



An intervention to address deteriorating water quality: An application of Ajzen's theory of planned behavior

Albert Ebo Duncan¹ · Nanne de Vries¹ · Kwabena Biritwum Nyarko²

© Springer Science+Business Media, LLC, part of Springer Nature 2020

Abstract

This study investigates the factors which influence illegal miners' intention to choose an alternative job using the theory of planned behavior (TPB). Three hundred and thirty-eight respondents from illegal mining communities in the Pra Basin completed a questionnaire on behavioral, social and demographic factors which might motivate an illegal miner to choose an alternative job. The attitude was found to be the only dominant significant antecedent of the behavioral intention. The findings from the study reveal that Perceived Behavioral Control (PBC) which has been the focus of the job intervention in the basin is not a predictor of their intention.

Keywords Illegal miners · Alternative jobs · Intervention · Theory of planned behavior, pollution control

Introduction

Unregulated illegal mining is posing a major threat to the security of most water resources in Ghana. All efforts by the Water Resources Commission (WRC) and other state institutions to mitigate the threat have failed to yield fruitful results. With the new government assuming office in January 2016 efforts to address the threat augmented. And barely a year and a few months after being in office, had the government of Ghana issued an edict for all illegal mining to be stopped by March 2017. This action reduced illegal mining activities in 2017 until January 2018 when illegal miners started going back to sites. One question many Ghanaians asked at the time was: can this government decision stand the test of time? As a way of addressing the plight of illegal miners that will be rendered unemployed, the government proposed roping them into their 'planting for food' project. The project is aimed at reducing migration of unemployed youth to the city centers and stopping the importation of foodstuff from neighboring

countries. This is not the first-time efforts of such nature have been introduced to stop the illegal miners. It was, therefore, the expectation that more effort will be invested in finding out why illegal miners keep coming back to sites they are hunted out. Unfortunately, this was not done. On the 23rd of March 2017, task forces were deployed all over the country to drive out illegal miners and constantly monitor the mining sites. It was indeed a very robust exercise which resulted in the seizure of some excavators. Barely a month after that, the planting for food program was launched on April 19, 2017, with a lot of promises. Indeed, the package was attractive: prices of fertilizers were reduced by 50% and farmers were provided with free seeds. Furthermore, the government promised to employ an additional 2000 agricultural extension officers and the construction of about 1000 metric ton capacity warehouse in each of the 216 districts. On the 1st of March 2018, the Alliance for Green Revolution in Africa (AGRA) reported on their webpage: 715000 jobs were created in the planting for food projects in the rural areas in Ghana. Strangely, almost all illegal miners were back to site around the same period in the Pra Basin (field visit April & March 2018). The question therefore remains whether planting for food proposes the best alternative jobs for the illegal miners? Were they even ready to change for an alternative job? What will influence their choice of an alternative job?

This paper argues that the approach adopted in dealing with the illegal miners was not sustainable. It, therefore, proposes that the behavior of the illegal miners requires empirical assessment instead of just proposing an alternative job. The

✉ Albert Ebo Duncan
aduncan@ucc.edu.gh; bert_ebo@yahoo.com

¹ Department of Health Promotion, Faculty of Health Medicine and Life Sciences, Maastricht University, P. O. box 616, 6200 MD Maastricht, Netherlands

² Department of Petroleum Engineering, Kwame Nkrumah University of Science and Technology, Kumasi, Ghana

empirical assessment, when done properly, will help to uncover the behavioral as well as the related social and economic issues to the pending challenge of illegal mining. It is only after this, that the right intervention needed to address the problem can be identified for proper solution design. Many behavioral theories do exist which have been successfully used in addressing human behavior; because the decision to quit mining and adopt alternative employment seems a reasoned one, the theory of planned behavior (TPB) seems the best option (Lee et al. 2010).

Overview of Theory of Planned Behavior (TPB)

The theory of planned behavior (TPB) as proposed by Ajzen (1991) has been used successfully in many ways to better understand a range of behaviors and why certain individuals behave in which way (Sommer 2011). The theory is described as one of the best supported social psychological theories in predicting human behavior (Sommer 2011). It has been used to predict a wide array of behaviors such as an enterprises' willingness to adopt/develop cleaner production technologies (Zhang et al. 2010); identify key behaviors underlying pro-environmental behaviors of high school students (De Leeuw 2015), predict willingness to pay for the conservation of an urban park (López-Mosquera, 2014), to name just a few. TPB has been used successfully to predict human behaviors in business, health, energy, environment etc.

Ajzen (1991) proposes that behavior is driven by an individual's intention (I) to execute an action which in turn is determined by an individual's attitude (ATT), subjective norm (SN) and perceived behavioral control (PBC). The TPB framework, Fig. 1, specifies indirect determinants of these constructs. Belief about the likelihood of outcomes of a

behavior (behavioral beliefs) multiplied by the evaluation of each outcome determine the attitude; beliefs about expectation of referent persons and organizations (normative beliefs) and the motivation to comply with such expectations constitute the subjective norm; the perceived power over the presence of factors which may facilitate or impede the performance of a behavior (control beliefs) make up the indirect determinant of PBC. Attitude is about the individual's positive or negative evaluation of a particular behavioral performance (Fishbein and Ajzen 1977). In this case, the attitude of the illegal miners towards the choice of an alternative job can also be defined by the illegal miner's positive or negative evaluation of choosing the alternative job. Individual's perception of what others think he should or should not do is the SN and it can be defined as illegal miners' perceptions of what friends, family etc. approve or disapprove concerning choosing an alternative job and his willingness to comply. PBC is about people's perception of the ease or difficulty of performing the behavior of interest (Ajzen 1991). Similarly, the PBC will involve the illegal miner's difficulty or easy of choosing an alternative job. The relationship between the indirect determinants and the direct determinants is illustrated in Fig. 1. With a favorable attitude and subjective norm, and greater perceived control it is expected that a person's intention to engage in a behavior should be stronger. External variables (demographic, socio-economic etc) are assumed to affect the basic variables in TPB.

Background and Method

The Pra Basin is located between latitudes 5°N and 7° 30'N, and longitudes 2° 30'W, 0° 30'W, in south-central Ghana. It is the fourth basin to implement Integrated Water Resources

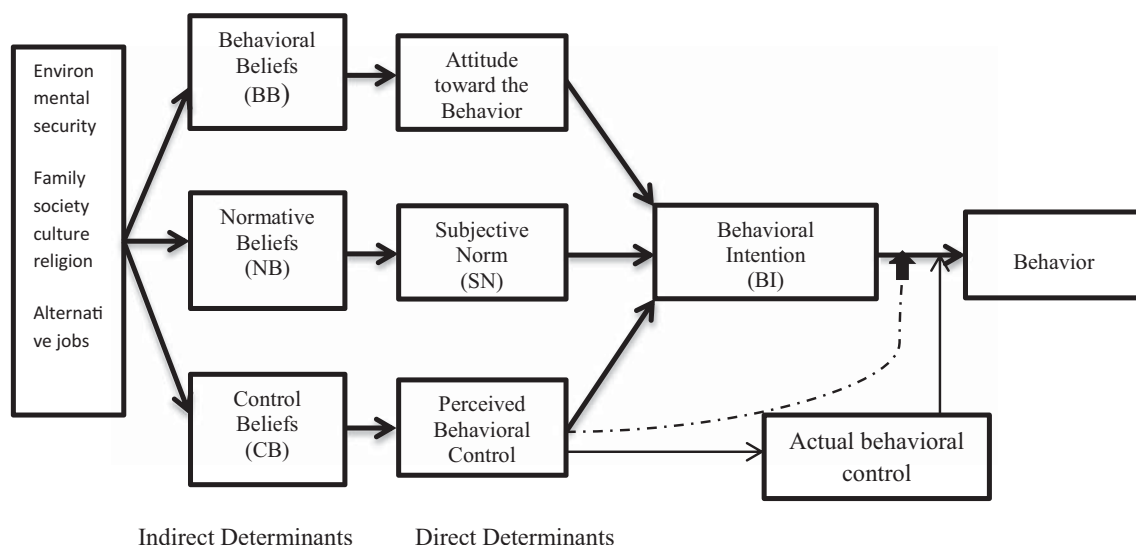


Fig. 1 The conceptual framework of TPB

Management in Ghana and the largest river basin among the three principal south-western basins of Ghana namely the Ankobra, Tano, and Pra. The total basin area is approximately 23200km². The basin houses one of the largest gold mining companies in Africa, AngloGold Ashanti, and many uncounted illegal mining sites. It also houses one of the largest crater lakes, Bosomtwe, with a maximum depth of nearly 80 m and a rim diameter of about 8 km across. Lake Bosomtwe is a major tourist attraction and fetches the country a lot of income from foreign and local tourists. The main river is the Pra with four tributaries: the Offin, Birim, Anum, and Oda.

In studies of this nature, the target behavior of the illegal miners at an appropriate level of specificity must be defined in order to obtain a more accurate insight into the factors that influence the illegal miners choice of an alternative job (Lee et al. 2010). Under this condition, the target behavior is defined as stopping illegal mining and adopting an alternative job with an available market for products. The aim of this study is to predict illegal miners' intention of choosing an alternative job. The overall aim was to assess the validity of a modified TPB model and to predict illegal miners' behavioral intention (BI). The specific objectives are to: 1) assess the validity of a modified TPB model 2) test the effect of the antecedents on attitudes, subjective norm, and perceived behavioral control 3) to examine the effect of SN, PBC, and attitude on BI. Eight hypotheses were developed to answer the specific objectives.

Hypothesis 1: behavioral belief and its evaluative outcome (BB_iE_i) is a significant predictor of attitude (ATT).

Hypothesis 2: normative belief and the motivation to comply (NB_iMC_i) is a significant predictor of subjective norm (SN).

Hypothesis 3: control belief and its evaluative outcome is a significant predictor of perceived behavioral control (PBC).

Hypothesis 4: SN is a significant predictor of ATT.

Hypothesis 5: SN is a significant predictor of PBC.

Hypothesis 6: ATT is a significant predictor of behavioral intention (BI).

Hypothesis 7: SN is a significant predictor of BI.

Hypothesis 8: PBC is a significant predictor BI.

Prior to the development of the final questionnaire, an elicitation study was conducted within four selected illegal mining communities in the Pra Basin in January 2017, to identify the set of relevant beliefs which underlie illegal miners' choice of alternative employment. Moving from house to house, facilitators explained to the respondents where they were coming from and their mission. This was very necessary because at the time there were rumors being circulated in the towns/villages about government's plan to arrest illegal miners. Strangers in the community could well be associated with

such actions. With these measures in place, still some households refused to grant the facilitators audience. The target groups were the illegal miners and the youth: the potential illegal miners. To disabuse their fear, when explaining our purpose, we assured them of not revealing their identity however about 6 of the thirty respondents told us they are illegal miners. The subjective impression of interviewers, also based on their answers, was that almost all the respondents were illegal miners. One of the communities had an information center, so through the assemblyman, our presence was made known which made our work in that community easier (Appendix 1).

Trained assistant was used in the administration of the questions to compensate for the educational level of most of the respondents. Open-ended questions were used in the study. In the administration of the questionnaire, the trained personnel read out the questions to the respondents and wrote down their responses. They were asked questions on how they feel about stopping illegal mining and what motivates people to engage in it. They were then asked about the advantages and disadvantages of illegal mining. We also asked about the factors which could influence someone to stop illegal mining for another job. They were then asked to provide a list of individuals or groups who are important in deciding what job to take. Fifty-six percent of the 30 respondents involved were between the ages of 15 to 30 and 44 % being between the ages of 31–35. The process is summarized in Table 1.

Elicitation Study

Respondents who were engaged in the elicitation studies expressed a number of behavioral, normative and control beliefs regarding choosing an alternative job. Respondents' beliefs regarding choosing an alternative job can be summarized in water security and economic instability. There were varied opinions concerning the benefits and economic challenges that come with quitting illegal mining for another job. Whereas some complain that the alternative job may not pay well others spoke about the need to save the water resources before they get beyond recovery. The most relevant people/group/factors the respondents considered crucial to their choice of an alternative job are family, society, religion, culture and to some extent state institutions that enforce the law.

Table 1 Summary of salient beliefs from elicitation study

Behavioral beliefs	Normative beliefs	Control beliefs
Water security	Family	Alternative job
Economic challenge	Religion	Training and support
	Culture	Capital
	Society	Market
	State	

Those who talked about the family explained that whatever decision they take also would have a strong influence on their immediate family. Example if they have their children in private school, then they have to consider if the alternative job can provide them with the means to pay their fees. When it came to the alternative job as a subject of choice, respondent argued extensively about these things: the kind of alternative job, the capital to start the job, the creation of a market for products, and the skills needed to start that alternative job. Below are some of the comments during the elicitation studies. The result of the elicitation is summarized in Table 3.

I wouldn't want my pastor to know that I deal in illegal mining (Religion).

"What kind of job can pay at least 300 Ghana cedis a day?" (Economic instability).

"We did not get a good education but our children should attend good schools" (Economic instability).

"If we have to carry water in gallons to the farm today, then we should not only think about money but what will happen in future?" (Water security).

"Most of us are afraid to eat fish from the river" (Water security: pollution).

A job which comes with a capital to start will be worth considering (alternative job with capital).

Sample and Scenario

The participants for the main study were drawn from twenty-seven town/villages in the Pra Basin of Ghana using stratified sampling. Looking at the sizes in terms of population and area, a predetermined number of questionnaires was administered in each village or town with the help of trained assistance. In the same way as the elicitation studies, assistants read the questions to respondents and wrote their responses. An average of 15 to 18 min was spent in the administration of one questionnaire. In all three hundred and thirty-eight questionnaires were successfully completed. A detailed description of the purpose of the research study, instructions and assurance of confidentiality was clearly written on the front page of the questionnaire and read out.

The information gathered from the elicitation study was used together with the guidelines recommended by Ajzen (2006) to develop the closed-ended questionnaire. The questionnaire used in this study was in four sections: The first part covered the respondent's behavioral beliefs and their evaluation (ATT). Section two focused on the normative beliefs and their evaluation (SN). The third part was on the control beliefs and their evaluation (PBC). The final part of the section looked at respondents intentions of carrying out the behavior. Data collected was analyzed using structural equation model (SEM) to find the best-fitting model and to test causal

relationships. SEM is a general model framework that integrates a number of different multivariate techniques into one model fitting framework.

Variables

The behavioral belief towards the choice of an alternative job was measured by 5 items with a seven-point Likert scale (e.g., stopping illegal mining will help reduce the pollution of rivers.' 1 = strongly disagree, 7 = strongly agree). To evaluate the outcomes, 5 items on a seven-point Likert scale was used (e.g. 'for me to reduce river pollution by stopping illegal mining is.' 1 = extremely bad, 7 = extremely good). To measure normative beliefs, 5 items with a seven-point Likert scale were employed (e.g. 'my family approves of illegal mining.' 1 definitely false =, 7 = definitely true). To evaluate the motivation to comply, 5 items on the seven-point Likert scale were used (e.g. 'what my family thinks I should do is important to me.' 1 = strongly disagree, 7 = strongly agree). To measure control beliefs, 5 items on a seven-point Likert scale were used (e.g. 'I will stop illegal mining if there is an alternative job by stopping illegal mining is.' 1 = extremely bad, 7 = extremely good). Finally, 3 items on a seven-point Likert scale was used to assess the behavioral intention (e.g. 'I plan to stop illegal mining.' 1 = very unlikely, 7 = very likely). Before the administration of the questionnaire, it was first piloted among 30 respondents in Atwereboanda, a small town in the basin and further reviewed by the researcher before the final fieldwork.

Results

Measurement Model

Before testing the measurement model, screening was conducted on the collected data through the confirmatory factor analysis (CFA) using maximum likelihood estimation. From the results of the CFA variables ATT₂, SN₁, PBC₁, PBC₃, and PBC₅ were deleted due to their low factor loading and their difficulty in causing the model to run. After the deletion of these variables which were unexplained empirically, the remaining variables were then subjected again to CFA to assess the underlying structure of the variables in the model. The CFA results show that the model fit the data well ($\chi^2 = 205.77$, $df = 59$, $\chi^2/df = 3.48$, $p < 0.001$, NFI = 0.91, IFI = 0.93, TLI = 0.90, CFI = 0.93, RMSEA = 0.073, $R^2 = 0.20$). The model gave very strong grand mean and a high path coefficient of the factor representing behavioral intentions 0.94 ($p < 0.05$). The very strong mean implies that the illegal miners' strong positive intentions towards performing the behavior which is also significant. There is a very strong positive mean towards the attitude. The path coefficient of the factor representing attitude was significant. This implies that the

illegal miners do not show only strong positive behavioral beliefs towards the attitude but they are also significant in predicting the attitude. There is a very strong grand mean measured for the PBC, however, the path coefficient of the factor representing subjective norm was not significant. This implies that even though the illegal miners' have strong control over their control beliefs, it is not significant in predicting their PBC. There is positive but weak grand mean measured for the normative beliefs. This notwithstanding, the path coefficient shows, that the normative beliefs are predictors of the subjective norm. Cronbach's alpha and composite reliability were used to check the goodness of fit for the model. Item reliabilities ranged from 0.65 to 0.90 except for the behavioral control which fell below the range. Cronbach's alpha of the variables was between 0.65 and 0.94 which indicated internal consistency. Estimated composite reliability for all the constructs except that of perceived behavioral control was above 0.7 which signifies internal consistency among items for these constructs. The measurement properties of the measured construct and their reliabilities are presented in Table 2.

Structural Equation Model (SEM)

A satisfactory fit is obtained when the RMSEA is less or equal to 0.08, and NFI, IFI, and TLI are equal to or above 0.9 (Bentler 1990). The results of the SEM ($\chi^2 = 205.77$, $df = 59$, $\chi^2/df = 3.48$, $p < 0.001$, $NFI = 0.91$, $IFI = 0.93$, $TLI = 0.90$, $CFI = 0.93$, $RMSEA = 0.073$, $R^2 = 0.20$) shows a satisfactory data fit to the model (Fig. 2) and hence the model is

reasonably capable of predicting illegal miners intention of choosing an alternative job. There are occasions when researchers modified the relation between attitude and the subjective norm in the TPB model in order to improve fit (Chang 1998; Ryu and Jang 2006), however, in this model due to the beliefs elicited, the modification was done between subjective norm and intentions, and perceived behavioral control and intentions. The modified SEM (Fig. 3) results ($\chi^2 = 189$, $df = 556$, $\chi^2/df = 3.38$, $p < 0.01$, $NFI = 0.91$, $IFI = 0.94$, $TLI = 0.90$, $CFI = 0.94$, $RMSEA = 0.07$, $R^2 = 0.18$) shows a satisfactory data fit implying that the modified SEM could be used to predict illegal miner's intention of choosing an alternative job. The modified SEM which contains better fit chi-square ($\chi^2/df = 3.38$), is considered for the analysis. The results of the TPB model and the modified model (MTPB) are presented in Table 3.

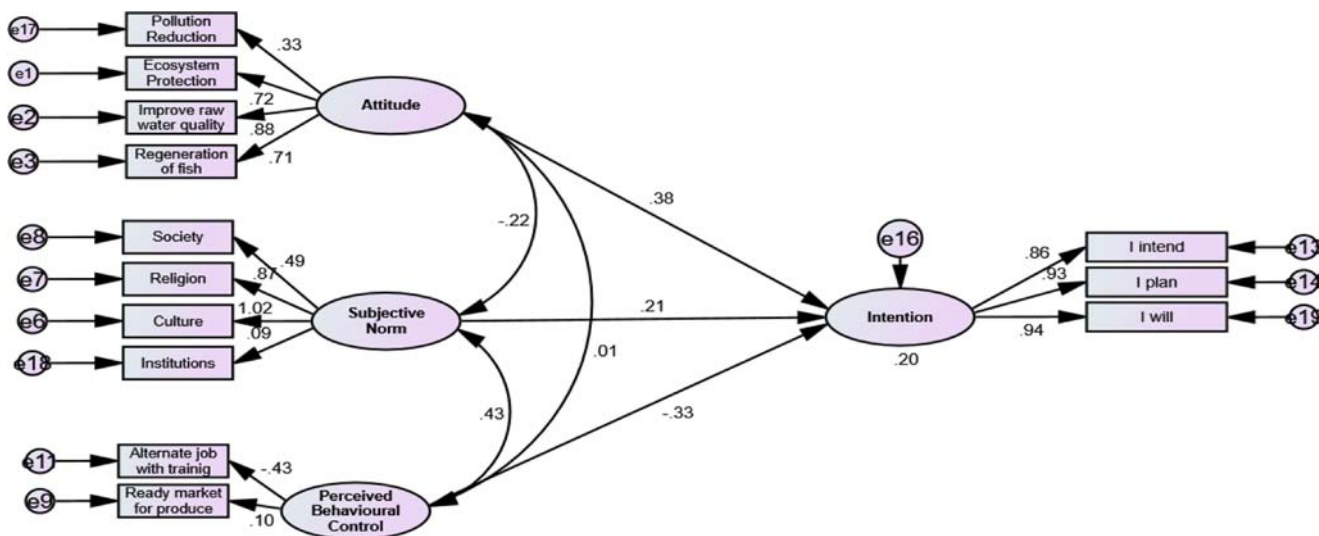
Testing the Hypothesis

The estimate of the standardized coefficients indicate that the linkages between BB_iE_i and ATT are significant ($\beta = 0.77$; $p < 0.05$) and the path between NB_iMC_i and SN was also significant ($\beta = 0.76$; $p < 0.05$). Therefore, hypothesis 1 and 2 were supported. This implies that the illegal miner's attitude towards choosing an alternative job is influenced by his behavioral beliefs. From Fig. 3 all the behavioral belief variables predicting attitude all show positive, strong and significant predicting power except variable on pollution. Usually, individuals possess a favorable attitude when the outcomes are

Table 2 Measurement properties of latent constructs

Factors	Standardized factor loadings	Item (r^2)reliability	Composite reliability	Beta value	Significance	Grand mean	Cronbach alpha	SD
ATT			0.77	0.38	0.000	20.20	0.74	0.21
BB ₁ E ₁	0.33	0.109						
BB ₃ E ₃	0.71	0.50						
BB ₄ E ₄	0.88	0.774						
BB ₅ E ₅	0.72	0.518						
SN			0.75	0.21	0.442	0.89	0.72	2.52
NB ₂ MC ₂	0.44	0.194						
NB ₃ MC ₃	0.87	0.757						
NB ₄ MC ₄	1.023	1.047						
NB ₅ MC ₅	0.09	0.008						
PBC			0.13	-0.33	0.519	17.92	0.65	2.06
CB ₂ E ₂	0.10	0.01						
CB ₄ E ₄	-0.42	0.176						
I			0.94		0.000	6.73	0.94	0.00
I ₁	0.86	0.74						
I ₂	0.93	0.87						
I ₃	0.94	0.88						

ATT attitudes, BB behavioral beliefs, E evaluations of outcome, NB normative beliefs, MC motivation to comply, I intention



Chi-Square=205.77, df = 59, p-value =0.000, RMSEA = 0.073

Fig. 2 The result of the structural equation model

positively evaluated and he is potentially going to engage in that specific behavior(Han et al. 2010). In this regard, the illegal miner believes that choosing an alternative job will bring some environmental and health benefits such as improving raw water quality, protecting the ecosystem, helping regeneration of fishes and reducing pollution. Similarly, what

others think he should or shouldn't do is also a significant predictor of the subjective norm. Hypothesis 3 was however not supported ($\beta = 0.13; p > 0.05$) which differs from previous studies (Lee et al. 2010; Zhang et al. 2010), indicating that the control beliefs are not the direct predictors of the PBC. Testing for the TPB assumption that predictive factors in the model are

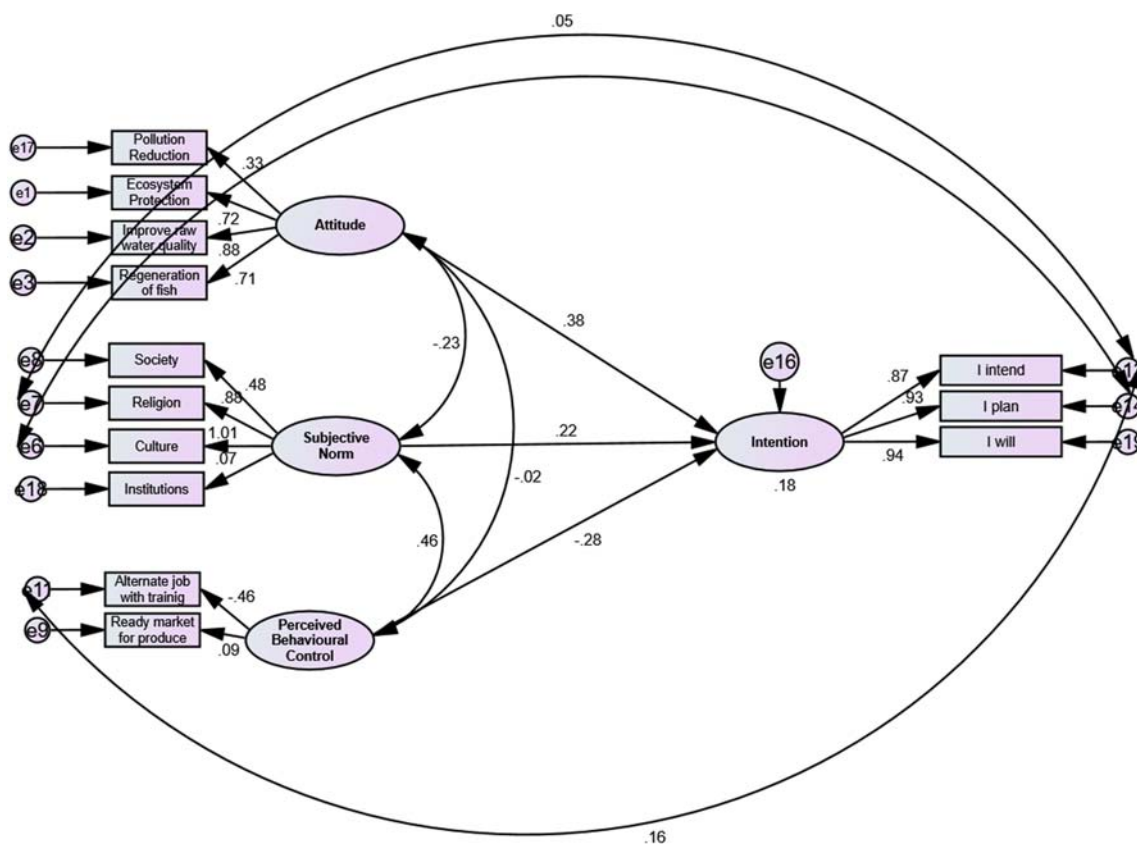


Fig. 3 Modified SEM

Table 3 Explanatory power fit indices

Fit indices	Recommended value	TPB	Modified TPB
χ^2	–	205.77	189
Df	–	59	56
χ^2/df	≤ 2 – ≥ 5	3.48	3.38
RMSEA	≤ 0.08	0.073	0.071
CFI	≥ 0.90	0.93	0.94
NFI	≥ 0.90	0.91	0.91
IFI	≥ 0.90	0.93	0.94
TLI	≥ 0.90	0.9	0.90
BI	–	0.20	0.18

correlated show a correlation between ATT and SN ($\beta = -0.26$; $p < 0.05$) but no correlation between SN and PBC ($\beta = 0.46$; $p > 0.05$). The correlation between ATT and SN shows some level of interdependence between these direct determinants supporting hypothesis 4. The assumptions being supported suggests that the attitude was not only influenced by the behavioral beliefs but may also be affected by the normative beliefs as well. This correlation can practically be exploited in addressing the problem of choosing an alternative job. The absence of correlation between the SN and PBC may imply the two constructs are independent (Ryu and Jang 2006). Hypothesis 5 (SN to PBC) was not supported. The estimate of the standardized coefficient shows attitude was significant ($\beta = 0.38$; $p < 0.05$) in predicting illegal miner's behavioral intention (BI) of choosing an alternative job and explains 18% of the variance in BI (Fig. 3), supporting hypothesis 6. Regarding hypothesis 7 and 8, the subjective norm was positive in predicting the intention but not significant whereas the estimated standardized coefficient of perceived behavioral control was negative and not significant, hence both hypotheses were not supported. The positive values of coefficient of SN indicted that SN has some level of positive influence on illegal miner's choice of an alternative job, however, that level is not significant and the vice versa holds for the PBC. The non-significance of SN-BI may be due to the sample used. Most of respondents are youth who might have experience this kind of promises which never became a reality and as such maybe more concerned about their own beliefs (Vallerand et al. 1992). The findings in hypothesis 6, 7 and 8 suggests that of the three direct determinants, attitude towards the behavior had the most substantial influence ($\beta = 0.38$) on illegal miners intention to stopping illegal mining and adopt an alternative job, producing a change of 0.38 units of the behavioral intention for each unit change in attitude, positively insignificant by the opinion of others and negatively insignificant by factors such as provision of alternative jobs. The finding that PBC is not a predictor of illegal miner's intention of choosing an alternative job is a confirmation of why illegal miners are going back to their work sites. Figure 3 shows the

direct influence of religion and alternative job on BI. In both modifications, the path coefficient is positive showing that these two indirect determinants have a positive impact on the BI. This confirms the data gathered during the elicitation on how the indirect behaviors influence BI.

Conclusion

This study investigated the factors which influence illegal miner's decision in choosing an alternative job using the Theory of Planned Behavior (TPB). The findings revealed that the model could predict illegal miners intention of choosing an alternative job ($\beta = 0.18$) indicating that it is applicable to this environmental issue. The findings from the study reveal that PBC which has been the focus of facilitating illegal miner's choice of an alternative job is not a predictor of their intention ($\beta = 0.13$; $p > 0.05$) explaining why miners are back to the site. The finding of the study suggests positive though not significant prediction from subjective norm (SN) on the BI of the illegal miners. Although SN and PBC were not significant predictors of illegal miner's BI of choosing an alternative job, the attitude was found to be the dominant significant antecedent of the behavioral intention. This empirical evidence can be used by the Water Resources Commission (WRC) to address the issue of choosing alternative job by illegal miners. WRC could achieve that by strategically directing all their expertise and resources in the sensitization and education of illegal miners' by focusing on the behavioral belief variables: improving raw water quality, protecting the ecosystem, helping regeneration of fishes and reducing water pollution. Because the study reveal a link between subjective norm and attitude, WRC may first establish ties with the communities' using focus group discussion by using the traditional/ opinion and religious leaders as facilitators. As time elapse, it could be expanded gradually into a form of durbar with the focus on short sketches, demonstrations which will highlight on the behavioral beliefs. This can be enhanced with picture demonstration posters in the community and market centers. This can further be augmented by education in primary, junior and senior high schools, and on radio and, television. These processes have a lot of benefits. First, the illegal miners' will be well sensitization and educated for any possible change over. Second, the miners and the entire communities will have confidence and trust in the proposals that will be brought before them and be ready to own it. Third, community members or the youth who wished to join will now be educated, informed and unmotivated to engage in such act. The assumption that predicting factors in TPB are correlated was partially supported. The assumptions being supported suggests that the attitude was not only influenced by the behavioral beliefs but might be affected by the normative beliefs as well. The results did not support hypothesis 3, 7 and 8. The findings of this study call for the creation of a non-threatening platform or environment for

a win-win situation where factors which are still unidentified but have a strong influence on the intentions of the illegal miners could be unearthed instead of putting so many resources into areas which have no empirical evidence to yield results. The study has some limitations which should be pointed out. There were certain areas where questionnaires could not be administered due to the risky nature of the area. The respondents in the research even though are from illegal mining communities or towns may not necessarily all be illegal miners which could affect the level of judgment in the answering of the questions. It will be interesting to conduct this research in all the other existing basins since most of the conditions such as the presence of the task force are no longer present. It will also be interesting to carry out this research in the same area but provide the option for respondents to choose their preferred alternative job.

Compliance with Ethical Standards

Conflict of Interest We declare as authors of this study that there is no conflict of interest. The study focused mainly on the choice of alternative job by illegal miners in the Pra Basin of Ghana. This was an intervention meant to reduce the impact of the illegal mining on the water resources in

the basin. The work did not receive any financial support from any external organization.

Ethical Approval In Ghana ethical approval is not needed to conduct a survey which does not bother on the health of the individuals involved. However, the consent of the individual would have to be sorted before the questionnaire can be administered. In this case the views and beliefs of the miners is what the study focussed on.

Appendix 1

Considering the fact that government has proposed to engage all illegal miners in the planting for food project after stopping the illegal mining business. I want to know your views about the factors which influence an illegal miner’s choice of an alternative job. Please answer all sections of the questionnaire and select **ONE** choice only per question. If you need to change a chosen answer, please **cross** out the previous one and select a new one instead as indicated below. Please note that your personal opinion of how you agree or disagree with these statements is what is being requested here. Please be assured that this is for academic purposes only and your identity will never be disclosed. Use the following scale in answering the questions:

1	2	3	4	5	6	7
Very Unlikely	Unlikely	Somewhat Unlikely	Neutral	Somewhat likely	Likely	Very likely
Definitely false	False	Somewhat false	Neutral	Somewhat true	True	Definitely true
Extremely bad	Bad	Somewhat bad	Neutral	Somewhat good	Good	Extremely good
Strongly disagree	Disagree	Somewhat disagree	Neutral	Somewhat agree	Agree	Strongly agree

Example of how to answer the questions

Environmental Protection Agency needs military support to fight illegal mining							
Strongly Disapprove	1	2	3	4	5	6	7√ Strongly Approve

In this example, the respondent feel’s strongly (7) environmental protection agency needs military support.

Environmental Protection Agency needs military support to fight illegal mining							
Strongly Disapprove	1	2√	3	4	5	6	✗7 Strongly Approve

If the respondent made a mistake and want to change his answer, then he can cross out the chosen answer as shown above and choose a new one.

Sex		Educational Background					Religion			Age Range
M	F	NFE	B E	Secondary	CVT	Tertiary	CH	MS	Others	

Non formal education (NFE), Basic education (BE). Commercial, Vocational Technical (CVT), Christianity (CH), Moslem (MS), Others OT)

Behavioral beliefs

(1 = strongly disagree; 7 = strongly agree)

Stopping illegal mining will help reduce the pollution of rivers.

Stopping illegal mining will deprive me of my livelihood.

Stopping illegal mining will lead to regeneration of fishes in the river and improve water quality.

Stopping illegal mining will help reduce cost of drinking water treatment.

Stopping illegal mining will help protect the ecosystem.

Evaluation of beliefs

(1 = extremely bad; 7 = extremely good)

or me to reduce river pollution by stopping illegal mining is.

For me to be deprived of my livelihood by stopping illegal mining is.

For me to help in fish regeneration and improve river quality by stopping illegal mining is.

For me to help reduce the cost of treatment for drinking water by stopping illegal mining is.

For me to protect ecosystem by stopping illegal mining is.

Normative beliefs

(1 = definitely false; 7 = definitely true)

My family approve of illegal mining.

My society approve of illegal mining.

My religion approves of illegal mining.

My society approves of illegal mining.

My culture approves of illegal mining.

The institutions such as EPA, WRC, MC, and MMDA's approve of illegal mining.

Evaluation of beliefs

(1 = strongly disagree; 7 = strongly agree)

What my family think I should do is important to me.

What my society think I should do is important to me.

What my religion think I should do is important to me.

What my culture think I should do is important to me.

What the institutions think I should do is important to me.

Control beliefs

(1 = strongly disagree; 7 = strongly agree)

I will stop illegal mining if there is an alternative job.

I will stop illegal mining and adopt an alternative job which provides training before starting.

I will stop illegal mining and adopt an alternative job which provides free capital.

I will stop illegal mining and adopt an alternative job which has a 'ready market'.

I will stop illegal mining when there is constant task force monitoring on the field.

Evaluation of beliefs

For me to adopt an alternative job by stopping illegal mining is.

For me to stop illegal mining by adopting an alternative job that provides training is.

For me to stop illegal mining by adopting an alternative job that provides free capital is.

For me to stop illegal mining by adopting an alternative job that has a ready market is.

For me to stop illegal mining by using task forces is.

Intentions

(1 = very unlikely; 7 = very likely)

I intend to stop illegal mining.

I plan to stop illegal mining.

I will to stop illegal mining.

References

- Ajzen, I. (1991). The theory of planned behavior. *Organizational Behavior and Human Decision Processes*, 50(2), 179–211.
- Ajzen, I. (2006). Constructing a TpB questionnaire: Conceptual and methodological considerations. Retrieved June 27, 2011 from the World Wide Web: http://www.people.umass.edu/aizen/pdf/tpb_measurement.pdf.
- Bentler, P. M. (1990). Comparative fit indexes in structural models. *Psychological Bulletin*, 107(2), 238–246.
- Chang, M. K. (1998). Predicting unethical behavior: A comparison of the theory of reasoned action and the theory of planned behavior. *Journal of Business Ethics*, 17(16), 1825–1834.
- De Leeuw, A., Valois, P., Ajzen, I., & Schmidt, P. (2015). Using the theory of planned behavior to identify key beliefs underlying pro-environmental behavior in high-school students: Implications for educational interventions. *Journal of Environmental Psychology*, 42, 128–138.
- Fishbein, M., & Ajzen, I. (1977). Belief, attitude, intention and behavior: An introduction to theory and research.
- Han, H., Hsu, L. T. J., & Sheu, C. (2010). Application of the theory of planned behavior to green hotel choice: Testing the effect of environmental friendly activities. *Tourism Management*, 31(3), 325–334.
- Lee, J., Cerreto, F. A., & Lee, J. (2010). Theory of planned behavior and teachers' decisions regarding use of educational technology. *Journal of Educational Technology & Society*, 13(1).
- Ryu, K., & Jang, S. (2006). Intention to experience local cuisine in a travel destination: The modified theory of reasoned action. *Journal of Hospitality & Tourism Research*, 30(4), 507–516.
- Sommer, L. (2011). The theory of planned behaviour and the impact of past behaviour. *International Business & Economics Research Journal*, 10(1), 91–110.
- Vallerand, R. J., Deshaies, P., Cuerrier, J. P., Pelletier, L. G., & Mongeau, C. (1992). Ajzen and Fishbein's theory of reasoned action as applied to moral behavior: A confirmatory analysis. *Journal of Personality and Social Psychology*, 62(1), 98.
- Zhang, B., Yang, S., & Bi, J. (2010). Enterprises' willingness to adopt/develop cleaner production technologies: An empirical study in Changshu, China. *Journal of Cleaner Production*, 40, 62–70.

Publisher's Note Springer Nature remains neutral with regard to jurisdictional claims in published maps and institutional affiliations.