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Real Estate Investment as a Panacea for Economic Instability in Nigeria: Evidence from Northeastern States of Nigeria

Muhammad Umar Bello [1], **Aliyu Ahmad Aliyu** [1], **David Martin @ Daud Juanil** [2], **Rozilah Kasim** [2]

[1] *Abubakar Tafawa Balewa University*
Tawafa Belewa Way, P. M. B. 0248, Bauchi, 740272, Nigeria

[2] *Universiti Tun Hussein Onn Malaysia*
101 Parit Raja, Batu Pahat, Johor, 86400, Malaysia

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Corresponding Author:
Muhammad Umar Bello,
mubello78@gmail.com

Abstract. Real estate investment is an emerging business in many countries of the world. Real estate investment was thoroughly investigated to come up with solution faced by the transaction of land and building. Real estate investment is strictly related to the housing price. It has been pointed out by many researchers that the housing price is affected by many factors, such as interest rate, land supply, government policies and inflation rate. The research highlighted most important aspects of the outcomes. An increase in international real estate capital flows could foster increasing demand for stronger institutions across a global real estate market. The method adopted in this research was quantitative through which 100 questionnaires were developed and distributed within the study area (Bauchi, Gombe, Adamawa and Yobe States). The simple percentage was used to analyzed the data collected. The research is exploratory in nature; hence, a non-probability purposive sampling technique was used for the study. The finding of the research vindicated that real estate investment has a significant role in sharpening the economy of the region, and also the findings revealed that real estate investment opportunity is huge. And again for suggested that housing provision cannot be realized only by private individual excerpts through government intervention. The study concludes that real estate investment, if explore it will create a reliable return to the investment owners, the benefits that can be derived from real estate investment, has been revealed by this study. The study also highlighted that private developers are key important for real estate investment in Nigeria. The conclusion drawn by this research shows that real estate investment has a capacity of transforming economic hardship in the country.

Keywords: real estate investment; land; speculator; developer; projects.

INTRODUCTION

Real estate investment is among the key investment that enables the investor to recover his investment as at when due [2, 8, 10, 24]. For any investment to flourish one has to make any aspect of the business feasibility and viability studies for proper dealings and carefulness from avoiding fraudulent business, real estate business has less harm if the owner or the buyer makes a proper investigation of the subject matter. An increase in international real estate capital flows could foster increasing demand for stronger institutions across global real estate market [2, 13, 28, 31, 37]. A number of article have argued that real estate investment has realized tremendous positive abnormal risk adjustment returns [13], return on real estate investment is certain as rent or prestige as indicated by [32]. Sale or lease of parcel of land by a speculator or prospective seller to willing buyer entails good returns to the seller and asset possession to the willing buyer. Another good aspect of investment on real estate is tenants selection [18, 29, 6, 40, 38, 7, 28, 31, 37].

However, real estate investment is strictly related to the housing price. It has been pointed out by many researchers that the housing price is affected by many factors, such as interest rate, land supply, government policies and inflation rate [4, 19]. A major part of this research is concentrated on the solution to economic hardship when investing in real estate, in order word economic viability of real estate investment. More again, recent urbanization of Nigerian cities also help in real estate returns through rent and sale of houses [34, 43]. While a great deal of attention is given to real estate investment policies worldwide concerned with such areas as forest management, coastal zone management, environmental sustainability and managing the urban environment, less attention is given to the infrastructures which facilitate the implementation of the associated policies and programs [5, 9, 11, 36]. While positively much is known about the economic and social implication of real estate investment among the populace of urban and cities centers in Nigeria [14]. Even though, the processes involved in marketing survey for prospective buyers are many, this may be through registered estate agents, real estate brokers or real estate neighbours.

Real Estate Investment Dimension

As indicated above that real estate investment has been condoned globally as an aspect of investment with very minimal risk [16, 17, 41]. Real estate investment create employment to citizen and beautified new cities [44]. The dimension postulated by real estate investment is regulated by law of supply and demand [26]. Housing provisioning is the key factor to determine how successful an economy is. Adoption of real estate investment by private organisations elevates the level of an economy, it has been recorded that real estate investment helps in promoting decent living in Nigeria [31, 32].

Real estate investment go hand in hand with stock market in providing shareholders with a lot of benefits and creation of entrepreneurship [4, 20]. The main method of conveying real estate investment has been through leasing, selling and mortgaging [27]. Leasing has safeguarded cities' regulation over type of land use and semi-urban and urban development, also in the forthcoming. Maintaining the planning regulations in the hands of professionals' town planners has tremendous advantage in sanitizing urbanization.

MATERIALS AND METHODS

Primary data was employ through structure questionnaire was used to fetch information. From 100 respondents who were private developer within Bauchi, Gombe, Adamawa and Yobe States. Simple percentage was used to analyzed the data collected. This research is exploratory in nature; hence, a non-probability purposive sampling technique was used for this study as is in line with the work of [12]. A total of 100 questionnaires (25 questionnaires for each State) were distributed to private developers in Bauchi, Gombe, Adamawa and Yobe States. Such States were chosen partly for convenience sake. The questions were a mixture of open ended and close ended questions (Figure 1).

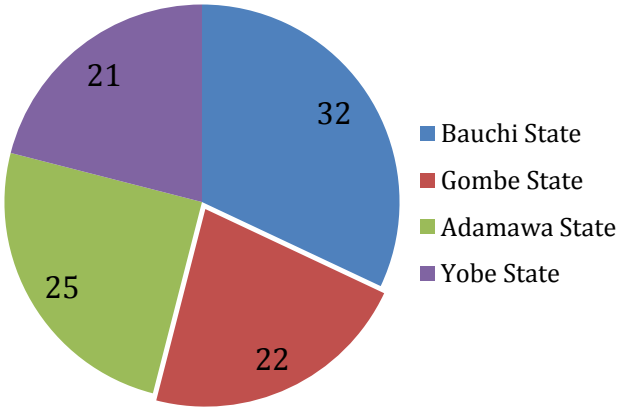

Figure 1 – Percentage of Questionnaire retrieved from Study Area

From the Figure 1 Bauchi states has the largest number of respondents with 32 %, then followed by Adamawa State with 25 %, followed by Gombe State with 22 % and the lowest was Yobe State with 21 %. These shows that private developer in Bauchi State are more of up and doing than other States in Study area.

Figure 2 above revealed none of States reached 50 % of their projects completion which shows that a striding efforts needs to be concerted so that housing should be adequate in the country. Only Adamawa State has the highest percentage of projects completion within the duration of this study, followed by Bauchi State with 30 %, Gombe State 18 % and Yobe State 12 %.

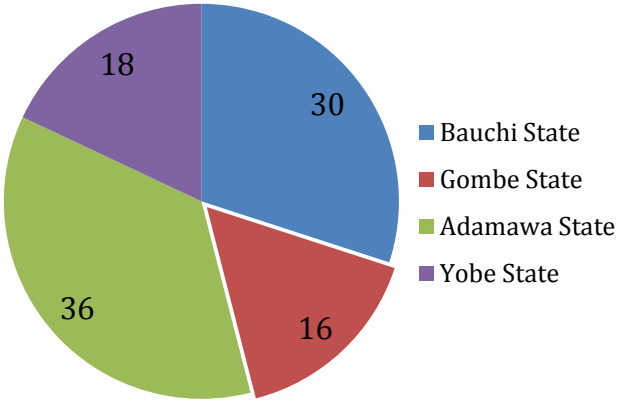

Figure 2 – Percentage of Properties developed within 2014-2016 in the study Area

RESULTS AND DISCUSSION

Findings of this research revealed that up till now there is low pace for projects completion in Nigeria due to numerous factors, this are in relation with the work of [23, 36]. It was understood that Nigerian property market was the best in the African sub-region but lack adequate records [42, 35]. As such, housing provision for all would be of great difficult as reiterated by [15]. Real estate investment in most of this States shows that viability of the business is not fast coming as indicated in Latvia by [22], the real estate investment owners in the study area are confronted with many problems such as, high price of building materials, tenants selection, government policies, fraudulent land transaction, etc. as revealed in [4, 25]. It was gathered in this research that real estate investment in the study area contributes in housing provision as revealed in [35]. The percentage of the developed projects shows the viability of real estate investment in Nigeria as indicated by [1] and [33]. But study by [39] suggested that housing provision cannot be realized only by private individual excepts through government intervention. However, this assertion is against [3, 6, 30, 32]. Relatively, the outcomes of this research revealed that real estate investment has opportunity of providing employment to many unemployed youth this proclamation is in agreement with the work of [21].

CONCLUSION

This research study concludes that real estate investment if explore it will create reliable return to the investment owners, the benefits that can be derived from real estate investment has been revealed by this study. This study has shown that government policy should be enacted to create more viability to the business. The study also postulated that economy of a nation can be enhanced if property markets are well coordinated. It also concluded that building materials should be manufactured locally so that the cost would be minimize. The study also highlighted that private developers are key important for real estate investment in Nigeria. The conclusion drawn by this research shows that real estate investment has a capacity of transforming economic hardship in the country.

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APPENDICES

Figure A.1– Building sites in Bauchi

Figure A.2 – Building sites in Gombe

Figure A.3 – Building Sites Yola, Adamawa

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Application of Markov Model in Crude Oil Price Forecasting

Nuhu Isah [1], Abdul Talib Bon [1]

[1] *Universiti Tun Hussein Onn Malaysia*
101 Parit Raja, Batu Pahat, Johor, 86400, Malaysia

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Corresponding Author:
Nuhu Isah, nuhuisah33g@gmail.com

Abstract. Crude oil is an important energy commodity to mankind. Several causes have made crude oil prices to be volatile. The fluctuation of crude oil prices has affected many related sectors and stock market indices. Hence, forecasting the crude oil prices is essential to avoid the future prices of the non-renewable natural resources to rise. In this study, daily crude oil prices data was obtained from WTI dated 2 January to 29 May 2015. We used Markov Model (MM) approach in forecasting the crude oil prices. In this study, the analyses were done using EViews and Maple software where the potential of this software in forecasting daily crude oil prices time series data was explored. Based on the study, we concluded that MM model is able to produce accurate forecast based on a description of history patterns in crude oil prices.

Keywords: forecasting; crude oil; price; Markov model.

INTRODUCTION

Crude oil is a complex mixture consisting of more than 200 organic compounds, especially hydrocarbons [1] mostly alkenes and smaller fraction aromatics. Crude oil varies in colour from nearly colourless to tar black, and in viscosity from close to that of water to almost solid. In fact, there are more than 300 different crude types produced around the world [1]. Two of the most important characteristics are density and sulfur content. High-quality cruds are characterized by low density (light) and low sulfur content (sweet) and are typically more expensive than their heavy and sour counterparts: light crudes produce more high-value products, while sweet crude oils require less processing than sour [2].

The oil and gas bearing structure is typically of porous rock such as sandstone or washed out limestone. The sand might have been laid down as desert sand dunes or seafloor. Oil and gas are formed from organic material (tiny plants and animals) deposited in early geological periods (100–200 million years ago) together with sand or silt and later transformed by high temperatures and pressure into hydrocarbons[3]. Formation of oil reservoirs requires meeting of various climatic, geophysical and historical conditions and enormous amount of time.

However, the most oil reach region is Middle East possessing 51 % of total oil reserves, then Central and South America with 16 %. Europe (excluding Eastern Europe and Russia) owns only 1% of world oil reserves [3]. On the country level the biggest oil reserves belong to Saudi Arabia and Venezuela (262.6 and 211.17 bb in 2011 respectively) together owning around one third of world oil. Among ten countries with biggest reserves are also Canada, Gulf states (Iraq, Iran, Kuwait, UAE), Russia, Libya and Nigeria [4, 5, 6].

In the last 21 months, the average price of oil has dropped by about 60 %. Oil prices swing as a result of many factors. Growth in global economic activity can increase demand and drive prices higher, while increasing production rates can lead to decline in prices [7, 8]. Though simple demand and supply theories are useful in describing oil price movements, the factors driving such changes are often difficult to identify. As a result, large fluctuation in oil prices can come as a surprise, as was the case with the recent decline starting in mid-2014 [8].

The current period of price instability is not unique, oil prices also declined by over 50% during global recession of 2007 to 2009 [9]. However, the decline in crude oil price during the recession was due to a noticeable slowdown in global economic activity. Soft global demand also caused prices for goods and services in addition to crude oil to fall suddenly [10]. These movements propose that only a portion of the decline in 2014 is likely due to fragile global economic activity. Increase in supply was another justification for the oil price decline that started in 2014 [11]. Total global oil production increased 3.7% year over year as of December 2014. This increase is on the higher side, though not remarkable by the standards of the past five years.

However, prices are affected not because of the changes in production, but by changes in production relative to what the market projected. Higher production levels in the United States due to new technologies were to some extent expected. But some developments on the supply side were unexpected, such as the comeback of Libyan production, the refusal of the OPEC to reduce supply, and the probable future return of Iran on the global oil market, which likely caused shifts in expectations of future oil supply relative to demand [7].

However, forecasting crude oil price has been one of the biggest challenges to the artificial intelligent (AI) community [8]. The objective of forecasting research has been largely beyond the capability of traditional AI research which has mainly focused on developing intelligent systems that are supposed to emulate human intelligence [7, 8]. By its nature crude oil price is mostly complex, nonlinear and volatile [9]. The rate of price swings in such series depends on many factors such as economic, political and social [9] ets. Therefore, developing AI systems for this kind of forecasting requires an iterative process of knowledge discovery and system improvement through data mining, knowledge engineering, theoretical and data-driven modelling, as well as trial and error experimentation. Crude oil has become an integral part of the global economy [10]. Any fluctuation in crude oil prices affects our personal and corporate financial lives, and the economic health of a country [10]. A bright prediction model for crude oil price forecasting would be highly desirable and would be of wider interest.

A substantial amount of research has been published in recent times and is continuing to find an optimal prediction model for crude oil price [12, 13]. Most of the forecasting research has employed the statistical time series analysis techniques like ARMA model, GARCH model as well as the multiple regression models [14]. In recent years, numerous crude oil price forecasting techniques based on AI, including artificial neural networks (ANN), fuzzy logic, hybridization of ANN and fuzzy system, support vector machines have been proposed [15]. Most of them have their own shortcomings [15]. For example, ANN is very much problem oriented because of its chosen structural design [12]. Some researchers have used fuzzy systems to develop a model to forecast crude oil price behaviour. To build a fuzzy system one requires some background expert knowledge [13]. In this paper, we make use of the well-established Markov Model (MM) to forecast crude oil price. The MM have been extensively used in the area like speech recognition, DNA sequencing, electrical signal prediction and image processing [14] etc. In here, MM is used in a way to develop forecasting model. We locate pattern(s) from the past datasets that match with today's crude oil price behaviour, then interpolate these two datasets with appropriate neighbouring price elements and forecast tomorrow's crude oil price.

METHODOLOGY

If we have a state sequence $\{q_n \cap \in \mathrm{N}^+\}$, we can find the transition frequency F_{ij} in the sequence by counting the number of transitions from state S_i to state S_j in one step. Then the one-step transition frequency matrix for the sequence $\{q_n\}$ can be constructed as follows (1)-(2):

$$F = \begin{bmatrix} F_{11} & F_{12} & F_{13} & \cdots & F_{1m} \\ F_{21} & F_{22} & F_{23} & \cdots & F_{2m} \\ F_{31} & F_{32} & F_{33} & \cdots & F_{3m} \\ \vdots & \vdots & \vdots & \ddots & \vdots \\ F_{m1} & F_{m2} & F_{m3} & \cdots & F_{mm} \end{bmatrix}, \quad (1)$$

$$A=\begin{bmatrix} a_{11} & a_{12} & a_{13} & \dots & a_{1m} \\ a_{21} & a_{22} & a_{23} & \dots & a_{2m} \\ a_{31} & a_{32} & a_{33} & \dots & a_{3m} \\ \vdots & \vdots & \vdots & \ddots & \vdots \\ a_{m1} & a_{m2} & a_{m3} & \dots & a_{mm} \end{bmatrix}, \quad (2)$$

where $a_{ij}=\frac{F_{ij}}{\sum_{j=1}^{m}F_{ij}}, if \sum_{j=1}^{m}F_{ij}>0;$

and $a_{ij}=0, if \sum_{j=1}^{m}F_{ij}=0.$

Suppose there are three states: Up, Same and Down, to simulate the movement of the crude oil price. Here is an explanation of Up, Same and Down. We only compare two crude oil prices, v_n is the current price, v_{n-1} is the price of yesterday. If $v_n - v_{n-1} > 0$ is called Up, $v_n - v_{n-1} < 0$ is called Down and $v_n - v_{n-1} = 0$ represents Same.

We use the information to calculate the transition probabilities. There are only three states. On the assumption that the state space is $S=(S_1,S_2,S_3)$. S_1 = Up, S_2 = Same and S_3 = Down.

Up, Same and Down are three states, which are decided by comparing the previous closing price and the current closing price. We calculate the number of days that both the first day and the second day are up by using the data. We also get the number of days that the first day is down and the second day is up.

RESULTS AND DISCUSSION

We chose the true values of the closing index from the WTI dating from the 2 January, 2015 to 29 May, 2015 yielding 103 trading days. The closing index is chosen to model the process.

In this model, there are three states, on the assumption that the state space is $S=(S_1,S_2,S_3)$. The definition of Up is $u_n - u_{n-1} > 1$, where the u_n is the current closing index and the u_{n-1} is the previous closing index. The definition of Same is $|u_n - u_{n-1}| \le 1$, the definition of Down is $u_n - u_{n-1} < 1$. We train the true values of the closing index and use the definition of the states to get the Figure 1 and the Table 1.

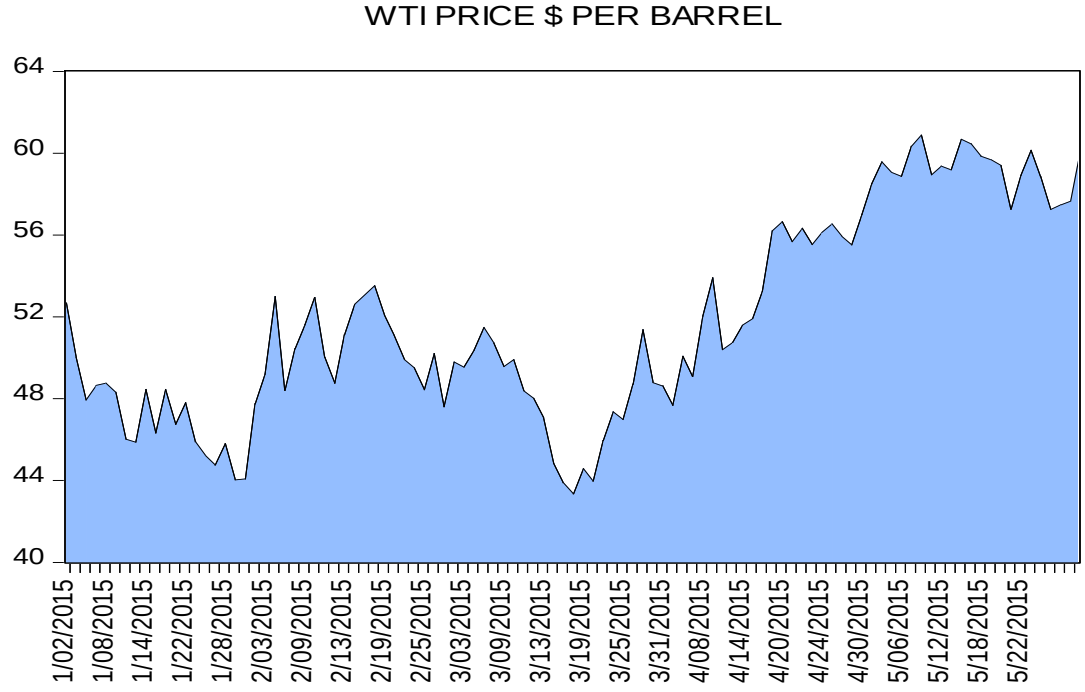

Figure 1 – Actual movement of the crude oil prices closing index from 2 January to 29 May 2015

Table 1 – States of Transition Matrices

Date	State	Date	State	Date	State	Date	State	Date	State
1/02	Down	2/09	Up	3/16	Down	4/21	Down	5/27	Up
1/05	Down	2/10	Down	3/17	Down	4/22	Up	5/28	Up
1/06	Down	2/11	Down	3/18	Up	4/23	Up	5/29	Up
1/07	Up	2/12	Up	3/19	Down	4/24	Down		
1/08	Up	2/13	Up	3/20	Up	4/27	Down		
1/09	Down	2/16	Down	3/23	Up	4/28	Up		
1/12	Down	2/17	Up	3/24	Down	4/29	Up		
1/13	Down	2/18	Down	3/25	Up	4/30	Up		
1/14	Up	2/19	Down	3/26	Up	5/01	Down		
1/15	Down	2/20	Down	3/27	Down	5/04	Down		
1/16	Up	2/23	Down	3/30	Down	5/05	Up		
1/20	Down	2/24	Down	3/31	Down	5/06	Up		
1/21	Up	2/25	Up	4/01	Up	5/07	Down		
1/22	Down	2/26	Down	4/02	Down	5/08	Up		
1/23	Down	2/27	Up	4/06	Up	5/11	Down		
1/26	Down	3/02	Down	4/07	Up	5/12	Up		
1/27	Up	3/03	Up	4/08	Down	5/13	Down		
1/28	Down	3/04	Up	4/09	Up	5/14	Down		
1/29	Up	3/05	Down	4/10	Up	5/15	Down		
1/30	Up	3/06	Down	4/13	Up	5/18	Down		
2/02	Up	3/09	Up	4/14	Up	5/19	Down		
2/03	Up	3/10	Down	4/15	Up	5/20	Up		
2/04	Down	3/11	Down	4/16	Up	5/21	Up		
2/05	Up	3/12	Down	4/17	Down	5/22	Down		
2/06	Up	3/13	Down	4/20	Up	5/26	Down		

We chose the true values of the closing index of crude oil from WTI dated 2 January to 29 May, 2015 yielding 103 trading days. We define the given transition matrices as Up, Same and Down. In this model, the three states transition matrices are assumed to be $S = (S_1, S_2, S_3)$.

To find the trend of the stock index movement, we need to find the state transition probability by calculating the number of days that both first day and second day are the up, we could find the probability from up to up. Then we to get the number of days that first day is up and second day is down.

$$S_1 \to S_1 \to 23\,days \to S_1 \qquad S_2 \to 0\,days \qquad S_1 \to S_3 \to 26\,days$$

$$S_2 \to S_2 \to 0\,days \to S_2 \qquad S_2 \to 0\,days \qquad S_2 \to S_3 \to 0\,days$$

$$S_3 \to S_1 \to 27\,days \to S_3 \qquad S_2 \to 0\,days \qquad S_3 \to S_3 \to 26\,days$$

Then we get the transition matrix as follows:

$$\hat{A} = \begin{bmatrix} \frac{23}{49} & 0 & \frac{26}{49} \\ 0 & 0 & 0 \\ \frac{27}{53} & 0 & \frac{26}{53} \end{bmatrix} \to \quad \hat{A} = \begin{bmatrix} 0.4694 & 0 & 0.5306 \\ 0 & 0 & 0 \\ 0.5094 & 0 & 0.4906 \end{bmatrix} \quad \to$$

$$\rightarrow A^2 = \begin{bmatrix} 0.4906 & 0 & 0.5094 \\ 0 & 0 & 0 \\ 0.4890 & 0 & 0.5110 \end{bmatrix} \rightarrow \lim_{n\to\infty} A^n = \begin{bmatrix} 0.4898 & 0 & 0.5102 \\ 0 & 0 & 0 \\ 0.4898 & 0 & 0.5102 \end{bmatrix}$$

Trend of the WTC Crude Oil Price Forecasting from 2 January to 29 May 2015 presents in the Figure 2.

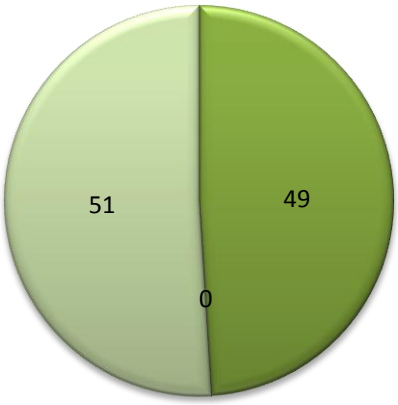

Figure 2 – Trend of the WTC Crude Oil Price Forecasting from 2 January to 29 May 2015, %

In the above model, we got information about three states which are up, same and down. According to the above result, the transition matrix is stable and the most likely trend of index is down, since the probability of down is biggest. The previous price dated May 29 2015 was $60.25 and the price of predicted day dated 1 June 2015 was $60.24 respectively. This shows that the forecasting is tune to be acurate and reliable.

CONCLUSION

This paper explained the application of Markov Model in crude oil price forecasting, crude oil is important natural resources to mankind. The swinging of crude oil prices has affected many economic sectors and stock market indices. In this study, daily crude oil prices data were obtained from WTI dated 2 January to 29 May 2015, the analyses were done using EViews and Maple software where the potential of this software in forecasting daily crude oil prices time series data was explored. Based on the study, we concluded that Markov Model is able to produce accurate forecast based on a description of history patterns in crude oil prices.

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Cash-Cow into the Purse of Malaysian Property Investors: Students Housing Investment

Zubairu Abubakar Ghani [1, 2], **Noralfishah Suleiman** [2]

[1] *Abubakar Tafawa Balewa University*
Tawafa Belewa Way, P. M. B. 0248, Bauchi, 740272, Nigeria

[2] *Universiti Tun Hussein Onn Malaysia*
101 Parit Raja, Batu Pahat, Johor, 86400, Malaysia

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Corresponding Author:
Zubairu Abubakar Ghani,
zubairughani@yahoo.co.uk

Abstract. Growing demand for higher education (HE) and increasing students enrolment in higher education institutions (HEI) has been a global issue especially in the last three decades and housing the growing student population has become a dilemma for all concern HEIs stakeholders. Globally increasing demand for HE and enrolment has long been not corresponding with student housing supply. Most HEIs provide housing accommodation for a small proportion of their total students' population while the majority depend on private rental sector for their alternative housing. In most of the HEIs neighbouring community residential houses were rented out to students. These houses are not sufficient to accommodate the teaming student population because the market is dominated by traditional small-scale private developers. However, with the continuing expansion and demand for HE, increasing enrolment and increasing students housing demand, the study highlighted and suggested for private investors to pull up and dig into student housing investment. This will ameliorate and fill the shortfall created by inadequacy of HEIs housing provision. Student housing investment is a resilient market, lucrative venture and guaranteed cash cow.

Keywords: student housing; higher education institutions (HEIs); student population; student enrolment; student housing demand; private housing market.

INTRODUCTION

Students are special group of people, most of them young men, who were given admission for study in Higher Education Institutions (HEI) in their respective fields of studies and levels. Similarly, [1] described students as those who are admitted into colleges to study. Usually this group of people leaved their parents' homes and live in the student housing in either on-campus or off-campus.

In recent years, colleges of higher learning experienced high growth in population as enrolment increases. Student enrolment in HEI is increasing tremendously all over the world more especially in the UK, USA, Ireland, China, India, Malaysia [2, 3, 4, 5, 6, 7, 8, 9, 10, 11, 13]. This is supported by [13] and [7] that, student number has risen globally and students overall enrolment are postulated to increase by 32 million over the next ten (10) years. Accordingly [14] reported that, global number of higher education (HE) students is anticipated to grow to '263 million by 2025'.

Despite this demographic growth of students in HEIs, provisions of student housing is not congruent to the population growth, most of the students will not get accommodation in the HEI students housing and thus had to find alternative housing in the private housing rental market. Many studies have reported that, it has been a tradition of many HEIs that, the enrolment is much higher than the available housing facilities for students [15, 4, 16, 10, 17, 18, 2, 1, 19, 20, 8, 21, 22, 6]. This causes constraints and pressure on the existing student housing facilities in many

HEIs across the world and it is increasingly becoming difficult especially for HEIs to provide accommodation for all students despite few other students may prefer to live in their family house or refuse to live on-campus. At the beginning of every academic session when new students were enrolled, most HEIs with their existing students housing, accommodate a small segment (20–30 %) of their total students population, majority of the students will not get accommodation in HEIs housing system. This necessitates many other students to scout for alternative housing where opportunities exist outside the campus in private housing market [2, 3, 23, 4, 1, 19, 21, 10, 6, 22, 24, 8].

LITERATURE REVIEW

Being students are special group of people with a common interest; they are also special consumers of housing like any other special areas or institutions. Such special areas or institutions include military barracks, care homes, hospitals, prisons and camps, to mention but a few. These special areas or institutions' housing requirements are slightly different, based on their peculiarities from the general family house. The differences are basically in their respective housing facilities requirements more especially in the areas of supportive facilities. However, housing in terms of basic requirements, the special areas and family housing are obviously the same. According to [3] family and student housing are distinctive where the later embody basic facilities like bedroom with other shared facilities such as bathroom, toilets, laundry, kitchen, students' lounges and cafeteria. Furthermore, student housing security tenure and freedom are limited compared to family housing.

Student housing, is the housing unit for college students to live for the purpose of studies where many young men leave their homes and parents, reside in student housing without parental monitoring and control which is a different experience for new life style, learn how to compromise with other students, endure, tolerant, shared space and facilities and live independently which was described as a transitional phase towards adulthood [12, 25, 6]. Also student housing offers chances for students to develop attitudes of living and working together in the college environment and to understand further ethos of the college and life [26]. Furthermore, [27] reported that student housing is important in motivating students' academic performance. Hence student housing is impacting on students' comfort, convenience and safety, therefore, conducive student housing in HEIs cannot be overemphasized because students are expected to be comfortable and in a sound state of mind to excel in their academic endeavours which can be achieved by a good student housing system. In support of this [2] expressed that, student housing is an important physical facility that influenced in expanding students' intellectual proficiencies of their academic mission and also help to achieve responsible citizenship and leadership.

Globally there is progressive growth of HEIs following the unprecedented growth in the youth demography age 18–24 years old. Higher education (HE) has been growing rapidly in both developed and developing countries especially in the last three decades where many young men are graduating from high schools and gaining access into colleges and universities [7, 9, 4, 2, 11, 16, 12, 21, 6]. In the last three decades student enrolment has radically raised globally and is expected to increase as [6] described, more "children of baby boomers" are graduating from high schools. Aol Real Estate Contributor [21] reported that student enrolment has raised from 98 million in 2000 to 165 million in 2011 globally with an average increase of 6 million yearly and it is expected to increase to around 195 million students by 2020. While, [13] submits that the total number of HEIs student enrolment is expected to reach 263 million globally in 2025. Further, [4] opined in 2011, a record of 21.6 million students was enrolled in American postsecondary institutions; this has shown a growth of over 40 % since 2000. Similarly, [16] stated that in Malaysia, in 2009 there were approximately about 1.5 million students and expected to increase in years to come as expected 50 % or more of the Malaysian youth aged 18–30 year olds would gain access to HEIs. It was observed that HEIs Students population in Malaysia has been increasing consistently from 664,402 in 2002 to 1.134 million in 2010 with an average increase of 58,717 annual enrolments. More so, the Ministry of Education Malaysia [28] reported that, HEIs student enrolment in 2014 was 560,359 in public universities alone and estimated 1.5 million total enrolments for both public and private universities in 2014.

These entire scenarios, implies commensurate increase in demand and pressure on the existing HEIs facilities. Despite all these growth in stu-

dents' number, the provision of students' accommodation is not matching with the growth which led to the constraints and stretching the existing housing facilities. As [4] positioned, the increase in the number of college students along with the expansion of HEIs presented challenges for the provision of student housing in the United States and the rest of the Western world. The residential real estate news of the World Property Journal also wrote in their June, 4th 2014 edition, that many university cities in the UK have sufficient student housing deficit. In many universities there is significant or gross shortfalls in student housing that compelled many students to rent residential quarters outside their campuses. By implications, growth of students' population in HEIs with no corresponding provisions of housing facilities resulted in intensifying shortage and increase in student housing demand in rental market. This trend of student housing development and rapid enrolment making sufficient shortage of student housing will have negative impact on students' comfort, convenience, performance and safety [2]. In the face of growing global students' enrolment in HEIs, student accommodation has become one of the teething problems faced by HEIs especially in the developing countries [1].

METHODOLOGY

This paper begins with a survey of the literature of related work from journals and other source materials available. The methodology adapted in this study is qualitative and qualitative study allow the use of one or combination of research instruments observation, interviews, documents and audio-visual materials as [29] suggested. The study adopted document analysis as suggested by [30], [31] and [32] if a circumstances seem to be thorny to take a complete field surveys, therefore, the study should employ secondary data to takes advantage of the existing data. S. G. Naoum [33] and B. L. Berg & H. Lune [34] opined this type of data collection relies on availability of data and convenience that are easily accessible. In this case secondary data are easier to source and use, therefore, the authors take advantage of existing sources of data and studies where relevant information are taken. Basically the study employs secondary data to highlight student housing pressure in Malaysian HEIs and the need for provision from private investors to supplement HEIs' student housing. Due to non-availability of the actual figure of HEIs housing system capacity to the authors at the time, some assumptions were applied in the determination of HEIs student housing needs. This is followed by a conclusion towards filling the gap created by HEIs' housing system.

RESULT AND DISCUSSION

Student housing in Malaysia

In Malaysia, the population is steadily growing right from late 1950 to date. This can be attested from the country's demographic evidences where in 1957 the country's population was 7.3 million. However, the population has doubled to the figures of 13.3 million and 27.0 million by 1980 and 2008 respectively [35]. According to Population Reference Bureau [36], Malaysian population in 2015 stands at 30.8 million and just in 6 years time from 2008–2015, the population increased by over 3 million. These population growths are evident indicator of potentiality for the future demand of educational facilities.

According to M. Muslim [3] HEIs Students population in Malaysia has been increasing tremendously in the past two decades and enrolment stood at 1,134,134 in the year 2010. Similarly, the Ministry of Education Malaysia [28] estimated 1.5 million HEIs student enrolment in 2014 and postulated continuous increase in the future. This is a clear testimony that the student population has been increasing and will continue to increase in the future as more children are graduating from high schools. Table 1, below justified the steady growth of HEIs student enrolment in Malaysia.

Internationalization of HE in particular has motivated the Malaysian government to push ambitions for becoming a HE regional hub in Southeast Asia and citizens were encouraged to study locally rather than abroad to save costs [15, 37]. This serves as an opportunity for HEIs to increase their capacity and position themselves better in the global market of international education. As [38] reported Malaysia has placed internationalization as a key drive for transforming its HE to compete with global class HE providers. For Malaysia to realize its aim of becoming an international education hub by 2025, aimed to have 250,000 international student enrolments into its HEIs. In addition to the local student population seeking enrolment in HEIs, govern-

ment set a goal of attracting 100,000 international students in 2010 where in 2009 & 2010 HEIs recorded 80,750 & 86,919 international student enrolments respectively with 7.6 % increase toward achieving international education hub. Planned also to increase to 150,000 & 200,000 by 2015 and 2020 respectively and targeted the foreign student population to grow to 250,000 in 2025 [28, 15, 3, 16, 38]. Therefore, with these, Malaysia is regarded as an emerging candidate in the world class education providers for attracting international students. However, by implication this will increase the demand tempo for HE and will eventually have positive impact on the demand for other education-related sector in the country such as student housing.

Table 1 – Higher Education Institution (HEI) Students Enrolment in Malaysia, 2002–2010

HEI Type	Years								
	2002	2003	2004	2005	2006	2007	2008	2009	2010
Public HEI	281,839	294,359	293,978	307,121	331,025	382,997	419,334	437,420	462,780
Private HEI	294,600	314,344	322,891	258,825	323,707	365,800	399,852	484,377	541,629
TARC	31,850	29,537	26,098	24,846	26,150	25,753	26,235	25,179	23,774
Polytechnic	52,898	53,492	64,382	73,834	82,045	84,250	85,280	86,471	87,751
Community Colleges	3,207	6,424	8,945	9,873	11,273	14,438	17,082	17,279	18,200
Total	664,402	698,156	717,294	674,499	774,280	873,238	947,783	1,050,726	1,134,134

Source: [3], [28]

The unprecedented increase in students' population in Malaysia resulted to continuing extension and establishment of HEIs which triggers student housing demand. HEIs provided student housing facilities in Malaysia generally are insufficient and the students' enrolment each year exceeds the available housing accommodation. Therefore, student housing provisions become a challenge for many HEIs thus the situation increases the demand tempo for student housing in the private rental market. According to [39] majority of HEIs students were necessitated to rents housing accommodation in the private housing market. So this is an indication that student population growth has not been corresponding with student housing supply, thereby, making sufficient deficit in HEIs student housing. Consequently, if such trend continues where demand and supply for student housing are by far at parity, the situation will be regarded as student enrolment boom while student housing bust.

It became clear in Malaysia students' population has been growing and is expected to increase in years to come where many of the Malaysian youth will seek and gain access to HEIs. These entire scenarios are by implications, indicating commensurate increase in demand and pressure on the existing HEIs student housing facilities. In the last two decades provisions of student housing facilities are not proportionate to the enrolment which widened the gap of adequacy that led to a tremendous increase in student housing demand hence, demand and supply are not corresponding. As M. Muslim [39] concludes that shortage of student housing exists nationwide as the majority of Malaysian HEIs students at the nation's largest institutions live off-campus in the private housing rental market. This concurred with many studies on student housing that shown most of the HEIs student housing facilities are grossly in adequate and provides housing accommodation for only 20–30 % of their total students' population whereas 70–80 % of the students relied on private rental market.

Student housing market

In the last decade student housing market has been considered as the promising, speedy growing property rental market and guaranteed demand. This is because it offers relatively high yields compared to other property sectors like retails, warehouses and offices. Yields have moved rapidly over the last decade in the wider real estate market and income returns in the sector has exceed the residential investment market as a whole [40, 41]. Unlike the residential sector, student housing is one of the best performing sectors during the global economic downturn and it is largely unaffected by home market

prices plummet [6, 21, 40]. It was observed that student housing have lower volatility than multi-family and other property sectors and also provides higher cash return. Student housing now is considered a 'global asset class' therefore, private developers' interest in student housing in UK and USA is not surprising hence, investors generally, are looking for more generous income yielding sectors for investment. Consequently, [24] regarded commercial operators to have been extremely active over the last five years, with the leading players expanding properties by acquiring more stocks, as well as, funding speculative developments in HEIs towns. However, this may not be unconnected with stagnated supply of HEIs student housing to satisfy the demand and a continuing trend of increase in the students' enrolment has created an excellent opportunity for investment and development of student housing market.

In the world student housing market, UK and USA are the leading players, because the market is matured, as dissimilarity to many other countries. As a result of the insufficiency of HEIs' owned student housing, the private investors have taken a great advantage of students demand and are driven into the student housing market not only in the UK and USA, but in many other countries of the world. Student housing is a distinct niche market, for investors and homeowners to invest. It was reported from a survey that in USA 20 private students' house developers have over 167 student properties under construction consisting of over 97,045 beds spaces in 2015 alone [42]. This is because, the waves of student demand adjacent to HEIs campuses is extremely high thus, demand tells much about the likelihood of the better place for investment opportunity in student housing.

It was observed that central London in Europe is the major location for students housing and the total return from the sector grew significantly to 6.7 % between 2010 and 2011. The world student housing sector grew from $0.8 billion investment globally in 2009 and hasty to a lofty of $7.2 billion in 2013 [43]. Chiefly, the US and UK markets have driven global investment in student housing to reaching an elevation of $7.2 billion in 2013. European student housing market predicted gross average yields of 5.5–8.5 % in 2014. Similarly it was observed that major achievable yields in the sector are in the region of 7 % in Spain, Italy and the Netherlands [14, 40]. In a UK study it was reported that, student housing experienced annual rental growth of 1.6 % and 2.8 % in 2013 and 2014 respectively [44]. Moreover, returns from student housing have been explored to have outperformed all other property sectors since 2011 and student housing recorded total returns of 7.8 % and 10.9 % in 2013 and 2014 respectively; all other properties recorded 5.4 % growth while residential rental rates in particular have remained relatively stagnant in 2013.

In German student housing market, investors' interest has been growing and the sector saw $185 m deals in 2013 and over 7,600 units are planned in the top ranking university cities. The average student housing provision rate among the key cities is 13 % and vacancy rates have declined to below 2 % [14]. Student housing has positively shown an upward trend in Germany, the returns are significantly higher which is driven by an increasing demand and it is very attractive alternative investment [45]. Likewise, in Australia, Singapore and India the experience seems to be surging considerably within their student housing sectors, though the market is considered 'immature' when compared to that of the UK and US [46, 9]. According to [9], recently in India, Manipal Integrated Services, build and manage student housings complex in Bangalore with 1,000 rooms to provide housing to around 2,000 students.

For the Malaysian case, still student housing market is relatively new and not matured though some investors are beginning to see the growing viability in student housing market as an investment. It was found that Sunway Monash Residence is a 22-storey apartment block located at three minute walk from Monash University Malaysia campus. The complex is designed to function as a student community, offering 2,114 bedrooms furnished with beds, desks, wardrobes and Wi-Fi and the vacancy rates have recorded below 1 % [46]. Also Gromutual Property built and managed student housing located between Multi-Media University and University Technical Malaysia at Emerald Park, Melaka. Despite insufficient supply of student housing and a continuing trend of increases in the students enrolment in Malaysia, Federal Land Development Authority (FELDA) Malaysia through Felda Investment Corporation (FIC) has made two international real estate investments in student housing known as FELDA House Wembley, located in Wembley and FELDA Grand House located in the city of London, UK [47]. Unfortunately, similar

effort has not been made for the local student housing market as it has been left to be dominated by the traditional (small-scale) actors. Therefore, HEIs inability to accommodate their teaming student population couple with insufficient supply of student housing and a continuing influx of students resulted to continual uptrend in demand which created an excellent opportunity for investment in student housing.

Investment landscape

Malaysia population is indicating broader base of normal population pyramid where school going age cohort (14 years old and below) constituted 7.8–8.2 million representing 27 % of the Malaysian total population [28]. This is clear evidence that as they are graduating from high schools, future demand for HEIs and students housing will be guaranteed, all things being equal. Similarly the enrolment statistics of both primary and secondary schools suggested that the future demand is on a high side as the population is much greater than the HEIs enrolment in 2015 (1.5 million) see Table 2 below.

Table 2 – Enrolment in Primary and Secondary Schools from 2012–2014

School type	Years		
	2012	2013	2014
Primary School	2,804,405	2,742,169	2,698,883
Secondary School	2,281,224	2,296,189	2,234,621

Source: [28]

According to Malaysian Education Minister, Datuk Seri Idris Jusoh, Malaysia's higher education is a world class now on par with those of the developed nations like Britain, Germany, US and Australia [48]. University Malaysia is rated the 151st position up from 167th in 2013 in the list of 400 top world institutions in 2014. He further said, now about 135,000 foreign students are confident of studying in Malaysia [48]. Similarly Malaysia is now experiencing a well encouraging scenario where many people are attending the HEI both locally and internationally, is increasing yearly. With this positive drift, Malaysia has successfully gained global recognition and ranked at 11th worldwide top countries in the global education providers by the United Nations Educational, Scientific, and Cultural Organization (UNESCO) for her attractiveness to international students [49].This will indeed, facilitate the attainment of becoming educational hub by attracting foreign students. The student housing demand from international students will obviously be high as many HEIs are not accommodating foreign students in their housing programme or else Graduate students who require privacy, isolation from general students prefer off-campus housing. International students will provide a big, essential and guaranteed market.

Some scholars have reported investment in student housing is lucrative and promising business that guaranteed demand and return for a long term investment. As M. Garg [9] reported that student housing is one of the most vibrant Indian real estate markets in the foreseen future. Prominent HEIs with dense student population positively affect the demand for student residential houses. Students housing niche is lucrative not only in the developed nations but also in the developing countries the scenario is the same. As it has been observed, private off-campus student housing in the US and UK is matured and very lucrative business with rent rates growth of 7 % between 2004 and 2006 in 64 college towns across the UK. In fact, the future of student housing niche is extremely promising not only an investment, but a competitively high returning asset and also is becoming one of the really important sectors that create job opportunities. The high level of student demand for rental houses will guaranteed good return rates and low void rates, therefore, targeting students rental properties at densely student HEI neighbourhood is an attractive investment. It's a resilient market outperforming other investment sectors, rapid growth with fairly economic recession-proof and proving relatively resilient during the recent economic crisis. It has been observed, student housing market has consistently been one of the best performing rental sectors during the economic meltdown as the demand was unaffected by other sectors market tumble.

Therefore, student housing provides reliable rental returns which is secured by degree and stability of demand, and often tallied by little or no competing supply. Student housing properties experience the lowest incidence of empty properties. Investors/landlords who rent their properties to students are more likely to find tenants and receive rent on time. Students pay upfront, had no problems with rental payment and many investors may even prefer students over families

because, if the tenants fail to pay, it is more difficult to evict family tenants. Investments in student housing is an attractive property investment option, promising better returns and offer long-term income streams.

Today, the unimaginably high enrolment and demand for student housing has been on the increase yearly in all Malaysian HEIs and as a result of incapability of the HEIs to provide housing to the teaming populace, private housing developers will take advantage of stagnant supply and increasing demand to make an exceptional investment in students housing. It has been observed that private housing developers will contribute to a large proportion of the entire housing stocks for student hence; HEIs provide accommodation to only a small fraction of their students' population. The contribution of private developers in housing delivery cannot be over emphasise thus they accommodate majority of the students. In spite of their efforts in complementing HEIs efforts in housing delivery, they should aim at providing descent and comfortable students housing to the test of their clients.

CONCLUSION

The needs to provide adequate and good quality students housing should not be over emphasis hence students are expected to be in a sound state of mind to excel in their academic endeavours. However, there is a dire need to ensure that students housing are adequately and qualitatively provided to avoid any possible disruptions to students learning process and to minimize hassles students encountered in trying to get affordable and convenient accommodation at all cost.

It has become clear student housing is one of the best performing rental sectors, a distinct niche market which produces reliable rental income flow secured by intensity and steadiness of demand and is often correspond with low levels of competing supply. Student housing properties experienced the lowest incidence of void/empty properties; demand is guaranteed, has lower volatility than other property sectors and provides a higher cash yield. Being resilient nature of student housing market is also regarded as a world asset class.

Student enrolment is the major driver for the student housing demand therefore, rising demand of HE and increasing enrolment has increased student housing demands in the HEIs towns. It is clear HEIs students housing are limited and the housing system is grossly inadequate to satisfy the growing demands, majority of the students are often forced to find alternative housing accommodation in the private housing rental market. Therefore, filling the gap created by the deficit of HEIs housing system lies in the hands of the private housing developers around the HEIs. As a result of HEIs inability to provide sufficient students housing and a continuing increase in the student enrolment has created an excellent opportunity for investment in student housing. Private housing developers should take the advantage to pull-up in student housing investment in order to meet-up the growing demand for more housing infrastructure. These creates conducive atmosphere for private housing developers to invest in purposely built student housing, a resilient niche market that will guarantee cash cow into their purse.

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The Evaluation of Public Policies from the Perspective of the Agenda 21 of Culture: a Case Study

María Aracely Mendívil-Portillo [1], **Luz Cecilia Gálvez-Bon** [1], **Juan Pedro Ibarra-Michel** [1], **José Guadalupe Soto-Karass** [1]

[1] *Universidad de Occidente*
169 Gral. Gabriel Leyva Avenue, Centro, Los Mochis, Sinaloa, 81200, México

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Corresponding Author:
Juan Pedro Ibarra Michel
juanpedroibarra.udo@gmail.com

Abstract. This research shows the results of the implementation of a public cultural policy at the municipal level and has as a main objective to evaluate, from the perspective of the agenda 21 of culture, the program "Art for social development" by the Municipal Institute of Art and Culture developed in a secondary-level boarding school located at the Topolobampo community, in the municipality of Ahome, Mexico. A QUAN-QUAL methodology was used with instruments like questionnaires applied to the young participants and interviews with the workshop facilitators and administrative staff. Guitar, painting and theatre workshops were given, through which the development of new artistic expression skills was achieved, as well as contributing to the strengthening of social behaviors such as tolerance, patience and interpersonal communication, among others. It was found the constant need of having permanent programs of integral training, both in the field of artistic training and socio-emotional, giving priority to groups at risk, such as students of the boarding school that mostly come from families of scarce resources, some of the low performance academic and aggressive behavior. The conclusion is that public policies are required to promote greater articulation of education and culture in order to have a stronger impact on the social and cultural inclusion of young people.

Keywords: culture; public policies.

INTRODUCTION

The complexity of the analysis of the social impact that programs related to culture have in society goes hand in hand with the need to have mechanisms and instruments for the evaluation of cultural policies and programs relevant to the different fields of application: local, state and national levels.

The elaboration and design of public policies on culture face the same obstacles that the concept of culture has, being mainly the ambiguity of the term and the multiple interpretations that has been done of it that demands a theoretical methodological position for the analyst of the cultural phenomenon, as it is for the decision makers in the public sector, involved in the design, implementation and evaluation of public policies.

In the discursive review of the governments, the issue of social impact is a constant that seeks to justify the relevance of a public policy, is the most arduous and persistent argument when it comes to raising cultural programs and their potential benefits, that in very few occasions, evidence of social transformation among citizens is evident, but the lack of evaluation mechanisms and instruments, and particularly a culture of evaluation in all actors involved in cultural policy makers, program managers, artists, facilitators, and others, it does not allow to be certain of the achievements or at least to know what it was that really happened with the participants.

An effort made by organized civil society is constituted by the work of United Cities and Local Governments (UCLG), crystallizing in 2004 the

document "Agenda 21 of Culture"[1], with the purpose of guiding public policies of culture and contributing to the cultural development of humanity. The proposal establishes the relationship between culture and sustainable development, embodied in the Declaration "Culture is the fourth pillar of sustainable development" [20]. This organization, whose headquarters are in Barcelona, later elaborated the document "Culture 21 Actions" in 2015, which aims to be a self-assessment guide that establishes guidelines for evaluating, designing and implementing cultural policies that contribute to sustainable development in the field local.

Recently, the state government of Sinaloa has been incorporated in the 2015-2016 program, promoted by UCLG, "Cultura 21 Acciones", which provides guidance to cities interested in evaluating, designing and implementing cultural policies that contribute to sustainable development. It is in this context that it was considered pertinent to retake some "commitments" or axes of analysis that arises the agenda 21 of culture: cultural rights, culture and education and culture, equity and social inclusion.

In the State of Sinaloa, the planning and implementation of cultural policies and programs fall mainly in the Sinaloa Institute of Culture (ISIC[2]). With more than 40 years of operation, this unit has recognized the lack of information systems and evaluation instruments for its cultural policies and programs that allow the beneficiaries to know the results, as well as the performance of government management and agencies and Actors. Efforts in this regard have mainly been to count the number of attendees to cultural events.

At the level of the municipalities of the state of Sinaloa, the problem is similar, information on the results of cultural programs is minimal or null and specifically in the municipality of Ahome, where this research was developed, there is little systematized information on the planning, development and evaluation of the cultural programs operated from the local government. The Municipal Institute of Art and Culture (IMAC) is the municipal body that has had the responsibility in the last decade to design and operate cultural programs aimed at the various sectors of society.

For this reason, it was considered pertinent to evaluate a cultural program in a locality of the State of Sinaloa and of the municipality of Ahome, that serves as an exploratory study for the design of evaluation instruments with the perspective of the agenda 21, that contemplates some of the dimensions and actions considered by this agenda.

The specific objective of the research is to evaluate from the perspective of agenda 21, the cultural program "Art for social development" implemented by the Municipal Institute of Art and Culture (IMAC) belonging to the municipality of Ahome in the secondary school No 9 of the Topolobampo community. Likewise, this study reviewed national and international benchmarks in the evaluation of cultural policies, plans and programs.

It was considered important to evaluate public policies, through the monitoring of government actions at the local level, and specifically at the syndicate level, to emphasize the importance of the analysis as a permanent tool that contributes to improving the formulation of public policies, strengthen local cultural information systems and generate knowledge in the field of cultural management and cultural policies.

METHODOLOGY

This research was addressed with a mixed methodological approach, that is, from a qualitative and quantitative perspective.

As a unit of analysis, a cultural program developed from February to May of 2016 was analyzed at the Topolobampo branch of the municipality of Ahome in order to know the results and the specific development of its implementation from the perspective of different agents or participants such as the cultural managers themselves, project beneficiaries/participants and workshop instructors.

The cultural program evaluated in this research, was designed by the Municipal Institute of Art and Culture, is called "Art for Social Development"; was developed in Technical Secondary School No 9 of the Port of Topolobampo, in the municipality of Ahome.

[1] Document approved on May 8, 2004 at the IV Forum of local authorities for the social inclusion of Porto Alegre within the framework of the Universal Forum of Cultures - Barcelona 2004 (edited in 2008).

[2] Instituto Sinaloense de Cultura (in Spanish).

This program included three artistic workshops: theatre, painting and guitar, which were given to young inmates of the educational institution that mostly come from rural communities of northern Sinaloa.

A total of 48 questionnaires were applied to all students/beneficiaries of the cultural program and continuous visits were made to the secondary school to observe the local conditions in terms of infrastructure, proportion of work materials, as well as the behavior of participants and instructors during the development of the workshops.

Among the sources of information were the revision of the Municipal Development Plan of Ahome, the annual reports of the municipal government, the conduction of 6 semi-structured interviews that included the person responsible for the implementation of the program in the IMAC, the three instructors of the Cultural workshops and two members of the administrative staff of Topolobampo secondary school where the cultural program was developed.

The public policies and the cultural policies

One of the most important tasks of governments is the design, management, implementation and evaluation of public policies. However, most studies carried out in public policies have been focused on the phases of policy and program formulation, leaving in most cases one of the phases of great importance, such as the evaluation phase. As mentioned by C. Salazar Vargas [17], evaluation is indispensable for the analysis of public policies, the evaluation tries to explain why the facts were given in this or that sense.

Among the main experts is P. Muller [11], who considers public policy as a process of social mediation, insofar as the purpose of each public policy is to take care of the mismatches that may occur between a sector and other sectors, or even between a sector and global society.

In contrast, R. Velásquez Gavilanes [22] considers that a public policy is the process integrating decisions, actions, inactions, agreements and instruments, advanced by public authorities with the eventual participation of individuals, and aimed at solving or preventing a defined situation as problematic. Public policy is part of an environment from which it is nourished and which it intends to modify or maintain.

A. Vargas Velasquez [21] mentions that a public policy is not an isolated decision but a set of positions that involve one or more state institutions. But it also means the materialization of decisions taken in terms of actions that produce results on the problematic situation and the actors involved with it. Public policy is not static, it is modified according to the incidence of the actors with respect to it.

On the other hand, H. Lasswell [7] proposes to consider public policy as a scientific discipline and an applied social science [6; 10]. Th. Dye states that a policy "is all that government actors decide to do or not do" (cited by [10, p. 92]).

The French researchers Y. Meny & J.-C. Thoenig [10] argue that the study of public policies is nothing else but the study of the action of public authorities in society. A public policy is the work of the authorities of governmental public legitimacy. This, of course, encompasses several aspects, ranging from definition and selection to decision-making, administration and evaluation. That is to say, the aspects and non-committed acts of a public authority in relation to a problem or in a relevant sector of its competence, where it is presented in the form of a set of practices and rules emanating from one or more public actors. Finally, the authors conclude that a public policy must be able to be presented as a program of governmental action in a sector of the society or in a geographic space, of which it is attributed the following characteristics: content, program, normative orientation, factor of coercion and social competence.

Public policy can also be conceived as "the set of activities of government institutions, which act directly or through agents, are directed at influencing the lives of citizens" [18].

Another fundamental author in the study of public policies, points out [13, p. 37]:

It can be said that 'policies' deal with those spheres considered as 'public'. The idea of public policies presupposes the existence of a sphere or sphere of life that is not private or purely individual, but collective. The public understands that dimension of human activity that is believed to require governmental or social regulation or intervention, or at least the adoption of common measures.

Regarding cultural policies, it is undoubtedly necessary to address cultural rights first; since, compared to economic and social rights, much remains to be done about them. According to

M. Aguilera [2], cultural rights are the least developed with respect to their scope, legal content and the possibility of having them respected.

These rights are treated as the "poor relatives" of human rights. It is difficult to find a Constitution in the world that contains a chapter that deals exhaustively with cultural rights, meaning the inclusion of artistic freedom, scientific and cultural communication, copyright, the right of access to culture, the right to identity and cultural difference, the right to the preservation of cultural heritage, the right to education, religion and expression [2].

Cultural rights should be considered as those fundamental rights that guarantee the free, equal and fraternal development of human beings in their different contexts of life, using this unique capacity that we have, among living beings, to be able to symbolize and create senses of life we can communicate to others [14].

There is a need to promote and strengthen cultural rights, to demand that they be taken seriously and that they be reflected in a specific policy on the subject. According to J. Symonides [19], cultural rights are a neglected category of human rights and therefore this can be reflected in a lack of consolidated cultural policies. Hence, many organizations, such as UNESCO, have been organizing to give them the corresponding impetus, such as Agenda 21 to name a few.

Cultural policies were defined at a meeting of UNESCO in 1967, such as practices and knowledge of administrative or financial management, intervention or non-intervention, which serve as a basis for state action to meet the cultural needs of the community [8].

For N. García Canclini [4], cultural policies are the set of interventions carried out by various agents, such as the state, non-governmental organizations or community groups, with the aim of orienting symbolic development and responding to the cultural needs of the population. Culture is considered the fourth pillar of sustainable development and is increasingly becoming the center of local politics, gaining relative weight and visibility through economic, social, urban or intrinsically cultural factors (identity, memory, creativity, critical knowledge, etc.), all linked to the concept of development.

In the second half of the 1980, the so-called "triangle" of sustainable development, described in the Brundtland Report [12] and the basic pillars of sustainable development (defined as that which satisfies the needs of the present without compromising the needs of future generations), which is currently used in local, national and global strategies as a model for analysis and public action oriented towards sustainable development.

Responding to this relatively recent phenomenon of the centrality of culture, there is a trend that stems from the work of J. Hawkes "The Fourth Pillar of Sustainability. Culture's Essential Role in Public Planning" [5] which advocates that culture square "the triangle of sustainable development, thus becoming the fourth pillar.

Agenda 21 of Culture, continues this idea in an international document that systematically addresses the importance of the relationship of culture, citizenship and sustainability. It is a document that expresses a series of commitments agreed upon and prioritized by cities and local governments, which acts as a "declaration of the cultural rights of citizens at the local level" [20, p. 41].

Also, Agenda 21 for culture was the first document of a global nature that sought to establish bases for a commitment of cities and local governments for cultural development, in which representatives of cities and local governments from around the world participated.

In this agenda, principles, commitments and recommendations were established that collaborate with the cultural development of local governments, with a total of 67 articles that contemplate the five dimensions: culture and human rights; culture and governance; culture, sustainability and territory; culture and social inclusion; and culture and economy.

Assessment of cultural policies

The evaluation of public policies is undoubtedly in recent years a central concern of governments, policy makers. Since, through this, it allows them to formulate policies with rationalization and coherences that give real solutions to the social problems that must face.

An important trend in the evaluation is the formative modality, oriented to three questions [16, p. 163]:

1) the extent to which the program is reaching the target population,

2) the extent to which the presentation of services is consistent with the program design specifications, and

3) what resources have been spent or are being spent to carry out the program.

Y. Meny & J.-C. Thoenig [10] point out that the evaluation consists of taking sides and giving up the evaluation is to leave aside the applicability of the social sciences, that is why it is necessary to front facing the problems, for this is it is necessary to have greater rigor in understanding the effects of public action, which implies three options for a given public policy. A first option is the reference values, these values can be objective expressed by a public policy, which will be selected by the analyst and, in the case of the descriptive attitude is not considered any value explicitly. As a second option are the impacts or observable effects on the ground, these impacts can be seen as transformations linked to government actions. Because all public policy has a theory of change, but also shows that a policy can be preventive, that is, it can prevent transformations voluntarily or authoritarian, we can also say that the impacts can mark the physical environment and finally, it is important to point out that the effects refer to the opinions and perceptions of the people, to their way of believing and thinking, more than anything, to the satisfaction of an intervention.

Thus, we can see that the evaluation function, carried out by citizens or analysts, constitutes the center of political debate in a society. Both J. Mejía [9] and the Spanish Evaluation Society [1] agree on three phases of policy evaluation:

The first is the *ex ante or prior* evaluation, which is carried out prior to the political project or program and is intended to provide the appropriate criteria for a qualitative decision to implement a policy, project or program; this type of evaluation is also known as feasibility, when it comes to a social policy should be considered its internal consistency and feasibility and not only economic profitability.

As a second, we have process evaluation, also called continuous evaluation, which is carried out during the implementation of the policy and seeks to detect the difficulties presented in programming, administration, control, etc., in order to make the corrections in a timely way and reduce the costs of inefficiency.

And as a third ex post exposure, also known as the terminal assessment, or the impact (considering that the impact assessment establishes the extent to which objectives were achieved and what their side effects are), focus on whether the expected results and the effects, both sought and collateral, attributed to the actions or instrumented projects were obtained.

The Agenda 21 of Culture, in its article 25, points out the need to "promote the implementation of forms of cultural impact assessment to consider, with a prescriptive nature, public or private initiatives that imply significant changes in the cultural life of the cities" [20, p. 10].

In the document “Culture: 21 actions. Self-evaluation guide”, approved in the framework of the Bilbao Culture Summit (March 2015), establishes nine lines of action that are intended to serve as a basis for the level of development achieved by local governments regarding their cultural actions and programs:

- Patrimony, Diversity and Creativity;
- Culture and Education;
- Cultural Rights;
- Culture and Environment;
- Culture and Economy;
- Culture, Equity and Social Inclusion;
- Culture, Urban Planning and Public Space;
- Culture, Information and Knowledge;
- Governance of Culture.

For the purposes of this research the focus is on three of the axis: the first of these, cultural rights, are aimed to really be exercised or put into action, requires cultural policies that give special attention to the most vulnerable people and groups. The axis of culture and education, emphasized that municipal governments must approve local strategies that link education policy with cultural policy and, finally, the axis of equity and social inclusion, refers to the importance of looking for municipal strategies of the social sphere such as health, employment, welfare and social inclusion explicitly include cultural aspects as tools to combat all forms of discrimination. It is sought that the cultural institutions that receive public support carry out programs related to disadvantaged groups such as poverty, exclusion, among others.

In 2009, the Spanish Federation of Municipalities and Provinces (FEMP3) developed a system of indicators to evaluate their cultural policies in the following areas:

- Culture as a factor of development Economic, Social and Territorial;

- Transversality of culture;

- Access to culture;

- Culture and citizen participation;

- Role of initiatives related to memory and innovation in the construction of local identity.

These themes make up a system of interdependencies and polysemy that makes their isolated and individual treatment difficult and even artificial.

Regarding to the theme of culture and citizen participation, the FEMP establishes three formulas of participation:

1) Use / assistance: refers to the behavior of use / practice and consumption / assistance that are given with respect to the local cultural offer;

2) Proposal: refers to how the local cultural offer is planned and configured;

3) Management: refers to how the local cultural offer is implemented, managed or produced.

And three types of "participant" agents:

1) Individuals: unorganized individual citizens;

2) Groups: associations, "non-formal" groups and voluntary structures, all linked to culture, in a broad sense;

3) Entities: public institutions (or with a significant public participation) or private (commercial entities or independent professionals) that intervene in the local cultural field.

Context of the Secondary School No 9 of Topolobampo

The port of Topolobampo, where the educational institution is located, it is part of the eight commons of the municipality of Ahome and according to the catalogue of localities of the Social Development Office from the federal government, in Topolobampo there are 6,032 people, of which 3,045 are men and 2,987 are women.

In this locality, there are two secondary schools, Technical High School No 9, which is full shift and Mar de Cortez High School, which is an afternoon shift. Technical High School No 9 was founded in the year 1972 and in this one it is offer the technical specialties of fishing, refrigeration, processing and navigation. From its beginnings, the objective of this institution was the one to support to the families of low resources, offering them the service of masculine boarding. In the past school year 2015-2016, the school's enrolment was 280 students, of which 60 are inmate students, who participated mostly in the cultural program.

RESULTS AND DISCUSSION

Background and design of the cultural program

The cultural program "art for social development" in the municipality of Ahome is contemplated as one of the actions of the Municipal Development Plan (2014–2016). It was done considering the importance of establishing programs in the most vulnerable communities of the municipality. The Direction of the Municipal Institute of Art and Culture (IMAC) designed a program focused on a space with young people on risk situations, for this, technical secondary No 9 was chosen, located in the port of Topolobampo, municipality of Ahome.

According to the Principal´s assistant of the secondary school the program was planned to carry out the cultural project with the young inmates because they consider that they are a group at risk with problems of family disintegration, underachievement, low income families, and some students with behavioral problems in their homes and previous schools. The program consisted in three free art workshops: theatre, music and painting, which were held from Monday to Thursday from 5:00 p. m. to 6:30 p. m. from March 15 to May 30, 2016.

It is important to mention the processes that were implemented for the hiring of teachers since there are elements that directly or indirectly affect the fulfillment or non-fulfillment of certain goals.

The planning of the program. According to one of the managers of the program, the biggest diffi-

[3] Federación Española de Municipalidades y Provincias (in Spanish).

culty that the program had was the little budget to hire the instructors of the workshops and buy the necessary materials. On the one hand, the tabulation of some teachers who give art workshops in the municipality of Ahome, in some cases is inaccessible to the budget of municipal government programs, since some teachers are quoted in institutions where they guarantee economic perceptions that the municipality can´t cover.

In other cases, they are artists who independently obtain significant dividends to which the municipal government on certain occasions, if not the majority, cannot fulfil.

It is important to mention that in the budget heading for this program, the municipal government emphasized that it had to include an instructor (guitar workshop) of another cultural program sponsored by tripartite resources (from the Federal Office of Culture, the Sinaloa Institute of Culture and the Municipality of Ahome), within the framework of programs approved by the Citizen Council for Municipal Cultural Development, requesting the instructor to develop part of their activities in the secondary school, since they only had a budget for two workshops.

The availability of instructors. The inconveniences of the availability of some artists were also curiously a factor that played against the hiring of the teachers who would give the workshop, most were developing activities in public or private institutions and some could only at certain times, contrary to the Idea that could prevail in the imaginary collective artists are more occupied when they are occupied.

The experience of the instructors. Because of the above, it is difficult for the council to demand certain conditions when there are no elements to reconcile the interests of the artists with those of the program itself, some of the teachers could find some experience in their field, but in others it was evident that it lacked an artistic pedagogy suitable for the goals that the city council itself had in mind (Table 1).

Table 1 – Biographical data of workshop facilitators

Workshop	Facilitator			
	Gender	Age	Training	Experience as an instructor
Guitar	Masculine	35	Bachelor in music, specialty in classical music	7 years as a guitar instructor
Painting	Feminine	18	High school and a course in painting in the vocational school of art	No experience
Theatre	Masculine	40	Self-learning actor in independent groups	5 Years as an actor and theatre director

Source: Own elaboration based on interviews

Material Resources for the workshops. The young participants in the workshops were given the necessary materials such as guitars and painting materials: paper shells, water paints and drawing pencils. In the case of the guitar workshop, the instructor took the guitars (purchased with the program budget mentioned above) and the guitar instructor was not provided with material.

Diagnosis on the level of cultural consumption of participants in the cultural program

The results obtained from the questionnaires applied at the beginning of the cultural program show that young inmates have limited contact with art and culture outside of what is shown to them in Secondary School.

First, to know the social and economic context of the students was considered essential for this research and the socio-demographic data obtained, show that the general socioeconomic level of these students is medium to low and the educational level of the parents is located between secondary and high school, a factor that has probably influenced the type of cultural consumption of students that will be shown later.

The second category of analysis was "use of leisure time", where it was observed that young people use their free time for various activities, among which exercise, internet use and TV. Below the results for the total of 48 students is shown (Figure 1).

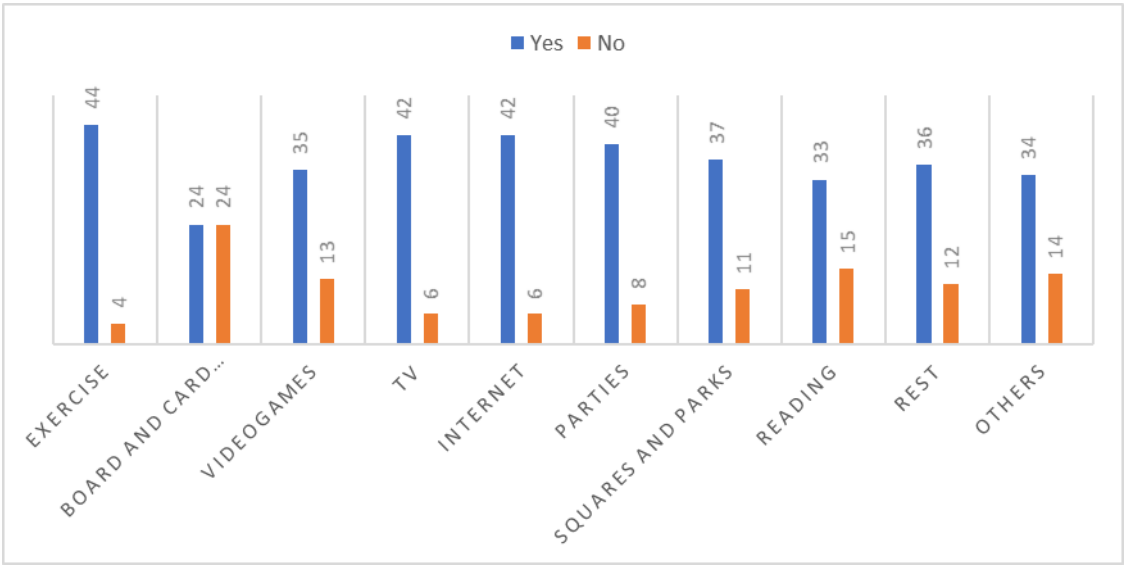

Figure 1 – Leisure time use

The third category of analysis focused on "cultural consumption", which was divided into four areas: cultural sites visited, attendance at festivities, attendance at cultural and artistic workshops, and appreciation of shows on public roads.

As for the cultural sites visited, the one that had the highest incidence was the Natural Park and the least visited is the House of Culture, even some of the young people surveyed did not know what the item "House of Culture" was referring to. The full graph is shown below (Figure 2).

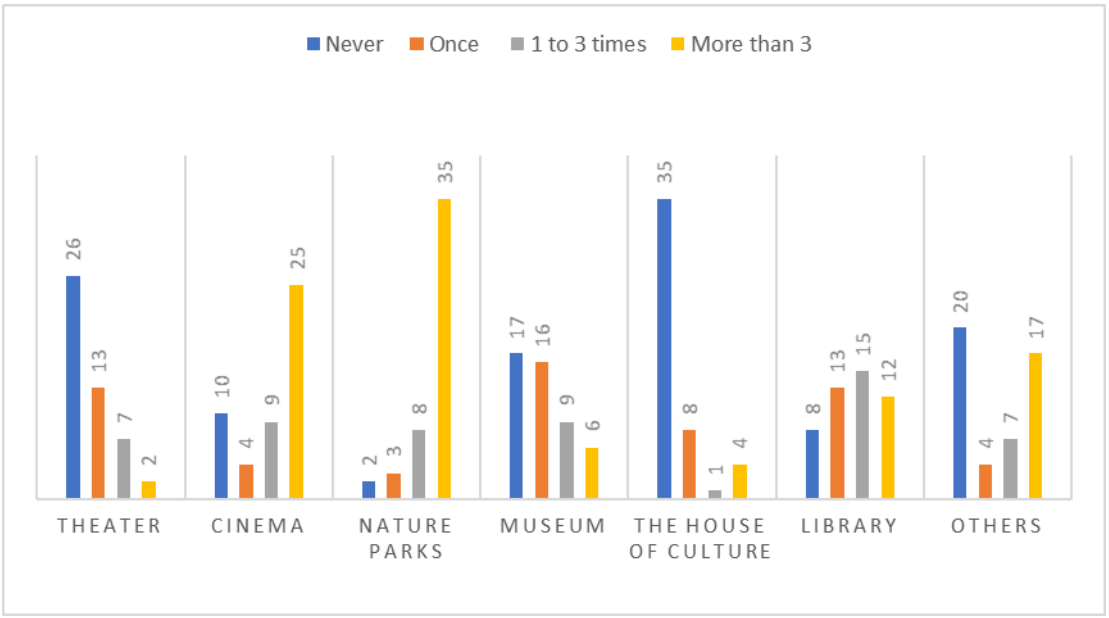

Figure 2 – Cultural consumption

Regarding attendance at festivities, the fairs were the ones that received the highest percentage of attendance, since 39 of the 48 students surveyed mentioned that they have attended fairs on more than three occasions, also, civic festivities also have a significant positive percentage, reaching 96 % attendance at least once (Figure 3).

Carnivals reach 52% in the assistance option on more than three occasions, while religious festivals and artistic festivals present similar results in the different options, having the first 75% attendance at least once and the second 73% in the same field.

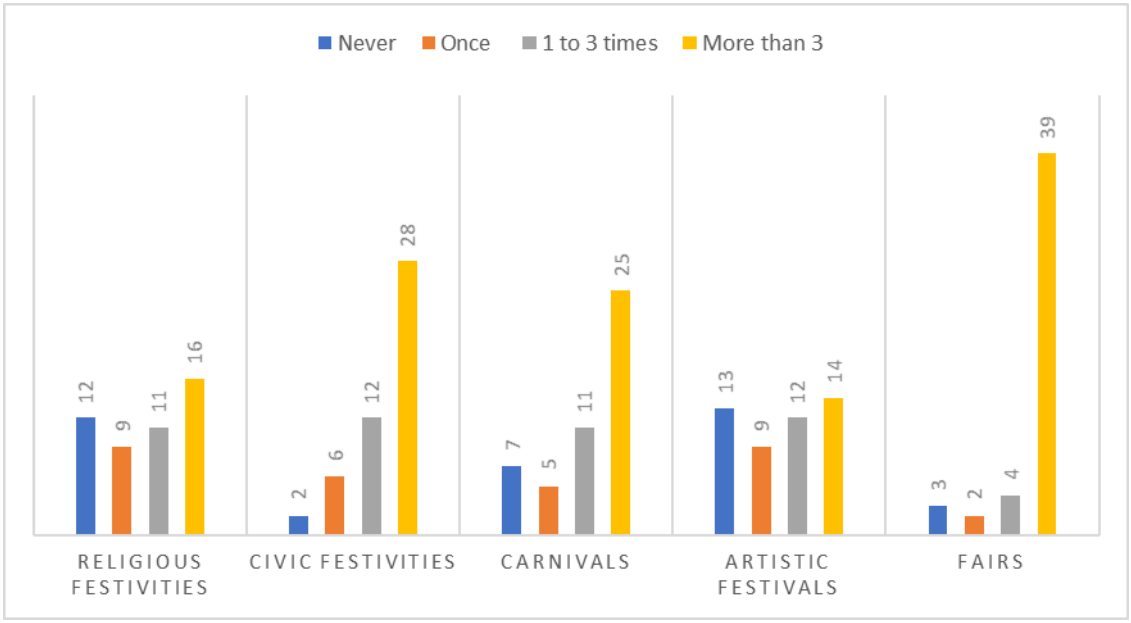

Figure 3 – Attendance to festivities

The section on "Participation in artistic and cultural workshops" shows that most of the young interns have never attended an art workshop, since only the drawing and music workshops had a greater impact on the participation of young people, are the only items that obtained a positive percentage of participation of 58 % and 62.5 % respectively. The workshops in which most of the young people have not participated or have attended little are photography, literature, sculpture and theatre (Figure 4).

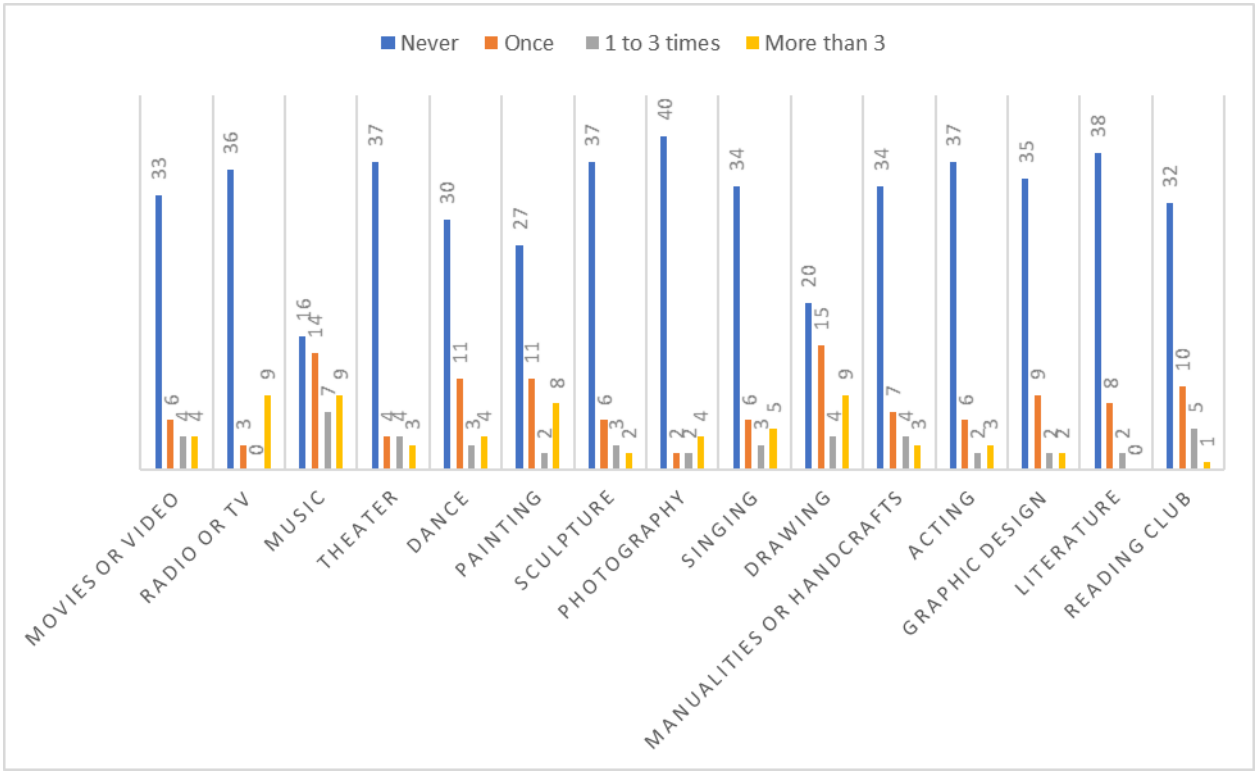

Figure 4 – Workshop participation

In the section on "Appreciation of public performances" the most attended kind of show is music, since 23 of the 48 students surveyed indicated that they have been to see this type of spectacles more than three times. The public spectacle less seen according to the results of the surveys is related to sculpture (Figure 5).

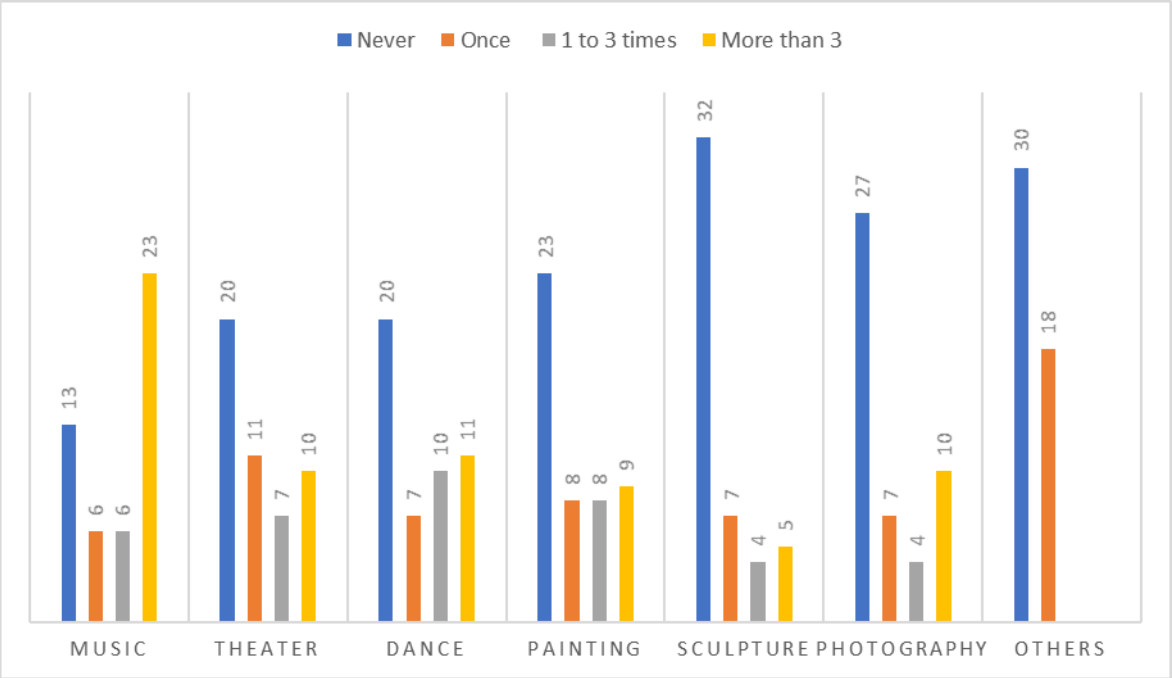

Figure 5 – Appreciation of public performances

According to the information above, it can be deduced that it is necessary to socialize, and to disseminate in a broader and sustained manner all that in the matter of culture has the municipality of Ahome. In addition, the diagnosis reflects the urgent need for cultural policies and programs that pay special attention to the most vulnerable people and groups, considering the tangible and intangible aspects of the promotion of art and culture. Likewise, the municipal government could articulate educational and cultural programs that value in an efficient and effective way the cultural resources and thus be able to contribute to a greater cultural consumption in the population.

Development of the cultural program from the perspective of young participants and facilitators

Initial Expectations. There was an inquiry about the expectations they had at the beginning of the cultural program. Most participants noted that the workshop they chose was the one that most attracted their attention. They expressed that " we expect to learn a lot about it", as the schedule seemed 100% adequate to develop in the evening shift after finishing their high school classes.

They were asked about expectations as to the workshop facilitator, responses varied. Most of the guitar pupils answered that they expected the teacher to be patient, followed by this characteristic are the qualities "to know how to explain" and "who knows a lot of guitar"; The painting students pointed out that what they expect from the workshop teacher is that "clear up all doubts", followed by the "be patient" option; and the theater students indicated that they expect "to be able to explain". From what is perceived, most of the interns have negative references to the performance of some professors who do not tempt them or who do not know how to explain, not of the cultural and artistic field, since they have not had previous experiences, but rather of the academic field.

Regarding the question "what do you expect from your classmates?", The students surveyed at the guitar workshop mentioned that the most important thing is for their peers to take care of the workshop materials; the painting students agreed that the three most important options are "respect", "pay attention" and "good behavior in class"; While theatre students emphasized respect as the most important option.

Guitar workshop development. For the participants of the guitar workshop was their first experience with this instrument, who expressed their desire to be able to rehearse more continuously and with a greater number of hours, however, the workshop lasted a short time (4 months), the lack of possibilities for the facilitator to attend was a factor that the students regretted, a situation that was not considered by the IMAC and which is, obviously, a serious failure because it

generates a counterproductive emotive effect, the young people lamented that the teacher did not attend all the programmed classes for having other commitments, even though the facilitator expressed great interest in supporting the students, his personal and work agenda was an element that worked against the project of the workshop.

The intervention of the facilitator had an important emotional impact in the youngsters of the school, if it is considered as a success to facilitate the encounter with a musical instrument in an environment designed for it and with a person willing to transmit knowledge in relation to that instrument; this seemingly small experience could have further effects that a workshop hardly will be able to gauge or evaluate in its right measure, somehow the effects of art are temporally conditioned as a unique experience are incubated in the people and will become significant in their integral formation, the possibility of being attended from the elementary perspective of art that does not qualify or become an experience of a coercive nature will give the youth an idea of art very linked to freedom, a condition not given by other experiences of a formative nature.

The guitars were provided by the facilitator and they remained at the school while the workshop was held, so those who wished could practice outside the workshop hours during the afternoons they had available.

The commitment to the development of a skill linked to learning and master an instrument such as guitar is eminently personalized, so the strategy of designing a program in which students could continue practicing outside the workshop classes will surely have its repercussions in the future, since there were enough young people who applied to experiment and work with the guitar.

The facilitator, when interviewed, stated that his goal was to form a group and set up a small guitar recital, an objective that was not fulfilled since the students had no previous knowledge of the instrument and the guitars were insufficient for all the participants.

It was observed that the objectives and goals to be achieved by this program were not met with some of the expected products, however, the students expressed their interest to continue studying the instrument.

Where there was a coincidence was in the type of music they wanted to be taught, since the teacher indicated that although "the aim of the guitar workshop is to teach classical music, there will also be time for students to learn some pieces of music of their preference". The obvious thing is that the objective was not in accordance with the needs of the students. The teacher is a career musician, but the conditions for teaching classical music in a three-hour workshop a week seems difficult to achieve. As for the students surveyed, they mentioned that what they would most like to learn is classical music and ballads, with a 30% mention each, followed by the regional music option with a mention percentage of 20%.

One of the objectives mentioned by the facilitator of the workshop is to form a guitar orchestra and present a recital at the end of the workshop, this is consistent with the expectation of the young inmates, as they mentioned that they hoped to learn songs, they were also interested in learning to read musical notes, an aspect that is addressed in the subject of solfeggio, which was the first to be given to the boys.

Development of the painting workshop. The painting workshop was the most constant, although the facilitator had little experience she was able to work with young people in a positive way. According to the testimony of the instructor the discipline was a difficult aspect to control, especially at the beginning of the workshop; she clarified to the students that this was the only workshop that was developed four days a week, therefore she managed to give greater continuity to development of the skills of the young participants. The instructor also attended in hours and days off schedule to meet needs or requests of young people.

One of the constants of the workshops was the polarity that existed between the instructors, some extremely dedicated to the dynamics and others at the opposite end without enough time to accompany them, besides this polarity manifested in the time that the teachers had, giving the ages of each of them, academic training and work experience, which opens a space to develop some working hypotheses that could focus on these differences and what are the effects in the development of cultural practices.

One aspect to emphasize in this sense, is the one related to the age and the work experience or the documentation of some facilitators, specifically the teacher of the painting workshop, a young

woman of 18 years with little experience in the teaching, this disadvantage also becomes the element of analysis in the later development of workshops. To overcome this disadvantage, she gave the workshop much dedication that was an important factor in generating empathy with the students of the school and in obtaining better results.

A painting workshop that the teacher complemented with patience, tolerance, active listening and solidarity with the workshop, the conditions that can obviously be considered as a plus for her. She managed to teach some techniques that allowed the students to finished some good paintings, so this is a prove that, if the instructor can strength the self-confidence in the young, the achievements can also exceed their expectations.

The young people stated at the end of the workshop they were excited about having done three works of painting mostly on themes related to the port landscape and about characters (comic heroes) of their preference. They acknowledged that the teacher gave them the facilities to choose the subject.

Development of the theatre workshop. The theatre workshop had few participants, ranging from 4 to 6 students. In this workshop, it was much more difficult to get young people excited, the instructor did not attend in some occasions, which was discouraging the participation, it was not possible to mount any final work with the young people.

Even though the theatre workshop did not culminate in a final work, it is necessary to consider relevant aspects of it such as the young people who participated in this formative experience as actors that became involved in a creation process that was much more complex than other disciplines, since they developed the capacity to dialogue around a text that was redesigned according to their own experiences. And although it is true that the work did not end on stage, there were ephemeral staging on each occasion that they rehearsed in the hall.

Contribution of the workshops. In short, the students considered important the development of new artistic expression skills, activities that allowed them to occupy their time in a fun way and in turn allowed them to de-stress from all the daily work in school; 100% of the students expressed their interest that the workshops will continue the next cultural cycle and 50% indicated that they would like to have other activities focused on sports.

Within the practices they carried out, the facilitators established affective links with the participants, related to one of the thematic axis about human rights, the possibility of coexistence and working on issues related to participatory assertive communication. This was mostly appreciated in the paint shop.

Undoubtedly, culture cannot be subject to the production of subjectivities about its value and its importance in the socio-economic and political machinery. The purpose of cultural discourse must be supported in the systematization of its planning and evaluation processes that communicate with certainty its achievements in the short, medium and long term.

CONCLUSIONS

The cultural program "Art for the social development" developed in the Secondary School No 9, was included, although of incipient form, in the axis of action scooped by the Agenda 21 of Culture, from the perspective of the social inclusion and the socialization of the cultural rights of young people. While it is true that elements that have not been evaluated for their transitive dimension, the inherent characteristic of the transformation processes, it can be deduced, according to testimonies issued by the participants to the workshops, that there is an optimistic indication to ensure that in the short time the young people who enter to one of the workshops, recognize the fact that they were taken into account by the municipality's program and, as it was expressed in their comments, the satisfaction of social inclusion and the feeling of belonging.

It was detected that some of the goals were not met, such as forming a group of strings to show the learning obtained in the guitar and theatre workshop, since only the drawings and paintings of the painting workshop were exhibited.

Also, it was observed the need for greater support by the government through the Office of Public Education and Culture of the State of Sinaloa towards the secondary school and the boarding school as it is a school with infrastructure problems and lack of staff to support students in the afternoons.

Likewise, other programs are required to prevent antisocial behavior in young people, since

the main problem they have among them is excessive violence among peers, they are bullying as it is a game among them. Since they have new activities in which to invest their free time, the violence diminished, hence the importance of greater cultural, sporting and artistic activities, among others.

And even if the distinctive feature of culture is linked to the emotional and spiritual transformation of the subjects involved in cultural processes, it will be an exercise in the creativity of public policy to find indicators that point out the advantages that these transformations in subjects and in the community in general mean for the development of a community that persists in the search for guarantees of peaceful coexistence in a local development environment.

The social tool provided by the agenda 21 of culture from an integrative approach, gives guidelines to obtain doses of credibility that base the potential of the cultural process on social transformation.

Cultural politics and cultural programs in Ahome have at best a vision of culture from the aesthetic point of view that limits their scope and which is still in the process of becoming a vision that establish a systematic cultural development based on the Agenda 21, which prioritize in its cultural proposal, the factor of transversality of culture, access to culture, citizen participation, innovation in the construction of local identity and culture as a factor of economic, social development and territorial.

The contemporary era requires a greater emphasis on the need for cross-cutting approaches in the development of cultural programs and actions that allow the development of a public policy with connectivity characteristics towards sustainable development. In addition, they require determining the approach that generates cultural works, vision of pluralistic perspective, that attend the technological revolution and the culture.

In an odd world where the distorted industry of violence imposes the practices of social coexistence, it is imperative to provide cultural activities with tools that allow it to consolidate programs and actions at the local level that promotes the pacific coexistence and make better human beings in every aspect.

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Experts' Opinion on the Validation of Socio-Environmental Design Factors (SEDeF) Model as a Residential Neighbourhood Crime Prevention Technique in Nigeria

Sunday Emmanuel Olajide [1], **Mohd Lizam** [2]

[1] *Universiti Tun Hussein Onn Malaysia*
101 Beg Berkunci, Parit Raja, Batu Pahat, Johor, 86400, Malaysia

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Corresponding Author:
Sunday Emmanuel Olajide
gp140026@siswa.uthm.edu.my

Abstract. This article centres on validating a proposed model, socio-environmental design factors (SEDeF) meant to complement the penal system in the area of combating residential neighbourhood crime within the Nigerian residential estates. The research sought experts' opinion on the desirability and sustainability of the model. Purposive and snow-ball sampling methods were adopted to administer 100 sets of questionnaire out of which 62 were considered usable for the analysis after data screening. SPSS and SEM-AMOS were the key analytical tools adopted to conduct the reliability test, normality test, cumulative mean, exploratory factor analysis (EFA) and the measurement model. The results of the analysis showed that, from the perspectives of the experts, the model is desirable and sustainable for the purpose for which it is proposed (Neighbourhood crime control). The model, if tenaciously implemented is capable of boosting housing values/investment, improve national economy and ensure civic and serene residential neighbourhood.

Keywords: experts' opinion; measurement model; residential neighbourhood crime; SEDeF model; validation.

INTRODUCTION

The importance of residential property (housing) to mankind cannot be underestimated. Apart from providing living accommodation, it could serve as a source of investment which in no small measure could influence the prosperity of a given economy [2]. Hence, any negative influence on housing in the form of residential neighbourhood crime (property crime) should be a concern not only for researchers but also for government and practitioners alike. As a matter of fact, property crime is soaring globally [12] and this over time had called for a paradigm shift in crime control technique especially from the penal system to a better technique. It is in the light of this that the authors of this article proposed in their earlier research a model titled socio-environmental design factors (SEDeF) as a modern and more efficient residential neighbourhood crime prevention strategy based on Nigeria situation.

The thrust of the model dwells on the premise that a conceptual marriage between crime prevention through environmental design (CPTED) and crime prevention through social development (CPSD) would produce better result in crime prevention [19].This concept has been tested and seen to be working in countries like Canada, United States of America, United Kingdom, Australia and few other countries in Europe and Asia [16]. CPTED as a concept believes that a purposeful manipulation of residential developments through design is capable of discouraging prospective offenders. The elements of CPTED include access control, activity support, territorial functioning and natural surveillance among others [9, 17]. CPSD on the other hand believes that a sincere and concerted effort in tackling the crime risk factors like unemployment, illiteracy, homelessness, family disintegration, juvenile delinquencies and poverty among others which literature identify to be the root causes of crime,

through effective social development programmes is capable of stemming down crime rate if not eliminating criminal tendencies [21, 23, 25].

In order to validate the potency of this proposed model, this particular research was embarked upon and it centred on seeking experts' opinion on the efficiency and sustainability of socio-environmental design factors (SEDeF) model as a veritable crime prevention strategy within the Nigerian residential neighbourhoods.

Hence, in line with the objective of the study, this paper consists of five sections. Section one treats general introduction to the study with reference to relevant literature. The section two describes the methodology adopted for the study, whereas section three presents the data analysis and results. Section four discusses the results of the analysis, Section five concludes the paper, as well as presenting the limitation of the study and further research.

MATERIALS AND METHODS

In line with the purpose of this research, that is, to seek experts' opinion on the applicability and sustainability of socio-environmental design factors (SEDeF) model as a compliment, if not substitute, to the penal system in the area of residential neighbourhood crime prevention, a structured questionnaire made up of 5-Likert scale design centering on the sustainability of the model (SUS), relevance of the model to the national economy (SNE), SEDeF and residential neighbourhood crime (SRNC) as well as the relationship between SEDeF and residential property values (SRPV). The measurement instrument passed through data screening which included missing values/data, reliability test, normality test and expository factor analysis (EFA). The refined data were later subjected to validity tests (discriminant and convergent) in order to build a fitted measurement model. As a way of introducing the thrust of the model SEDeF to the selected experts, a two page write-up was attached to the questionnaire.

The analysis of the data was initially based on 100 sets of questionnaire rolled out, out of which 76 were retrieved and 62 passed the screen test and were found usable for the analysis. The respondents covered senior academic and practicing professionals in the field of real estate, housing, urban and regional planning, legal practice and senior government officials. Purposive and snow-ball sampling techniques were adopted due to the nature of the respondents. The respondents were selected from academic institutions, government offices and private practice within the south-western Nigeria where the initial research was carried out.

Considering the uniqueness of the research, most of the questions were formulated by the researchers with reference to existing literature. The 5-Likert scale adopted the two extreme agreements, that is, strongly disagree to strongly agree. The findings were based on the existing benchmark setting for each stage of the analysis upon which the conclusions of the research were drawn.

RESULTS AND DISCUSSIONS

Data analysis process: Introduction

Prior to the process of data analysis, the data collected from the respondents were coded and entered into statistical package for social science (SPSS) version 22 in order to prepare the data for analysis process. Also, the missing data were considered as missing values. Established codes were employed to assign numbers for each respondent answer, thus, enable the transference of the data from the usable questionnaire collected to SPSS.

In summary, after data were entered into the SPSS data file, data screening processes were conducted. These were to identify errors such as out of range values and omitted entries in the process of data entering. Therefore, original questionnaire were used to correct all the identified errors before the commencement of the appropriate data analysis process for this research. Next were the assessment of normality and reliability of the data collected.

SEM-AMOS which incorporates the factor analyses was adopted being a relatively modern multivariate analytical tool which has been recommended to measure relationships among variables [3]. Its diverse means of reaching research conclusions make it preferable.

Assessment of normality

Z. Awang [3] asserted that assessment of a scale data is commonly assessed to determine normality of the data distribution. The reason is that

both factor analysis and structural equation modelling require variables to be normally distributed. More so, distributions of data that is highly skewed or with high kurtosis suggest non-normality and this implies that there may be presence of outlier cases which resultantly affects the estimation. J. Pallant [20] stated that distribution of variables needs to be checked before using them in the analysis process.

In addition, this research checked for the outliers in the data distribution scores by examining the normality probability plots (Normal Q-Q plot) and the results showed that there was no serious divergence from the normality. In addition, data distribution box plot were checked and 14 outliers were identified out of the 76 useable respondents (cases) in the data distribution. Therefore, upon the completion of the descriptive analysis, only 62 respondents (cases) were used for the multivariate research statistical analyses.

J. Pallant [20] recommended that the skewness and kurtosis values of -1 to +1 are considered a symmetry distribution which are suitable for parametric tests and presume a normal distribution. In this regards, the absolute value of skewness and kurtosis for the entire constructs in this research were presented in Tables 1–4 to establish that they are within the recommended ranges. This implied that data distribution for this research satisfied univariate normality. Therefore, additional modification of the data was not needed.

Table 1 – Descriptive statistics for the experts' perception of SEDeF and the national economy (SNE)

Code	Item' Description	Mean	Skewness	Kurtosis
		Statistics	Statistics	Statistics
SPGG	SEDeF can promote good governance	3.56	-.543	-.424
SCIN	SEDeF is capable of curbing incivility	3.55	-.504	-.741
SRPS	SEDeF reduces public spending	3.50	-.498	-.630
SEPR	SEDeF enhances public revenue	3.55	-.571	-.605
SRNP	SEDeF lessens neighbourhood policing	3.55	-.592	-.382
SGFEP	SEDeF good for economic prosperity	3.65	-.584	-.346
SIMC	SEDeF is more civil	3.58	-.600	-.454

In Table 1, the mean, skewness and kurtosis values of the entire items for the respondents' understanding of the relevance of SEDeF model to the national economy were presented. The cumulative mean value for the construct on a 5-Likert scale was 3.562 and this indicated that experts have good perceptions of the relevance of SEDeF model to the national economy.

Table 2 – Descriptive statistics for the experts' perception of the sustainability of SEDeF model (SUS)

Code	Item' Description	Mean	Skewness	Kurtosis
		Statistics	Statistics	Statistics
PSSS	Political structure will support SEDeF	3.68	-.672	-.226
BAFS	Cost-Benefit analysis favours SEDeF	3.60	-.595	-.479
SESS	Socio-economic supports SEDeF	3.77	-.830	.059
SPSI	SEDeF will enjoy public support to implement	3.56	.131	-.576
SIBN	SEDeF implementation will benefit Nigerians	3.63	-.610	-.365
SSSO	SE$DeF can be sustained over time	3.60	-.595	-.497
SBEP	SEDeF brings economic profitability	3.47	-.521	-.362
SEMP	SEDeF brings environmental profitability	3.69	-.691	-.334
GASF	There will be general acceptability for SEDeF	3.66	-.669	-.417

In Table 2, the mean, skewness, kurtosis and values of all the items of measurement for the sustainability of SEDeF model as scored by the experts from within the relevant professions were presented. The cumulative mean value for the SEDeF sustainability was 3.629 on a 5-Likert scale and this indicated that the experts believed in the sustainability of SEDeF model as a veritable neighbourhood crime prevention technique. However, research finding made known that socio-economic capacity of Nigeria as a nation will support the implementation of SEDeF which scored highest mean (3.70).

Table 3 – Descriptive statistics for the experts' perception of the relationship between SEDeF and residential property values (SRPV)

Code	Item' Description	Mean	Skewness	Kurtosis
		Statistics	Statistics	Statistics
SDHV	SEDeF determines housing values	3.68	-.672	-.226
SPREP	SEDeF promotes real estate practice	3.60	-.595	-.497
SCND	SEDeF curbs neighbourhood decline	3.68	-.693	-.292
SBHI	SEDeF boosts housing investment	3.71	-.591	-.424
SDRM	SEDeF discourages residential mobility	3.69	-.669	-.274
SIHV	SEDeF increases housing values	3.55	-.504	-.741
SCNS	SEDeFcurbs neighbourhood stigmatization	3.65	-.353	-.714

In Table 3, the mean, skewness and kurtosis values of the entire items for the respondents' understanding of the relationship between SEDeF model and residential property values were presented. The cumulative mean value for the construct on a 5-Likert scale was 3.650 and this indicated that experts have good perceptions of the relationship between SEDeF model and residential property values.

Table 4 – Descriptive statistics for the experts' perception of the relationship between SEDeF and residential neighbourhood crime (SRNC)

Code	Item' Description	Mean	Skewness	Kurtosis
		Statistics	Statistics	Statistics
SSDB	SEDeF stems down burglary	3.68	-.672	-.226
SCI	SEDeF controls incivility	3.60	-.595	-.497
SDPPC	Social development programs cures crime	3.68	-.693	-.292
SNCPS	SEDeF, a veritable crime prevention technique	3.71	-.591	-.424
VSCPS	Virtual house curbs property crime	3.69	-.669	-.274
SCCRF	SEDeF cures crime risk factors	3.55	-.504	-.741
EDCPS	Environmental design curbs property crime	3.65	-.353	-.714

In Table 4, the mean, skewness, kurtosis and values of all the items of measurement for the relationship between SEDeF model and residential property values as scored by the respondents were presented. The cumulative mean value for the residential neighbourhood crime was 3.567 on a 5-Likert scale and this indicated that the respondents believed in the relationship between SEDeF model and residential neighbourhood crime. However, research finding made known that 'SEDeF as a veritable crime prevention technique scored highest mean (3.71) while SEDeF as a cure to the crime risk factors scored least mean value (3.55). Nonetheless, it is obvious that this research outcome infers that experts support the relationship between the SEDeF and residential neighbourhood crime (RNC) which corresponded with [22] and [24] research findings.

Reliability assessment

Reliability is the degree to which research measurement are free from random error and the extent to which a scale used produces consistent results if repeated measurements were made on the variable concern [10, 20]. This implies that reliability and error are related and that the larger the error, the smaller the reliability of the research measurement or vice-versa. As a result, the reliability of the total scale of every constructs in this research was examined to ascertain their internal consistency. J. Pallant [20] recommended that Cronbach's alpha values above 0.7 are considered appropriate and acceptable, even though, above 0.8 are preferable.

Table 5 presents the reliability analysis result for SEDeF and National Economy (SNE), Sustainability of SEDeF (SUS), SEDeF and Residential Neighbourhood Crime (SRNC); SEDeF and Residential Property Values (SRPV). The Cronbach alpha for SNE, SUS, SRNC and SRPV are 0.800, 0.778, 0.875 and 0.866 respectively. These values exceeded 0.70 indicating that the items are reliable for measuring the respective constructs [20].

Table 5 – Reliability Analysis

Factors/Constructs	Items	Cronbach alpha
SEDeF and National Economy (SNE)	SPGG, SCIN, SRPS, SEPR, SGFEP and SIMC	0.800
Sustainability of SEDeF (SUS)	PSSS, SESS, SIBN, SBEP, SENP and GASF	0.778
SEDeF and Residential Neighbourhood Crime (SRNC)	SSDP, SDPPC, SNCPS, VSCPS, SCCRF AND EDCPS	0.875
SEDeF and Residential Property Values (SRPV)	SDHV, SPREP, SCND, SBHI, SDRM, SIHV, and SCNS	0.866

Exploratory Factor Analysis

Exploratory factor analysis (EFA) is generally employed in the multivariate statistical analysis to select set of items from a large pool of group into a manageable form. This is simply termed data reduction process in the statistical analysis. The purpose is to examine the relationships among the variables prior the application of the confirmatory factor analysis [18, 20]. However, Z. Awang [4] argued that exploratory factor analysis cannot assess unidimensionality directly, in fact, EFA is commonly used to assess the factor structure of a scale. However, J. Hair [13] reported that confirmatory factor analysis (CFA) is a more reliable method for use in a research model where hypotheses about relatively new constructs of variables exist such as the case of this research's proposed Socio-Environmental Design Factors (SEDeF) model. In this regards, the EFA for this research and EFA final result is presented in Table 6.

The 30 items of the four constructs measuring the validation of the sustainability of SEDeF model assessment scales were subjected to exploratory factor analysis using SPSS version 22 out of which 30 items passed the data reduction process. Prior to performing EFA, the suitability of data for factor analysis was assessed and satisfactory.

Inspection of the correlation matrix showed the presence of several coefficients of minimum of 0.5.

Table 6 – Exploratory factor analysis for the research constructs

	Rotated Component Matrix			
	1	2	3	4
SPGG				.776
SRPS				.616
SEPR				.643
SGFEP				.718
SIMC				.565
SDHV				
SPREP			.720	
SCND			.812	
SBHI			.863	
SDRM			.852	
SIHV			.689	
SCNS			.853	
SESS		.774		
SIBN		.668		
SBEP		.599		
SENP		.862		
GASF		.689		
SDPPC	.900			
SNCPS	.930			
VSCPS	.497			
SCCRF	.785			
EDCPS	.893			
SSDB	.798			

In addition, Kaiser-Meyer-Olkin value score was 0.725 which exceeded the recommended value of 0.6 [14] reached statistical significance, supporting the factorability of the correlation matrix (Table 7).

Table 7 – KMO and Bartlett's Test

Kaiser-Meyer-Olkin Measure of Sampling Adequacy		.725
Bartlett's Test of Sphericity	Approx. Chi-Square	894.862
	df	300
	Sig.	.000

Measurement Model

The use of structural equation modeling (SEM) in analyzing the data through AMOS 21.0 software required a two-step approach which was employed as a pre-requisite for the use of SEM [3]. The first step required the preparation of the

measurement model estimated for the purpose of confirmatory factor analysis (CFA) with the principal aim of checking the model fit and validity. The goodness of fit is in agreement with the laid down principles. Findings as presented in Figure 1 show that the factor loadings after necessary deleting were found to be significant.

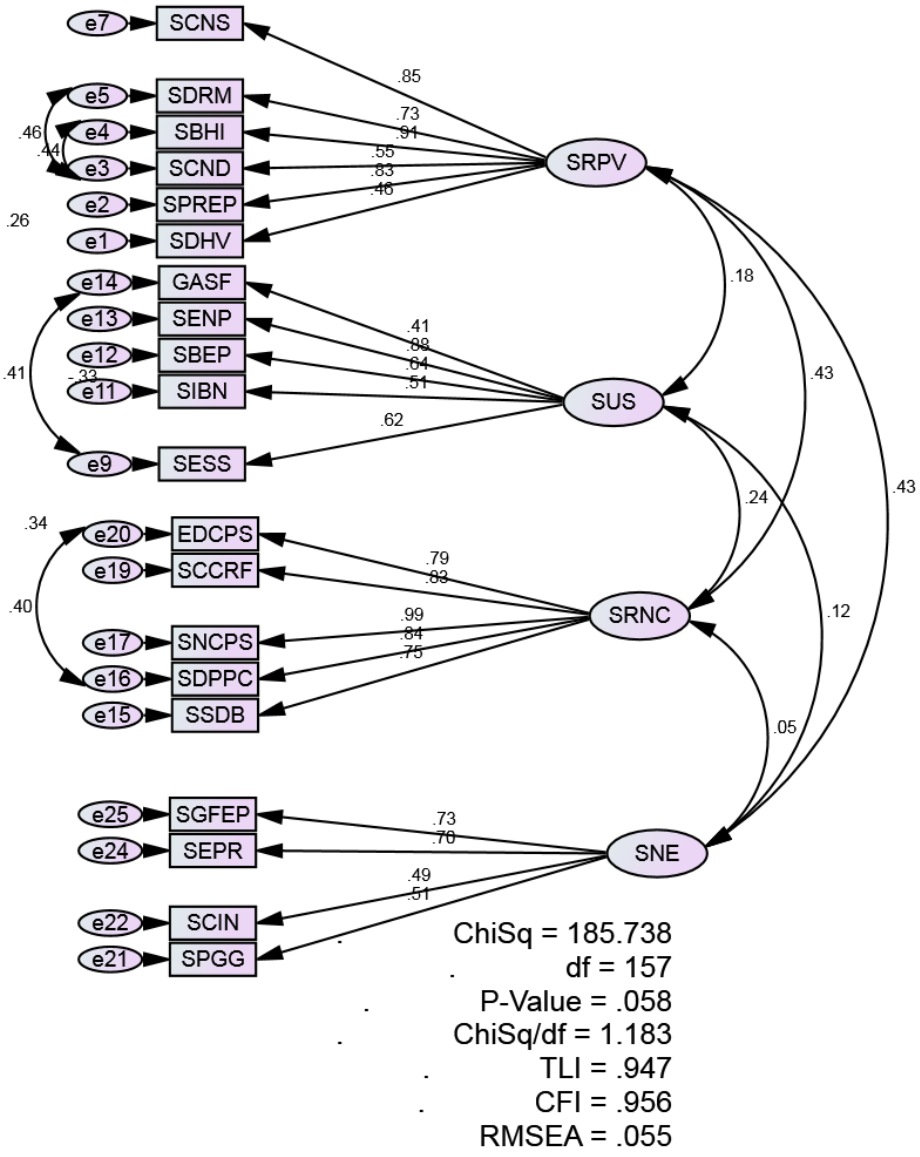

Figure 1 – The measurement Model

That is, not less than 0.5 [4, 13]; the chi-square/df stood at 1.183 which is less than the benchmark 0f < 5.0 [15]; CFI is 0.956 [6]. TLI is 0.947 [7]; RMSEA (root mean square error of approximation is 0.055 which is less than the benchmark of ≤ 0.080 [8]. In summary, these result figures meet all the recommended criteria for the good model fit [3, 5, 13].

To ensure that the model is properly fit, the data were also tested for construct validity which involved the discriminant and convergent validity as well as the correlation matrix for the entire research constructs [4, 13].

Discriminant validity is achieved when the square root of the Average Variance Extracted (AVE) is greater than the correlation with other constructs [13]. The loadings of all reflective indicators are above 0.5 (being new measurement instrument) after the data had been refined through reliability test (Cronbach alpha) and expository factor analysis (EFA). The values of composite reliability for all reflective constructs are above 0.7 [3, 13] and the AVE for each construct is above 0.40 [11] confirming a convergent validity as shown in Tables 8–9.

Table 8 – The summary of measurement Model

Construct	Items	Loadings	CR[a)]	AVE[b)]
SNE	SPGG	0.51	0.82	0.44
	SCIN	0.50		
	SRPS	0.70		
	SGFEP	0.73		
SUS	SESS	0.62	0.83	0.47
	SIBN	0.51		
	SBEP	0.64		
	SENP	0.88		
	GASF	0.41		
SRPV	SDRM	0.73	0.84	0.52
	SBHI	0.91		
	SCND	0.55		
	SPREP	0.83		
	SDHV	0.50		
	SCNS	0.85		
SRNC	SSDB	0.63	0.92	0.70
	SDPPC	0.65		
	SNCPC	0.75		
	SCCRF	0.83		
	EDCPS	0.79		

Note:
a) Composite Reliability (CR) = (square of the summation of the factor loadings) / {(square of the summation of the factor loadings) + (square of the summation of the error variances);
b) Average Variance Extracted (AVE) = (summation of the square of the factor loadings) / {(summation of the square of the factor loadings) + (summation of the error variances)}

Table 9 – Correlation matrix for the entire research constructs

	SNE	SUS	SRNC	SRPV
SNE	0.66			
SUS	0.12	0.68		
SRNC	0.05	0.24	0.84	
SRPV	0.43	0.18	0.43	0.72

Note: N=62; Numbers in parentheses are standard error; SNE = SEDeF and the national economy; SUS = Sustainability of SEDeF; SRNC = SEDeF and Residential Neighbourhood Crime; SRPV = SEDeF and Residential Property Value

The main intention of the analyses is to build a measurement model that is adequately fit. From the foregoing, this has been achieved. The interpretation of this achievement is that the respondents (experts in related professions) in line with the measurement instruments adopted support the sustainability and desirability of socio-environmental design factors (SEDeF) model as a veritable strategy for residential neighbourhood crime in Nigeria. The various aspects of the analysis supporting the result of the research include the reliability test (all above 0.7), normality test (all within the benchmark of -1 to +1), the cumulative mean of the constructs (all above 3.5) which indicates that the responses of the respondents were above average, the discriminant validity, convergence validity, correlation matrix and the fitted measurement model. The outcome of all these findings is that if the tenets of the model (SEDeF) could be tenaciously implemented, it would go a long way in curbing residential neighbourhood crime thereby enhancing a liveable housing environment which could translate to boosting housing investment as well as improved national economy.

CONCLUSION

From the research findings, it was statistically established that residential neighbourhood crime is transparently present within the Nigerian landscape [1] and that penal method of crime control strategies was prominent which existing studies had described to be grossly insufficient [22]. Hence, socio-environmental design factors (SEDeF) model was proposed as a better technique to the penal system. Consequently, from the responses of the various experts on the suitability and sustainability of SEDeF model as a veritable residential neighbourhood crime prevention alternative, which were statistically adjudged to be positive, it can therefore be asserted that the model is capable of effectively tackle residential neighbourhood crime as it is seen to be working in other countries like Canada, Australia, UK and USA where a replica of the model is in use.

Furthermore, in line with the results of this study, a clarion call is made on the various tiers of government in Nigeria to pay better attention to the social development programmes which have been described as the sure cure of the social risk factors like poverty, unemployment, illiteracy, homelessness, family disintegration and juvenile delinquencies to mention a few. Also, government needs to allow for a conducive environment that will enable workable and feasible residential layout design through site and services scheme. Developments on these schemes

must be seen to comply with the building regulation to enhance the sustainability of the model. A tenacious implementation of the model is expected to result in value appreciation within the residential neighbourhoods, enhanced efficiency of labour, improved gross domestic product, housing sustainability, civil society, decrease in government annual budget on crime control and curbing psychological fear of crime which over time had resulted in sudden death of residents.

Conclusively, it is noteworthy that this study could not do enough justice to the deep comparison between penal system and SEDeF as well as delving into the key drivers of sustainability as they influence this proposed model. Future researches are set to bridge these research gaps.

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Effect of Surface Passivation on $Cd_xNi_{1-x}S$ Thin Films Embedded with Nickel Nanoparticles

Cliff Orori Mosiori [1]

[1] *Technical University of Mombasa*
P. O. Box 90420-80100, Mombasa, Kenya

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Corresponding Author:
corori@tum.ac.ke

Abstract. Certain treatments done to binary *CdS*, such as incorporating *Ni* onto *CdS* produces ternary thin films may cause major optical parameters that have a number of applications including for solar cell device fabrication. In this paper, we report on the effect of surface passivation on the band gap and other related optical properties of *CdNiS* thin films. Thin films for $Cd_xNi_{1-x}S$ were prepared on glass substrates by chemical solution method. Effects of surface passivation and variation of the volume of nickel ions on the optical properties *CdS* hence obtaining $Cd_xNi_{1-x}S$ thin films was investigated. It was observed that the thin films hard an average Transmittance above 68 %, with *reflectance* below 25 % across UV-VIS-NIR region. A plot of $(ahv)^2$ versus *hv* gave energy band gap between 2.55–3.49 eV for as-grown samples and 2.82–3.50 eV for annealed samples. The passivated samples had *band gap* energy values within the range 2.85–3.12 eV. It was concluded that an increase in concentration of Cd^{2+} and Ni^{2+} ions in the reaction led to an increase the *band gap* while *optical conductivity* ranged between 3.78×10^{11}–2.40×10^{12} S^{-1}.

Keywords: absorbance; annealing; optical conductivity; solar cell; spectrophotometer.

INTRODUCTION

Certain treatments done to binary *CdS*, such as incorporating *Ni* onto *CdS* produces ternary thin films. Such ternary thin film materials may cause major change in the optical parameters that may have a number of optoelectronic applications. It may have a direct influence on the electrical properties of the resulting material or the modification may result into some properties useful for single hetero-junction solar cells [8, 10] and especially nickel, *Ni*. The concept used in this report to explain observations made in $Cd_xNi_{1-x}S$ is based on the ion-to-ion model [7, 12]. In this growth condensation of Cd^{+2} and S^{-2} that results in thin film formation. The growth of $Cd_xNi_{1-x}S$ results from the incorporation of the Ni ions in the *CdS* precipitate [4, 28]. Thus a thin film photovoltaic cell is made by depositing one or more thin layers of photovoltaic material on a substrate. The substrates are immersed in an alkaline solution containing the chalcogenide source, metal ion and base. A chelating agent is added to control the release of the metal ions. Here, we report on a CBD process that promotes large area deposition [24] for efficient photovoltaic cells, sensors and lasers applications [2, 6].

MATERIAL AND METHODS

Preparation of substrates. Ordinary glass slides were used as substrates with dimensions 76.2 mm × 254 mm × 10 mm. Prior to use; they were soaked in a bath of acetone and then rinsed in dei-onized water after which they were degreased in dilute hydrochloric acid, rinsed in deionized water, dried and then stored in a desiccators ready to be used.

Growth of $Cd_xNi_{1-x}S$ thin films. The set up in Figure 1 was used. The reaction bath composed of 0.01 M $CdCl_2$ solution, 1.0 M CH_4N_2S, some drops of Concentrated NH_3 solution with varying volumes of 0.01 M $NiCl_2$ solution as tabulated in Table 1.

Table 1 – Optimized depositional Parameters for $Cd_xNi_{1-x}S$ at 0.01 M $NiCL_2$ and 0.01 M $CdCL_2$

RB	$CdCl_2$		$NiCl_2$		Value of x	Value of (1-x)
	Conc. (M)	Vol. (ml)	Conc.(M)	Vol. (ml)		
N1	0.01	10	0.01	0	1	0
N2	0.01	10	0.01	1.1	0.9	0.1
N3	0.01	10	0.01	2.5	0.8	0.2
N4	0.01	10	0.01	4.3	0.7	0.3
N5	0.01	10	0.01	6.7	0.6	0.4
N6	0.01	10	0.01	10	0.5	0.5

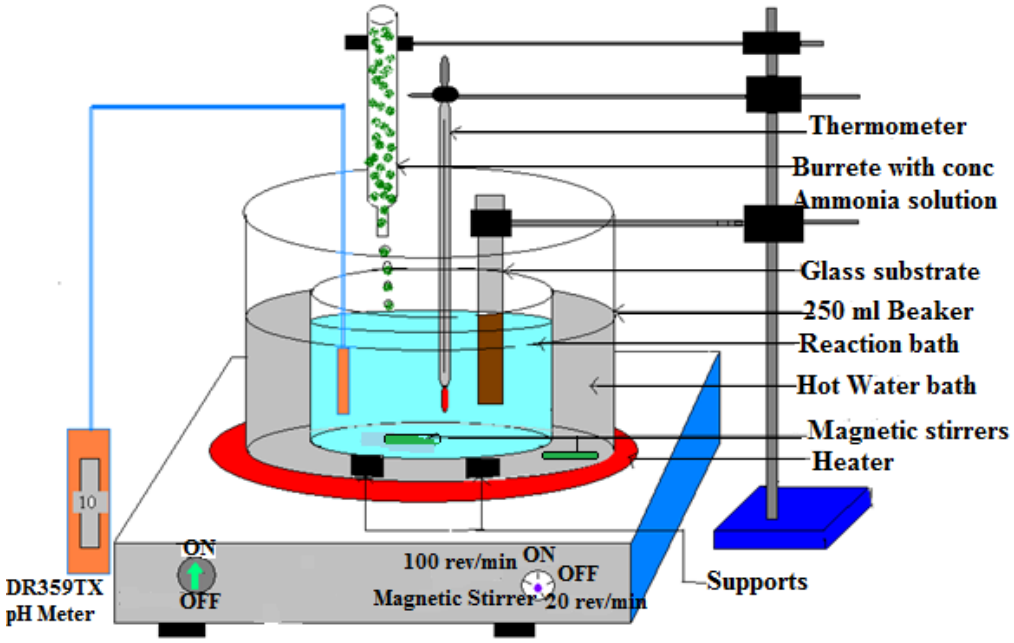

Figure 1 – Chemical bath deposition Schematic diagram

Deposition was done at 0.8 M for $NiCl_2$ and $CdCl_2$ in the order shown in Table 2 in which 10 ml $CdCl_2$ solution was put in 100 ml beaker and few drops of concentrated NH_3 solution added. Specified volumes of $NiCl_2$ solution were then added followed by accurately measured volumes of 1 M CH_4N_2S solution where the value of x varied between 1.0 and 0.5 according to the expression $Cd_xNi_{1-x}S$.

Table 2 – Optimized depositional Parameters for $Cd_xNi_{1-x}S$ at 0.8 M $NiCl_2$ and 0.8 M $CdCl_2$

RB	$CdCl_2$		$NiCl_2$		Value of x	Value of (1-x)
	Conc. (M)	Vol. (ml)	Conc. (M)	Vol. (ml)		
N7	0.8	10	0.8	0	1	0
N8	0.8	10	0.8	1.1	0.9	0.1
N9	0.8	10	0.8	2.5	0.8	0.2
N10	0.8	10	0.8	4.3	0.7	0.3
N11	0.8	10	0.8	6.7	0.6	0.4
N12	0.8	10	0.8	10	0.5	0.5

The volume of $NiCl_2$ solution was equally varied according to the formula (1):

$$x = 1 - \frac{Ni^{2+}}{Ni^{2+} + Cd^{2+}}, \quad (1)$$

where Ni^{2+} was the value of varying volume of $NiCl_2$ solution;

Cd^{2+} was the volume of $CdCl_2$ solution.

The mixture was then topped to 100 °C by adding some distilled water, placed in a warm water bath at 45 °C for 1 hour. Six samples were prepared at same deposition time. NH_3 solution was used as a complexion agent and a pH controller. Substrates were inserted at an inclined angle and after deposition; they were rinsed in distilled water; dried and kept for characterization.

Some of the thin films were annealed in a tube furnace in argon atmosphere at a temperature of 250 °C for 1 hour. The films were passivated by annealing them in a nitrogen atmosphere in a tube furnace in figure 3 for 1 hour at an average temperature of 250 °C.

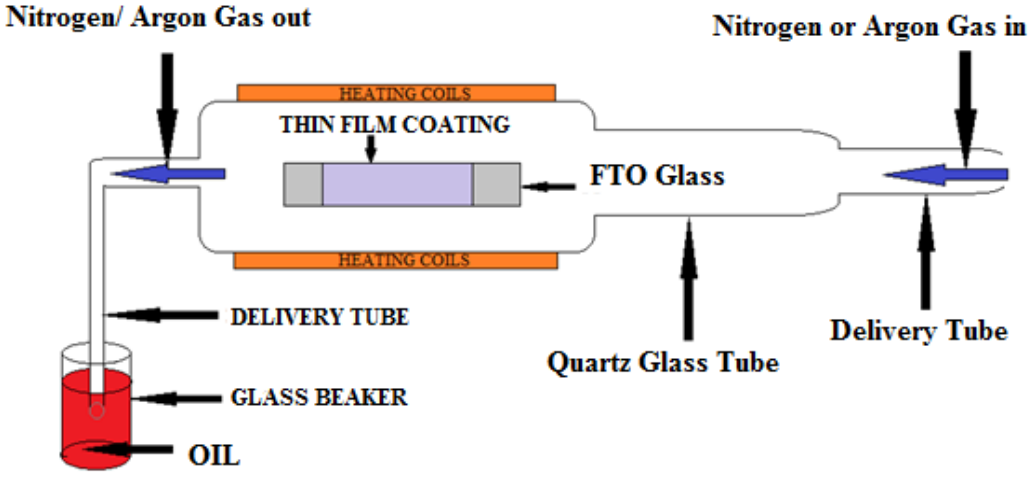

Figure 3 – Schematic diagram for a horizontal tube furnace

Optical Characterization. Transmittance measurements were measured using a computerized double beam Solid-Spec 3700 DUV Shimadzu Spectrophotometer in the spectral range from 300–1100 nm of wavelength. Scout 2.4 Software was used for simulation to obtain refractive indices, absorption coefficients, dielectric constants, real and imaginary parts and energy losses. EDX-800 HS Energy Dispersive X-rays spectrometer was used to ascertain presence of S^{2-}, Ni^{2+} and Cd^{2+} ions and their abundances (Figure 4, 5).

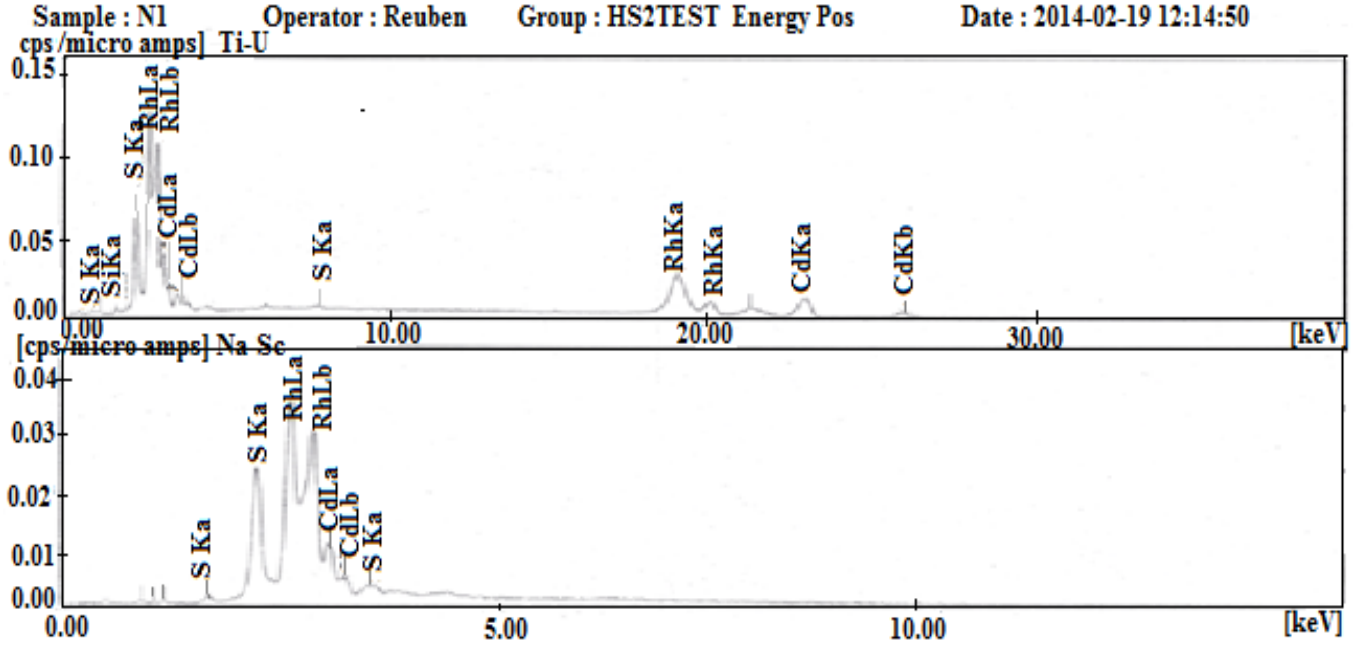

Figure 4 – XRF spectrum for as-deposited *CdS* thin film (N1) from EDX 800HS

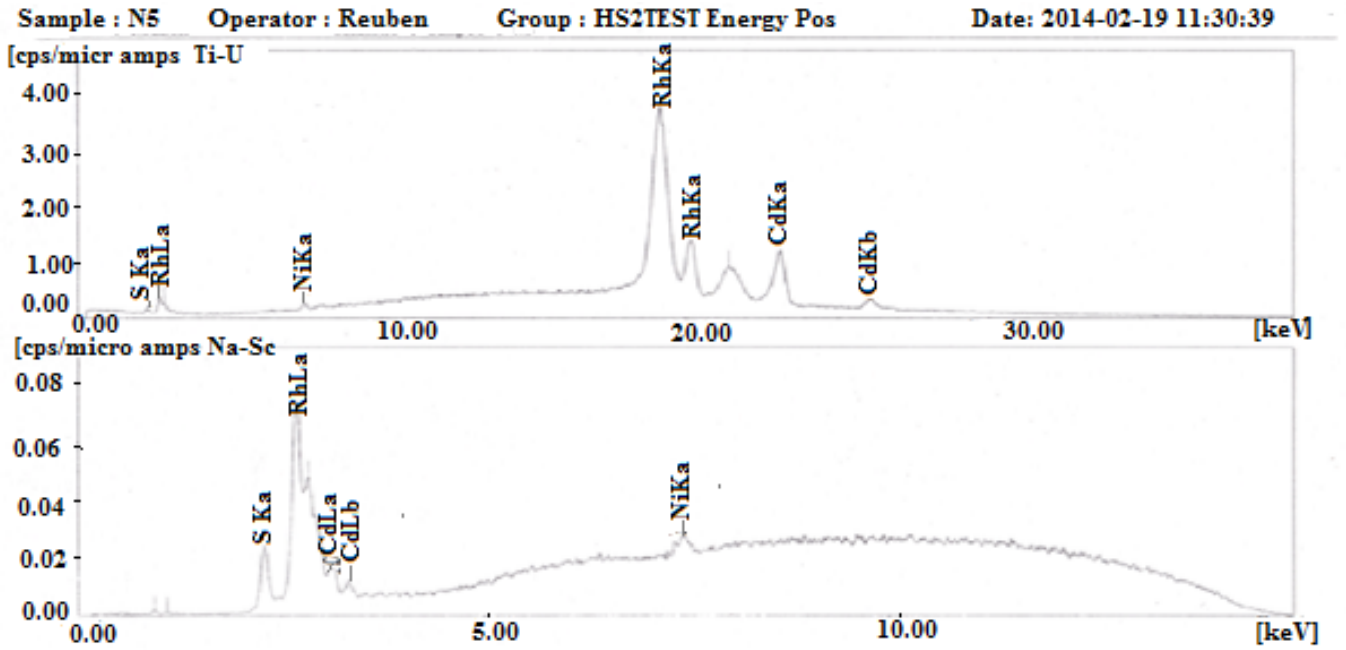

Figure 5 – XRF spectrum for as-deposited $Cd_xNi_{1-x}S$ thin film (N5) from EDX 800 HS

RESULTS AND DISCUSSION

Elemental Composition Analysis. Qualitative results in Table 3 (sample b) shows presence of *S*, *Rh*, *Ni*, *Cd* and *K* in sample N5. The sample comprised of *Cd*, *Ni* and *S* ions with *Ni* appearing in trace quantity. This implies that *Ni* acted as an impurity in $Cd_xNi_{1-x}S$ thin films. Part of the results obtained are tabulated in Table 3 (sample a) in which *S* and *Cd* were found to be the major elements in sample N1, though this include, *Si* with a trace impurity which might be due to silicon internal fluorescence peak due to the photoelectric absorption of X-rays by the silicon dead layer in the detector resulting in the emission of *Si* K-X rays from this layer into the active volume of the detector.

Table 3 – The elemental composition analysis results

Sample Analysed	Qualitative Results	Quantitative Results, %
(a) N1 – ($Cd_xNi_{1-x}S$) , x =1	S	55.223
	Cd	44.642
	Sb	0.029
	Ca	0.101
	Fe	0.005
(b)N5 – ($Cd_xNi_{1-x}S$), x = 0.6	S	21.643
	Ni	4.006
	Cd	74.345
	K	0.006

Presence of *Rh* element was as a result of the X-ray tube. Presence of *Sb*, *Ca* and *Fe* might have been caused by Spectral interference problems in EDX machine which occur at low energy (<3 keV) [25].

Optical Properties. Transmittance range was found to range between 37–44 %, 57–66 % and 83–87% in UV, VIS and NIR region respectively for $Cd_xNi_{1-x}S$ thin films deposited at 0.01 M concentration of Cd^{2+} and Ni^{2+} ions in Figure 6a while for annealed samples slightly dropped to 36–42 % in UV region, improved to 60–67 % in VIS region and remained high at 86–88 % in NIR region in Figure 6b. Highest transmittance was at 4.3 ml of nickel concentration at about 66 % and 67 % for as-grown and annealed respectively. Transmittance dropped to 12–52 %, 55–84 % and 77–86 % for as-grown films and after annealing the films (Figure 6d) respectively. The passivated films had a transmittance in the range 38–45 %, 58–68 % and 82–88% in UV, VIS and NIR region respectively (Figure 6e). The increase in transmittance spectra after annealing was attributed to enhanced crystallity and packing orderliness. This was as a result of minimal number of free carriers coupling to the electric field hence reducing the reflection and causing the transmittance to be enhanced [3]. An increase in transmittance with the volume of Cd^{2+} ions in the reaction bath was attributed to decrease in diffuse and multiple reflections caused by increase in grain size and in light-scattering effect [17, 26].

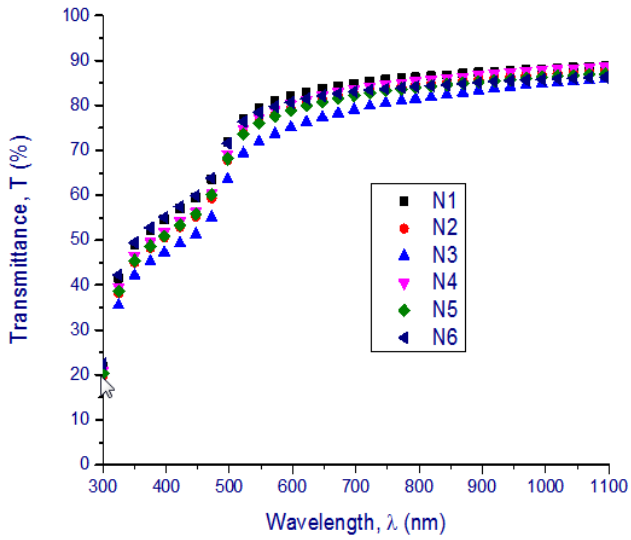

Figure 6a – Transmittance for as-deposited $Cd_xNi_{1-x}S$ films at 0.01 M of Ni^{2+} ions, %

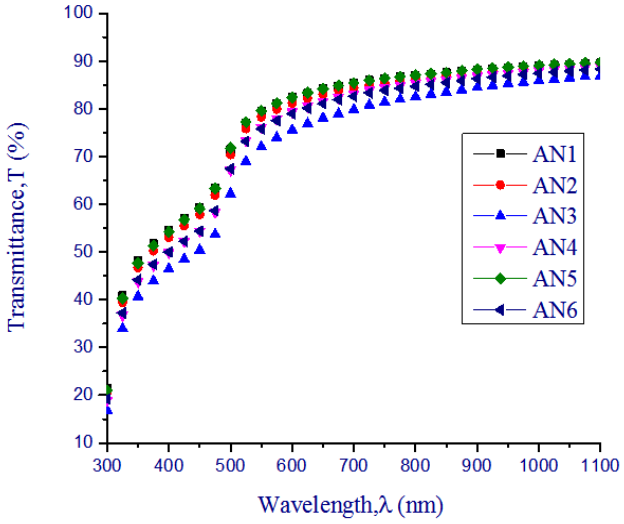

Figure 6b – Transmittance for annealed $Cd_xNi_{1-x}S$ films at 0.01 M of Ni^{2+} ions, %

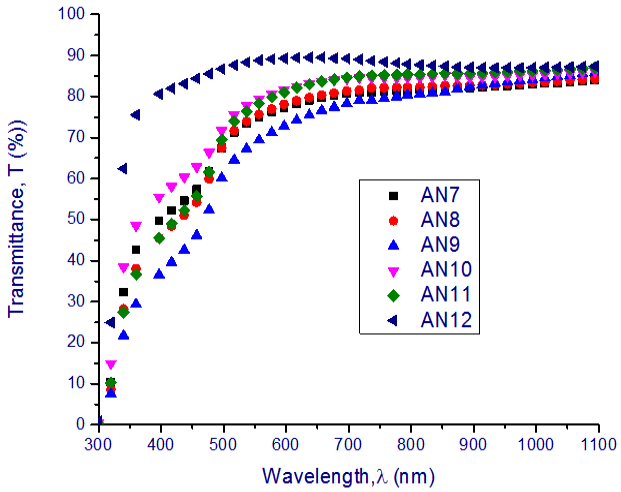

Figure 6c – Transmittance for as-deposited $Cd_xNi_{1-x}S$ films at 0.8 M of Ni^{2+} ions, %

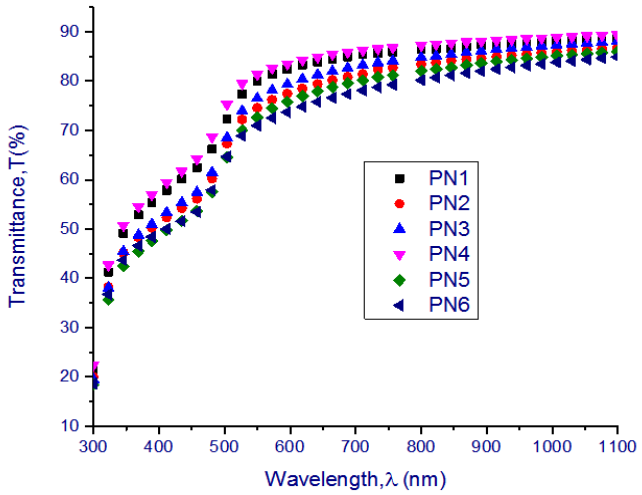

Figure 6d – Transmittance for annealed $Cd_xNi_{1-x}S$ films at 0.8 M of Ni^{2+} ions, %

In all the Figures 6, transmittance decreased as the concentration of $Cd^{2+}$and Ni^{2+} ions increased from 0.01 M to 0.8 M and this was attributed to increased free carriers coupling to the electric field hence increasing the reflection [20, 3, 16, 26]. Surface passivation had minimal influence on transmittance while an increase in transmitance at 4.3 ml of nickel ions was attributed to decrease in diffuse and multiple reflections caused by increase in grain size and in light – scattering effect [27].

Films deposited at 0.01 M concentration of ions (Figure 7a) had average reflectance range between 24–27 %, 21–30 % and 10–15 % in the UV, VIS and NIR region respectively. Annealed thin films at 0.01 M concentration (Figure 7b) had reflectance range between 21–25 %, 21–24 % and 10–13 % in the UV, VIS and NIR region respectively. Thin films deposited at 0.8 M concentration (Figure 7d) had the reflectance range decrease to between 6–14 %, 7–19 % and 7–12 % in the UV, VIS and NIR region respectively. Annealing had minimal influence on the reflectance spectra (Figure 7e).

A decrease in the reflectance was attributed to increased transmittance. With low reflectance value in the VIS-NIR region, the material is best for photovoltaic devices like solar cells as a window layer as this reduces reflective loss on the cell surface [2, 6]. Passivated thin films deposited at 0.01 M concentration of Ni^{+} ions (Figure 7c) had average reflectance range between 19–28 %, 22–28 % and 10–16% in the UV, VIS and NIR region respectively. Surface passivation had mini-

mal influence on average reflectance spectra due to optical interference which a rises as a result of difference in refractive indices of the thin films and the glass substrate used which results in multiple reflections [12, 23].

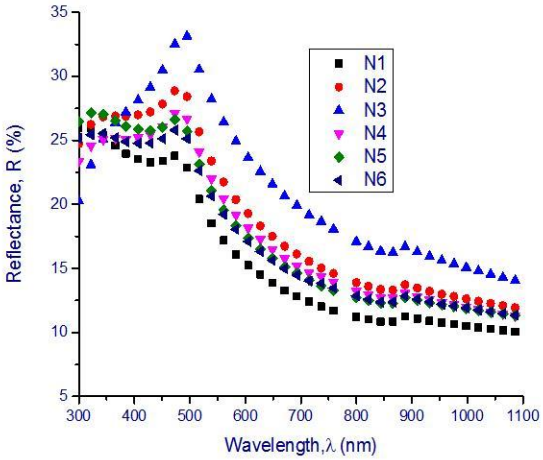

Figure 7a – Reflectance for as-deposited $Cd_xNi_{1-x}S$ thin films at 0.01 M of Ni^{2+} ions, %

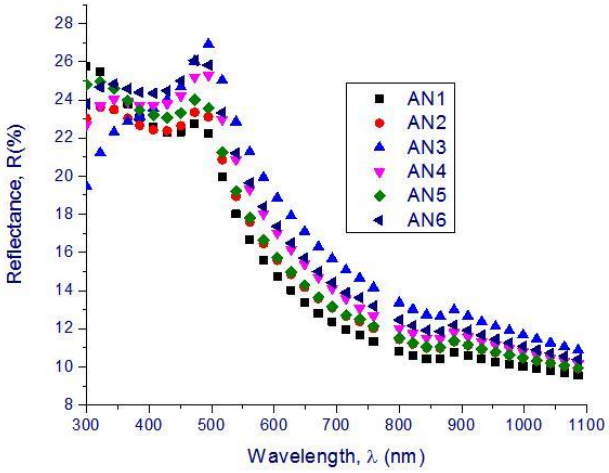

Figure 7b – Reflectance for annealed $Cd_xNi_{1-x}S$ thin at 0.01 M of Ni^{2+} ions, %

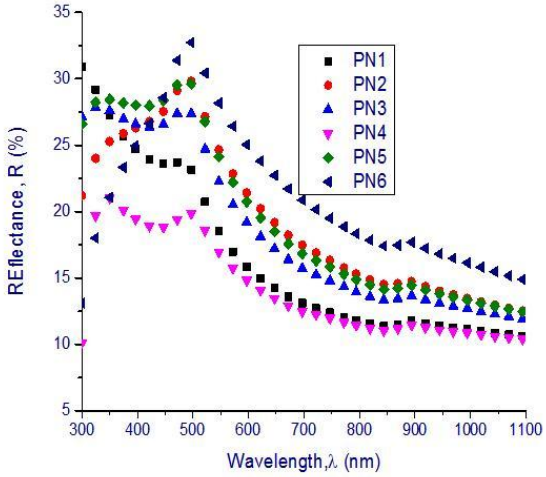

Figure 7c – Reflectance for Passivated $Cd_xNi_{1-x}S$ thin films at 0.01 M of Ni^{2+} ions, %

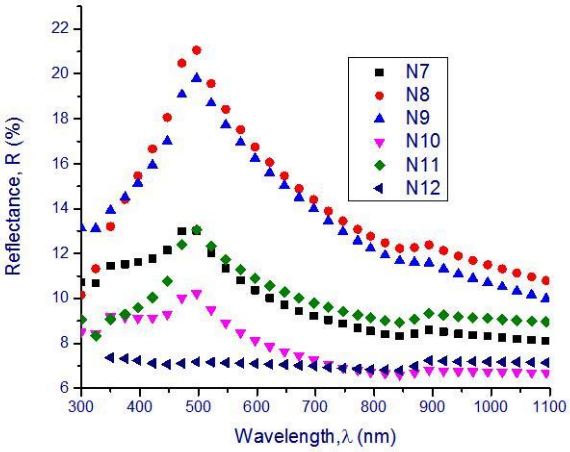

Figure 7d – Reflectance for as-deposited $Cd_xNi_{1-x}S$ thin films at 0.8 M of Ni^{2+} ions, %

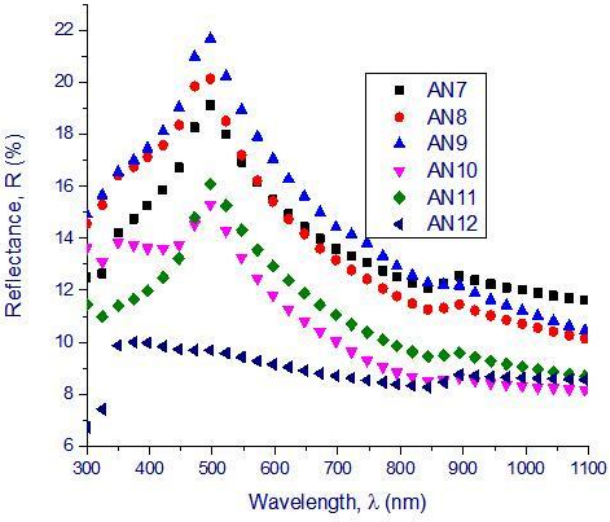

Figure 7e – Reflectance for annealed $Cd_xNi_{1-x}S$ thin films at 0.8 M of Ni^{2+} ions, %

High value of reflectance observed at 500 nm was attributed to high value of refractive index (Figure 8a–8d) with 33–42 %, 10–17 % ; 0–2 % ; 41–74 %, 9–30 % ; 9–12 % in UV, VIS and NIR region respectively [2].

The increase in the absorbance spectra with increase in the concentration of $Cd^{2+}$and Ni^{2+} ions in the reaction bath was attributed decrease in transmittance and reflectance as a result of increased photon absorption [17]. Highest value of absorption was noted at 2.5 ml doping of Ni^{2+} ions and the least value at 10 ml forming films fit for window layers in *p-n* junction solar cell [11, 25]. There was low absorption at photon energy less than 2.5 eV and 3.75 eV at 0.01 M and 0.8 M concentrations respectively. The range of the refractive index for films deposited at 0.01 M and

0.8 M ranged between 1–2 and 1–2.6 respectively. The maximum values of k and n occurred at same photon energy of 4.125 eV and these findings agree with the findings of Greenway and Harbeke [2, 7] of average magnitude for σ_0 close to 10^{12} S^{-1} and this occurs at high photon energy.

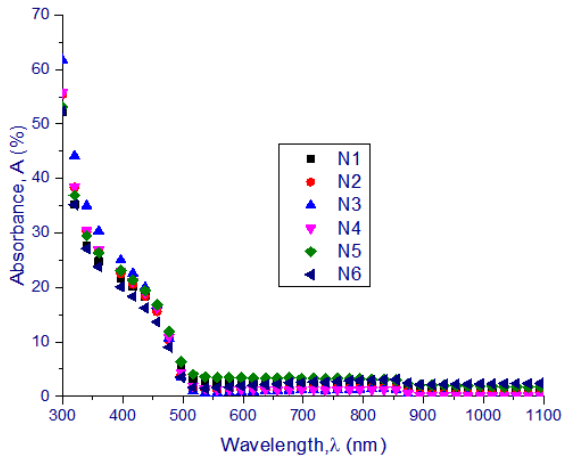

Figure 8a – Absorbance for as-deposited $Cd_xNi_{1-x}S$ thin films at 0.01 M of Ni^{2+} ions

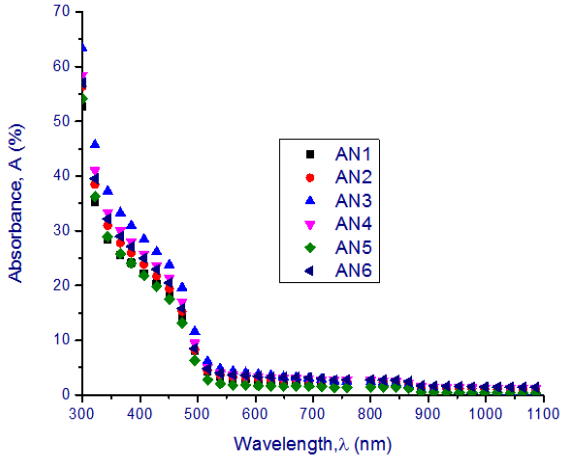

Figure 8b – Absorbance for annealed $Cd_xNi_{1-x}S$ thin films at 0.01 M of Ni^{2+} ions

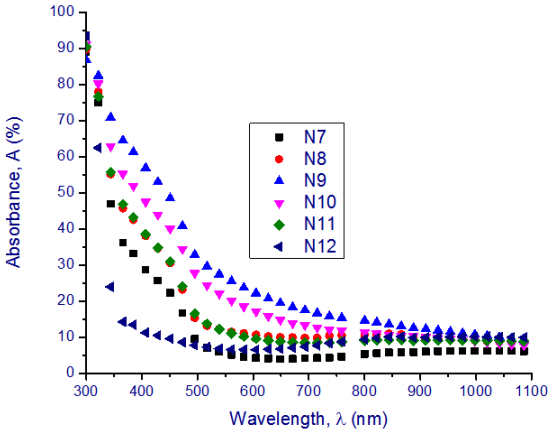

Figure 8c – Absorbance for as-deposited $Cd_xNi_{1-x}S$ thin films at 0.8 M of Ni^{2+} ions

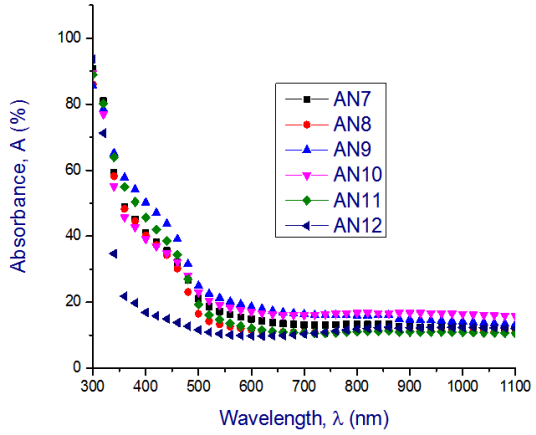

Figure 8d – Absorbance for annealed $Cd_xNi_{1-x}S$ thin films at 0.8 M of Ni^{2+} ions

The variation of α versus photon energy (Figure 8c) gave a straight line curve indicating presence of direct optical transitions [1] in which the real part indicates how the speed of light in the material can be slowed down while the imaginary part deals with the absorption of energy by a dielectric from the electric field due to dipole motion [10]. ε_r and ε_i were obtained from Scout 2.4 software by fitting the experimental transmittance data within the wavelength range 300–1100 nm. ε_r was averagely close to 2.0 from lowest to the highest photon energy values while ε_i values were below 0.5 for lower energy values and showed upward trend for energy values above 3.5 eV. The values for ε_r can be attributed to the fact that for semiconductors $k^2 << n^2$.

Band gap variation. The band gap varied between 2.55–3.17 eV (Figure 9) for as deposited films while annealing the thin films narrowed the band gap as it increased with ion concentration. An increase in the band gap attributed to the Burstein-Moss effect [17].

The decrease in the band gap due to annealing was attributed to annealing which facilitates ordered packing of crystallites of molecules reducing the intermolecular defects within the material and these causes a reduction in the band gap value [19]. High band gap values ranging between 2.56 to 3.6 eV are in good agreement with results obtained by [18] and [6]. This also increases the chance that an ejected electron will meet up with a previously created hole in the material before reaching the p-n junction [9, 15].

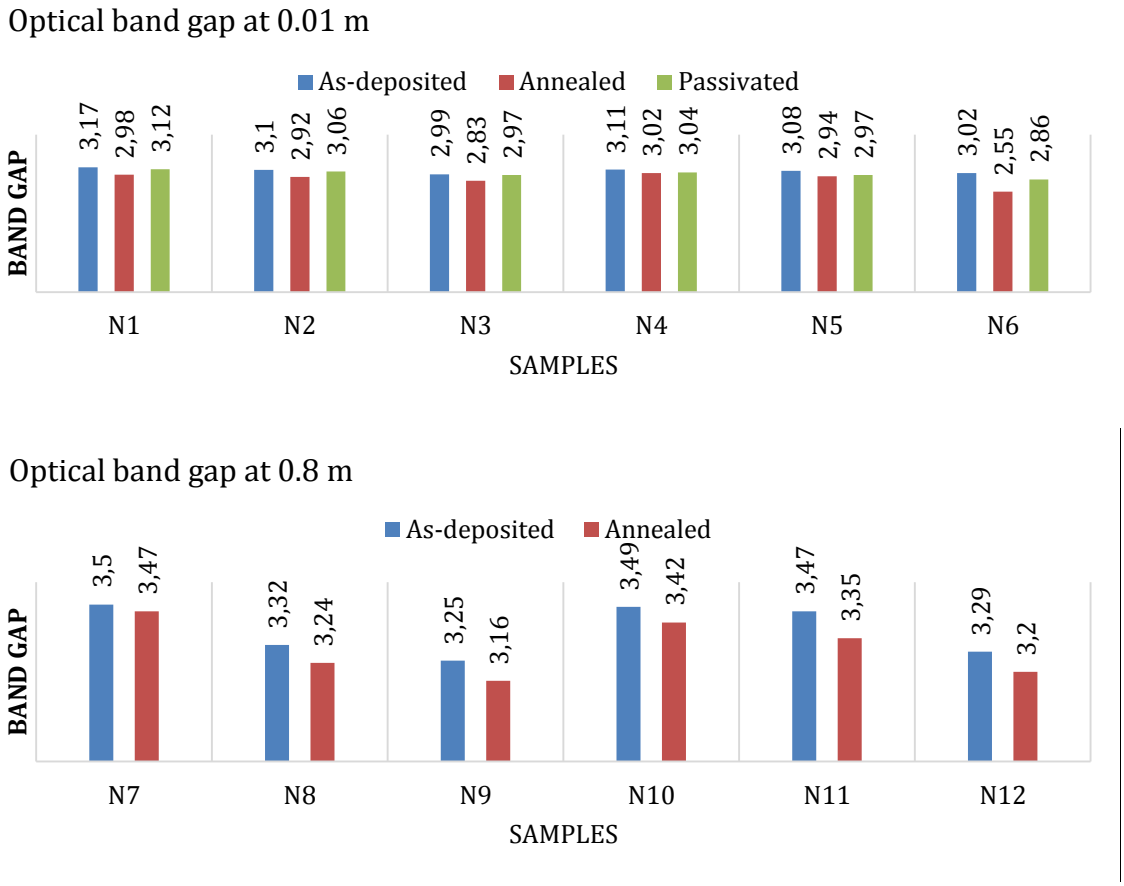

Figure 9 – Optical Band Gap for $Cd_xNi_{1-x}S$ of Ni^{2+} and Cd^{2+} ions

Effect of Passivation. Figures 6 and Figure 7c show the transmittance and reflectance spectra of as-grown passivated $Cd_xNi_{1-x}S$ thin film. Surface passivation had very little influence on transmittance and reflectance spectra since the absorbance spectra ranged from 0 % to 35 % in the VIS-NIR region for passivated thin films and 0 % to 32.5 % for as-grown and annealed thin films. Low absorption at photon energy less than 2.5 eV for passivated thin films was noted. Values obtained for these constants for as-grown, passivated and annealed thin films were within the same range. The band gap ranges were 2.85 eV–3.12 eV for passivated, 2.56 eV–3.42 eV for as-grown and 3.12 eV–3.48 eV for annealed thin films. The band gap was also least influenced by passivation.

CONCLUSION

$Cd_xNi_{1-x}S$ thin films were grown using CBD technique. The films were found to have low reflectance value in the UV-VIS-NIR regions but low transmittance values at UV region while very high transmittance at VIS-NIR regions. The average band gap has been found to be above 2.80 eV while surface passivation was found to be negligible effect on the optical properties and band gap and thus the films were well suitable for solar cell applications.

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Статистичний аналіз активності тематичного контенту в мережі Інтернет для прогнозування розвитку інформаційних загроз

Statistical Analysis of the Activity of the Thematic Content on the Internet for Predicting the Development of Information Threats

Олексій Писарчук [1], **Олександр Лагодний** [1], **Юрій Міхєєв** [1]
Oleksii Pysarchuk, Oleksandr Lahodnyi, Yurii Mikhieiev

[1] *Zhytomyr Military Institute named after S. P. Koroljov*
22 Prospekt Myru, Zhytomyr, 10004, Ukraine

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Corresponding Author:
Oleksandr Lahodnyi
lov.82@ukr.net

Анотація. У статті наведено результати статистичного аналізу активності тематичного контенту в мережі Інтернет на сегменті реальних експериментальних даних інформаційних повідомлень. Проведений аналіз довів можливість розгляду частоти появи тематичного контенту, як монотонного міандрового процесу з адитивною випадковою складовою Результати аналізу забезпечили визначення виду залежності частоти появи тематичного контенту від часу, закону розподілу випадкової складової та отримати його статистичні характеристики. Отримані результати доцільно застосовувати на етапі прогнозування розвитку інформаційних загроз. Результати статистичного аналізу показали, що частота активності тематичного контенту в мережі Інтернет має нелінійний характер, є випадковим стаціонарним процесом з явно вираженим зростаючим або спадаючим міандровим трендом.

Ключові слова: контент; мережа Інтернет; статистичний аналіз; прогнозування; закон розподілу.

Abstract. The article presents the results of the statistical analysis of the thematic content of the Internet in the segment of real experimental data of information messages. The analysis proved the possibility of considering the frequency of appearance of thematic content as a monotone meander process with an additive random component. The results of the analysis provided the definition of the type of dependence of the frequency of thematic content occurrence from time, the law of the distribution and of the random component, and obtain its statistical characteristics. The obtained results should be used at the stage of forecasting the development of information threats. The results of the statistical analysis showed that the thematic content frequency on the Internet is nonlinear, is a random stationary process with a clearly pronounced rising or declining meander trend.

Keywords: content; internet; statistical analysis; prognostication; distribution law.

ВСТУП

Практика останніх локальних війн і збройних конфліктів, зокрема які відбулися в Грузії, Україні, Сирії, стан дипломатичних відносин, політичних рішень та виборів в Франції, США показують важливість інформаційної складової із залученням ресурсів мережі Інтернет, що негативно впливає на стан національної безпеки держави [7, 6, 3]. Більшість підходів щодо виявлення інформаційно-психологічного впливу (ІПсВ) у мережі Інтернет базуються на релевантному та семантичному аналізі тексту, в ході яких оцінюється тільки якісна складова контенту, в якому розміщена деструктивна інформація.

Зростання домінуючого контенту в мережі Інтернет становить загрозу для інформаційної безпеки держави і потребує невідкладних

рішень щодо протидії. Сучасні методи та способи ведення інформаційних війн вимагають адекватних контрзаходів протидії інформаційним загрозам (ІЗ), які можливо реалізувати за допомогою своєчасного виявлення та прогнозування розвитку ІЗ. Прогнозування активності тематичного контенту в мережі Інтернет дає вихідні дані на прийняття рішення, що є важливим заходом у реалізації протидії ІПсВ. Основними заходами з протидії ІЗ в мережі Інтернет (рис. 1) мають бути:

- моніторинг мережі Інтернет – процес збору статистичних даних контенту в обраній сфері життєдіяльності соціуму за обраною тематикою з ефективних Інтернет-сайтів цільового спрямування [5];

- виявлення ІЗ – процес розпізнавання в контенті ІЗ за сформованими ознаками [4];

- прогнозування розвитку ІЗ – застосування математичних операцій, моделей та методів апроксимації, екстраполяції часових рядів щодо побудови адекватних моделей опису досліджуваного процесу для кращої точності прогнозу.

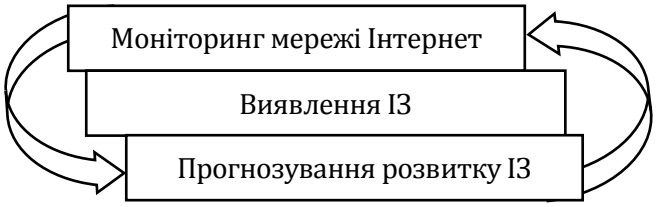

Рисунок 1 – Заходи протидії інформаційним загрозам у мережі Інтернет

Рівень ІЗ пропонується оцінювати через величину активності тематичного контенту в мережі Інтернет за частотою його появи в дискретні проміжки часу у відкритих джерелах інформації (ВДІ) – форумах, блогах, сайтах соціальних мереж, інформаційних сайтах. Це дає змогу отримувати кількісні характеристики досліджуваного процесу, але залежність частоти появи тематичного контенту в мережі Інтернет від часу має невідомі характеристики і є невідомим процесом. Тоді виникає необхідність у проведення статистичного аналізу активності тематичного контенту в мережі Інтернет для: визначення виду процесу; знаходження закону розподілу випадкової складової та його числових характеристик. Надалі отримані залежності та характеристики будуть вихідними даними для прогнозування активності тематичного контенту в мережі Інтернет з метою розрахунку сил та засобів протидії ІЗ.

Тому актуальним завданням є здійснення статистичного аналізу активності тематичного контенту під час проведення противником інформаційної війни в мережі Інтернет.

Аналіз досліджень і публікацій свідчить про те, що питанням статистичного аналізу загалом приділена увага в працях як вітчизняних так і закордонних науковців [10, 2, 12, 11, 1, 8]. Статистичний аналіз широко використовують у економічному аналізі, маркетинговій справі, соціальній, медичній та інших сферах життєдіяльності. Аналіз джерел показує факт застосування статистичного згладжування, але не доведено, що процес дійсно випадковий з реальними числовими характеристиками. Похибки прогнозування активності тематичного контенту є наслідком відсутності проведення статистичного аналізу і в свою чергу неможливістю адекватного вибору закону і моделі зміни досліджуваного процесу та відповідного алгоритму згладжування. Таким чином, на даний час існує потреба у застосуванні відповідного математичного апарату до активності тематичного контенту в мережі Інтернет для пошуку закономірностей, тенденцій, кількісних характеристик процесу. Після виявлення закону розподілу та його числових характеристик можливо проводити прогнозування розвитку активності тематичного контенту в мережі Інтернет, який завдяки статистичному аналізу буде мати адекватні та кращі прогностичні дані.

Тому *метою статті* є проведення статистичного аналізу активності тематичного контенту в мережі Інтернет для прогнозування розвитку інформаційних загроз.

РЕЗУЛЬТАТИ ДОСЛІДЖЕНЬ

Планування проведення інформаційних війн в мережі Інтернет передбачає попереднє проведення інформаційно-психологічних атак та інформаційно-психологічних акцій в критичних сферах життєдіяльності соціуму. Часові інтервали даних заходів можуть тривати від одного дня до місяця. Активність тематичного контенту в мережі Інтернет пов’язана з частотою появи інформаційних повідомлень, яка залежить від таких факторів:

- одночасна поява інформаційних повідомлень у всіх сферах життєдіяльності соціуму;

- почергова поява інформаційних повідомлень у критичних сферах життєдіяльності соціуму;

- інформаційні повідомлення можуть розміщуватися на замовлення;

- активність появи інформаційних повідомлень зростає після виступу авторитетних осіб, політиків;

- цілеспрямовано розміщувати інформаційні повідомлення можуть підрозділи інформаційно-психологічних операцій.

Необхідно на перших етапах підготовки проведенню інформаційної війни проводити прогнозування розвитку ІЗ з метою подальшої протидії. Для забезпечення даного завдання необхідно провести статистичний аналіз активності тематичного контенту в мережі Інтернет щоб виявити основні закономірності та тенденції процесу в умовах обмеженої кількості інформації.

Таким чином в результаті моніторингу ВДІ в мережі Інтернет отримуємо рівноточну і рівнодискретну вибірку параметрів процесу частоти активності тематичного контенту (1):

$$\overline{Y} = |y_i|^T, i = 1, 2, \dots n, \quad (1)$$

де y_i – значення кількості контенту за обраною тематикою;

$1, 2, \dots, n$ – дискретні проміжки часу в які було отримано значення.

Вимірювання проводяться в мережі Інтернет за пошуковою фразою в дискретні проміжку часу і фіксуються у відповідній базі даних. Дослідження закономірностей контенту було проведено на основі отриманих параметрів досліджуваного процесу в головних, на нашу думку, сферах життєдіяльності соціуму (економічна, політична, екологічна, військова, релігійна, соціальна) на зрізі 20 новин з ІЗ в кожній сфері і по 220 точок (дискрет) в них. На (рис. 2) наведено графік залежності частоти появи контенту однієї з новин «Економічне блокування території Криму» у тематиці «Політичні новини».

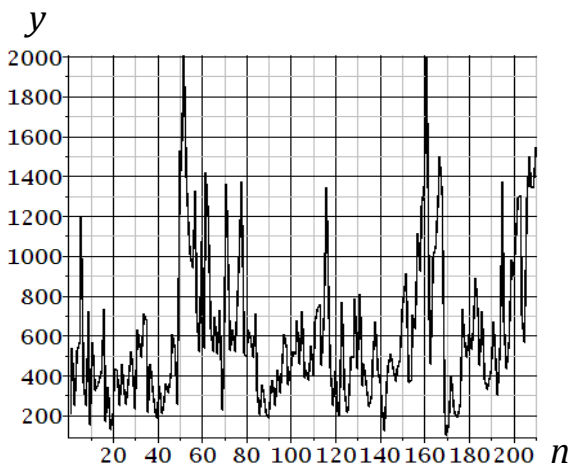

Рисунок 2 – Залежність значень частоти появи контенту в мережі Інтернет

За виглядом кривої, яка описує досліджуваний процес активності тематичного контенту в мережі Інтернет, можна стверджувати, що це стохастичний процес. Аналіз решти новин після опрацювання масиву даних, який становив у сумі 26400 значень показав, що в кожній з них присутній зростаючий або спадаючий тренд, він є нелінійним і на нього накладається випадкова складова.

Висунемо гіпотезу про те, що зміна частоти появи тематичного контенту в часі – випадковий стаціонарний процес, в якому присутня систематична складова у вигляді тренду та випадкова складова у вигляді коливань навколо тренду, яка розподілена за невідомим законом і має свої ймовірнісні характеристики. Математична (статистична) модель, якою можна описати процес (рис. 2) має наступний вигляд (2):

$$y_t = f(t) + \xi_t, t = 1, 2, \dots n, \quad (2)$$

де $f(t)$ – тренд (міандрова модель);

ξ_t – випадкова складова.

Закон розподілу невідомої величини ξ_t розраховуємо після виділення тренду і тим самим наближаємо до значень y_t. Побудуємо гістограму щільності розподілу появи тематичного контенту в мережі Інтернет для даного часового ряду (рис. 3).

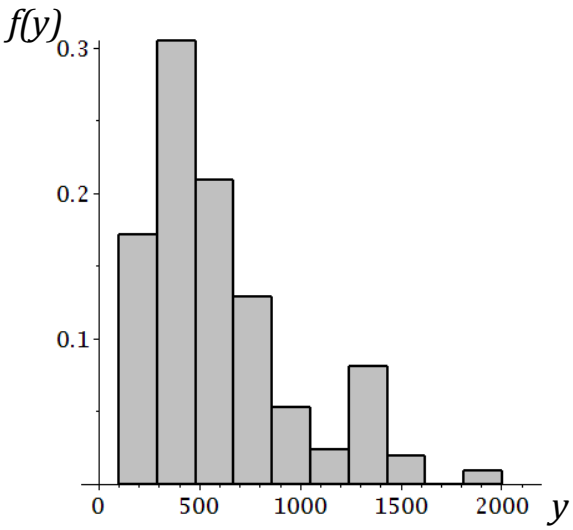

Рисунок 3 – Гістограма щільності розподілу появи тематичного контенту

За формою гістограми можливо зробити припущення про те, що в часовому ряді присутня випадкова складова, яка розподілена за логарифмічно-нормальним закон.

Здійснимо статистичний аналіз для визначення характеристик та закономірності випадкової величини, а саме: виділимо тренд; виявимо закон розподілу випадкової складової та розрахуємо характеристики; визначимо вид процесу.

Розв'язання даної задачі можливе з використанням наступного алгоритму:

Виділення систематичної складової (тренду) з часового ряду, на яку накладається випадкова складова, проводиться за рахунок апроксимації з використанням методу найменших квадратів (МНК) [9].

Розраховують характеристики закону розподілу випадкової складової з оцінок математичного сподівання m_y, дисперсії D_y, середнього квадратичного відхилення σ_y, достовірності апроксимації R^2 моделі згладжування, що виступають в якості контрольованих параметрів, вирази (3)–(6).

$$m_y = \frac{1}{n}\sum_{i=1}^{n}\Delta_i, \quad (3)$$

$$D_y = \frac{1}{n-1}\sum_{i=1}^{n}\left(\Delta_i - m_y\right)^2, \quad (4)$$

$$\sigma_y = \sqrt{D_y}, \quad (5)$$

$$R^2 = 1 - \frac{\sum_{i=1}^{n}\left(y_i - \hat{y}_i\right)^2}{\sum_{i=1}^{n}\left(y_i - \bar{y}\right)^2}, \quad (6)$$

де $\Delta_i = |y_i - \hat{y}_i|$; $\bar{y} = \frac{1}{n}\sum_{i=1}^{n} y_i$; y_i – виміряне значення;

$\hat{y}_i$ – оцінка виміряного значення [13].

На стаціонарність часовий ряд перевіряється завдяки знаходження статистичних характеристик: математичне сподівання (середнє) $m\{y_t\} = a = const$, дисперсія (середнє квадратичне відхилення) $D\{y_t\} = \sigma^2 = const$. Коли дані характеристики не залежать від моменту часу то це доказує стаціонарність процесу.

Знаходження закону розподілу випадкової складової реалізується за допомогою графічного відображення часового ряду у формі гістограми.

Адекватність роботи алгоритму досліджувалась при наявності у вимірах стаціонарного процесу випадкової складової з відомими характеристиками. За тестовими даними на вхід розробленого алгоритму подавалася модель з відомими параметрами:

$$y(t) = 815 - 86t + 4{,}4t^2 - 0{,}08t^3 + \\ + 7\times10^{-4}t^4 - 3\times10^{-6}t^5 + 5\times10^{-9}t^6.$$

Потім проводилось зашумлення ξ з характеристиками $m_y \cong 0$, $\sigma_y = 3$, що є контрольованими параметрами. Після накладання випадкової складової на модель ми отримали нову вибірку вимірів з наступними характеристиками $m_y \cong 0$, $\sigma_y = 76$, рис. 4а. Працездатність алгоритму розрахунків з використанням МНК підтвердилась на практичних розрахунках та побудові гістограм, де $m_y \cong 0$, $\sigma_y = 2{,}8$, рис. 4б. Дані розрахунки свідчать про те, що у статистичних даних частоти поя-

ви тематичного контенту в мережі Інтернет присутня випадкова складова, що обумовлено похибками вимірювання і виявляється після виділення тренду за допомогою розробленого алгоритму. Таким чином розроблений алгоритм можливо використати для вирішення поставлених завдань та провести статистичний аналіз активності тематичного контенту в мережі Інтернет.

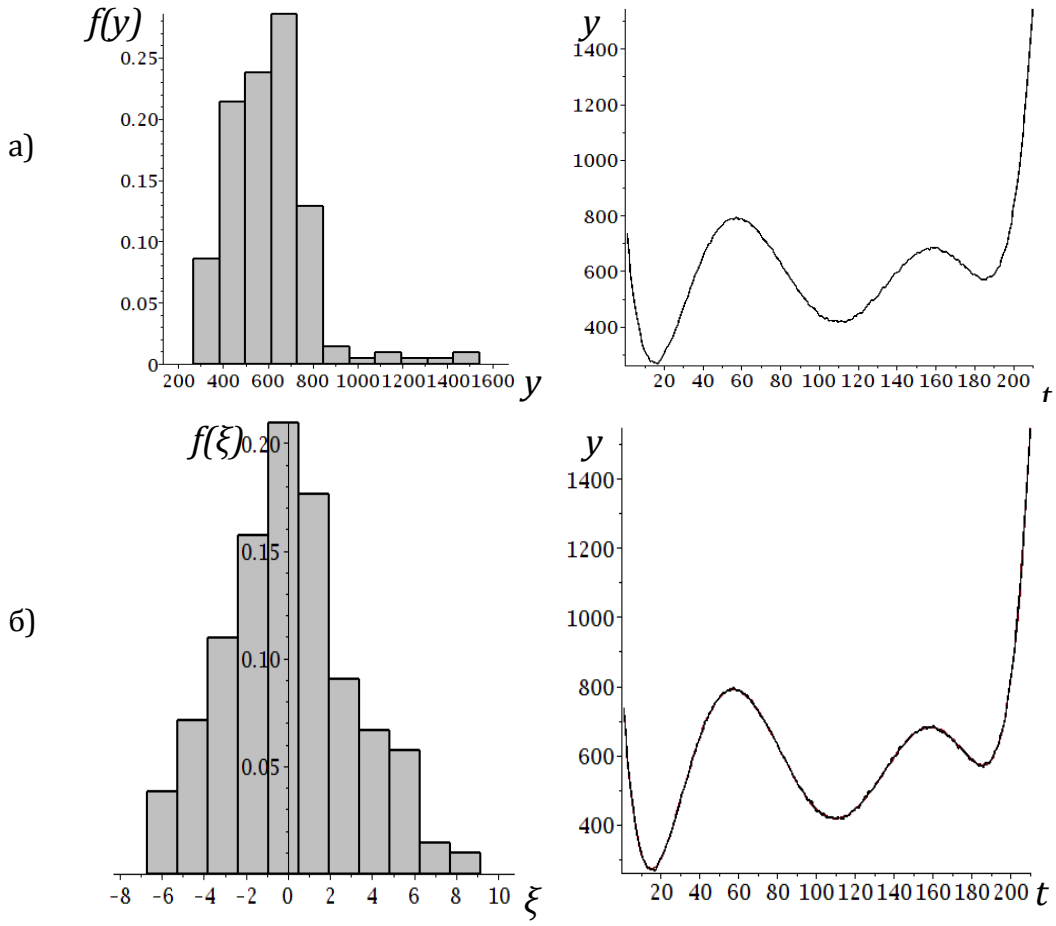

Рисунок 4 – Гістограма щільності розподілу часового ряду та розподілу випадкової складової: а) – виміряні дані до обробки; б) – випадкова складова у часовому ряді після обробки

Практичний приклад застосування

Нехай під час моніторингу мережі Інтернет та виявлення ІЗ отримано вибірку вимірів за пошуковою фразою – «Економічне блокування території Криму» за контентом К1 в тематиці «Політичні новини». Обсяг вибірки для контенту складає 210 значень за період з 14.09.2015 р. по 15.10.2015 р. (тобто 30 діб (7 вимірів на добу)) у дискретні проміжки часу з інтервалом 2 год. $t_1 = 8:00 \ldots t_7 = 20:00$.

Розрахунок характеристик закону розподілу випадкової складової проводився для знаходження параметрів часового ряду до і після обробки даних розробленим алгоритмом. Характеристики закону розподілу часового ряду на вході алгоритму мають наступні значення $m_y \cong 600{,}43$, $\sigma_y = 371{,}51$. Після проведення розрахунків за розробленим алгоритмом отримано результати закону розподілу випадкової складової, які наведені в табл. 1, де ρ – степінь полінома. З отриманих результатів табл. 1 видно, що чим більше степінь апроксимуючого полінома, тим кращі контрольовані параметри.

Виділення систематичної складової проводилося за допомогою згладжуванням часового ряду за МНК поліномами до шостого порядку включно, рис. 5. Наведені графіки дають можливість узагальнити результати розрахунків та наочно показують, що в часовому ряді присутня систематична складова (тренд) і із збільшенням порядку апроксимуючого полінома збільшується адекватність кривої, яка описує досліджуваний процес.

Таблиця 1 – Статистичні характеристики закону розподілу випадкової складової часового ряду «Економічне блокування території Криму»

Характеристики	Поліном					
	$\rho=1$	$\rho=2$	$\rho=3$	$\rho=4$	$\rho=5$	$\rho=6$
m_y	274,20	272,60	260,31	259,48	259,47	240,92
D_y	55912,16	55304,83	51150,82	51462,73	51464,63	43908,88
σ_y	236,45	235,16	226,16	226,85	226,85	209,54
R_y^2	0,05	0,06	0,13	0,13	0,13	0,26

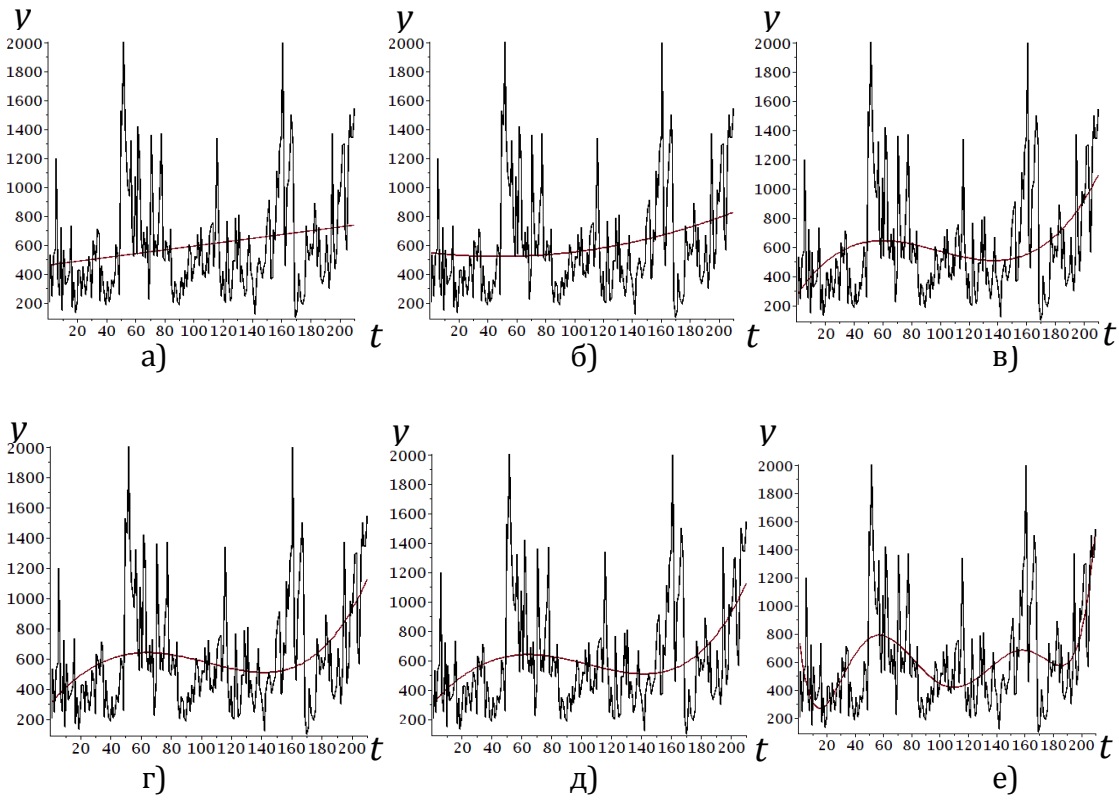

Рисунок 5 – Згладжування часового ряду поліномами:
а – лінійний; б – квадратичний; в – кубічний; г – 4-го порядку; д – 5-го порядку; е – 6-го порядку

Виявлення закону розподілу випадкової складової є наступним кроком статистичної обробки даних. Від того, якому закону розподілу підпорядкований часовий ряд залежить тактика подальшого аналізу. Якщо гістограма має єдиний чітко виражений максимум і є приблизно симетричною, то припускають, що випадкова величина розподілена за нормальним законом. Також при висуненні гіпотези про закон розподілу випадкової величини враховуються апріорні дані про закони розподілу, що притаманні обраній області дослідження.

Після згладжування часового ряду за розробленим алгоритмом отримані наступні гістограми щільності розподілу випадкової складової у статистичних даних, рис. 6. Після проведення згладжування статистичних даних за допомогою МНК закон розподілу випадкової складової є логарифмічно-нормальний, а зі збільшенням порядку полінома вигляд гістограми має виражену форму та наближається до нормального розподілу.

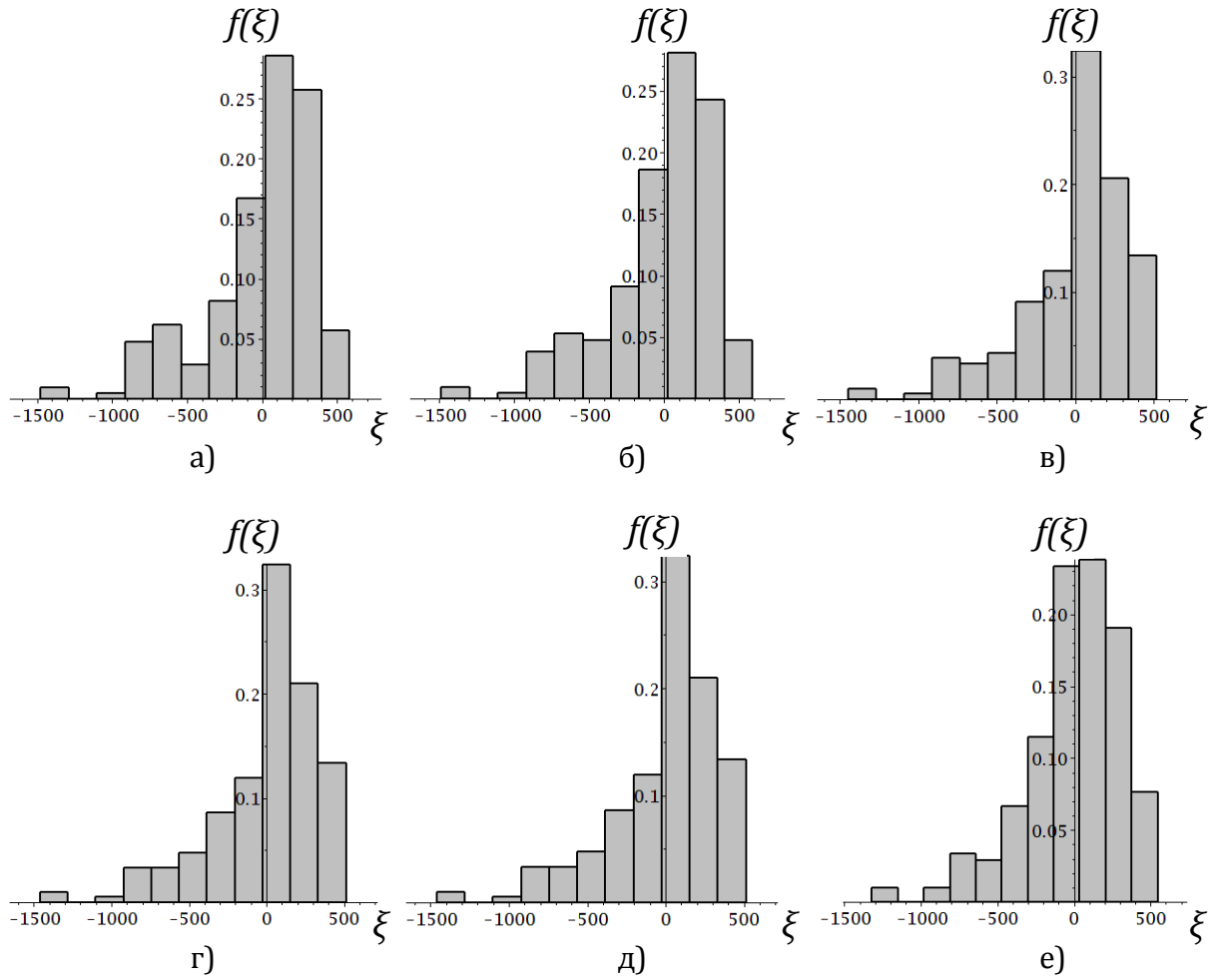

Рисунок 6 – Гістограми щільності розподілу випадкової складової після згладжування поліномами: а – лінійний; б – квадратичний; в – кубічний; г – 4-го порядку; д – 5-го порядку; е – 6-го порядку

ВИСНОВКИ

1. Залежність частоти появи тематичного контенту в мережі Інтернет від часу має нелінійний і складний характер, що не дає можливості точно знайти модель процесу при відсутності відповідного алгоритму розрахунків. Динаміку тематичного контенту в мережі Інтернет під час проведення противником інформаційної війни можливо відслідковувати за частотою його появи у ВДІ і вести розрахунки, основані на математичній статистиці.

2. Випадкова складова є обов'язковою компонентою часового ряду, яка визначає стохастичний характер його елементів y_i і розподілена за логарифмічно-нормальним або нормальним законом. Вид закону розподілу випадкової складової змінюється в залежності від виду апроксимуючої функції і зі збільшенням її кривизни наближається до нормального закону розподілу. Після проведення розрахунків, виділення тренду і виявлення закон розподілу випадкової складової можна використовувати отримані дані для прогнозування.

3. Достовірність апроксимації часового ряду частоти появи тематичного контенту в мережі Інтернет збільшується зі збільшенням порядку полінома.

4. Проведення статистичного аналізу дозволяє зменшити вплив випадкової складової і наблизити часовий ряд до систематичної складової.

5. Часовий ряд є стаціонарним, оскільки має систематичну складову та не змінюються статистичні характеристики з часом.

Перспективою подальших досліджень є використання міандрових та біфуркаційних моделей з перенесенням на них знайдених параметрів поліноміальних моделей за допомогою диференціальних перетворень та методу балансів диференціальних спектрів. Даний підхід є перспективою для пошуку адекватних моделей опису активності тематичного контенту в мережі Інтернет з подальшим його прогнозуванням.

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Фізичні властивості овочів як основа прийняття рішення щодо їхньої технологічної переробки (на прикладі кабачків)

Physical Properties of Vegetables as a Basis for Making Decisions on Their Technological Processing (on the Example of Zucchinis)

Тетяна Непочатих
Tetyana Nepochatykh

[1] *Kharkiv Institute of Trade and Economics of Kyiv National University of Trade and Economics*
8 Otakara Yarosha street, Kharkiv, 61103, Ukraine

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Corresponding Author:
alisova2608@gmail.com

Анотація. Стаття присвячена вивченню фізичних властивостей (пористості, фізичної та істинної густини) кабачків різних сортів. Теоретично та практично перевірено тісний зв'язок між цими показниками. Рекомендовано, розглядаючи залежність істинної густини овочів від вологовмісту, враховувати співвідношення зв'язаної та вільної вологи в них, тому що їх густина за величиною відрізняється. Що особливо важливо для швидкості протікання процесу дифузії цукрового сиропу в сировину під час виробництва цукатів.

Ключові слова: кабачок; сорт; волога зв'язана та вільна; густина істинна та фізична; пористість.

Abstract. The article is devoted to the study of physical properties (porosity, physical and true density) of zucchinis of different kinds. Close relationship between these indicators were proven theoretically and practically. It is recommended, considering the dependence of the true density of vegetables on the moisture content, take into account the ratio of bound and free moisture in them, because their density is different in size. This is especially important for the rate of process of diffusion of sugar syrup into raw material during the production of candied fruits.

Keywords: zucchini; varietal; bound and free moisture; true and physical density; porosity.

ВСТУП

Аналіз літератури показав, що фізичні властивості овочів на цей час вивчені недосить повно. Але вони є визначальними для формування якості рослинної сировини та консервів з неї [1, 2, 3, 4, 5]. Рослинна сировина, що використовується для виробництва, наприклад, цукатів, становить собою капілярно-пористе тіло з різними формами зв'язку вологи, що накладає відповідний відбиток на строк їх приготування. Причиною цього є різні форми дифузії цукрового сиропу в рослинні тканини: молекулярна дифузія, що супроводжується об'ємним (молярним) переміщенням цукрового сиропу і вибіркова дифузія, що викликана осмотичними явищами. При цьому загальне переміщення цукрового сиропу лімітується швидкістю його дифузійного перенесення, який значно менше швидкості молекулярного руху сиропу під дією капілярних сил.

У зв'язку з цим постає завдання дослідження фізичних властивостей рослинної сировини з метою виявлення найбільш придатної для виробництва цукатів, тобто сировини, яка б мала максимальне значення коефіцієнта мо-

лекулярної дифузії й мінімальне вибіркової. Для цього не обов'язково вимірювати швидкість дифузії різних видів сировини, а достатньо визначити їхні фізико-механічні характеристики. З цією метою необхідно визначити фізичні характеристики різних сортів рослинної сировини: пористість, густину, клітинну проникність, структурно-механічні властивості та ін.

Овочі являють собою складні гетерогенні біологічні системи, фізичні та структурно-механічні властивості яких визначаються хімічним складом, видовими особливостями структури, а також такими фізичними параметрами як густина (фізична та істинна), твердість, пористість. З іншого боку овочі є капілярно-пористими за структурою і колоїдними за природою. Тому їм притаманна наявність міцел порівнянних з мікрокапілярами, у яких волога зв'язана адсорбційними й осмотичними силами, тобто волога, що знаходиться усередині плодів і овочів, має різну енергію зв'язку зі скелетом. Найпростішою фізичною моделлю овочів може служити гетерогенна система, що складається з трьох фазових складових: твердого скелету, рідини (соку), що заповнює порожнечі (міжклітинники), скелету і пароповітряної суміші, що заповнює вільний від вологи об'єм мікрокапілярів. Кожна з фракцій відрізняється індивідуальними фізико-хімічними й структурно-механічними властивостями, що залежать від природи речовини, температури і вмісту вологи. Тверда фаза чи скелет структури рослинної тканини складається з клітковини, вуглеводів, крохмалю, білків. Причому концентрація компонентів коливається в різних частинах овочів (корова і центральна паренхими).

Густина овочів залежить від їх хімічного складу, пористої структури і вологості. З літератури відомо, що чим більше газів міститься в продукті, тим менше його фізична густина. Виміру густини овочів дотепер приділялося мало уваги, у той же час ця властивість є істотно важливим елементом для оцінки їхньої якості. Це важливо для овочів, що направляються на технічну переробку. Тому що, чим вище густина, тим вище вихід крохмалю з картоплі, пюре з томатів, тим краще вони зберігаються, чим менше в них повітря, тим надійніше вони поводяться, як консервовані продукти, і нарешті, чим менше густина овочів, тим більше швидкість дифузії цукрового сиропу і менший час варіння цукатів.

Також звісно, що під час зберігання овочі в'януть, унаслідок чого зростає пористість і зменшується густина. Тому густина змінюється не лише від виду овочу, але й у межах різних сортів одного овочу. В літературі показано, що фізична густина різних овочів за однієї й тієї ж масової частки сухих речовин може розрізнятися, а за різної її частки може бути однаковою, і пов'язано це з неоднаковою кількістю внутрішньоклітинних газів (пористістю) [1, 5, 6].

Істинна густина (густина моноліту) – це густина продукту, у якому відсутні газові включення і вільна волога (пористість дорівнює нулю). Істинна густина визначається як відношення маси продукту до його об'єму (за винятком об'єму пор) при температурі Т. Істинна густина овочів залежить від густини компонентів хімічного складу, який, у свою чергу, залежить також від умов вирощування [4, 7]. Масова частка жирів у продуктах невелика [8], тому їхня густина практично не впливає на густину моноліту. Густина білків і особливо вуглеводів (їхня частка в овочах найбільша), навпаки, істотно впливає на істинну густину.

Вважається, що істинна густина підкоряється закону адитивності, тобто що волога і суха речовина в плодах і овочах – нейтральні продукти, хоча, суворо кажучи, це не зовсім так; при утворенні деяких форм зв'язку вологи існує контракція системи (об'єм змінюється) [9].

Деякі результати вказують на те, що істинна густина залежить від вологи, що впроваджується в моноліт, тобто в рослинну тканину овочів. Так, істинна густина сухої речовини моркви дорівнює 1610 кг/м^3 [10], 1534 кг/м^3 [1] чи 1530 кг/м^3 [2]. Істинна густина сухої речовини буряка за Т=288… 298 К дорівнює 1600 кг/м^3 [3], бурячних вичавків, залежно від вологості (від 0 до 0,833) має такі значення 1350…1040 кг/м^3 [10].

У той же час до залежності істинної густини від вологості овочів і плодів, необхідно підходити обережно. Справа в тому, що тут спостерігається деяке протиріччя; з одного боку істинна густина – це густина моноліту, тобто це густина кістяка продукту без обліку його капілярно-пористої структури, а з іншого ця

густина, якимось чином, залежить від вологи, що знаходиться в мікрокапілярах. У скелеті продукту волога може бути присутня лише у вигляді вологи гідратації, що не видаляється механічним шляхом чи сушінням у тепловій шафі, тому що входить у структуру молекул кристалогідратів. Тому не можна розглядати істинну густину залежно від тієї ж вологи, що знаходиться в мікрокапілярах – осмотичної, адсорбційної чи об'ємної.

Структура плодів і овочів у цілому така, що тверда маса пронизана системою мікропор (міжклітинників) заповнених повітрям, їхні розміри коливаються від декількох ангстрем до тисяч (1А=10^{-10} м). Об'єм порожнеч (кількість повітря) у плодах і овочах неоднаковий, але коливається в невеликих інтервалах і залежить від кількості вологи в них. Так пористість моркви коливається від 2 до 10 %. Тому при однаковому вмісті масової частки вологи (наприклад, 0,885) фізична густина моркви сортів Консервна і Шантенє різна. Вона відповідно складає 1032 кг/м^3 і 1026 кг/м^3 [10, 11]. Цікавими в цьому плані є результати про вплив температури на пористість. У процесі обжарки температурне поле коренеплодів регулюється, а істинна густина сухої речовини складає 1450… 1570 кг/м^3, фізична густина – 350… 560 кг/м^3, а пористість досягає значень 69… 76 % [5], тобто різко зростає (приблизно в 6 чи 7 разів). З цим ефектом необхідно рахуватися, наприклад, під час виробництва цукатів, де цей ефект зростання пористості за підвищення температури овочів є позитивним, і сприяє більш швидкому їхньому приготуванню, тому що коефіцієнт молярної дифузії набагато більше виборчої, що виникає за рахунок осмосу.

У процесі зберігання овочів вільні пори в результаті сорбції можуть частково заповнюватися вологою і пористість їх зменшується. І, навпаки, під час зберігання в приміщенні, де відносна вологість повітря невелика, можливі процеси десорбції, після чого пористість плодів і овочів буде зростати. Це вказує на те, що пористість не є постійним параметром овочів чи плодів, а залежить від передісторії зразка (умов у яких він до цього знаходився). Крім того, експериментально встановлено, що в процесі сорбції об'єм мікропор росте за рахунок розсунення існуючих і утворення нових мікропор під впливом розклинюючого тиску сорбата. При цьому виникає ефект набрякання зразка, що супроводжується збільшенням його об'єму.

Таким чином, літературні дані свідчать про те, що фізична густина овочів менше густини скелету, унаслідок наявності в них порожнеч (міжклітинників), заповнених сорбованою вологою і вологим повітрям. Тому густина залежить від видових особливостей овочів (наявності мікрокапілярів) і їхнього вологовмісту (наявності вологи в мікрокапілярах). Пористість залежить від роду овочів, їхніх видових відмінностей, сортових особливостей, району вирощування і визначається в кожному конкретному випадку експериментально.

Якщо прийняти нашу концепцію, що істинна густина не залежить від вологості овочів і плодів, то при збільшенні вологості фізична густина зростає; заміна повітря в порах водою веде до збільшення густини овочів. Тому в цьому випадку пористість буде зменшуватися, тобто при сорбції вологи пористість зменшується під час зберігання овочів, а при десорбції, навпаки, зростає.

Далі вирішено перевірити вище сказане на прикладі досліджень фізичних властивостей (фізичної, істинної густини та пористості) кабачків різних сортів. Кабачок, як об'єкт дослідження, обрано з позиції дешевої тобто місцевої сировини.

РЕЗУЛЬТАТИ ДОСЛІДЖЕННЯ

При плануванні експериментів зроблено уточнення поняття істинної густини овочів. Запропоновано відрізняти істинну густину без вологи і ефективну густину $\rho_{еф}$, коли волога присутня в кабачках у тій чи іншій формі. Вологу, яка завжди присутня в сировині, тем більш, як у нашому випадку понад 85... 90 %, можна визначити як хімічну складову. Тому в поняття істинної густини входять не лише речовини, що утворюють сухий скелет овочу, але і воду в тій чи іншій формі.

Таку густину назвемо ефективною. Наведена нижче формула (1) для $\rho_{еф}$ отримана нами з формули перемішування з урахуванням різних форм зв'язку вологи в рослинній сировині:

$$\rho_{еф} = \frac{1}{\frac{(1-W)}{\rho_c} + \frac{W_з}{\rho_з} + \frac{W_в}{\rho_в}} = \\ = \frac{\rho_c \times \rho_з \times \rho_в}{\rho_в \times \rho_з(1-W) + \rho_c \times \rho_в \times W_з + \rho_c \times \rho_з \times W_в}, \quad (1)$$

де ρ_c – густина сухої сировини (істинна густина ρі без вологи і пустощів), кг/м^3;

$\rho_з$ – густина зв'язаної вологи, кг/м^3;

$\rho_в$ – густина вільної вологи, 1000 кг/м^3 ;

W – вміст загальної вологи;

$W_з$ – вміст зв'язаної вологи;

$W_в$ – вміст вільної вологи.

Експериментально істинну густину сухої речовини (ρ_i) кабачків визначали пікнометричним методом, побудованим на заповненні мікрокапілярів зразка індиферентною рідиною (гасом), але вдосконаленим нами для даного випадку [1, 2]. Для визначення ρі зразки висушували до сталої маси за температури 100 °С, роздрібнювали і вміщали в пікнометричну колбу до позначки. Потім колбу заповнювали індиферентною рідиною таким чином, щоб вона заповнювала всі пустоти між частинами сировини. Спочатку зважували зразок на аналітичних терезах в повітрі, потім пікнометр, заповнений зразком і гасом, рівень якого в пікнометрі в обох випадках має бути однаковим. Величину ρ_c визначали за (2):

$$\rho_i = \frac{m_0 \rho_г}{m_1 + m_0 - m_2}, \quad (2)$$

де m_0 – маса зразка в повітрі, кг;

m_1 – маса пікнометра з гасом, кг;

m_2 – маса пікнометра з гасом та зразком, кг;

$\rho_г$ – густина гасу, кг/м^3 (0,8111).

Фізичну густину ($\rho_{еф}$) кабачків визначали шляхом гідростатичного зважування в гасі (у воді кабачок плаває), методом витискання, а також використовували розчини солі з відомим вмістом густини, рицинову олію, машинну олію тощо. Методику визначення фізичної густини гідростатичним зважуванням наведено в праці [1], яка за низкою показників не зовсім підходить до нашого випадку. Тому виведення формули гідростатичного зважування для визначення фізичної густини гідростатичним зважуванням нижче наведено повністю.

Пристрій для гідростатичного зважування – це аналітичні терези АДВ-2М (границя зважування – до 200 г, точність – 0,001 г). На лівій чашці терезів влаштований гачок, на якому закріплено сітчастий циліндр на металевому дроті, циліндр занурюють в посудину з гасом, який обрано як індиферентну рідину, оскільки його густина менше густини кабачка.

Для визначення ρф методом гідростатичного зважування за допомогою шаблону з середини кабачка вирізали зразки в формі кубиків з ребром 15 мм. Після зважування в повітрі на аналітичних терезах (маса m_0) зразки покривали непроникною для гасу плівкою парафіну, це здійснювали зануренням зразка в розплавлений при температурі 80±5 °С парафін. Плівка парафіну на зразках мала товщину 1 мм. Парафіновані зразки зважували на аналітичних терезах у повітрі (m_n), а потім на гідростатичних терезах ($m_г$).

Формулу для розрахунку фізичної густини при гідростатичному зважуванні з використанням парафінування отримали наступним способом. На зразок сировини в рідині діє сила $m_г g$ рівна вазі зразка в повітрі – $m_з g$, вазі парафіну в повітрі – $m_n g$ і відштовхувальній силі Архімеда – $m_p g$. Остання спрямована у протилежний бік по відношенню до попередніх двох (3):

$$m_г g = m_з g + m_n g - m_p g = \\ = \rho_ф V_з g - \rho_n V_з g - \rho_p (V_з + V_n) g, \quad (3)$$

де $V_з$ – об'єм зразка;

V_n – об'єм парафіну, густина парафіну (0,93 г/см^3);

$\rho_р$ – густина рідини (гасу), (0,811 г/см³);

g – прискорення вільного падіння;

$\rho_ф$ – фізична густина зразка.

З формули (3) маємо формулу розрахунку об'єму зразка (4):

$$V_з = \frac{m_г - V_п(\rho_п - \rho_р)}{\rho_ф - \rho_р}. \quad (4)$$

Фізична густина дорівнює $\rho_{еф} = \frac{m_з}{V_з}$, тоді, підставляючи сюди $V_з$ з (3), отримуємо (5):

$$\rho_ф = \frac{m_з \rho_р}{m_з m_г + V_п(\rho_п - \rho_р)}. \quad (5)$$

Ще фізичну густину визначали за давно відомою методикою за витисканням [12], як відношення маси продукту до його дійсного (фізичного) об'єму за температури T (6):

$$\rho_ф = \frac{m}{V_{с.р.} + V_в + V_г} = \frac{m}{V_о}, \quad (6)$$

де m – маса продукту;

$V_{с.р.}$ – об'єм моноліту сухої речовини;

$V_г$ – об'єм газів;

$V_в$ – об'єм вологи;

$V_о$ – загальний об'єм продукту.

Вимірювання $\rho_і$ та $\rho_ф$ дає змогу розрахувати пористість сировини (7):

$$П = 1 - \frac{\rho_ф}{\rho_і}. \quad (7)$$

Для співвідношення отриманих значень за пористістю в кабачках кількість повітря визначали методом зворотного холодильника [7], який засновано на вимірі об'єму цілого зразка ($V_ц$) і подрібненого зразка ($V_{др}$). Видалення газів з овочів ведеться шляхом відгонки за допомогою зворотного холодильника. Розрахунок ведеться за (8):

$$V = V_ц - V_{др}. \quad (8)$$

Вміст загальної, вільної та зв'язаної вологи плодів і овочів визначали за відомими методиками [13, 14, 15].

Дані за вмістом загальної, вільної та зв'язаної вологи кабачка різних сортів наведено на рисунку.

З даних рисунку видно, що серед обраних сортів кабачка найбільшими значеннями вмісту вільної вологи характеризується Гайдамака, далі йдуть сорти Акробат, Престиж та Аспірант. Сприятливим для виробництва цукатів слід вважати сорт кабачка Чаклун, тому що він має значну кількість зв'язаної вологи, тому просочування цукровим сиропом буде відбуватися повільним процесом вибіркової дифузії [16].

Ці значення також використовували при розрахунках $\rho_{еф}$ за (1). При цих розрахунках також було використано значення $\rho_з = 1400$ кг/м³, яке отримано з літературних даних [17, 18].

Фізичну густину сировини визначали описаним вище методом. Пористість сировини визначали за уточненою формулою замість формули (7).

Значення $\rho_{еф}$ розраховували за (1). Відзначимо, що пористість є непрямим показником присутності повітря в овочах. Тому було порівняно результати розрахунків величини $П$ з прямими вимірюваннями кількості повітря методом зворотного холодильника, описаним у праці [7].

Результати вимірювань і розрахунків наведено в таблиці.

З даних таблиці видно, що істинна густина кабачків даних зразків лежить у межах 1180... 1550 кг/м³, фізична – 930... 1010 кг/м³, пористість – 9,73... 13,15 %. Істинна густина обраних кабачків з вологою лежить у межах 1050... 1140 кг/м³ .

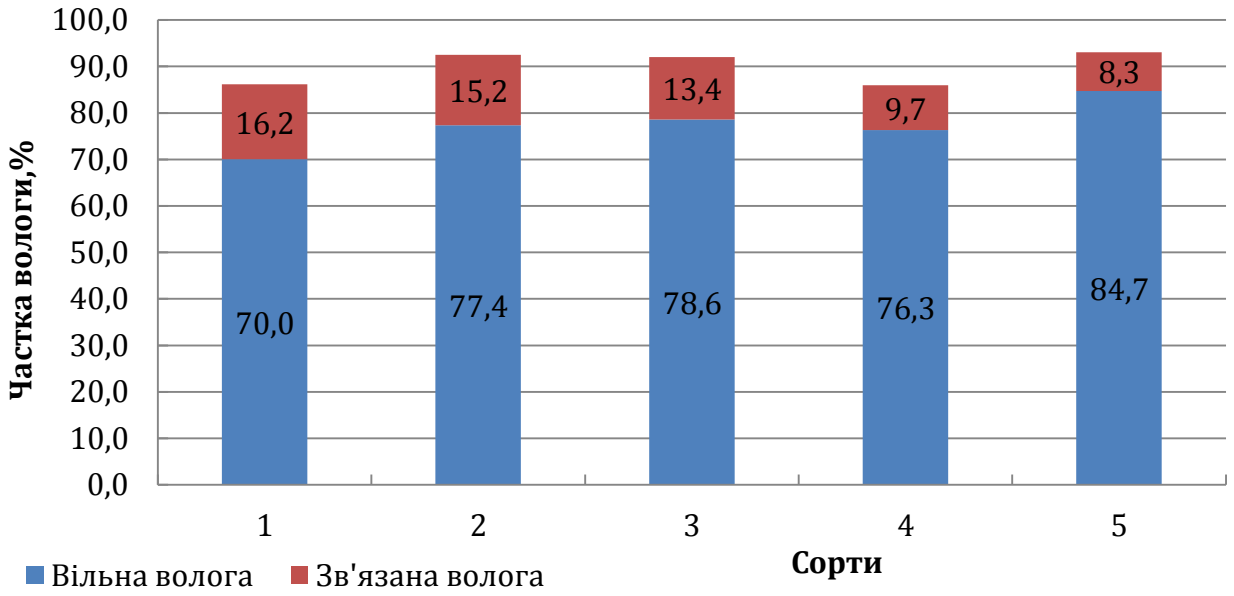

Рисунок - Вологовміст кабачків різних сортів
(1 – Чаклун, 2 – Аспірант; 3 - Престиж, 4 – Акробат, 5 – Гайдамака).

Таблиця – Густина та пористість кабачків різних сортів

Сорт кабачків	Істинна густина сухої речовини (порошку), кг/м^3·10^{-3}	Фізична густина, кг/м3·10^{-3}	Істинна густина з вологою, кг/м^3·10^{-3}	Пористість (методом зворотного холодильнику), %	Пористість (розраховано за (7)), %
Чаклун	1,35±0,15	1,01±0,12	1,14±0,13	9,73±0,20	7,25±0,10
Аспірант	1,18±0,14	0,96±0,10	1,06±0,12	11,03±0,25	9,30±0,11
Престиж	1,35±0,15	0,95±0,10	1,06±0,12	12,45±0,325	10,80±0,12
Акробат	1,47±0,16	0,96±0,11	1,08±0,11	12,11±0,30	10,95±0,12
Гайдамака	1,55±0,16	0,93±0,10	1,05±0,12	13,15±0,35	11,50±0,13

ВИСНОВКИ

Підводячи підсумок аналізу досліджень фізичних властивостей кабачків різних сортів необхідно відзначити, що пористість, фізична та істинна густина тісно пов’язані між собою. Рекомендовано, розглядаючи залежність істинної густини овочів від вологовмісту, враховувати співвідношення зв’язаної та вільної вологи в них, тому що густина вільної і зв'язаної вологи за величиною відрізняються. Що дуже важливо для швидкості протікання процесу дифузії цукрового сиропу в сировину під час виробництва цукатів.

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Розробка інформаційного забезпечення автоматизованої системи моніторингу стану промислової безпеки газотранспортної системи

Development of Information Support of the Automated System for Monitoring the State of the Gas Transportation System's Industrial Safety

Руслан Скриньковський [1], **Соломія Леськів** [1], **Володимир Юзевич** [2]
Ruslan Skrynkovskyy, Solomiya Leskiv, Volodymyr Yuzevych

[1] *Lviv University of Business and Law*
99 Kulparkivska Street, Lviv, 79021, Ukraine

[2] *Karpenko Physico-Mechanical Institute of the NAS of Ukraine*
5 Naukova Street, Lviv, 79601, Ukraine

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Corresponding Author:

Ruslan Skrynkovskyy
uan_lviv@ukr.net

Анотація. Метою статті є розробка інформаційного забезпечення автоматизованої системи моніторингу стану промислової безпеки газотранспортної системи у рамках системи управління безпекою праці, яка дасть можливість своєчасно і об'єктивно виявляти несприятливі аварійні ризики (небезпечні події) та вжити необхідні конкретні заходи щодо їхнього усунення і безпечно експлуатувати газотранспортну систему. Доведено, що в основі інформаційного забезпечення автоматизованої системи моніторингу стану промислової безпеки газотранспортної системи лежить методика, яка включає такі основні процедури, як: ідентифікування небезпек; якісне та кількісне оцінювання аварійних ризиків; встановлення недопустимих (неприйнятних) ризиків та внесення їх до інформаційної бази (реєстру) недопустимих ризиків об'єктів газотранспортної системи; комплексне оцінювання та паспортизацію стану промислової безпеки об'єктів газотранспортної системи; визначення дієвих конкретних (ефективних, результативних) заходів управління ризиками. Перспективою подальших досліджень у даному напрямі є розроблення та впровадження автоматизованої системи моніторингу стану промислової безпеки на об'єктах газотранспортної системи на основі результатів дослідження (поданого інформаційного забезпечення).

Ключові слова: газотранспортна система; промислова безпека; аварійні ризики; моніторинг; автоматизована система; інформаційне забезпечення.

Abstract. The purpose of the article is to developing the information security of the automated system for monitoring the state of industrial safety of the gas transportation system within the framework of the safety management system, which will enable timely and objective detection of adverse accident hazards (hazardous events) and taking the necessary specific measures to eliminate them and operate the gas transport system safely. It is proved that the basis of the information provision of the automated system for monitoring the state of the industrial safety of the gas transmission system is a methodology that includes the following basic procedures: identifying hazards; qualitative and quantitative assessment of emergencies; establishing of unacceptable (unallowable) risks and their introduction to the information base (register) of unacceptable risks of objects of the gas transportation system; comprehensive assessment and certification of the state of industrial safety of objects of the gas transportation system; identification of effective, productive (efficient) risk management measures. The prospect of further research in this area is the development and implementation of an automated system for monitoring the state of industrial safety of the objects of the gas transmission system based on the results of the research (of the submitted information provision).

Keywords: gas transportation system; industrial safety; emergency risks; monitoring; automated system; information provision.

ВСТУП

Вигідне геополітичне та економіко-географічне положення України на основних шляхах транзиту природного газу від газовидобувних регіонів Росії і/або Центральної Азії до країн Європейського Союзу і Молдови, техніко-економічні переваги розвитку наявної діючої газотранспортної системи, порівняно з обхідними проектами Росії (газопроводи «Турецький потік», «Північний потік-1» і «Північний потік-2»), дають Україні можливість [1, 2, 3]:

1) відігравати ключову роль у міжнародній системі транспортування газу на основі забезпечення надійного транзиту природного газу, оскільки всі газопроводи України проходять по суші, що сприяє оперативному доступу технологічних служб до будь-якої частини газотранспортної системи для виконання аварійних робіт з гарантування безпеки чи спеціалізованим службам з ліквідації аварій (небезпечних подій) та їх наслідків на об'єктах газотранспортної системи;

2) сприяти прискоренню її інтеграції в європейський та світовий економічний простір на основі міжнародного економічного та політичного співробітництва;

3) здійснювати суттєвий вплив на конкуренцію за ресурси на зовнішніх енергетичних ринках тощо.

Варто зауважити, ПАТ «Укртрансгаз» постійно і системно працює над оновленням газотранспортної інфраструктури, зокрема протягом 2014-2017 рр. у 11 разів збільшив фінансування на будівництво і реконструкцію, модернізацію та технічну підтримку об'єктів газотранспортної системи України [4]. Водночас газотранспортна система України (рис. 1) характеризується [1, 5, 6]:

1) високим рівнем моральної та фізичної зношеності технологічного обладнання та устаткування;

2) низькою ефективністю роботи (низький коефіцієнт корисної дії) газоперекачувальних агрегатів компресорних станцій, що зумовлює досить значні виробничо-технологічні витрати газу для потреб його транспортування тощо.

Рисунок 1 – Газотранспортна система України здатна забезпечити транспортування газу до західного кордону України в діапазоні коливання до 250 млн. куб. м на добу [2]

Ефективне управління промисловою безпекою на об'єктах газотранспортної системи в системі «інформація – ресурс – час – можливості (загрози)» неможливе без здійснення постійного (ефективного, результативного) моніторингу її стану [7, 8].

Аналіз останніх досліджень і публікацій свідчить про те, що вагомий науково-практичний

внесок у вирішення окремих проблемних питань (аспектів) у сфері промислової безпеки на об'єктах газотранспортної системи зробили такі науковці, як Ю. М. Герасименко [7], Л. Т. Гораль [10], С. В. Дунас [9], Л. О. Митько [11], Л. В. Юзевич [12] та ін.

Разом з тим з'ясовано, що ключові прикладні аспекти у рамках системи управління промисловою безпекою на об'єктах газотранспортної системи регулюються вимогами законодавчих, нормативно-правових актів та нормативних документів, чинних в межах ПАТ «Укртрансгаз» [13], зокрема Постановою Національної комісії, що здійснює державне регулювання у сферах енергетики та комунальних послуг «Про затвердження кодексу газотранспортної системи» від 30.09.2015 р. № 2493 [14], Наказом Міністерства енергетики та вугільної промисловості України «Про затвердження Правил безпеки систем газопостачання» від 15.05.2015 № 285 [15], Наказом Міністерства енергетики та вугільної промисловості України «Про затвердження Порядку технічного огляду, обстеження, оцінки та паспортизації технічного стану, здійснення запобіжних заходів для безаварійного експлуатування систем газопостачання» від 24.10.2011 № 640 [16].

Водночас, як свідчать результати аналізу літературних джерел та практичних матеріалів за проблемою, існує об'єктивна необхідність дослідження, актуальність та практична значущість таких питань, як розроблення та впровадження автоматизованої системи моніторингу стану промислової безпеки на об'єктах газотранспортної системи на основі інформаційного забезпечення (підтримки).

Тому *метою статті* є розробка інформаційного забезпечення автоматизованої системи моніторингу стану промислової безпеки газотранспортної системи у рамках системи управління безпекою праці, яка дасть можливість своєчасно і об'єктивно виявляти несприятливі аварійні ризики (небезпечні події) та вжити необхідні конкретні заходи щодо їхнього усунення і безпечно експлуатувати газотранспортну систему.

РЕЗУЛЬТАТИ ДОСЛІДЖЕННЯ

З огляду на це, рухаючись у напрямі сформульованої мети, необхідно зазначити, що під промисловою безпекою слід розуміти безпеку від нещасних випадків, аварій (небезпечних подій) та їх наслідків на відповідних виробничих об'єктах, що забезпечується системою правових, соціально-економічних, інформаційних та організаційно-технічних заходів [17].

Поряд з тим, С. Дунас [9] акцентує увагу на тому, що сьогодні газотранспортна система України перебуває на стадії вичерпання граничного (допустимого) терміну експлуатації. Така ситуація потребує проведення комплексної діагностики технічного стану та певного (визначеного) переліку організаційно-технічних заходів з гарантування безпеки, зокрема комплексної модернізації газонасосних станцій із заміною агрегатів. Тут варто також відмітити, що важливим для гарантування безпеки працюючих є моніторинг, контроль (попередній, поточний, завершальний) та інформаційна підтримка системи управління промисловою безпекою газотранспортної системи з метою забезпечення її відповідності і сертифікації згідно з вимогами OHSAS 18001 тощо [8, 18, 19, 20]. Нехтування нормами безпеки при використанні газу може призвести до певної трагедії, внаслідок якої можуть постраждати не лише працюючі в газовій сфері, а й споживачі блакитного палива (підприємства, населення) [9].

Крім цього, визначальними цілями реконструкції української газотранспортної системи повинні бути орієнтовані на [10]:

1) забезпечення перспективних потоків;

2) формування ефективної системи транспортування газу (в тому числі енергозбереження);

3) забезпечення високого рівня надійності транспортування газу;

4) гарантування екологічної і технічної безпеки транспортування газу.

З урахуванням цього, результати аналізу наукової праці академіка Української нафтогазової академії Ю. М. Герасименка [7] дають можливість стверджувати, що методика моніторингу стану промислової безпеки газотранспортної системи України включає такі основні процедури (етапи):

1) ідентифікування небезпек;

2) якісне оцінювання аварійних ризиків;

3) кількісне оцінювання аварійних ризиків;

4) встановлення недопустимих ризиків та внесення їх до інформаційної бази (реєстру)

недопустимих (неприйнятних) ризиків об'єктів газотранспортної системи;

5) комплексне оцінювання та паспортизацію стану промислової безпеки об'єктів газотранспортної системи;

6) визначення дієвих конкретних (ефективних, результативних) правових, соціально-економічних, інформаційних та організаційно-технічних заходів управління ризиками, ієрархія зниження ризиків (усунення ризиків, заміна неприйнятних ризиків на прийнятні, блокування і нейтралізація ризиків технічними засобами, блокування ризиків адміністративними засобами тощо).

Варто зауважити, що паспортизацію стану промислової безпеки об'єктів газотранспортної системи доцільно проводити у режимі реального часу (після перевірки, ремонту, реконструкції тощо) шляхом періодичного комп'ютерного моніторингу на основі занесення поновлених фактичних показників промислової безпеки до карти небезпек і ризиків об'єктів газотранспортної системи (рис. 2).

Об'єкт газотранспортної системи _____
Об'єкт небезпеки _____
Оператор газотранспортної системи _____
Структурний підрозділ (філія) газотранспортної системи _____

Дата перевірки: "__" _____201_р.
Дата створення нової карти: "__" _____201_р.
Дата створення архівної карти: "__" _____201_р.
Орган нагляду _____

АРХІВ | СФОРМУВАТИ | ВИДАЛИТИ | ОБЧИСЛИТИ | ЗБЕРЕГТИ | ВИХІД

№ з/п	Нормативний параметр (показник) рівня промислової безпеки	Джерело інформації (внутрішнє, зовнішнє)	Оцінка ризику виникнення аварій			Фактичне значення аварійного ризику R_{FA} (бал)
			Імовірність виникнення аварійної ситуації по нормативному показнику промислової безпеки на об'єкті ГТС P (бал)	Важкість наслідків аварійної ситуації по нормативному показнику промислової безпеки на об'єкті ГТС V (бал)	Аварійний ризик нормативного показника промислової безпеки об'єкта ГТС $R_A=P\times V$ (бал)	
a	b	c	d	e	f	g
1.						
2.						
....						
- Сукупний потенційний аварійний ризик на певному об'єкті ГТС				$\sum R_A$		-
- Прийнятий аварійний ризик на певному об'єкті ГТС				$R_{PR} = \sum R_A \times 2/3$		-
- Сукупний фактичний аварійний ризик на певному об'єкті ГТС						$\sum R_{FA}$
- Рівень досягнення мети у сфері промислової безпеки						$\sum$

ВИСНОВОК:
1. Стан промислової безпеки – нормативний, ненормативний
2. Визначені фактичні аварійні ризики – прийнятні, неприйнятні
3. Сукупний фактичний аварійний ризик – прийнятний, неприйнятний, відносний, фоновий
4. Фактичні аварійні ризики визначені – повністю, не повністю

Рисунок 2 – Карта небезпек та ризиків об'єкта газотранспортної системи [7, 8]

Заходи (правові, соціально-економічні, організаційно-технічні тощо) управління ризиками плануються, організовуються та реалізуються залежно від (відповідно до) визначеного рівня та якісної оцінки ризику (табл. 1).

Таблиця 1 – Визначення заходів управління ризиками [7]

Фактичне значення аварійного ризику, R_{FA}		Якісна оцінка ризику	Заходи управління ризиками
у балах	ступінь (рівень) / категорія		
$R_{FA} = 9$	Дуже великий / Категорія F	Неприйнятний +	Об'єкт не можна експлуатувати. Необхідно знизити ризик до прийнятного.
$6 \le R_{FA} < 9$	Великий / Категорія E	Неприйнятний	Об'єкт не можна експлуатувати у проектних режимах. У разі неможливості зупинки слід вжити заходів щодо зниження ризику (робота на понижених параметрах тощо) з подальшою реконструкцією.
$3 < R_{FA} < 6$	Середній / Категорія D	Прийнятний	Розробити та здійснити компенсаційні заходи для зменшення ризику.
$1 < R_{FA} \le 3$	Низький / Категорія C	Відносний +	Включення до планів поточних ремонтів, здійснення контролю
$0 < R_{FA} \le 1$	Незначний / Категорія B	Відносний	Немає необхідності у будь-яких додаткових заходах
$R_{FA} = 0$	Незначний / Категорія A	Фоновий	Немає необхідності у будь-яких додаткових заходах

Беручи до уваги наведене вище, доцільно зазначити, що автоматизована система моніторингу стану промислової безпеки газотранспортної системи покликана виконувати такі функції [6, 8]:

1) формування структури та класифікаторів об'єктів газотранспортної системи;

2) автоматизоване введення фактичних параметрів в реальному часі аварійних ризиків на об'єктах газотранспортної системи;

3) автоматичне створення карт настання можливих небезпек та аварійних ризиків на об'єктах газотранспортної системи;

4) автоматичне визначення тих об'єктів газотранспортної системи, яким притаманні неприйнятні аварійні ризики;

4) проведення аналізу ризиків, а також їх порівняння за запитами користувачів;

5) планування та контроль процесу дотримання заходів стосовно скорочення (зниження) аварійних ризиків на об'єктах газотранспортної системи тощо.

Поряд з тим встановлено, що автоматизована система моніторингу стану промислової безпеки дозволяє вирішити ряд проблем, серед яких визначальне місце посідають [6, 7, 8, 20]:

1) проблеми ефективності контролю, оскільки використання надсучасних методів контролю стану промислової безпеки об'єктів газотранспортної системи дозволить не тільки провести об'єктивну оцінку стану безпеки, але і не враховувати при цьому рівень кваліфікації виконавців;

2) проблеми управління, що передбачають використання системного підходу до процесу управління промисловою безпекою;

3) проблеми дотримання критеріїв оцінки, бо лише достовірно оцінені якісні та кількісні параметри (показники) стану промислової безпеки об'єктів газотранспортної системи забезпечать ефективний результат щодо управління ризиками;

4) проблеми процесу ведення моніторингу стану промислової безпеки об'єктів газотранспортної системи;

5) проблеми інформаційної підтримки, які характеризують ступінь відповідності і сертифікації згідно з вимогами OHSAS 18001 [18] тощо.

ВИСНОВКИ

Результати дослідження доводять, що в основі інформаційного забезпечення автоматизованої системи моніторингу стану промислової безпеки газотранспортної системи лежить методика, яка включає такі основні процедури, як: ідентифікування небезпек; якісне та кількісне оцінювання аварійних ризиків; встановлення недопустимих (неприйнятних) ризиків та внесення їх до інформаційної бази (реєстру) недопустимих ризиків об'єктів газотранспортної системи; комплексне оцінювання та паспортизацію стану промислової безпеки об'єктів газотранспортної системи; визначення дієвих конкретних (ефективних, результативних) правових, соціально-економічних, інформаційних та організаційно-технічних заходів управління ризиками, ієрархія зниження ризиків.

Перспективою подальших досліджень у даному напрямі є розроблення та впровадження автоматизованої системи моніторингу стану промислової безпеки на об'єктах газотранспортної системи на основі результатів дослідження (інформаційного забезпечення).

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