



## Research article

## Analyzing physical and socio-economic factors for property crime incident in Addis Ababa, Ethiopia

Yeshimar Yigzaw<sup>a,b,\*</sup>, Asnake Mekuriaw<sup>b</sup>, Tadesse Amsalu<sup>c</sup><sup>a</sup> Cadet School, Ethiopian Police University, Ethiopia<sup>b</sup> Department of Geography and Environmental Studies, College of Social Sciences, Addis Ababa University, Addis Ababa, Ethiopia<sup>c</sup> Institute of Land Administration, Bahir Dar University, Bahir Dar, Ethiopia

## ARTICLE INFO

## Keywords:

Physical factors  
Socioeconomic factors  
Property crime  
Crime incident  
Addis-ababa  
Ethiopia

## ABSTRACT

Property crime has become a challenge in major cities of developing countries including Addis Ababa, Ethiopia. However, factors contributing to property crime have not been carefully examined. Therefore, this paper presents the physical and socio-economic factors that clearly have a substantial impact on property crime. In this study, both primary and secondary data were used. Recorded property crime was collected from Addis Ababa police commission. Property crime incidence locations were georeferenced using Google Earth as well as handheld Global Positioning System. Then, a property crime surface map and pattern were created using point pattern analysis and inverse distance weighted interpolation technique. The study area was then classified into low crime and hotspot areas based on the frequency of crime events as well as the created crime surface map. A total of 200 respondents (100 in high crime area and 100 in low crime area) were selected using purposive sampling techniques. Five key informants were selected purposely from senior police officers. Data were collected using questionnaires and in-depth interview. A binary logistic regression model was employed to analyze the collected data. The data analysis showed that physical features mainly commercial center, road with no street light and river courses were positively correlated at significant level with the committing of property crime. On the other hand, public participation in crime prevention, witness and crime events reporting influenced negatively the committing of property crime. In addition, unemployment, family background, education level, age, time, season and police patrolling activities determine the occurrence of property crime events. The finding depicts that the identified physical and socio-economic factors can influence the patterns and rate of crime incidents in the study area. Therefore, the law enforcement officers should consider these influential factors to deploy police officers and to reduce property crime problems.

## 1. Introduction

Crime is an act practiced by a person or group of people through violating the rules, regulations and social values of a country or a community [1]. Crime is an action practiced against a person, property, social norms and values [2, 3]. [4] defined crime as a misbehavior which is prohibited and made punishable by law. Common to all these definitions is that crime is against norms, beliefs, culture and binding laws.

\* Corresponding author. Cadet School, Ethiopian Police University, Ethiopia.  
E-mail address: [yeshimar.yigzaw@aau.edu.et](mailto:yeshimar.yigzaw@aau.edu.et) (Y. Yigzaw).

<https://doi.org/10.1016/j.heliyon.2023.e13282>

Received 16 March 2022; Received in revised form 24 January 2023; Accepted 25 January 2023

Available online 28 January 2023

2405-8440/© 2023 The Authors. Published by Elsevier Ltd. This is an open access article under the CC BY-NC-ND license (<http://creativecommons.org/licenses/by-nc-nd/4.0/>).

Many developing and developed countries are challenged with high level of offences [5]. For instance, property crime and cybercrime are committed in the USA, Africa (e.g., South Africa, Mali and Nigeria), Latin America (e.g., Mexico), Asia (e.g., Yemen, Afghanistan and Iraq) [6] and in Canada [7]. [8] reported that crime has become a problem in all continents except in Antarctica; however, the highest level of crime was recorded in African, Latin American and Asian countries. Even if the occurrence of crime in the USA is labeled as relatively low by Ref. [8] about 8 million property crimes offences were recorded in the country in 2015 [9]. Similarly, property crimes (e.g., looting, aggravated theft, check misappropriation, vehicle part theft, robbery, bribery, corruption and money laundering) have become a wide spread social problem in Ethiopia [10]. In Addis Ababa (capital city of Ethiopia), a total of 243, 063 crimes were recorded between 2014 and 2018 [11].

The degree of property crime varies from country to country mainly due to differences in economic development [12], and education and income [13]. Crime is more prevalent in areas where the residents' level of education and income is low [13], the level of poverty is high [14], the rate of unemployment is high [15] or law enforcement agencies particularly police personnel are lacking [16].

Crime has a pronounced impact on national economic development and citizens' psychological and spiritual well-being [17]. For instance, crime destabilizes politics and economic development and growth of any society [18]. Property crime negatively affects the activities of investors that in turn disturb the socio-economic activities of a society [6].

Realizing the increasing trend and negative impacts of crime, a Goal of Sustainable Cities and Communities (Goal 11) was established to make cities safe [19]. Strengthening crime prevention and criminal justice institutions helps to reduce crime rate [18]. Appropriate strategies and actions are required to reduce and prevent crime rate and its socio-economic impact. In this regard, it is claimed that crime analysis and mapping of crime that focused on selecting and prioritizing crime prone areas, analyzing patterns and trends of crime and criminal behavior are decisive elements to develop crime prevention strategies [20, 21, 22]. Spatial information about crime-susceptible areas is a key to effective policing in a given area [23]. [24] indicated that police can reduce crime by identifying crime hotspots and allocating their limited resources in such areas. A crime hotspot analysis is a common police strategy made by law-enforcement agencies to reduce crime and disorder problems [25].

Crime is a consequence of many social and economic problems [15, 20]. Crime and its determinants are closely related to variables, such as social exclusion, educational level, cultural dimension, and family background [15]. [26] noted that various variables including poverty levels, family stability, individual and societal health, demographic and political considerations are related to and have influence on crime. However, the determinants of crime and the degree of their influence on property crime incident are not the

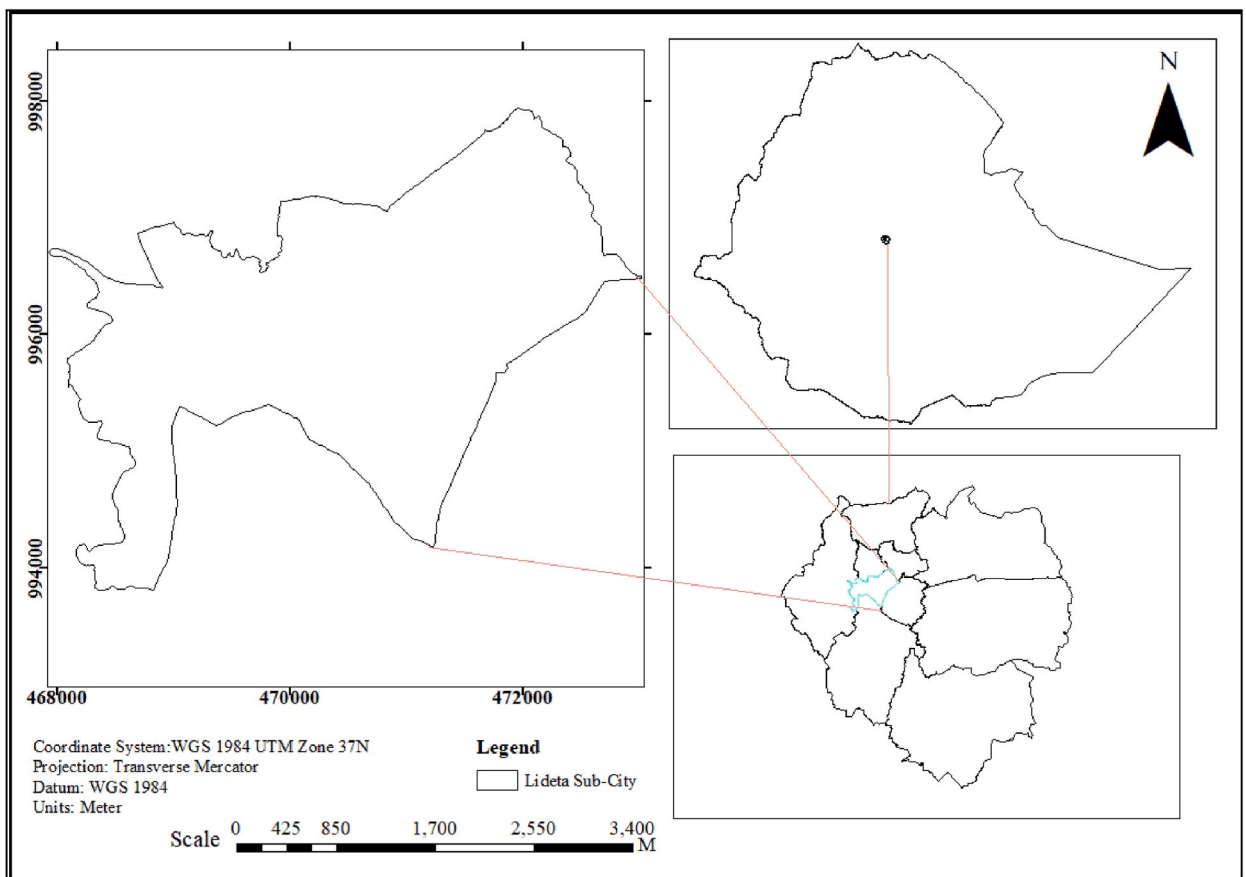


Fig. 1. Location map of the study area.

same in all countries [27]. It has widely been mentioned that unemployment is the main cause of property crime in developing countries [28, 29, 30] and developed countries [3, 7, 31]. Although examining the determinants of property crime in urban areas is fundamentally important to develop crime reduction strategy and to reduce crime incidents and associated problems, the socio-demographic structures of the offenders have not been investigated. We argue that examining socio-economic and physical factors can help law enforcement agencies to develop effective crime prevention strategies and to reduce property crimes rates. Only a few case studies are conducted related to the impact of the socio-economic factors in property crime in Ethiopia. In Addis Ababa however the socio-economic and physical factors contributing to property crime have not been identified and analyzed. Therefore, this paper is aimed to enrich the existing literature by identifying the socio-economic and physical factors contributing to property crime. In this study the researches focused on to answer the following research questions: (1) how crimes spatially distributed in the study area? (2) What are the socioeconomic and physical factors contributing to property crime incidence? And (3) Which attribute of the society and criminal offence are highly contributing to property crime incidence? It is expected that this study provides scientific input for law enforcers and inform stakeholders about property crime distribution, and add knowledge on socioeconomic and physical factors contributing to property crime.

## 2. Methods and materials

### 2.1. Description of the study area

The study was conducted in Lideta sub-city located in south west of Addis Ababa, Ethiopia (Fig. 1). Geographically, the study area covers about 9.2 km<sup>2</sup> and it extends from 8° 59'35" to 9° 01'50" N and 38° 42'32" to 38° 45'20" E. The study area has a total of 214,769 human population [32]. Addis Ababa is the political and economic center as well as the cultural hub of Ethiopia. Many international and continental organisations (e.g., the African Union) are found in the city. The main economic activity in the city is trade and commerce followed by manufacturing and industry, home making, civil administration, transport and communication. Rapid urbanization not complemented by commensurate employment opportunities has triggered poverty and social inequality which are currently considered as the main problem of the city.

### 2.2. Methods of sampling technique, data collection and data analysis

The study area was purposively selected due to the availability of data recorded on property crime for five consecutive years (2014–2018). The study employs qualitative and quantitative research approach because mixed approaches create enabling condition to investigate property crime incidence. In this study, both primary and secondary data (spatial and non-spatial data) were used. Secondary data on property crime (e.g., date, crime time, and location of each crime) was collected from Addis Ababa police commission, Lideta sub-city police office for the period 2014 to 2018 through police office crime record analysis. The primary data was collected through close-ended questionnaires and key informant interview from respondents and senior police, respectively.

Field research was conducted in February and March 2019. Collected property crime data were first geocoded to create latitudinal and longitudinal values using Google Earth as well as handheld Global Positioning System through the guidance of the Lideta sub-city police officers. The spatial extent and pattern of property crime was mapped using point pattern analysis and inverse distance weighted (IDW) interpolation technique. The IDW technique is sensitive to outliers and not efficient in mountainous areas; however, it is effective to determine values at unmeasured points by taking the mean weight of the nearby sampled points [33]. Considering the IDW suitability to fix the locations of crime within a bounded region this technique has been used by several researchers to identify crime hotspot areas [33, 34, 35, 36, 37]. The study area was classified into low crime and hotspot areas based on the frequency of crime events as well as the created crime surface map. ArcGIS 10.8.1 was used for low crime and hotspot area mapping. Hotspot represents an area of high crime concentration, relative to the distribution of crime across the whole region of interest. A hotspot is a condition indicating some form of clustering in a spatial distribution [38, 39] and it is one way of analyzing concentration of phenomena in space [40]. The number of crime events required to classify an area as hotspot area is not yet defined [41].

In order to analyze the relationship between crime events and physical as well as socioeconomic characteristics of the study area, representative crime places were selected from hotspot and low crime areas using purposive sampling technique. The numbers of neighborhood in the high and low crime areas were mapped. This was followed by selecting two neighborhoods from each crime zone. From each sample area, a total of 200 respondents (100 high in crime area and 100 in low crime area) were purposively selected. Five key informants were selected purposely from senior police officers working in the study area. Primary data (e.g., socioeconomic data, crime data, patrolling time and effectiveness of patrolling) was collected from respondents and key informants using an open ended and close ended questionnaire and a check list of questions for in-depth interview respectively. We developed ten survey questions consisting of focused on background information, built-up environment, place, time and season (annex 1). Preliminary ideas and concepts for the survey were conceived from a literature review and the personal experiences of the researchers. Moreover, data collected from the key informants was used to supplement and crosscheck the data collected through questionnaires. The study complies with all regulations and informed consent is not required. In addition, for all respondents, key informants and FGD participants the researchers clarified that their response will be kept confidential.

Unfortunately, the department of Geography and Environmental studies of Addis Ababa University that hosts the research "Analyzing physical and socioeconomic factors for property crime incidents in Addis Ababa, Ethiopia" does not have an ethical committee. However, the questionnaires that focus on human elements were approved by the postgraduate coordinator of the department.

### 2.3. Variables specification

In this study, a dichotomous dependent variable (property crime incident) and independent variables which have association with property crime incident were identified. More precisely, thirteen explanatory variables were identified based on the findings of previous studies conducted in developing and developed countries, a literature review and the personal experiences of the researchers. Many explanatory variables were used by Ref. [42] to investigate crime against person property Kenya. In addition [43], used ten variables for regression model. Similarly [44], used eight explanatory variables [45], used eleven explanatory variables, and [46] used seventeen explanatory variables to investigate factors influencing the adoption of soil and water conservation practices using a binary logistic regression model. For a dichotomous dependent variable there are only two possible responses: yes (1) if the event occurs; and no (0) if it does not [47]. The explanatory variables are presented below.

#### 2.3.1. Police station

We assume that the law enforcement has strong positive relationship with the reduction of property crime. This variable therefore takes a value 1 if a respondent experienced or perceived that property crime is committed around the police station and 0 otherwise.

#### 2.3.2. Open space

It is a place where every inhabitant has the right to recreate or walk around free of charge. This variable measures respondents' perception of a property crime incidence in open spaces. It takes a value 1 if a respondent perceived that property crime incidence is committed in open space and 0 otherwise [48]. reported that in the major cities of Lithuania (e.g., in Vilnius, Kaunas and Klaipeda) open space creates opportunities for criminals due to lack of restriction to access the open place at any time.

#### 2.3.3. Road with street light

It is the infrastructure that can be considered as part of the physical landscape of a city [49]. We assume that street lighting creates favorable condition for street usage during the night time that may discourage potential offenders who benefit from the cover of darkness. Therefore this dummy variable takes a value 1 if a respondent perceived or experienced that property crime event is committed in a road with street light and 0 otherwise.

#### 2.3.4. Road with no street light

This is a dummy variable, which takes a value 1 if a respondent perceived that property crime event is committed in a road where street light is lacking and 0 otherwise.

#### 2.3.5. School

In Ethiopia, school compound and its surroundings are considered as relatively safe places mainly due to the presences of law enforcers. Therefore, this variable takes a value 1 if a respondent perceived that property crime is committed around school and 0 otherwise.

#### 2.3.6. Residential area

In this study, residential area is hypothesized to have a positive effect on the reduction of property crime event. Therefore, this dummy variable takes a value 1 if a respondent perceived that property crime event is committed in the residential area and 0 otherwise.

#### 2.3.7. Public participation in crime prevention

This is a dummy variable that takes a value 1 if a respondent participates in crime prevention at own cost and 0 otherwise. We estimate that high percentage of public participation in crime prevention will reduce property crime event.

#### 2.3.8. Public participation in crime witness

This is a dummy variable that takes a value 1 if a respondent participates in crime witness voluntarily in the past and 0 otherwise. We assume that getting support from the community can strengthen law enforcement.

#### 2.3.9. Public participation in crime reporting

This is a dummy variable that takes a value 1 if a respondent participates in crime event reporting to the legal body at own cost and 0 otherwise. Reporting crime events increases the capability of the policy to acquire, process and use information and the end result will have a positive role in reducing property crime event.

#### 2.3.10. Health center

In Ethiopia, health centers and their surroundings are highly crowded and create favorable condition for offenders to commit property crime. Therefore, this variable takes a value 1 if a respondent experienced or perceived a property crime event committed in around health center and 0 otherwise.

#### 2.3.11. Commercial center

We assume that large numbers of people visit commercial centers every day and these areas create attractive opportunities for

criminals. This variable takes a value 1 if a respondent experienced or perceived property crime event in such places and 0 otherwise [48]. reported strong positive relationship between commercial centers and property crime incidence in Kaunas city, Lithuania.

2.3.12. Hotels, pensions and grocery

We assume that hotels, pensions and grocery are attracting large number of customers for recreation, refreshment or to make business. Therefore, this dummy variable has strong positive relationship with property crime incidence. The variable takes a value of 1 if a respondent experienced or perceived property crime incidence around hotels, pensions and grocery and 0 otherwise.

2.3.13. River course

It is hypothesized that riversides are highly vulnerable to property crime mainly due to lack of sufficient number of police officers. This dummy variable takes a value of 1 if a respondent experienced or perceived property crime incidence around River sides and 0 otherwise.

2.4. Data analysis

The data collected using close-ended questionnaires were processed and summarized using Statistical Product and Services Solutions software (SPSS.26). Given the dependent variables binary nature, a binary logistic regression (a global non-spatial model) and geographically weighted regression (a local spatial regression model) were used to model the effect of the aforementioned independent variables on property crime incident [50]. Geographically weighted regression is the best model when a phenomenon to be analyzed is location based and the purpose is measuring the spatial heterogeneity between dependent variable and explanatory variables [51]. When the dependent and independent variables are dichotomous, a binary logistic regression model is ideal to analyze their relationship [47]. The same author reported that the binary logistic regression model enables to determine the impacts of each independent variable on the dependent variable. Similarly [52], indicated that the logit model produces relevant outcomes if the dependent variable is binary [51]. stated that logistic regression and geographically weighted regression models have equal prediction power.

In this study, the dichotomous dependent variable and the independent variables were analyzed using binary logistic regression because our aim was to identify the relationship between property crime incidence and explanatory variables of the study area, and spatially explicit data about the respondents (an input for geographically weighted regression model) was not recorded because of security reason. The results of the study are presented using tables.

The qualitative data collected through key informants and open ended questions in the questionnaire were first categorized in

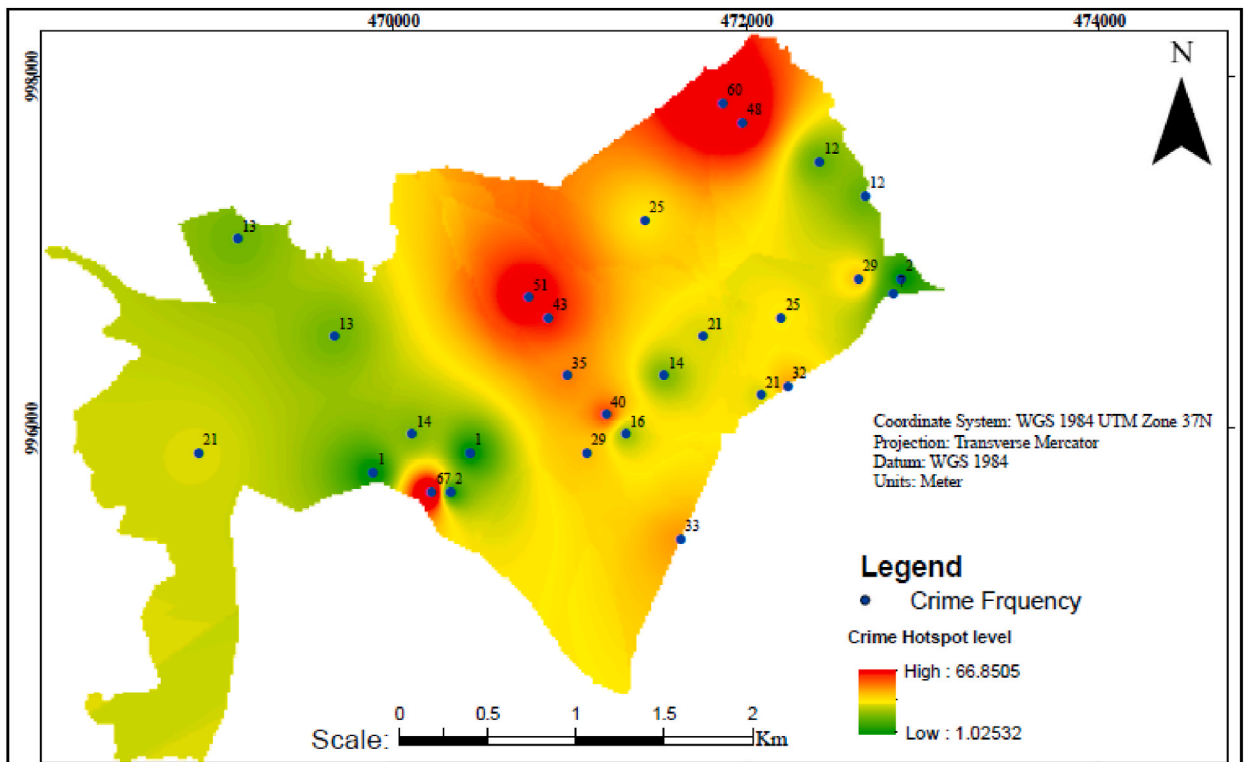


Fig. 2. Map showing property crime distribution in the study area.

specific themes and then interpreted qualitatively in content wise. It was used to supplement and crosscheck the data collected through questionnaires.

### 3. Results and discussions

#### 3.1. Spatial distribution of property crime

The study indicated that property crime is unevenly distributed in the study area (Fig. 2). Some areas particularly the north eastern parts of the study area have high proportion of property crime, hence these sites can be considered as hotspot areas. There is however low occurrence of crime in the western parts of the study area and according to the key informants this is attributed to the presence of defense camp and continental organizations (e.g., African Union) in this part of the study area. In fact, criminals commit crime as per their plan [53] and in areas where they know each and every thing [54]. Consequently, the spatial distribution of property crime over an area is diverse [55].

#### 3.2. Factors affecting property crime

The spatial density map indicates that some parts of the study area experience a higher amount of property crimes. The major factors that influenced the occurrence of crime events in the study area were identified by analyzing the dependent variable (property crime) against thirteen explanatory variables (Table 1). The variables are included in the model because we believe that they are contributing to property crime. The descriptive statistics shows that property crime is substantially committed in commercial centers, around river courses and hotels, and in areas where public participation in crime prevention is low or streetlight is lacking.

##### 3.2.1. Physical features

The result shows physical factors such as river courses and roads where streetlight is lacking showed positive relationship with the occurrence of property crime events (Table 1). The key informants asserted that property crime rate is high in areas where streetlight is lacking during night time. In line with the finding of the study [56], found that, in the USA, offenders are less likely to commit crime in places where there is streetlight because they fear someone who might intervene, call the police, or recognize the offender. In New York City, a nighttime outdoor crime was reduced by 36% after the provision of streetlight [57]. Similarly, a study conducted in United Kingdom, USA, Brazil and South Korea indicated a 12% reduction in property crime after street lighting interventions [49]. This implies that property crime committed during the night time along the street can be substantially reduced by improving lighting conditions.

The study also found out that commercial center is positively related with property crime event (Table 1). The key informants asserted that property crime rate is high at commercial centers. They described that commercial centers are areas of high business transactions and routine activities that create favorable conditions for offenders to commit crime. A crowded location such as commercial center and shopping malls are suitable for an offender due to the availability of many targets and the inherent difficulty of surveillance in such places [58, 59, 60]. Similarly [55], found that highly crowded places create an opportunity for the rational choice of criminals for committing a crime. In Mexico, downtown areas are known by high crime event [28]. In developed countries (e.g., Canada), downtown shopping malls are crowded so that they are creating situational opportunities for offenders [31]. On the contrary [61], reported that the crime event is higher in the suburban shopping malls of Los Angeles and San Diego than in those of their counterparts because the suburban shopping malls are highly crowded and this situation motivates people to commit crime.

Areas where hotels, pensions and grocery are located related insignificantly but positively with property crime incidences. However, the key informants reported that around hotels, pensions and groceries property crime is committed frequently because such places are creating an excellent opportunity for a motivated offender.

The result of binary logistic regression analysis shows that schools, police stations, health centers, and roads with street light and

**Table 1**  
Binary logistic regression model result for factors influencing property crime practices.

Explanatory variables	%	B	S.E.	Wald	P-value	Exp(B)
School	22	-0.547	0.404	1.825	0.177	.579
Police station	14	-0.613	0.527	1.355	0.244	.542
Road with street light	34	-0.001	0.342	0.000	0.999	1.001
Road with no street light	67	0.902	0.424	4.53	0.033**	.406
Residential area	23	-0.354	0.414	0.732	0.392	.702
Health center	34	-0.017	0.342	0.002	0.960	.983
Commercial center	83	2.37	0.558	18.04	0.000*	.093
Hotels, pensions and grocery	74	0.676	0.446	2.303	0.129	1.966
River sides	69	0.819	0.423	3.751	0.053**	2.267
Open spaces	62	-0.224	0.364	0.377	0.539	.800
Public participation in crime prevention	68	-1.26	0.523	5.807	0.016*	.284
Public participation in crime witness	76	-1.36	0.358	14.437	0.000*	.256
Public participation in crime events reporting	77	-1.11	0.843	13.79	0.000*	0.97

Note: \*\* = statistically significant at 0.05 level and \* = statistically significant at 0.01 level % = per cent or respondents who responded yes. N = 200.



residential areas have negative and insignificant relationship with property crime events (Table 1). In the study area such places are relatively safe mainly due to the presence of law enforcers according to the key informants. Contrary to the finding of the study [31], reported high crime event around schools (e.g., in Canada) because such places are characterized by high population number that creates fertile ground for the offenders.

### 3.2.2. Season and time

In the study area a total of 857 property crimes were committed for the period 2014 to 2018 (Table 2). The highest (39%) and the lowest (16%) number of property crime were recorded in summer and winter seasons respectively. According to the key informants, property crime was high in summer (rainy season) due to electric power interruptions during night time, foggy and rainy weather condition, and high unemployment rate because of limited job opportunity for daily workers during the rainy season. This shows that the occurrence of property crime is not distributed evenly thorough out the year instead its distribution varies from season to season. Similar trend in the incidence of crime event across seasons was reported by other researchers, for example [62] in England and Wales and [63] in Sweden.

Crime has different patterns at different temporal scales [64]. This was evidenced in the study area (Table 2). The time of crime event distribution shows that the lowest crime event was registered in night tour whereas the highest crime recorded during day tour hours particularly between 0800 and 1600 time (Table 2). In the study area, this time of the day characterized by high mobility of people to work places, active economic activities and congested car traffic. Service providing institutions are also open during this time. During night tour condition movements in the study areas are relatively low. The key informants asserted that this situation negatively affects criminals activity. Similarly [55], found that high crime rate was recorded during the day time mainly due to the daily activities of the people.

### 3.2.3. Socio-economic factors affecting property crime

**3.2.3.1. Community participation in property crime prevention.** Public participation in crime prevention, witness and reporting to the police were negatively correlated with property crime commission at statistically significant level (Table 1). This implies that when public participation in property crime prevention or reporting crime to the police officers is high the rate of property crime committed in the study area decreases. The key informants asserted that public participation in crime prevention, witness and crime event report reinforces social interaction as well as linkage between the community and the police officers. This negatively affects the offenders' rational choice and opportunity to commit crime in the study area. This finding is concurrent with the findings of [65, 66] which state that public participation increases the intimacy of neighbors and interpersonal networks that in turn helps to protect and control crimes. On the contrary [67], argued that social disorganization creates an opportunity for criminals to commit crime in an area.

**3.2.3.2. Awareness of the communities on crime prevention and controls.** In the study area the majority of the respondents (75% in hotspot area) and (88% in low crime area) perceived that both the community and police are responsible to prevent and control crime (Table 3). Awareness of communities on property crime prevention is reasonably higher in low crime area than in hotspot area. This indicates that when the awareness of the community on crime prevention and controls is high the rate of crime committed in the study decreases [68]. confirmed that public participation determines crime safety, police patrol and crime control functionality. Data analyzed from household respondents indicated that the effort made by the community police to create a strong local community institution that deals with crime prevention is weak. And, where some criminals are caught with the support of the local community the punitive measures against the criminals is low and this pushes them to committing further crimes. These claims are however not shared by police officers and the scenario implies the need for bringing on board both parties for a transparent dialogue and crafting strategies to combat crimes. Concurrent to the finding of this study [14], found, in India, a positive and statistically significant relationship between weak legal system and property crime incidences. A study conducted in eleven Asian countries also showed that weak law enforcement and control of corruption are significantly correlated with crime [69].

**3.2.3.3. Police activities.** The result shows that 50% (hotspot area) and 56% (low crime area) of the respondents stated that the police are usually patrolling in the study area (Table 3). Even though police activity in the study area is low it was relatively better in low crime area. The activities of police in law enforcement are the basic actions to decrease crime occurrence rate. When the police

**Table 2**  
Seasons and time when property crime was committed in the study area.

Variables		% of property crimes committed
Season	Summer	39
	Winter	16
	Autumn	24
	Spring	21
Time	0800–1600	60
	1600–2400	30
	2400–0800	10

Total number of property crimes committed in the study area is 857.

**Table 3**  
Awareness of the communities on crime prevention and control (N = 200).

Variables	% of 'yes' responses	
	Hotspot area (n = 100)	Low crime area (n = 100)
Police is responsible to prevent crime	15	6
Community is responsible to prevent crime	10	6
Community and police are responsible to prevent crime	75	88
Police patrolling	50	56

patrolling activities are low the rate of crime committed has increased. According to the key informants when police patrol is high in a given area the criminals' opportunity to commit a crime becomes low. This implies that the rate of property crime can be reduced by strengthening law enforcements. In line with this, a negative relationship between property crime rate and strong law enforcement activities was reported in the USA [70] and in Malaysia [30]. [14] also found a positive and statistically significant correlation between low quality legal system that prolongs a trial and property crime rate in India.

3.2.4. *Criminals personal attributes and criminal offences*

3.2.4.1. *Age.* Assessment of age and criminal offences showed that 84% of property crime was committed by productive age group (Table 4). Only 15% of property crimes were practiced by under 18 age groups. Property crime (by its nature needs a better decision) is committed by the productive age group. On the contrary [71], found that, in Germany, young people (15–24 years old) committed high crime rate than other age group since they are in a better physical position to commit crimes [72, 73]. reported that mostly property crime is committed by young people. Respondents claimed that early age crimes are evident due to exposure of the young to criminal offences released in electronic devices.

3.2.4.2. *Unemployment.* In the study area property crime was committed by both employed and unemployed people (Table 4). However, the highest amount of property crime (80%) was committed by unemployed people. In fact, most of the unemployed people may not have a permanent source of income that enables them to lead their life. Under this circumstance, unemployed people are committing crime to improve their economic situation. An indirect attempt to extract information from criminals by police officers why the unemployed commit crimes indicated that the opportunities they got to be employed in microenterprises proposed by the local government brings insignificant income and they refused to join microenterprise activities. Some other claimed that chances for employment opportunities are either rare or nonexistent and this triggers them to go for unlawful activities. The extreme criminals vividly told the police officers that their mind set up is not ready for work. These assertions of criminals can be considered as valid feedback for government institutions in their strategies to curb the unemployment challenge.

Similar to the finding of the study, a positive relationship was found between property crime rate and unemployment rate in Malaysia [27, 30], Mexico [28], India [14], Pakistan [29] and Toronto [7] as people with low income commit crime to fulfill their basic needs [6]. [12] also found that unemployment results in economic tension that in turn forces criminals to commit crime. A study conducted in 28 European Union countries by Ref. [3] found a positive correlation between unemployment and crime rate because unemployment indirectly affects purchasing and expenditure power of households to fulfill their basic needs. These imply that unemployment in urban areas lead to economic imbalances and normlessness that would in turn lead people to engage in property crime.

On the contrary [71], did not find any correlation between crime rate and unemployment. Likewise [70], found that, in the USA, unemployment does not have a significant relationship with property crime mainly due to the implementation of unemployment insurance policy.

3.2.4.3. *Family background and family status.* In the study area, property crime was mostly committed by unmarried persons (73%)

**Table 4**  
Criminals age group, job category, and family and education status.

Variables	% of crimes committed	
Criminal age	<18	15
	18–60	84
	>60	1
Criminal job categories	Unemployed	80
	Private worker	17
	Government	3
Criminal family status	Married	27
	Unmarried	73
Criminal education status	Below or grade 12	64
	Certificate	29
	Diploma or above	7

\*Data were collected from Lideta sub-city police office



(Table 4). According to the key informants most property crimes are committed by unmarried persons to fulfill their basic economic needs. They also noted that family life and marriage are important factors to control criminal activities. Data compiled from open-ended questions demonstrated that most criminals are from low income families and the environment they grew up is characterized by occurrence of criminal offences. Absence of close follow up of children activities during their childhood and schooling mainly due to lack of education in parents and economic pressures to secure daily bread for the family, was also boldly stated by many respondents. This again implies the need to carefully investigate the social fabric and design possible measures to bring up children with a great sense of social responsibility.

**3.2.4.4. Education.** The result in this study showed that the lowest property crime was committed by educated persons (Table 4). The key informants reported that relatively many educated persons are able to get good salary that is sufficient to answer economic issues that in turn discourages participation in crime. This implies that education reduces property crime commission rate. Key informants and respondent households however commented that the formal education in the country is not supported by moral education that could shape the attitude of the young towards better social responsibilities. Despite their education some of the criminals, as reported by the police officers, are employees in different institutions and their involvement in criminal offences is related to low monthly income. Taking note of the stated problems the need for incorporating moral education in the curricula of schools and involvement of religious institutions to play their share towards tackling the problem was given due emphasis by respondent households and police officers.

Similar to the finding of the study, in Pakistan, property crime appears to be strictly related to the level of education attained and to individuals' economic background [4]. In Malaysia, the number of property crime committed is negatively correlated with level of education [30]. Property crime was positively correlated with a higher education level in Toronto [7] and Switzerland [74]. Highly educated people earn high amount of money and this attracts the criminals to commit crime on these segment of the public for financial gains. On the contrary [6], reported that both educated and uneducated persons commit crimes.

## 4. Conclusions

The spatial density of property crime was different across the study area. This study was able to identify the physical and socio-economic factors influencing property crime commission. Being young, uneducated, and unemployed increases the probability of committing property crime. Crowded places, river sides and rainy and foggy weather condition create an excellent opportunity for criminals. Strong collaboration between the community and police officers as well as police patrolling activities negatively affects criminal rational choice and opportunity to commit property crime. We conclude that the root cause for property crime incidents is economic issue that in turn forces criminals to commit crime. We recommend that to reduce property crime incidences, the law enforcement offices should deploy police officers around river sides, commercial centers, roads where streetlight is lacking and open space. Moreover, the contribution of political factor for property crime as well as criminal and crime accident area networks, which were not covered in this study, needs detail investigation.

## Declarations

### *Author contribution statement*

Yeshimar Gizaw; Asnake Mekuriaw: Conceived and designed the experiments; Performed the experiments; Analyzed and interpreted the data; Wrote the paper. Tadesse Amsalu: Conceived and designed the experiments; Analyzed and interpreted the data; Wrote the paper.

### *Funding statement*

Mr Yeshimar Yigzaw was supported by Addis Ababa University postgraduate programme [PGS\_2019].

### *Data availability statement*

Data will be made available on request.

### *Declaration of interest's statement*

The authors declare no competing interests.

## Acknowledgment

We would like to thank the Addis Ababa University postgraduate programme for the generous financial assistance.

## References

- [1] Ethiopian Criminal Justice Policy., (2011). The criminal code of the federal democratic republic of Ethiopia, Article 1.4(d).
- [2] T. Balogun, H. Okeke, C. Chukwukere, Crime mapping in Nigeria using GIS, *J. Geogr. Inf. Syst.* 6 (5) (2014) 453–466.
- [3] F. Ayhan, N. Bursa, Unemployment and crime nexus in European Union countries: a panel data analysis, *J. Adm. Sci.* 17 (34) (2019) 465–484.
- [4] H. Kang, H. Kang, Prediction of crime occurrence from multi-modal data using deep learning, *PLoS One* 12 (4) (2017), e0176244.
- [5] M. Leitner, *Crime Modeling and Mapping Using Geospatial Technologies, Geotechnologies and the Environment* vol. 8, Springer Science and Business Media, 2013.
- [6] O. Jonathan, A. Olusola, T. Bernadin, T. Inoussa, Impacts of crime on socio-economic development, *Mediterr. J. Soc. Sci.* 12 (5) (2021) 71–81.
- [7] A. Sethi, K. Muth, S. MacDonald, T. Tsepel, The relationship between crime and socioeconomic status: a geospatial analysis of the correlation between crime and socioeconomic status, 2020. Abbotsford Youth Commission. Accessed on 12 January 2022, <https://storymaps.arcgis.com/stories/b5ab6df3741649c4bcc0a5fbd9e3b45b>.
- [8] J. Van Dijk, P. Nieuwebeerta, J. Larsen, Global crime patterns: an analysis of survey data from 166 countries around the world, 2006–2019, *J. Quant. Criminol.* 2021 (2021) 1–36.
- [9] Federal Bureau of Investigation, Crimes in the United States, 2015. <https://ucr.fbi.gov/crime-in-the-u.s/2015/crime-in-the-u.s.-2015/offenses-known-to-law-enforcement/property-crime>. Accessed on 26 July 2022.
- [10] N. Jibat, B. Nigussie, Criminality and victimization in oromia, Ethiopia: analysis of 2011/2012 police data, *SAGE Open* 5 (1) (2015) 1–13, <https://doi.org/10.1177/2158244014565335>.
- [11] Addis Ababa crime record report., (2016). Annual crime rate report Addis Ababa. Addis Ababa, Ethiopia. Unpublished.
- [12] G. Pieszko, The influence of socio – economic factors on crime 21 (9) (2016) 18–21.
- [13] J. Schweitzer, J. Kim, J. Mackin, The Impact of the built environment on crime and fear of crime in urban neighborhoods, *J. Urban Technol.* 6 (3) (2010) 59–73.
- [14] B. Ashish, Is Poverty the Mother of Crime? Empirical Evidence of the Impact of Socioeconomic Factors on Crime in India. *Atlantic Review of Economics*, 2014.
- [15] O. Lobont, A. Nicolescu, N. Moldovan, The effect of socioeconomic factors on crime rates in Romania: a macro-level analysis, *Economic Research-Ekonomska Istrazivanja* 30 (1) (2017).
- [16] J.E. Cobbina, A. Owusu-Bempah, K. Bender, Perceptions of race, crime, and policing among Ferguson protesters, *J. Crime Justice* 39 (1) (2016) 210–229.
- [17] W. Eidell, C. Ellis, Impact of Crime on Victims, in: *National Victim Assistance Academy Track, vol. 1, Foundation-Level Training, USA, 2010*.
- [18] United Nations Office on Drugs and Crime (UNODC), (2017). Annual report: Covering activities during 2017. Vienna. Accessed on 13 January 2022. Accessed on January 22/2022, from: [https://www.unodc.org/documents/AnnualReport/Annual-Report\\_2017.pdf](https://www.unodc.org/documents/AnnualReport/Annual-Report_2017.pdf).
- [19] United Nations, Transforming Our World: the 2030 Agenda for Sustainable Development, A/RES/70/1. Resolution Adopted by the General Assembly on 25 September 2015, 2015. New York, NY, USA.
- [20] W. Petherick, Applied crime analysis: a social science approach to understanding crime, criminals, and victims. <https://research.bond.edu.au/en/publications/applied-crime-analysis-a-social-science-approach-to-understanding>, 2015. Accessed on 2 February 2022.
- [21] M. Natarajan, C. Carcach, C. Ponce, M. De, Crime in developing countries: the contribution of crime science, *Crime Sci.* (2016).
- [22] S. Saravanakumar, S. Revathy, Crime mapping analysis : a GIS implementation in Madurai city, *Int. J. Sci. Res.* 5 (3) (2016) 1894–1897. [https://www.ijsr.net/search\\_index\\_results\\_paperid.php?id=NOV162301](https://www.ijsr.net/search_index_results_paperid.php?id=NOV162301).
- [23] O. Oguntunde, Data in brief analysis of selected crime data in Nigeria between 1999 and 2013, *Data Brief* 1–8 (2018).
- [24] A. Braga, The crime prevention value of hotspots policing, *Psicothema* 18 (2006) 630–637.
- [25] D. Chen, J. Weeks, J. Kaiser, Remote sensing and spatial statistics as tools in crime analysis, in: *Geographic Information Systems and Crime Analysis*, IGI Global, 2005, pp. 270–292.
- [26] Y. Salim, Poverty, inequality and the social causes of crime: a study between United States and Europe, *Int. J. Sci. Res.* (2015) 2319–7064.
- [27] A. Meera, M. Jayakumar, Determinants of crime in a developing country: a regression model, *Appl. Econ.* 27 (5) (1995) 455–460.
- [28] C. Fuentes, V. Hernandez, Assessing spatial pattern of crime in Ciudad Juárez, Chihuahua, Mexico (2009): the macrolevel, mesolevel and microlevel approaches, *Int. J. Criminol. Socio. Theor.* 6 (4) (2013) 242–259.
- [29] N. Khan, J. Ahmed, M. Nawaz, K. Zaman, The socio-economic determinants of crime in Pakistan: new evidence on an old debate, *Arab Economics and Business Journal* 10 (2015) 73–81.
- [30] S. Ishak, Y. Bani, Determinants of crime in Malaysia: evidence from developed states, *Int. J. Econ. Manag.* 11 (3) (2017) 607–622.
- [31] T.C. Lagrange, The impact of neighborhoods, schools, and malls on the spatial distribution of property damage, *J. Res. Crime Delinquen.* 36 (4) (1999) 393–422, <https://doi.org/10.1177/0022427899036004003>.
- [32] Addis Ababa City Administration, Socio-economic profile of Addis ababa. Addis ababa, Ethiopia, Accessed on 22 January 2022, from: <https://www.gfdr.org/sites/default/files/publication/>, 2016.
- [33] Y. Wu, M. Hung, Comparison of Spatial Interpolation Techniques Using Visualization and Quantitative Assessment, *Open Access* (2016).
- [34] David O'sullivan, David Unwin, *Geographic Information Analysis*, John Wiley & Sons, 2003.
- [35] R. Bivand, E. Pebesma, V. Gomez-Rubio, *Applied Spatial Data Analysis with R*, Springer, New York, 2008.
- [36] N. Cressie, C. Wikle, *Statistics for Spatio-Temporal Data*, John Wiley and Sons, 2015.
- [37] P. Kennao, D. Lal, L. Kesharwani, Crime hotspot mapping and GIS analysis based on police station in Allahabad city using inverse distance weighted, *International journal of research* 5 (21) (2018) 486–492. <https://pen2print.org/index.php/ijr/>.
- [38] J. Eck, S. Chainey, J. Cameron, M. Leitner, R. Wilson, Mapping crime: understanding hotspots, *Int. J. Crime Rep.* (2005). <https://discovery.ucl.ac.uk/id/eprint/11291/1/11291.pdf>.
- [39] A. Rubio, M. Ballera, D. Gonzales, Identifying crime hotspots in camanava by geographic information system using Spatio-temporal analysis, *Asia Pac. J. Multidiscip. Res.* 6 (3) (2018) 82–90. [www.apjmr.com](http://www.apjmr.com).
- [40] A. Braga, A. Papachristos, D. Hureau, Hotspots Policing Effects on Crime. *Campbell Systematic Review*, 2012.
- [41] S. Sivaranjani, S. Sivakumari, S. Maragatham, GIS based serial crime analysis using data mining techniques, *Int. J. Comput. Appl.* 153 (8) (2016) 19–23.
- [42] C. Muchwanju, Modelling crime rate using a mixed effects regression model, *Am. J. Theor. Appl. Stat.* 4 (6) (2015) 496–503.
- [43] K. Vogt, F. Johnson, V. Verbowski, An innovative, strengths-based, peer mentoring approach to professional development for registered dietitians, *Can. J. Diet Pract. Res.* 76 (4) (2015) 185–189.
- [44] Mekuriaw Asnake, H. Andreas, Zeleke Gete, H. Hans, Factors influencing the adoption of physical soil and water conservation practices in the Ethiopian highlands, *Int. Soil Water Conserv. Res.* 6 (1) (2018) 23–30.
- [45] Asfawa Daniel, Neka Mulugeta, Factors affecting adoption of soil and water conservation practices: the case of Wereillu Woreda (district), South Wollo zone, Amhara region, Ethiopia, *Int. Soil Water Conserv. Res.* 5 (4) (2017) 273–279.
- [46] P. Asrat, K. Belay, D. Hamito, Determinants of farmers' willingness to pay for soil conservation practices in the southeastern highlands of Ethiopia, *Land Degrad. Dev.* 15 (2004) 423–438.
- [47] H. Park, An Introduction to logistic regression: from basic concepts to interpretation with particular attention to nursing domain. College of nursing, Seoul national university, *Journal of Korean academy of nursing* 43 (2) (2013).
- [48] I. Stankevici, J. Sinkiene, K. Zaleckis, I. Matijosaitiene, K. Navickaite, What does a city master plan tell us about our safety? Comparative analysis of Vilnius, Kaunas and Klaipeda, *Soc. Sci.* 80 (2) (2013).
- [49] B. Welsh, D. Farrington, S. Douglas, The impact and policy relevance of street lighting for crime prevention: a systematic review based on a half-century of evaluation research, *Criminol. Publ. Pol.* (2022) 1–27.
- [50] Q. Muzdalifah, A. Deliar, R. Virtriana, A. Naufal, S. Ajie, Using geographically weighted – binary logistic regression to analyze land cover change phenomenon (case study: northern west java development region), *IOP Conf. Ser. Earth Environ. Sci.* 488 (2020).

- [51] H. Mayfield, J. Lowry, C. Watson, M. Kama, E. Nilles, C. Lau, Use of geographically weighted logistic regression to quantify spatial variation in the environmental and sociodemographic drivers of leptospirosis in Fiji: a modeling study, *Lancet Planet. Health* 2 (5) (2018) e223–e232.
- [52] T. Amemiya, Qualitative response models: a survey, *J. Econ. Lit.* 19 (1981) 1483–1536.
- [53] X. Zhao, J. Tang, Crime in urban areas: a data mining perspective, *ACM SIGKDD Explorations Newsletter* 20 (1) (2018) 1–12.
- [54] T. Almanie, R. Mirza, E. Lor, Crime prediction based on crime types and using spatial and temporal criminal hotspots, 2015. , arXiv preprint arXiv:1508.02050.
- [55] C. Marzan, M. Baculo, R. Bulos, C. Ruiz, Time series analysis and crime pattern forecasting of city crime data, in: *Proceedings of the international Conference on Algorithms, Computing and Systems*, 2017, pp. 113–118.
- [56] R. Clarke, *Improving Street Lighting to Reduce Crime in Residential Areas: Problem-Oriented Guides for Police Response Guides Series Guide 8*, 2008. U.S. Department of Justice Office of Community Oriented Policing Services, [www.cops.usdoj.gov](http://www.cops.usdoj.gov).
- [57] A. Chalfin, B. Hansen, J. Lerner, L. Parker, *Reducing Crime through Environmental Design: Evidence from a Randomized Experiment of Street Lighting in New York City*, 2019.
- [58] R. Clarke, Technology, criminology and crime science, *Eur. J. Crim. Pol. Res.* 10 (1) (2004) 55–63.
- [59] R. Wortley, L. Mazerolle, *Environmental Criminology and Crime Analysis (Crime Science Series)*, 2008.
- [60] S. Lama, S. Rathore, Crime mapping and crime analysis of property crimes in Jodhpur, *Int. Ann. Criminol.* 55 (2) (2017) 205–219.
- [61] R. Peiser, J. Xiong, Crime and Town Centers : are downtowns more dangerous than suburban shopping nodes? *J. R. Estate Res.* 25 (4) (2003) 577–606.
- [62] C. Hird, C. Ruparel, Seasonality in Recorded Crime: Preliminary Findings, 2, 2007. No. 07). London.
- [63] A.C. Uittenbogaard, V. Ceccato, Space-time clusters of crime in Stockholm, Sweden, *Rev. Eur. Stud.* 4 (5) (2012) 148–156.
- [64] L. Brantingham, J. Brantingham, M. Vajihollahi, K. Wuschke, Crime analysis at multiple scales of aggregation: a topological approach, in: *Putting Crime in its Place*, Springer, New York, NY, 2009, pp. 87–107.
- [65] G. Kelling, J. Wilson, Broken windows, *Atl. Mon.* 249 (3) (1982) 29–38. Accessed on 22 January 2022, from: [https://urbanpolicy.net/wp-content/uploads/2012/11/Kelling+Wilson\\_1982\\_BrokenWindows\\_policing.pdf](https://urbanpolicy.net/wp-content/uploads/2012/11/Kelling+Wilson_1982_BrokenWindows_policing.pdf).
- [66] R. Sampson, S. Raudenbush, F. Earls, Neighborhoods and violent crime: a multilevel study of collective efficacy, *Science* 277 (5328) (1997) 918–924. Retrieved on January 22/2022, from: <https://www.science.org/doi/abs/10.1126/science.277.5328.918>.
- [67] D. Kumar, K. Selvavinayagam, S. Babu, Assessment of crime & its mapping using remote sensing & 3D Geo-spatial model for Chennai city, *Assessment* 3 (3) (2014). Accessed on January 22/2022, from: <http://ijsetr.com/uploads/621534ijsetrsample.docx>.
- [68] K. Price, K. Chan, Neighborhood crime-related safety and its relation to children’s physical activity, *J. Urban Health* 92 (3) (2015) 472–489. Accessed on 22 January 2022: <https://link.springer.com/article/10.1007/s11524-015-9949-0>.
- [69] S. Waqar, A. Rafi, How Does Quality of Governance Influence Occurrence of Crime? A Longitudinal Analysis of Asian Countries, MPRA Paper 94142, University Library of Munich, Germany, 2019.
- [70] S. Yin, Property crime and socioeconomic factors, *Open J. Soc. Sci.* 5 (2017) 226–237.
- [71] H. Entorf, H. Spengler, Socioeconomic and demographic factors of crime in Germany Evidence from panel data of the German states, *Int. Rev. Law Econ.* 20 (106) (2000) 75.
- [72] C. Cornelius, C. Lynch, R. Gore, *Aging Out of Crime: Exploring the Relationship between Age and Crime with Agent Based Modeling*, Society for Computer Simulation International, San DiegoCA, USA, 2013.
- [73] A.R. Piquero, D.P. Farrington, A. Blumstein, The criminal career paradigm, *Crime and Justice* 30 (2003) 359–506. Accessed on January 22/2022, from: [https://www.journals.uchicago.edu/doi/abs/10.1086/652234?casa\\_token=YkNwdOMjRGwAAAAA:9Uc3go4FolTweqArYt6c\\_sEjyy4xGN8EzJBFXPYBoZrudv1IeowJqkPhuU3QGo5bql-EhTqGrQEC9Q](https://www.journals.uchicago.edu/doi/abs/10.1086/652234?casa_token=YkNwdOMjRGwAAAAA:9Uc3go4FolTweqArYt6c_sEjyy4xGN8EzJBFXPYBoZrudv1IeowJqkPhuU3QGo5bql-EhTqGrQEC9Q).
- [74] R. Milani, L. Molnar, S. Caneppele, Lost in paradise? The perception of security among immigrant communities in Switzerland and its correlates, *Crime Prev. Community Saf. Int. J.* 24 (2) (2022) 97–115.