all covariances between the components,  $v$  is the average variance of each component (item), and  $K$  is the number of scale items. The results of the alpha test are shown here in Table 1, below:

**Table 1.** Item analysis of 15 perception statements.

Statement	Mean of Scale If Item Removed	Variance Scale If an Item Is Deleted	Total Correlation of Correlated Items	Alpha If the Item Is Removed
1.	52.5000	52.5000	52.5000	0.816
2.	52.6875	52.6875	52.6875	0.817
3.	52.8594	52.8594	52.8594	0.815
4.	52.8438	52.8438	52.8438	0.814
5.	52.8906	52.8906	52.8906	0.816
6.	53.3438	53.3438	53.3438	0.818
7.	53.2656	53.2656	53.2656	0.819
8.	52.4062	52.4062	52.4062	0.840
9.	52.9844	52.9844	52.9844	0.827
10.	53.1094	53.1094	53.1094	0.839
11.	52.5312	52.5312	52.5312	0.853
12.	53.3594	53.3594	53.3594	0.826
13.	53.2188	53.2188	53.2188	0.859
14.	52.8906	52.8906	52.8906	0.822
15.	52.0781	52.0781	52.0781	0.837
Reliability coefficient for the 15 statements			<b>Cronbach’s Alpha</b>	<b>Alpha of Standardized Item</b>
			<b>0.838</b>	<b>0.853</b>

The perception statements of fifteen respondents in total were evaluated, and the above method was used to calculate the perception statements’ reliability [31], and 0.838 was discovered to be the value of alpha. Cronbach’s alpha internal consistency values are commonly interpreted as follows: >0.5 indicates poor, <0.5 shows unacceptable, >0.6 indicates questionable, >0.7 indicates acceptable, and >0.9 indicates excellent [32]. The perception statements might be considered dependable as the Cronbach’s alpha value was 0.838.

#### 2.4.1. Assessing the Respondents' Perceptions of the Environment and Health Risks Associated with Tobacco Farming

Using an easy two-step process, we constructed an environment and health hazard perception index (EHPI) that took into account the following elements (Equation (3)):

$$EHPI = \sum_{j=1}^{15} \sum_{m=0}^5 \sum_{q=0}^1 E_j R_m W_q \quad (3)$$

The sample respondents were given a total of 15 perception statements about the health and environmental risks associated with tobacco farming, and they were then asked for their opinions ( $E_j$ ). Next, we gave each identified perception a value of 01, and if none, we gave it a value of 0. The respondents were asked to express their opinions on a five-point rating system ( $R_m$ ) in the second phase. As a result, each highly agreed response received a score of 05, while each strongly disagree response received a score of 1.

Following that, we created a weighted score ( $W_q$ ) using these ranks. Next, we placed 02 at position 01, which was the lowest, and 01 at rank 05, which was the highest. However, the weighted score was added up to determine each respondent's EHPI. Some other researchers (like [33,34]) also utilized this formula and calculation.

#### 2.4.2. Assessing the Respondents' Perceptions of Tobacco Cultivation and Forest Cover Change

Through this study, we tried to comprehend the respondents' perceptions about the tobacco cultivation situation as well as the forest situation in the study area. Accordingly, we asked the respondents whether the tobacco cultivation and forest situation of the study had changed, increased, decreased, or remained the same as before. Here, the forest situation meant the overall forest area and the different services obtained by the respondents from the forest areas. We then simply allocated a score of 03 for increase, 02 for remaining the same, and 01 for a decrease response. Following the collection of all replies from the sample respondents, we computed and displayed the information.

#### 2.4.3. Procedure for Multiple Linear Regression

To find out what influences tobacco farmers' perceptions of the environment and health risks related to tobacco cultivation, we employed full-model regression analysis on the eight independent variables, including participants' age, size of family, background in education, yearly family income, tobacco income, agriculture-related training, total land holding, and tobacco land holding. Next, we ran the linear regression model because of the characteristics of the dependent variable. Consequently, the latent equation (Equation (4)) that was employed in this study is as follows:

$$y = \beta_0 + \beta_1 x_1 + \beta_2 x_2 + \dots + \beta_8 x_8 + \varepsilon \quad (4)$$

where  $y$  is denoted as the dependent variable,  $\beta_0$  represents the intercept,  $\beta_{1-8}$  is characterized as the coefficient, and  $x_{1-8}$  is denoted as the independent variables.

The following independent variables affected how respondents felt about the environment and health risks related to tobacco cultivation:

- $x_1$  = Age of the respondent in years;
- $x_2$  = Size of family in numbers;
- $x_3$  = Background in education in years;
- $x_4$  = The respondents' family yearly income in BDT;
- $x_5$  = Respondents training received on agriculture;
- $x_6$  = Respondents total land holding;
- $x_7$  = Respondents tobacco land holding;
- $x_8$  = Income from tobacco in BDT.

Following the collection of data from study participants, we classified and categorized the data in accordance with the goals of the investigation. Furthermore, we estimated the

contribution of the attributes using multiple regression analysis with significance values of 5% and 1%. To analyze the data and generate the findings, we used the SPSS (v.26) software.

### 3. Results

#### 3.1. Current Status of Tobacco Cultivation in the Study Area

The current status of tobacco cultivation in the study area is discussed in Table 2. The findings in Table 2 show that the amount of land used for tobacco production in hilly areas has increased significantly, despite the fact that tobacco cultivation is widely practiced in Bangladesh's northern districts. The main reasons for this are that growing tobacco is more profitable, it is easier to access markets, other crops' market prices are uncertain, it is an ancestral occupation, and there are incentives (loans, seeds, fertilizer, pesticides, etc.) and technical support from companies, among other things. Talukder et al. [35] highlighted that Bangladesh produces a significant amount of tobacco around the world and is ranked as the 14th biggest tobacco producer in the world. Table 2's findings reveal that the majority of respondents (43.1%) had medium-sized land, followed by large (30.8%) and small land (26.2%). This reveals that around 74.9% of the respondent farmers possessed medium-sized to large tracts of tobacco land. Meanwhile, the farmers in the study site cultivated tobacco in both hilly slope land (18%) and plain land (82%). For many years, the production of tobacco has been shifting from one place to another, not because farmers have become more interested but rather because the soil fertility in the locations where it is grown has declined and sources of firewood have been destroyed. It should be emphasized that tobacco farming is profitable compared to several other crops. Because of this, the research region's respondents grew tobacco on both their plains and their property on a mountainous slope. The respondents have been cultivating tobacco for many years in the study region. From 2 to 40 years, the respondents farmed tobacco on their properties for increased output and profitability.

According to information in Table 2, each season of tobacco cultivation required, on average, 5397 kg of fuel wood for curing purposes. It is significant to note that while respondents in the study area used 840 kg to 26,124 kg of fuel wood per season, roughly 44.6 percent of respondents needed more than 5000 kg per season. The respondents heavily rely on natural forests to meet their needs for fuel wood. Through their research, Akhter et al. [36] noted that there were 8500 kilns in total spread across three upazillas in the districts of Bandarban and Cox's Bazar of Bangladesh, each of which required a sizable quantity of wood from the hill forests, and 10 tons of firewood per kiln were needed each tobacco season, totaling 85,000 tons of firewood throughout the region. For firewood, a mature tree yields around half a ton. Extrapolated, 170,000 trees must be cut down in order to cure tobacco in this region. They also came to the conclusion that the hilltops' denudation causes soil erosion, which makes areas vulnerable to flash floods. For effective production, both fertilizer and chemical requirements are much higher, such as urea, TSP/DAP, pesticides/fungicides (such as Bovistin, Ridmil, etc.) [36]. The respondents required quite a bit of cash to cover this expense. Although the average cost of growing tobacco was BDT 63,538 (USD 578), tobacco producers spent a lot of money on wood curing. The research area's respondents produced a significant amount of tobacco each year, exploiting their land resources, ranging from 480 kg to 7000 kg. In the research area, the average yearly production of tobacco by the respondents was 2017.44 kg, or around 2.02 MT. 3222 MT of tobacco were produced overall in the Bandarban district in 2019–20 [37]. As a result, tobacco output showed that the Lama Upazila in the Bandarban district was a better region for producing tobacco. The respondents' tobacco cultivation-related earnings ranged from USD 91–1410, with USD 810 being the average.

**Table 2.** Distribution of the extent of tobacco cultivation.

Characteristics	Categories	Respondents (%)	Observed Score	Mean
Tobacco land holding	Small (<0.5 acre)	26.2	0.02–2.8 acre	0.97 acre
	Medium (0.51–1.00 acre)	43.1		
	Large (>1.00 acre)	30.8		
Tobacco land position	Hilly slope land	18.0	--	--
	Plain land	82.0		
Experience cultivating tobacco	Less than 10 years	66.2	2–40 years	10.14
	11–20 years	27.7		
	More than 20 years	6.1		
Tobacco curing wood collection	From natural forest	30	--	--
	From self-garden	15		
	From wood shop	55		
Tobacco curing wood requirement (kg)	Fewer than 1000	30.8	480–16,794 kg	5397.60 kg
	1001–3000	12.3		
	3001–5000	12.3		
	Over 5000	44.6		
Tobacco cultivation expenditure	Fewer than USD 35,000/389	15.4	10,000–140,000 Tk (USD 91–1273)	BDT 63,538/USD 578
	35,001–70,000 (USD 389.01–378.00)	55.4		
	Over 70,000 (USD >378)	29.2		
Tobacco production (kg/year)	Fewer than 1000	27.8	480–7000 kg	2017.44
	1001–2000	33.8		
	2001–3000	24.6		
	Over 3000	13.8		
Tobacco income	Income (BDT <50,000) (USD <556)	7.6	BDT 10,000 to 155,000 (USD 91–1410)	BDT 89,066 (USD 810)
	Income (BDT 50,001–100,000 (USD 556.01–1111)	66.2		
	Income (BDT >100,001) (USD >111)	26.2		

USD 1 = BDT 110.

### 3.2. Sociodemographic Profile of the Respondent Farmers

The sociodemographic characteristics of the respondent tobacco farmers are presented in Table 3, below. Based on the data shown in Table 3, the age group of 41 to 50 years old accounted for the largest percentage of respondents (33.8%), followed by the age group of 31 to 40 years old (29.2%), with an average age of 41.45 years. Families with five to six people make up the majority of respondents' families (43.10%), with an average family size of 5.48—higher than the 4.06 national average [38]. Primary-level education accounted for the largest percentage of respondents (43.1%), followed by secondary-level education (26.2%). Three-fourths (76.9%) of the families fell into the BDT < 100,000 income category, with an average BDT of 91,064, which was much less than the BDT 165,200 national average income in Bangladesh's rural areas [38].

Table 3's information also reveals that the majority of respondents (67.7%) had 1–4 training on topics relevant to agriculture, and 75.4 percent of them had 1–3 training on growing tobacco. A sizeable segment of the participants (75.4%) belonged to the small land (0.51–2.47 acre) holder category with an average of 1.55 acres of land, and it was less than the national average

(1.97 acre) [39]. In the case of tobacco land holdings, most (73.9%) of them possessed medium (0.51–1.00 acre) to large (>1 acre) land areas.

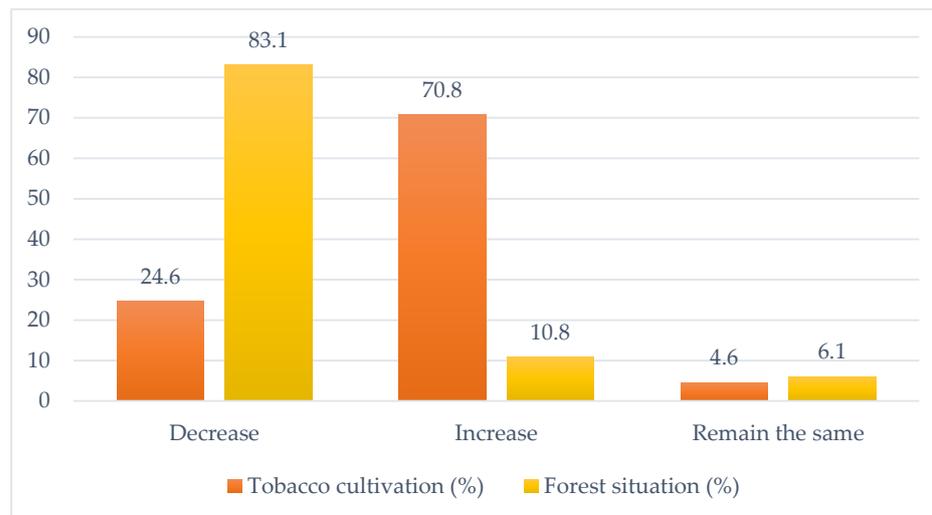
**Table 3.** Socio-demographic profile of the tobacco farmers.

Sociodemographic Factors	Classes	Respondents (%)	Observe Score	Average Score
Age	Up to 30 years	18.5	25–65 year	41.45 year
	31–40 year	29.2		
	41–50 year	33.8		
	51–60 year	15.4		
	More than 60 years	3.1		
Family size	Up to 4	30.70	2–10	5.48
	5–6	43.10		
	More than 6	26.20		
Education level	No formal education	30.7	0–10	3.37
	Primary (1–5)	43.1		
	Secondary (6–10)	26.2		
Total annual family income	BDT < 100 K	76.9	BDT 202–580 K	BDT 91 K
	BDT 101–200 K	18.5		
	BDT 201–300 K	3.1		
	BDT > 300 K	1.5		
Agricultural training received	No training (0)	30.8	0–5	1.43
	Training no. 1–4	67.7		
	Training no. (more than 4)	1.5		
Tobacco training received	No training (0)	20.0	0–4	1.54
	Training no. 1–3	75.4		
	Training no. (more than 3)	4.6		
Total land holding	Landless (<0.05 acre)	1.5	0.05–4.0 acre	1.55 acre
	Marginal (0.05–0.5 acre)	7.7		
	Small (0.51–2.47 acre)	75.4		
	Medium (2.48–7.41 acre)	15.4		
	Large (>7.41 acre)	00		

### 3.3. Perceptions of Respondents Regarding Tobacco Cultivation, Its Effects on the Environment, and Health Hazards

#### 3.3.1. Perception toward Tobacco Cultivation and Forest Situation

There exists a close relationship between tobacco cultivation and forest situations (like forest clearing), and in this connection, through this study, we tried to explore the respondent's perceptions of tobacco cultivation and forest situations. Accordingly, we collected the response data and constructed the following Figure 2 below:



**Figure 2.** Respondents' perceptions of tobacco cultivation and the forest situation.

Figure 2's data show that 71% of study area respondents thought that the amount of tobacco grown had increased. Just 4% of respondents thought that there had been no change in tobacco cultivation in the research area, while over 25% thought that it had decreased. On the other hand, almost 83% of respondents thought that there was less forest now, compared to 11% and 6% who thought it had increased or stayed the same. Sultana and their colleagues [8] conducted their studies in the Rupshipara union of Lama upazila and, after analyzing the satellite images, found a 95.05% growth in tobacco cultivation in the region between 1989 and 2012.

Sauer and Abdallah [9] recognized that deforestation and eventually desertification are largely caused by the overuse of wood for tobacco curing, unsustainable tobacco growing, including unrestricted clearing of land, and the habit of burning farm residues. The farmers at the study site are still relying more on their surrounding forest plants (wood) to cure tobacco leaves. Sultana et al. [8] conducted their study in one union of the Lama upazila in the Bandarban district also observed that the tobacco farmers used to collect huge amounts of tobacco curing firewood from their nearest forest areas. Moreover, Akhter and his associates [36] reported that Bangladesh ranks third globally among the nations where deforestation is caused by tobacco cultivation. Hence, the current findings were in line with these findings.

### 3.3.2. Perception of the Respondents toward Environment and Health Hazards

We calculated the individual perception score of the respondents' farmers (on 15 statements) toward environment and health hazards due to tobacco cultivation and developed the following Table 4:

**Table 4.** Individual perception score of the perception statements.

Sl.	Statements	EPI Score
<b>Statements related to environmental hazards</b>		
1.	Tobacco cultivation causes huge environmental damage	0.83
2.	Tobacco farming is causing a decline in soil fertility	0.79
3.	Soil water holding capacity is decreasing as a result of tobacco farming	0.77
4.	Excess fertilizers and pesticides are required for tobacco cultivation	0.87
5.	Tobacco farming is causing a decline in "Jhum" cultivation	0.73
6.	Farmers are concerned about the good price of tobacco but not about the environment	0.85

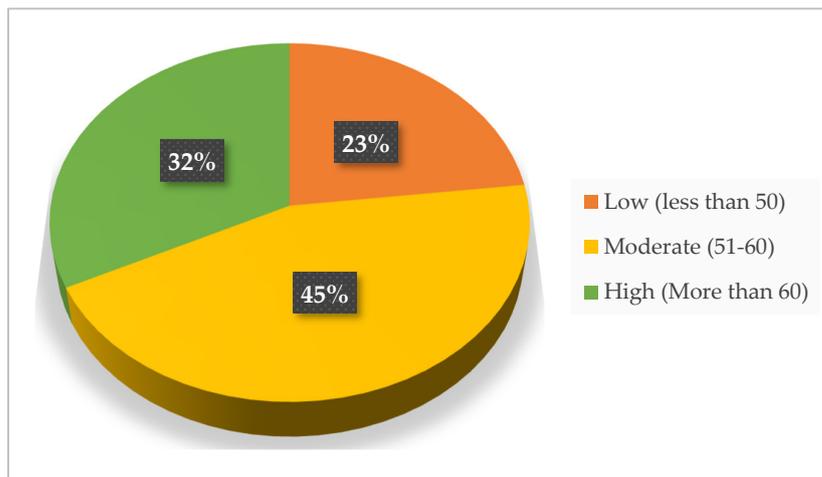
**Table 4.** Individual perception score of the perception statements.

Sl.	Statements	EPI Score
7.	Deforestation is occurring in my area due to tobacco cultivation	0.69
8.	We are interested in the tobacco company's incentives to cultivate tobacco but not in the environment and biodiversity	0.91
<b>Statements related to health hazards</b>		
9.	Food crisis is happening due to decreasing 'Jhum' cultivation, causing poor health	0.71
10.	Schools' nearby tobacco fields create health hazards for the students	0.65
11.	Pregnant women and children face health problems due to tobacco cultivation	0.75
12.	Toxic waste in tobacco fields pollutes the nearby drinking water	0.76
13.	Toxic wastes in the tobacco field are hampering fish, microorganisms, and public health	0.75
14.	Tobacco leaf marketing is responsible for decreasing the health of tobacco-related workers	0.66
15.	We are suffering different physical problems due to tobacco cultivation	0.68

Based on the facts displayed in Table 4, it was determined that the highest EPHI score (0.91) was found in the statement, "tobacco companies give us advance money, insecticide, marketing facilities and many more facilities for tobacco production". This was followed by an EPHI score of 0.87, in which the statement was "excess fertilizer and pesticides are required for tobacco cultivation in every year". The third highest ranked EPHI score was 0.85, and the statement was "good price of tobacco leaves motivated farmers to cultivate it more". Meanwhile, we witnessed the lowest EPHI score (0.65) with the statement, i.e., "closeness of tobacco fields with the schools help to increase the health hazards of students". The second lowest EPHI score (0.66) was found in the statement, "tobacco leaf marketing is responsible for decreasing forest area in Chittagong hill tracts".

Next, we created Figure 3 below by calculating the tobacco farmers' overall perceptions of the environmental and health risks associated with tobacco farming in the research area. Each respondent's score for each of the 15 statements was totaled up to determine the respondents' perception score regarding the environmental and health risks associated with tobacco production. Accordingly, a respondent's perception score could range from 15 to 75, where 15 represents "extremely poor perception" and 75 represents "extremely strong perception". The respondents' perception scores were divided into three categories: high (more than 60), moderate (51 to 60), and low (up to 50) using the mean  $\pm$  SD formula. Here, tobacco farmers' high perceptions of the environmental and health risks due to tobacco cultivation suggests that they are particularly aware of or concerned about the harmful impacts of tobacco cultivation on the environment and on their health.

The majority of respondents (45%) had a moderate perception of the harm that tobacco farming does to the environment and health of tobacco farmers, based on data from Figure 3. Only 23.1% of respondents had a low perception, compared to 32.3 percent who did. This is a result of the respondent's observations and understanding of the field under study. This is a result of the respondents' observations and knowledge of the studied region. Any man's awareness, knowledge, and education can shape his perception. A person can become more knowledgeable and reasonable, which increases his awareness, through education. Alotaibi et al. [40] discovered similar results, indicating that 65% of farmers expressed a moderate level of anxiety about climate change. Grimberg et al. [41] found that, whereas 48.3 percent of American farmers expressed concern over climate change, 86.7 percent expressed moderate to high concern about how it might affect agricultural productivity.



**Figure 3.** Respondents’ overall perceptions toward the environment and health hazards due to tobacco cultivation.

*3.4. Contribution of the Tobacco Farmers’ Chosen Traits to Their Perceptions of the Health and Environmental Risks Associated with Tobacco Growing*

To identify the factors influencing the respondents’ perception of environmental degradation caused by tobacco cultivation, we conducted a full model regression analysis using all eight independent variables (i.e., age, family size, educational level, per-year family income, training received related to agriculture, ownership of total land, and tobacco land and income from tobacco cultivation). The regression results, which are shown in Table 5, show that the respondents’ age, level of education, agricultural training, and ownership of tobacco land all had a significant impact. The R<sup>2</sup> value was 0.654, which demonstrated 65.4% variation in the perception of environmental deterioration related to tobacco cultivation. Table 5 below discusses how the chosen criteria affected the respondents’ perceptions.

**Table 5.** Contribution of the chosen attributes of the responders regarding their perceptions of health and environmental risks.

Sl. No.	Variables	Estimated Coefficient (β)	SE	t-Value	p
01	Age	0.473 **	0.105	4.440	0.008
02	Size of family	−0.038	0.695	−0.333	0.740
03	Educational level	0.508 **	0.115	4.811	0.000
04	Per-year family income	0.051	0.100	0.534	0.596
05	Training received related to agriculture	0.254 *	0.491	2.122	0.038
06	Ownership of total land	−0.054	1.344	−0.458	0.649
07	Tobacco land ownership	0.541 **	0.687	5.745	0.007
08	Income from tobacco cultivation	0.088	0.738	0.747	0.458

R = 0.809, R<sup>2</sup> = 0.654, Adjusted R<sup>2</sup> = 0.583, F = 9.118, \*\*—1% LOS, \*—05% LOS.

The results presented in Table 5 indicate that respondents’ age significantly and favorably influenced their perceptions of how tobacco farming was causing environmental deterioration and health risks. The value of the regression coefficient was 0.473 (significant at the 1% level), indicating that as people age, their perspective on how tobacco farming is destroying the environment as well as their health will also grow. However, researchers in Bangladesh (such as [42]) discovered that farmers’ awareness of climate change varied according to their age. Ghosh et al. [43] found a similar significant and favorable effect of age and respondents’ knowledge of sustainable farming in a different study conducted in Bangladesh. Furthermore, farmers’ perceptions of environmental degradation brought

about by tobacco cultivation were positively and significantly influenced by their level of education. The regression coefficient of 0.508, which indicated that one unit more of education would increase respondents' perceptions of environmental degradation owing to tobacco cultivation by 0.508 units, made this assertion significant at the one percent level. This indicates that respondents' perceptions would improve if their level of education rose. Saha et al. [29] found in Bangladesh that farmers' educational attainment had a significant and positive contribution toward ecosystem service perception. In a similar vein, several researchers discovered a comparable and noteworthy impact of educational degrees through their individual investigations. The results presented in Table 3 show that the farmers' impression of environmental deterioration as a result of tobacco cultivation had been impacted by their agricultural training, as the computed " $\beta$ " value was 0.254 (5% level of significance). This suggests that if local farmers obtain greater training in agriculture, their perceptions will change for the better. Similar results were obtained by Hasan et al. [44], who found that farmers' responses to floating agriculture for food security and sustainable development depended on their level of agricultural training. Other researchers (such as [4,33]) have also discovered via their studies that agricultural training significantly and positively affects farmers' attitudes and perceptions. Meanwhile, the tobacco land ownership of the farmers was also found to have a positively significant contribution to their perceptions of health and environmental hazards due to tobacco cultivation. The computed " $\beta$ " value was 0.541, which was significant at the 1% level. The findings indicate that with every increase in the farmers tobacco lands, there will consequently be an increase in their perception toward the harmful effects of tobacco cultivation on both their health and their surrounding environment.

#### 4. Discussion

Bangladesh is mostly an agriculturally-oriented country with a rural majority. Moreover, this country is well-known for growing a wide variety of tropical crops, such as oilseeds, legumes, sugarcane, wheat, paddy, tobacco, and jute [45]. Although tobacco cultivation has a prospect that also contributes one percent of the GDP of the country, due to its heart-threatening issue, the cultivation of tobacco has been discouraged. Due to the production of numerous harmful waste products, the tobacco sector has significant negative effects on biodiversity, climate change, deforestation, and ecological imbalance [19]. The CHT is the only significant hilly region in Bangladesh, accounting for almost 10% of the country's total size, and this area is important for maintaining the balance of ecosystem services of different types, including purification of air, preservation of soil, detoxification of water bodies, etc. [46]. The CHT of Bangladesh is home to a large tobacco farming population.

It is almost always required to cure tobacco right away after it is harvested if it is to be used for smoking or chewing. Because tobacco leaves are cured in order to change their color and have less chlorophyll, the process is also referred to as "color curing". The procedure by which the harvested tobacco leaf is prepared for the market is known as curing, which is the term used for drying tobacco. The desirable characteristics of the cured leaf are obtained through a well-standardized procedure that also involves the elimination of moisture [45]. The quality of the cured leaf is directly impacted by the curing procedure. The responders in the research area used wood to cure tobacco. When asked if they obtained these woods from natural forests, their own gardens, or by buying them from wood shops, they indicated that 55% of them obtained the wood from wood shops and another 30 percent obtained it from natural forests in their responses. Green tobacco leaves need to be cured after harvest, which is accomplished over wood fires in a special form of furnace called a kiln. As a result, a significant amount of fuel wood is required for tobacco curing in the research area [45].

The parameters related to tobacco cultivation were studied in Bangladesh by Talukder et al. [35]. They determined a number of variables that prompted farmers to encourage tobacco farming more quickly. The following were some of the significant factors: lower levels of education, short-term financial support from tobacco companies for growing

tobacco, ease of market sale of tobacco products, easier access to credit (also provided by the tobacco companies), and farmers' perceptions of higher profits from tobacco cultivation relative to other crops. Bangladesh continues to produce tobacco in part because, like in many other nations, the tobacco industry offers low-interest loans, inputs, and a future price for the farmers' output. The majority of farmers select the contract system because of the tobacco companies' first attractive inputs [47]. These offerings are quite alluring to poor farmers who are constrained by cash and both fixed and working capital. Additionally, as tobacco is a common agricultural product and a cash crop, it is qualified for almost all forms of government assistance, such as reduced irrigation electricity rates and assistance for small and marginal farmers [47].

Despite being harmful to human health, Bangladesh grows tobacco as one of its economic crops. Therefore, the majority of respondents' assumption that there was a growing tendency was accurate. Removing land for the growing of tobacco has had an influence on forest reserves. Flue curing, which is performed in kilns by burning wood at consistent temperatures for several days, is necessary for the production of Virginia tobacco, for which there is a higher demand and, consequently, a higher price. Farmers must therefore obtain wood for this type of crop from their own property, nearby forests, or public lands. Furthermore, the environment is damaged by harmful smoke and indiscriminate tree cutting [48]. Otanez [49] discovered through his research that one pound of tobacco requires 20 pounds of wood. Every year, almost 600,000 acres of forest are cut down for tobacco. However, tobacco growing is a significant contributor to deforestation in Bangladesh, according to reports by [12] through their studies.

## 5. Conclusions

Although tobacco cultivation in the hilly areas was injurious for the environment and also for the farmers' health, a considerable number of farmers in the study area cultivated it. The average tobacco farming experience of the farmers was about 10 years, and the average tobacco land size was 0.97 acres. Utilizing these lands in the study area, the tobacco farmers produced about 2000 kg (average) or 2 MT of tobacco each year. Producing and curing these amounts of tobacco, the farmers required an average of 5390 kg of wood, and they collected these amounts of fuel wood from the natural forests, self-gardens, or purchasing from the wood shops. The tobacco farmers earned about BDT 89 K (USD 810) from tobacco cultivation each year. About 77% of tobacco farmers had a moderate to high perception toward environmental hazards due to tobacco cultivation, which meant that they were moderately to highly concerned about the risks associated with tobacco cultivation. These findings were also assisted by their opinion when they opined that toxic waste from tobacco fields was responsible for polluting nearby water bodies as well as affecting human health. Moreover, curing tobacco leaves required a huge amount of fuel wood, which they collected from the forest area, which depicted the degraded environmental condition of the study area. Results of multiple regression analysis indicated that tobacco farmers' age, educational attainment, agricultural training received, and tobacco land ownership were the contributing factors that influenced their perceptions toward environmental and health hazards due to tobacco cultivation. That means the respondent with the higher above-mentioned characteristics perceived the perception of environmental hazards due to tobacco cultivation better than others. The current study was limited to Bangladesh's Lama upazila in the Bandarban district. Therefore, in order to obtain more accurate images of environmental deterioration, it is advised that comparable studies be performed in other forestry regions of the CHT where tobacco growing has been carried out. Furthermore, we limited the number of variables we included in the study to just eight. To obtain more reliable results in the future, more variables (such as knowledge about the environment, understanding of ecosystem services and their restoration, etc.) should be added. The study's lessons can give policymakers and decision-makers vital reference material to help them make decisions in the future based on tobacco farmers' perceptions of the health and

environmental risks associated with tobacco farming. As a result, appropriate actions can be undertaken to protect the environment and farmers' health.

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