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Farmers' Willingness to Stop Tobacco Cultivation and Perception of Alternate Food Crops to Replace It: Case of Major Tobacco Growing Areas in Bangladesh

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ABSTRACT

Background: The study was conducted to ascertain the farmers' willingness to stop tobacco cultivation, identify the determinants of farmers' desire to stop tobacco cultivation and discover alternate food crops farmers are interested in cultivating in Bangladesh.

Methods: A total of 377 tobacco growers in most tobacco-growing areas in Bangladesh were surveyed using a sample randomization technique using binary logistic regression and the factors influencing farmers' choice to produce tobacco were examined. Face-to-face structured surveys from January 2022 to March 2023 were conducted in Mirpur *Upazila* (Sub-district) from Kushtia and Gangachara *Upazila* from Rangpur districts of Bangladesh.

Result: Only 46.4% of the farmers are willing to stop tobacco cultivation. The key determinants for their willingness to stop growing tobacco are education level, tobacco cultivation experience, incentives and organizational participation of the tobacco farmers. In the farmer's view, maize, mustard, potatoes and lentils are the most suitable food crops to replace tobacco. To shift tobacco farmers to growing food crops, the Government should increase the farmers' educational level and offer inputs, loans and other incentives to promote alternate crops like maize, mustard, potato and lentil.

Key words: Agricultural economics, Agricultural extension, Environment, Socioeconomic status, Smoking.

INTRODUCTION

It is widely acknowledged that prolonged exposure to tobacco-related chemicals and tobacco consumption create significant health issues. For instance, it is predicted that around half of those who smoke regularly and for an extended period will die due to diseases related to tobacco smoking (Peto, 1994; Report of the Scientific Committee on Tobacco, 2023). Tobacco consumption is causing more than eight million deaths worldwide (WHO, 2019). Yet, this remarkable claim, tobacco use is still on the rise in countries with low and moderate incomes. For example, in Bangladesh, around 35 per cent use tobacco products and/or smokeless tobacco among adults (WHO, 2009). In this country, tobacco consumption causes at least 126,000 deaths among adults yearly, with an annual economic loss projected at around 306 billion Bangladeshi Taka (BDT) ($3.6 billion) or 1.39 per cent of Bangladesh's total GDP (Akm *et al.,* 2020).

The World Health Organization (WHO) has ratified the Framework Convention on Tobacco Control (FCTC) to curb tobacco consumption. Building on this global framework, Bangladesh enacted the Smoking and Tobacco Product Usage (Control) Act in 2005 to discourage tobacco usage in public areas and limit tobacco product development. Among the proposed measures, tobacco farmers were offered incentives for switching to other crops (Hoque and Tama, 2021). However, few were interested in taking crop-switching incentives and a minority of tobacco farmers stopped or reduced tobacco cultivation. In addition, research in Bangladesh found that tobacco production is encouraged by the availability of a guaranteed market (Rahman *et al.*, 2020). Furthermore, producers obtain quick payment from tobacco corporations, ensuring their purchases (Hossain and Rahman, 2013) are the main reason. behind the inclusion of more tobacco land in Bangladesh. Therefore, tobacco cultivation is still perceived as a more profitable and secure investment for Bangladeshi farmers compared to alternative food crops.

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Farmers who grow tobacco are aware of its negative effects. Still, they are not eager to replace tobacco with alternate crops. Tobacco corporations strongly support farmers' choices to produce tobacco, but local market conditions probably have a more significant impact on the decision to plant tobacco. Smallholder farmers in Bangladesh are in deep financial trouble: their income is in poverty. They are in debt. As the food crop market is highly volatile (Acharjee *et al.* 2020) with prices often crashing below the cost of production, farmers feel that tobacco production provides a higher and more secure income (Shava, 2021).

Using a budget analysis by Rhea *et al.*(2001) evaluated the possibility of switching tobacco greenhouses to tomato production. Other researchers also suggested that greenhouse crops or livestock could be suitable for farmers to replace tobacco cultivation (Halili *et al.*, 2000; Rhea *et al.*, 2001). In Bangladesh, several scholars argued that farmers could grow high-value crops, such as vegetables, tomatoes, potatoes, *etc.*, to replace tobacco (Anik *et al.*, 2017; Panth *et al.* 2020).

The growing of food crops will improve food security in Bangladesh. The higher food crop production implies a more-extensive more extensive food supply for a nation with more than 160 million people (Pervez *et al.* 2017). In addition, agricultural production increases the economy's GDP and reduces dependence on food imports. Therefore, shifting to other food crops from tobacco is an ultimate need for Bangladesh. Still, no research has been conducted to find alternative crops to replace tobacco cultivation in Bangladesh that farmers can accept and adopt. Therefore, the current research was conducted to (i) identify farmers' willingness to stop tobacco cultivation, (ii) identify the factors that are associated with that willingness and (iii) assess farmers' perception of different alternative food crops to replace tobacco cultivation.

MATERIALS AND METHODS

Population and sampling

Bangladesh is primarily an agricultural country, employing approximately 37 per cent [Bangladesh - Employment in Agriculture (% of Total Employment) - 2023 Data 2024 Forecast 1984-2020 Historical, n.d.] of the total agricultural labour force and accounting for 13.29 per cent of the national GDP (Krishi Diary, Agricultural Information Services, Ministry of Agriculture, Dhaka, 2021). Less than 0.5% of the farm labor is employed in tobacco cultivation. The nation's growing tobacco production areas include Rangpur, Lalmonirhat, Nilphamari, Kustia and the Chittagong Hills (Barkat *et al.*, 2019). The total tobacco land in Bangladesh is around 108 thousand hectares. Approximately 37%, or 40,000 hectares of land, is in Kushtia; 28% or thirty thousand hectares is in Nilphamari and Lamonirhat; 26%, or 28 thousand hectares, is in Bandarban and 9%, or 10,000 hectares, is in Rangpur (The Daily Star, 2014). Therefore, this study was conducted in sample *Upazilas* (sub-districts) in the tobacco-production areas in Bangladesh. The researcher purposively selected Mirpur from Kushtia and Gangachara *Upazila* from Rangpur Districts. Tobacco is being grown on more than 24,000 hectares of Mirpur's arable land. In contrast, other major crops, including wheat, lentils, gram, peas, maize and mustard, were grown, on the other hand, nearly eight thousand hectares in the *Upazila* (Nasim and Shahidullah, 2017). Gangachara *Upazila* has the most significant number of tobacco farmers among the *Upazilas* in Rangpur District. The total number of tobacco farmers was 15,000 in Mirpur and 7,500 in Gangachara. So the total population of the research was 22500.

The sample size was determined by the following equation adopted from Daniel and Cross, (2018):

$$n = N*X / (X + N - 1) \quad ...(1)$$

Where,

$X = Z_{\alpha/2}^2 -*p*(1-p)$.

For a confidence level of 95 per cent, the critical value is 1.96. MOE is the margin of error, p is the sample percentage and N is the population size. In the sample size formula, a finite population correction has been used.

Based on eq 1, the sample size was 377. The list of farmers was collected from the respective agriculture offices. Participants were selected using the table of random numbers. Data were gathered via structured personal interviews from January 2022 to March 2023.

Farmers' willingness to stop tobacco cultivation

Variable description

Farmers' willingness to stop tobacco cultivation (STC) is a dichotomous variable taking the value of 1 when farmers were inclined to stop cultivating tobacco and 0 otherwise.

Building on previous literature that identified socio-demographic characteristics explaining farmers' inclination to cease tobacco cultivation, several independent variables are included in the model. The variables were age, education, family member, family type, agriculture experience, tobacco cultivation experience, total tobacco land, farm size, training, extension media uses, incentives to tobacco cultivation and organizational participation.

Econometric method

According to previous literature (Tansey *et al.*, 1996) logistic regression method is used since the dependent variable of our model (*i.e.,* STC) is binary. This method has been frequently employed to determine how various demographic factors affect Bangladeshi farmers' binary choices (M. Uddin *et al.*, 2003). The logistic regression model assumes that the probability of desire to use Pi is determined by a vector of known factors (Xi) and an unknown variable vector (β). Therefore:

$$Pi = F(Zi) = F(\alpha + \beta Xi) = 1/[1+\exp(-Zi)] \quad ...(2)$$

Where

F(Zi) - Normal density function for the likely value of Zi.

α - Intercept.

βXi- Accommodation of explanatory variables, in a manner that

$$Zi = \log[Pi/(1-Pi)] = \beta_0+\beta_1X_1+.....+ \beta nXn+ \varepsilon \quad ...(3)$$

Where

Zi = Natural logarithm of choice for the i^{th} observation.

ε = Error term.

Farmers' perception of alternatives to tobacco

Only the farmers willing to stop tobacco cultivation were also asked to rate the suitability of the alternative crops based on a four-point Likert scale ranging from "0 = not suitable" to "4 = very suitable". Initially, a list of 25 alternative crops was prepared based on ten Key Informant Interviews (KIIs), five Focus Group Discussions (FGDs) and some informal interviews with the research scientists, tobacco farmers, extension experts, *etc.* To determine the instrument's reliability and consistency, Cronbach alpha values were measured. The statements were selected as an item of the risk because the Cronbach alpha value was greater than 0.70, indicating an acceptable reliability level (Nunnally, 1978).

RESULTS AND DISCUSSION

Characteristics of tobacco farmers

The descriptive statistics on the demographic socio-demographic features of tobacco farmers revealed their average age is 45 years (Table 1). The farmers' land size is categorized based on national farm size classification (Uddin

Table 1: The sociodemographic characteristics of tobacco farmers.

Variable and scoring technique form size	Categories	n=377	%	Standard deviation (SD)	Mean (M)
Age (actual number)	Young < (*M-SD*)	61	16.18	9.68	45.14
	Medium (*M+SD*)-(*M-SD*)	242	64.19		
	Old > (*M+SD*)	74	19.62		
Education (years)	Primary education (up to 5)	152	40.31	3.952	7.2202
	Secondary education (5-12)	199	52.78		
	Graduate (more than 12)	26	6.89		
Family type (0 for N, 1 for J)	Nuclear family (N)	297	78.8	-	-
	Joint family (J)	80	21.2		
Agricultural experience (Year)	Low (*M-SD*)	37	9.81	9.35	18.45
	medium (*M-SD*)-(*M-SD*)	257	68.16		
	High > (*M-SD*)	3	0.79		
Tobacco experience (Year)	Low (*M-SD*)	62	16.44	7.32	13.28
	Medium (*M-SD*)-(*M-SD*)	256	67.90		
	High > (*M-SD*)	59	15.64		
Tobacco land (Hectare)	Land less (up 0.02)	0	0	0.33209	0.2269
	Marginal (0.04-0.2)	249	66.04		
	Small (0.21-1)	130	34.48		
	Medium (1.1-3)	0	0		
	Large (above 3)	1	0.26		
Farm size (Hectare)	Landless (up to 0.02 ha)	0	0	0.319	0.4361
	Marginal (0.021-0.2 ha)	102	27.05		
	Small (0.21-1 ha)	248	65.78		
	Medium (1.1-3 ha)	25	6.63		
	Large (above 3 ha)	0	0		
Annual family income (in thousand BDT.)	Low < (*M-SD*)	67	17.77	73.69	115.179
	Medium (*M+SD)-(M-SD*)	242	64.19		
	High> (*M+SD*)	38	10.07		
Extension media involvement (score)	Low < (*M-SD*)	59	26.79	4.63	27.36
	Medium (*M+SD)-(M-SD*)	260	68.96		
	High> (*M+SD*)	58	15.38		
Incentives (1 for GI, 0 for GNo)	No incentives received (GNo)	164	43.5	.496	.565
	Got incentives (GI.)	213	56.5		
Training	No training received	195	51.72		
	Training received	182	48.27		
Organisational participation	Low < (*M-SD*)	40	10.61	1.514	3.29
	Medium (*M+SD)-(M-SD*)	337	89.38		
	High > (*M+SD*)	0	0		

Source: Field Survey, 2022.

et al., 2022). Based on the type, most tobacco farmers are in marginal and small-scale small scale. The average farm size was 0.4361 hectares and the average land committed to tobacco was 0.2269 hectares. On average, the annual family income of the farmers was BDT 115,800, which is less than the national average family income. Most farmers (56.6%) got incentives from cigarette companies.

In addition, it is interesting to point out that 46.4% of the surveyed tobacco farmers would be inclined to stop tobacco cultivation. Although tobacco cultivation is profitable, tobacco farming requires extensive labor. Therefore, most growers save money by employing their family members. When this is factored in, tobacco loses a significant portion of its profitability. As a result, tobacco often has a poorer economic return compared to other crops on a cost-benefit basis (Rao and Nancharaiah, 2012). Furthermore, most farmers seemed aware of tobacco's health and environmental risks. Therefore, they are thinking of stopping tobacco cultivation.

Determinants of STC

The results of the logistic regression are shown in Table 2. Educational qualification (β= 0.259, p<0.001), tobacco cultivation experience (β= 0.116, p<0.050) and organizational participation (β= 0.771, p< 0.001) are positively related to STC. In contrast, incentives (β= -3.864, p<0.001) have a negative influence on STC.

People with higher education are more aware of the negative consequences of tobacco production. Some recent results also found that educated farmers are decreasing tobacco cultivation (Appau *et al*., 2020; Rahman *et al*., 2020; Talukder *et al*., 2020).

Long-time tobacco cultivation creates health problems and complexities for farmers in many Bangladesh areas (Islam *et al.,* 2023; Choudhury *et al.,* 2007). Therefore,

Table 2: Farmers' Willingness to STC and their determinants.

Determinants	β	Exp (β)	Standard error	Wald	Sig.
Age	-.043	.958	.032	1.759	.185
Educational level	.259	1.295	.070	13.476	.000
Family member	.047	1.048	.158	.087	.768
Family type	.369	1.446	.653	.319	.572
Cultivation experience	.008	1.008	.033	.064	.800
Tobacco cultivation experience	.116	1.123	.048	5.895	.015
Total tobacco land	3.533	34.234	2.011	3.086	.079
Farm size	-.786	.456	.900	.762	.383
Annual family income	-.006	.994	.004	2.204	.138
Training received	.086	1.090	.076	1.306	.253
Extension media use	.051	1.052	.045	1.292	.256
Incentives	-3.864	.021	.432	80.149	.000
Organizational participation	.771	2.163	.154	25.246	.000
Constant	-3.982	.019	1.927	4.273	.039

Log likelihood= 200.095, Cox and Snell R Square= .573, Nagelkerke R Square= .765

Table 3: Alternate crops to replace tobacco.

Alternate crops	Not suitable = 0	Partially suitable = 1	Suitable= 2	Very suitable= 3	Total score	Rank
Lentil	7	26	80	62	372	4
Chilli	14	54	83	24	292	6
Eggplant	26	60	62	27	265	8
Cabbage	71	86	6	12	134	12
Maize	15	7	66	87	400	1
Mustard	14	14	59	88	396	2
Tomato	9	18	89	59	373	3
Potato	0	33	63	79	396	2
Boro rice	25	119	26	5	186	10
French beans	92	49	33	1	118	14
Bitter gourd	50	36	87	2	216	9
Yard long bean	79	72	24	0	120	13
Groundnut	82	49	37	7	144	11
Wheat	8	51	109	7	290	7
Sweet gourd	12	24	124	15	317	5

Score and Rank per Farmers Perceptions.

experienced tobacco farmers are shifting from tobacco to food crops.

Some previous researchers found that incentives increase tobacco cultivation, (Hasan, 2019; Jew *et al.*, 2017; Rahman *et al.*, 2020). The data in this research showed a negative correlation between receiving incentives to cultivate tobacco and being willing to stop tobacco cultivation. Farmers' organizational participation increases farmers' knowledge and awareness about tobacco cultivation through intra-organizational sharing (Tran *et al.*, 2018). Similarly, the data in this research shows a positive correlation between organizational participation and STC. Similar findings also accord with findings from WHO (2013) and Emteas (2014).

Farmers' perception of alternative crops

Results from the survey of 175 farmers who intend to stop tobacco cultivation indicate that maize is the most-suited alternate crop (score= 400) (Table 3), corroborating research (Kumer *et al.,* 2010; Kaur *et al.,* 2014). Mustard and potatoes scored 396 and ranked second (Table 3). Lentil cultivation ranked third (Table 3), confirming the findings of Karim *et al.* (1995). Altogether, our findings are in line with other research work revealing that winter vegetables, wheat, boro rice, potato, mustard and maize were considered suitable replacements for tobacco (Karim *et al.*, 2017).

CONCLUSION AND RECOMMENDATIONS

From the research findings, the farmers' educational level and organizational participation are significantly positively related to farmers' willingness to stop growing tobacco. Therefore, the Government should promote tobacco farmers' education if they want them to stop growing tobacco. In addition, non-formal education and marketing campaigns on the adverse effects of tobacco cultivation play a vital role in tobacco farmers.

Furthermore, farmers' cooperatives and organizations are a significant determinant of STC. These organizations also play a role in educating farmers. Therefore, the Government should support organization and cooperative efforts amongst tobacco farmers if they want farmers to be more willing to stop growing tobacco.

Incentives have a negative correlation with STC, which is simple logic. Grower incentives are a kind of market distortion that gives unwarranted advantages to tobacco in farmer decisions on output based on little more than bribery. If the Government finds this market distortion efficient and socially harmful to public health, it should prohibit such "incentives". Stopping incentives could tip many farmers over the edge toward at least considering food crops on an objective, market-driven basis and thus sharply reducing tobacco cultivation. On the positive side, the Government could also consider a public health-friendly market distortion like introducing other incentives to encourage the cultivation of maize, potatoes, mustard lentils, *etc*. This study has found that farmers have already consigned alternatives to cultivating tobacco. Even better, the Government could incentivize or create secondary industries based on these alternative food crops, to give them a market equal in reliability to tobacco. These measures would lead to a large-scale replacement of tobacco cultivation with alternative crops.

Conflict of interest

All authors declared that there is no conflict of interest.

REFERENCES

Acharjee, T.K., Hellegers, P., Ludwig, F., van Halsema, G., Mojid, M.A. and van Scheltinga, C.T. (2020). Prioritization of adaptation measures for improved agricultural water management in Northwest Bangladesh. Climatic Change. 163(1): 431-450. https://doi.org/10.1007/S10584-020-02852-W/TABLES/10.

Akm, G.H., Rouf, A.S.S., Shimul, S.N., Nargis, N., Kessaram, T.M., Huq, S.M., Kaur, J., *et al.* (2020). The economic cost of tobacco farming in Bangladesh. International Journal of Environmental Research and Public Health. 17(24): 1-21.https://EconPapers.repec.org/RePEc:gam:jijerp:v:17:y:2020:i:24:p:9447-:d:463442

Anik, A., Rahman, S., Sustainability, J.S. (2017). Agricultural productivity growth and the role of capital in South Asia (1980-2013). Sustainability. 9(3): 470. https://doi.org/10.3390/su9030470.

Appau, A., Drope, J., Goma, F., Magati, P., Labonte, R., Makoka, D., *et al.* (2020). Explaining why farmers grow tobacco: evidence from Malawi, Kenya and Zambia. Nicotine and Tobacco Research. 22(12): 2238-2245.

Bangladesh - Employment In Agriculture (% Of Total Employment) - 2023 Data 2024 Forecast 1984-2020 Historical. (n.d.). Retrieved March 12, 2023, from https://tradingeconomics.com/bangladesh/employment-in-agriculture-percent-of-total-employment-wb-data.html

Barkat, A., Uddin Chowdhury, A., Nargis, N., Rahman, M., Shahnewaz Khan, M., Kumar Pk, A., Bashir, S. and Chaloupka, F.J. (2019). The economics of tobacco and tobacco taxation in Bangladesh. Untobaccocontrol.Org. Retrieved March 12, 2023, from https://untobaccocontrol.org/taxation/e-library/wp-content/uploads/2019/12/Bangladesh-Report-WEB.pdf

Choudhury K., Hanifi, S.M., Mahmood, S.S., Bhuiya, A. (2007). Sociodemographic characteristics of tobacco consumers in a rural area of Bangladesh. J. Health Popul. Nutr. 25(4): 456-64. PMID: 18402189; PMCID: PMC2754020.

Daniel, W. and Cross, C. (2018). Biostatistics: A foundation for analysis in the health sciences. https://books.google.com/books?hl=enandlr=andid=PON1DwAAQBAJandoi=fndandpg=PA3anddq=Biostatistics:+a+foundation+for+ analysis+in+the+health+sciences.+Wiley%3B+2018+November+13.andots=a71ze_miLtandsig=3GYtQYKaO9g3nWRaGw7lJfeKcYs

Emteas, M. (2014). Use of Tobacco Products by The Farmers of Selected Areas of Rangamati (Doctoral dissertation), Dept. of Agricultural Extension and Information System, Sher-e-Bangla Agricultural University, Dhaka, Bangladesh.

Halili, R., Purcell, W.D., Taylor, D.B., Thompson, G.R., Pease, J., Reaves, D.W., Mcdowell, G. and Coale, C.W. (2000). Methods for evaluating agricultural enterprises in the framework of uncertainty facing tobacco-producing regions of Virginia. https://search.proquest.com/openview/8dd5cb87c42627a5ef40b3fbd4af7dfe/1?pq-origsite=gscholarandcbl=18750anddiss=y.

Hasan, K.M. (2019). Factors influencing farmers turning into tobacco cultivation in the Khulna division of Bangladesh: An empirical study. Tobacco Prevention and Cessation, 5(Supplement). https://doi.org/10.18332/TPC/105152.

Hoque, M.M. and Tama, A.Z.R. (2021). Implementation of tobacco control policies in Bangladesh: A political economy analysis. Public Administration Research. 10(2). https://doi.org/10.5539/par.v10n2p36.

Hossain, M. and Rahaman, M.M. (2013). A socioeconomic analysis on tobacco cultivation in Kushtia District of Bangladesh. Academia.Edu. Retrieved March 12, 2023, from https://www.academia.edu/download/77413994/10.11648.j.ss.20130203.14.pdf

Islam, M.M. (2023). Effective tobacco control measures in Bangladesh require a whole-of-government approach. Policy Design and Practice, pp 1-9.

Jew, E.K., Dougill, A.J., Sallu, S.M. and Eleanor Jew, C. (2017). Tobacco cultivation as a driver of land use change and degradation in the miombo woodlands of south west Tanzania. Wiley Online Library. 28(8): 2636–2645. https://doi.org/10.1002/ldr.2827.

Karim, Z. Islam, N. and Chowdhury, M.A. (1995). Rehabilitating Tobacco Growers in Bangladesh. In Tobacco and Health, Springer, Boston, MA. pp 915-918.

Karim, M A., Quayyum, M.A., Samsuzzaman, S., Higuchi, H. and Nawata, E. (2017). Challenges and opportunities in crop production in different types of char lands of Bangladesh: Diversity in crops and cropping. Tropical Agriculture and Development. 61(2): 77-93. https://doi.org/10.11248/jsta.61.77

Kaur, J., Rinkoo, A.V. and Arora, S. (2014). Operationalizing evidence into action for providing viable crop diversification options to tobacco farmers in India- A compelling case for change. Int. J. of Interdisciplinary and Multidisciplinary Studies. 2(2): 148-56.

Krishi Diary, Agricultural Information Services, Ministry of Agriculture, Dhaka. (2021). AIS.

Kumar, M.D., Naik, D.C., Sridhara, Vageesh, T.S., Girijesh, G.K. and Rangaiah, S. (2010). Investigation on economically viable alternative cropping systems for FCV tobacco (*Nicotiana tabacum*) in Karnataka. Karnataka J. of Agricl Sciences. 23(5): 689-692.

Nasim, M. and Shahidullah, S. (2017). Distribution of crops and cropping patterns in Bangladesh. Banglajol. Info. Retrieved March 12, 2023, from https://www.banglajol.info/index.php/BRJ/article/view/38195.

Nunnally, J. (1978). Psychometric Theory. 2nd ed. http://125.22.75.155:8080/handle/123456789/11061

Panth, M., Hassler, S., Agriculture, F.B.-G. (2020). Methods for management of soilborne diseases in crop production. Mdpi.Com. https://doi.org/10.3390/agriculture10010016

Pervez, A.K.M.K., Gao, Q., Zeng, Y. and Uddin, M.E. (2017). Hybrid rice: Bangladesh's failure and China's success. Journal of Agriculture and Ecology Research International. 10(1): 1-10.

Peto, R. (1994). Smoking and death: the past 40 years and the next 40. BMJ. 309(6959): 937-939. https://doi.org/10.1136/BMJ.309.6959.937.

Rahman, M.S., Ahmed, N.A.M.F., Ali, M., Abedin, M.M. and Islam, M.S. (2020). Determinants of tobacco cultivation in Bangladesh. Tobacco Control. 29(6): 692-694. https://doi.org/10.1136/TOBACCOCONTROL-2019-055167.

Rao, E. and Nancharaiah D.G. (2012). Alternative to tobacco crop cultivation in *rabi* season: A cost benefit analysis. Eands. Dacnet. Nic. In. https://eands.dacnet.nic.in/Publication12-12-2012/2541-may12/2541-1.pdf.

Report of the Scientific Committee on Tobacco (2023). Retrieved March 12, 2023, from https://scholar.google.com/scholar?hl=enandas_sdt=0%2C5andq=Report+of+the+scientific+committee+on+tobacco+and+health.+Stationery+Office%3B+%281998%29+March+ 11.andbtnG=

Rhea, A., Brooker, J., *et al.* (2001) An economic analysis of sequential cropping systems in greenhouses in Tennessee: tobacco and tomatoes. Academia.Edu. Retrieved March 12, 2023, from https://www.academia.edu/download/38521084/rs0901.pdf

Shava, G.J. (2021). Stability and adaptation of new tobacco varieties to three growing areas under rain fed conditions in Zimbabwe. Agricultural Science Digest. 41(1): 81-84. doi: 10.18805/ag.D-232.

Talukder, A., Haq, I., Ali, M. and Drope, J. (2020). Factors associated with cultivation of tobacco in Bangladesh: A multilevel modelling approach. International Journal of Environmental Research and Public Health. 17(12): 4277. https://doi.org/10.3390/IJERPH17124277.

Tansey, R., White, M. and Long, R., (1996). A Comparison of Loglinear Modeling and Logistic Regression in Management Research. Elsevier. Retrieved March 12, 2023, from https://www.sciencedirect.com/science/article/pii/S0149206396900525.

The Daily Star (2014). Rapid increase in land used for tobacco cultivation. The Daily Star. Retrieved March 12, 2023, from https://www.thedailystar.net/rapid-increase-in-land-used-for-tobacco-cultivation-12995

Tran, T., James, H., Learning, J. P. (2018). Social learning through rural communities of practice: Empirical evidence from farming households in the Vietnamese Mekong Delta. Learning, Culture and Social Interaction. 16: 31-44.

Uddin, M.E., Pervez, A.K.M.K. and Gao, Q. (2022). Effect of voluntary cooperativisation on livelihood capital of smallholder dairy farmers in the southwest of Bangladesh. GeoJournal. 87(1): 111-130. https://doi.org/10.1007/S10708-020-10218-Z.

Uddin, M., Quader, A., Alam, M. (2003). Farmers' willingness to use innovative indigenous technical knowledge for plant protection in major crop zones of Bangladesh. Isdsnet.com. Retrieved March 13, 2023, from https://isdsnet.com/ijds-v7n10-21.pdf

WHO (World Health Organization). (2013). WHO framework convention on tobacco control: guidelines for implementation of article 5. 3, Articles 8 To 14. World Health Organization.

WHO Report on Tobacco Control in Bangladesh. (2019).

WHO. (2009). Global Adult Tobacco Survey: Bangladesh Report 2009. https://apps.who.int/iris/bitstream/handle/10665/205136/B4415.pdf