IJHCUM

Tehran Municipality

ISSN 2476-4698

Quarterly Publication

International Journal of Human Capital in Urban Management

Volume 6, Number 3, Summer 2021

International Journal of Human Capital in Urban Managemet (IJHCUM)

(QUARTERLY PUBLICATION)

OPEN ACCESS

Publisher
Municipality of Tehran
Tehran Urban Research & Planning Center

Chairman
Dr. H. Mazaherian
Human Resouce Deputy
Municipality of Tehran, Tehran, Iran
Email: *editor@ijhcum.net*

Editor in Chief
Prof. A. Gholipour
University of Tehran
Email: *editor@ijhcum.net*

Managing Editor
Dr. S.M. Tehrani
Municipality of Tehran, Tehran, Iran
Email: *ijhcum@gmail.com*

Page layout and designer
A. Rezaei Soltanabadi
Email: *ardavanre@gmail.com*

Editorial Contact Information
International Journal of Human Capital in Urban Management (IJHCUM),No. 32, Agha Bozorghi Street, Akbari Street, Pol-E- Romi, Tehran, 1964635611 Iran

Tel.: +9821- 22392080
Fax: +9821- 22392096

Email: *editor@ijhcum.com*
ijhcum@gmail.com

Website: www.ijhcum.net

Printed at
Nashreshahr Institute
www.nashreshahr.com

Publication authorization is certified by the Ministry of Cultural and Islamic Guidance; No. 77163; 14 March 2016

Circulation: 200

***p*ISSN 2476-4698** ***e*ISSN 2476-4701**

Aims and Scope

International Journal of Human Capital in Urban Management (IJHCUM) aims to offer an outlook on the utilization of human capital in urban management based on existing urban and metropolitan problems. The journal expects to eventually turn into a convergence point as a reference available to professionals, managers and researchers in the field of urban management. Topics of interest include but are not limited to the following disciplines: Human Capital in Urban Management; Urban architecture, design, development and planning; Urban communications and services; Urban civil engineering and related management issues; Urban economics, administrative and financial management; Urban transportation systems and traffic management; Urban social and cultural welfare; Urban ecology and related; environmental concerns; Urban Health, Safety and Environment; Sustainable urban infrastructure.

Vision and Mission

International Journal of Human Capital in Urban Management (IJHCUM) is an open access, peer-reviewed journal affiliated with Municipality of Tehran focusing on employment and allocation of human capital for urban management, including urban multidisciplinary themes. IJHCUM is an integral partner with the scientific and technical communities, delivering superior Information products and services that foster communication, build insights and enables individual and collective advancement in urban management. Providing human capital information to the general public administration with description of contemporary advances in urban issues to be used in improving protection and management.

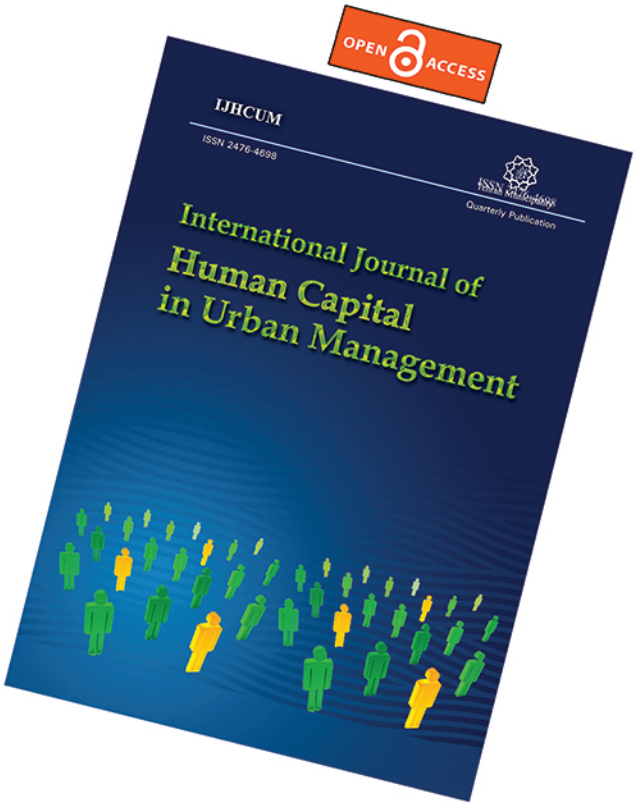
International Journal of Human Capital in Urban Management (IJHCUM)

Editor-in-Chief
E. Sheikh, Ph.D.

*p*ISSN 2476-4698
*e*ISSN 2476-4701

QUARTERLY FULL OPEN ACCESS PEER REVIEWED PUBLICATION

Journal Abbreviation: Int. J. Hum. Cap. Urban Manage.



CALL FOR PAPERS

Publication benefits in
International Journal of
Human Capital in Urban Management

- *Quarterly Publication journal*
- *Online submission and reviewing*
- *Online status inquiry*
- *Double blind peer reviewing*
- *Rapid evaluation and publication*
- *Immediate publication on the net*
- *Open access to all PDF full text of published articles*
- *No pay charge for publication*

Municipality of Tehran
Tehran Urban Research & Planning Center

www.ijhcum.net

editor@ijhcum.net
ijhcum@gmail.com

Tel.: +9821 6403 8606
Fax: +9821 9609 0402

CONTENTS

Volume 6, Number 3, Summer 2021

COVERING LETTER

Subject: **Submission of manuscript**

Dear Editor,

I would like to submit the following manuscript for possible evaluation

Manuscript Title:

Running Title (Short title):

Main Subjects:

Name and address of corresponding author:

Telephone #

Fax #

Email:

I affirm that the manuscript has been prepared in accordance with International Journal of Human Capital in Urban Management guide for authors.

I have read the manuscript and I hereby affirm that the content of this manuscript or a major portion thereof has not been published in a refereed journal, and it is not being submitted fully or partially for publication elsewhere. The manuscript has been read and approved by all listed authors.

The source(s) of financial support of study (if any):

Type of Manuscript (check one):

- ☐ Original research paper
- ☐ Case report
- ☐ Research note
- ☐ Short communication
- ☐ Review paper

Name:

Corresponding Author Signature:

Date:

Int. J. Hum. Capital Urban Manage., 6(3): 209-224, Summer 2021

International Journal of Human Capital in Urban Management
(IJHCUM)

Homepage: http://www.ijhcum.net/

ORIGINAL RESEARCH PAPER

Chemical reducing conditions through the photo-assisted electrochemical process in the treatment of the urban rainwater

Gh. Ebraheim, A.R. Karbassi*, N. Mehrdadi

Department of Environmental Engineering, School of Environment, College of Engineering, University of Tehran, Tehran, Iran

ARTICLE INFO

Article History:
Received 02 August 2020
Revised 08 December 2020
Accepted 14 December 2020

Keywords:
HSC chemistry software
Metal species
Rainwater
Reducing agents
Sodium ascorbate

ABSTRACT

BACKGROUND AND OBJECTIVES: Rainwater in the city of Tehran is regarded as a freshwater source; however, because of highly polluted air conditions, the rainwater quality could be seriously affected. Therefore, the treatment of it could be an attractive topic for assessment. The purpose of the present study was to treat Tehran rainwater by employing photoelectrocatalytic methods as one of the most powerful treatment methods. Also, this study aimed to find an easy laboratory procedure to create various redox environments and to assess a protocol for the release of metals.

METHODS: The photoelectrocatalytic process was achieved by using a photocatalyst (Titanium dioxide) as the photoanode for the treatment of Tehran rainwater. Sodium ascorbate was used as a reducing modifier to assess the effect of various redox potentials on the performance of the photoelectrocatalytic process.

FINDINGS: The positive redox potential, the 6 centimeter gap, and the sodium chloride concentration of o.65 g/L resulted in a considerable increase of the chemical oxygen demand, iron, manganese and lead removals. On the other hand, the negative redox potential, the 12 cm gap, and the sodium chloride concentration of o.65 g/L led to a noticeable increase in the removal of zinc. By employing the speciation and Pourbaix diagrams, the removal mechanisms of the PEC process were investigated. Chemical oxygen demand, iron and manganese by oxidation, lead, zinc and cadmium by precipitation were removed. Also, based on the cluster analysis, it was found that redox potential, dissolved oxygen and pH had a strong relationship.

CONCLUSION: This work provided evidence that the redox potential could be regarded as a critical parameter helping to better estimate the risks associated with the polluted sites.

DOI: 10.22034/IJHCUM.2021.03.01

NUMBER OF REFERENCES	NUMBER OF FIGURES	NUMBER OF TABLES
55	7	2

*Corresponding Author:
Email: *akarbasi@ut.ac.ir*
Phone: +98 21 6111 3199
Fax: +98(21)66407719

Note: Discussion period for this manuscript open until October 1, 2021 on IJHCUM website at the "Show Article.

INTRODUCTION

Environmental contamination caused by the high chemical oxygen demand (COD) load with heavy metals in rainwater is a common problem (Igbinosa and Aighewi, 2017). Most heavy metals belong to the group of permanent toxic materials. It has been reported that zinc (Zn), iron (Fe), manganese (Mn), lead (Pb), and cadmium (Cd) exist in rainwater (Agarwal, 2009). Excessive presence of these elements could cause notable health problems (Chen *et al*., 2013). More importantly, they cannot be completely destroyed by traditional treatment technologies which do not meet the strict discharge standard (Yao *et al*., 2015). Redox-active substances and reactions have recently been considered to serve as favorable ways for purification. This is due to their molecular eclectic and electronic tenability (Su *et al*., 2018). They could affect the structure of pollutants by with a rapid degradation rate (Jin *et al*., 2014). The basis of the photocatalytic process (PC), which is a renowned treatment process, is the occurrence of the redox reactions. It can lead to the ultimate mineralization of organic pollutants. Also, it can result in the conversion of metallic ions to less poisonous types or species that can be separated from the aquesystem (Litter, 2015). Through the PC process, a photon with an energy equal to or bigger than the photocatalyst*'s* gap band is utilized. It can stimulate the semiconductor particles generating electron-hole pairs. These pairs ultimately participate in the detoxification of contaminants. The major drawback of this process is the recombination of electrons and holes, as well as the emission of the absorbed energy as heat. This can prohibit the redox reactions (Chowdhury *et al*., 2014; Ab Aziz *et al*., 2018). The usefulness of integrating PC with electrochemistry (EC), by employing a photo-assisted electrochemical process (PEC), has been proved (Seibert *et al*., 2020). Through the PEC process, the semiconductor particles are immobilized on the conducting substrates. The problem of recycling particles and the involved cost can be then solved. Also, applying a positive potential can drive the photogenerated electrons to the cathode, contributing to the separation of electron–hole pairs and production of oxidants; so, the photocatalytic efficiency is improved (Wang *et al*., 2011; Qin *et al*., 2016; Zou *et al*., 2020). The change of the oxidation state of the metals in the solution can occur through the electrolytic system (Williams, 2006). The feasibility of changing the redox of the metallic couples depends on the relative value of the redox potential (E) of the metallic couples, as compared with the conduction band (CB) and the valence band (VB) of the semiconductor (Chowdhury *et al*., 2014). Increasing the Redox potential (Eh) indicates that the redox status of the system is transformed from a low oxidizing level to a more oxidizing one. Although the thermodynamic importance of Eh has been doubted, studying systems under a range of redox levels is a prerequisite. This can help to better comprehend the fate and transport of metals in the environment (Williams, 2006). The control of Eh can play a decisive role during the electrolytic system. This is realized by influencing the reactions on the surface of the electrodes, the speciation and oxidation state of the metals and consequently, the redox behavior. Such a control is commonly a composite function of dissolved oxygen (DO) and pH control. It can be obtained by using convenient chemicals such as potential modifiers (Chimonyo *et al*., 2017). The chemical modifiers or reducing agents include agents to achieve the reducing conditions, as well as changing the oxidation/reduction reactions. Many chemicals have been utilized, such as sodium ascorbate, ascorbic acid, ammonium thiosulfate, hydroxybenzene and sodium borohydride (Williams, 2006). Among these chemicals, Sodium ascorbate (NaAsc) has been widely employed. This is because it is a mild reducing reactant with a redox potential of +0.39V. vs NHE. It can display a significant range of reducing conditions, serving as a rapid means to achieve several redox environments (Chatain *et al*., 2005). Sodium ascorbate has been proposed to be an appropriate redox reactant for the Eh control. Bai *et al*. (2016) have reported that copper-containing metal–organic nanoparticles (MONPs) are easily characterized via the Cu^{2+}-mediated intramolecular reaction of the aspartate containing polyolefins in pure water. Therefore, in-situ, 2.5 mg of sodium ascorbate in 0.5 mL of water was utilized at 50 °C for 24 h to reduce Cu^{2+} to Cu^{+1} in the MONPs. Berardo *et al*. (2016) investigated the effects of sodium ascorbate on the protein oxidation. According to the results, sodium ascorbate could affect protein oxidation in different ways. It could reduce the formation of malondialdehyde, acting as a pro-oxidant in the presence of metal ions. Pareuil *et al*. (2008) also

established several reducing levels using sodium ascorbate solutions. This was to investigate the solubilization of metallic elements from soil samples. The results displayed that metallic mobilization was extremely raised with decreasing the redox potential within a limited and so, critical range. Chatain *et al.* (2005) also studied the effect of the reducing conditions on the Arsine release from pollutant sites, manipulating Eh and pH in the soil slurries. The addition of different concentrations of sodium ascorbate supplied various reducing conditions (from −7 to +345mV vs. NHE). According to the removal technique utilized, conflicting data have been determined. For example, a simultaneous increase in the mobility of metals was observed when the redox potential Eh was increased and decreased. However, very few researchers have examined the impact of sodium ascorbate on the reducing conditions and the mobility of the metals in water. In this context, the main aim was to suggest a chemical experimental process originating from a range of redox conditions by adding different concentrations of sodium ascorbate. This was to understand the impact of the reducing conditions on the PEC efficiency in the organic and metallic agents' removal for the treatment of Tehran rainwater. Because of the complexity of using sodium ascorbate under the current experiments, to check the changes in the oxidation state, speciation and solubilization of metals, the Pourbaix (Eh/pH) diagrams could be drawn by applying the HSC Chemistry software. To investigate the behaviors and the relationships between quality parameters and contaminants, cluster analysis was employed. The removal mechanisms were assessed during the PEC process and their conformity to the results was obtained from the study of metal species. The secondary aim was to optimize the PEC conditions and the experimental design parameters. The monitored parameters were the redox potential, the gap between electrodes, and the concentrations of the electrolyte. They were chosen due to their influence on the purification performance of the PEC process. For the PEC process, the procedures were followed by using Ti/TiO_2 and graphite (Gr) as the electrodes. These electrodes have recently received much attention. In the current study, Ti/TiO_2 was selected due to such advantages as high oxidizing ability, nontoxicity, chemical stability, corrosion resistance and low cost. Its properties could lead to apparent photocatalytic activity developments (Zhou *et al*., 2015; Sharififard *et al*., 2018; Cheng *et al*., 2020). Employing graphite as the cathode for oxygen reduction could lead to the generation of the hydrogen peroxide (H_2O_2). H_2O_2 serves a significant role as an electron acceptor. Thus, it can contribute to the separation of the electron-hole pairs and the increase of the production rate of radical hydroxyl ($^{\cdot}OH$). This radical could be formed by the oxidation of water molecules (H_2O) or hydroxides ions (OH^-) on the electron vacancy (a hole) (Zhao *et al*., 2014; Yao *et al*., 2019). The current work is a comprehensive chemical study of rainwater using a reducing modifier, speciation and statistical analysis. The PEC performance was evaluated by using COD and Zn, Fe, Mn, Pb, and Cd metals (which commonly exist in rainwater) as the target compounds. The aim of the study was to simultaneously remove metal and organic pollutants from Tehran rainwater by employing the photoelectrocatalytic method and to assess the impact of Eh on the removal mechanisms. This study was carried out in Tehran, Iran, in 2020.

MATERIALS AND METHODS

Sampling of Tehran rainwater

The rainwater samples were collected from the Kan canal, in the south of Tehran, near Azadi Highway, in 2020. Kan canal gathers the rainwater from different areas of the city and flows along with various pollutants from the north to the south of Tehran. Thus, it could guarantee that our samples were typical, representing all kinds of contaminants existing in Tehran rainwater. Before collecting the samples by polyethylene containers, some intensive agitation was done to ensure the similarity of the tested samples. The samples were transferred to the laboratory and saved under cooling (4°C). They were analyzed; their chemical and physical quality parameters were measured before and after PEC treatment. The Tehran rainwater characteristics are shown in Fig. 1.

Set-up and photo-assisted electrochemical experiments

The batch photo-electro-catalytic cell was according to Fig. 2. Ti/TiO_2 served as a working (photoanode) electrode with 5.0 × 10 cm^2. Graphite with the same active area was used as a cathode. The electrodes were purchased from Chinese plants and

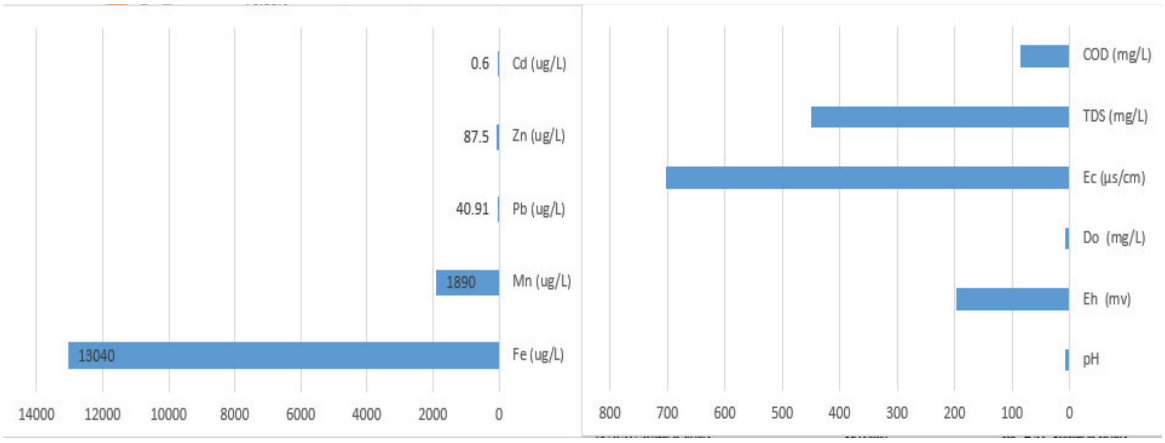


Fig. 1: Characteristics of Tehran rainwater in Kan canal in Tehran, Iran

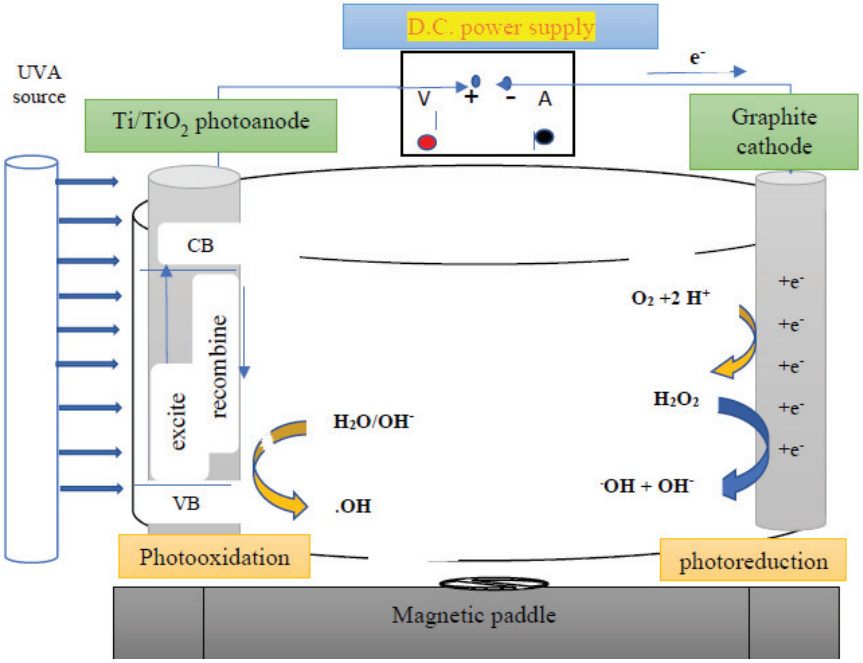


Fig. 2: Schematic diagram of the PEC reactor system

put in a Pyrex glass beaker and submerged in parallel. One anode/cathode potential (voltage) was applied between the electrodes (2.5 V). It was supplied by a DC-regulated power supply (UTP3704S UNI-T). A UVA lamp (Philips Actinic BL TL, 8 W) served as the light source; it was kept outside of the photo-cell. Its main wavelength was 380 nm. This could guarantee providing the energy needed to overcome the band gap (E = 3.2 eV) of TiO_2, as well as motivating the electrons and generating the electron-hole pairs for the oxidation and reduction reactions (Montenegro-Ayo *et al.*, 2019). The photo-anode was put 3 cm from the center of the UV lamp to avoid light attenuation. Doubly distilled water and alcohol (90 %) were used

before each experiment for electrodes cleaning. To reach the thermodynamic equilibrium conditions and to attain adsorption–desorption, a magnetic agitator was employed for 5 min for the solution stirring. This occurred without using any voltage. Also, the procedures were done in dark conditions and without any irradiation to prohibit the entry of the non UV lighting (Pareuil *et al*., 2008; Cheng *et al*., 2020). Although the experiments were performed at a laboratory temperature, the temperature of the solution after the PEC process was raised. This was because of the heat gained from the UV lamp.

To identify the condition of the typical system and examine the influence of the redox potential, NaCl concentration and the gap between electrodes on the photodegradation of the pollutants, two sets of tests were conducted. These sets could offer a chemical experimental method creating a different range of redox potential; it could also help to study the effect of the change of oxidation states on the metals purifications. Two tests were involved in the first set. They were achieved by fixing the anodic bias potential in each test. Every test had different gaps, but a specific redox potential. In the same order, two tests were included in the second set. In each test, the anodic bias potential was fixed. Every test had different concentrations of the NaCl electrolyte, but a specific redox potential. In the current study, NaCl was selected to be an electrolyte due to cheapness, availability, and its ability to increase the ionic strength. Most importantly, this was due to its capability to generate the holes, ·OH and reactive chlorine species (RCS) at the photoanode. They are strong oxidants and mediators for indirect oxidation (Vahidhabanu *et al*., 2015; Zarei and Ojani, 2017; Komtchou *et al*., 2020). The major characteristics of the photo-reactor were chosen as the desired parameters for the organic and metal removal, which were close to the literature (Liu *et al*., 2016). In this work, each experiment was repeated twice and each value was the average of two repeated analyses.

Analytical techniques and chemical measurements

The indispensable parameters at the sampling site were analyzed; these included temperature (by a normal mercury thermometer), pH, Eh, DO and electrical conductivity (EC) (via a portable multi-parameter probe). COD, which is a significant index for controlling the wastewater purification and estimating the water quality, was measured in duplicate, according to the standard methods APHA. To monitor the COD change, a spectrophotometer (DR 5000- Hach) was employed. An inductively coupled plasma-mass spectrometer (ICP-MS) was also chosen to quantify the concentration of the metals (Fe, Mn, Zn, Cd, and Pb). This was because of its distinctive properties, such as high thoroughness, suitable detection limits and its ability to measure many elements at the same time (Wilschefski and Baxter, 2019). Each test typically began with 2L. After 120 minutes, 0.1 L of the samples was separated and kept in the sulfuric acid solution (98%) (Until pH < 2) for the measurements of COD. On the other hand, 1 L samples were separated and kept in nitric acid (until pH < 2) for the measurements of metals. The metals and COD were removed from rainwater samples by the PEC purification. So, the remaining concentrations of these pollutants in the solution were measured after a 120 min interval. The COD and metals removal efficiency (RE) were determined using Eq. 1 (Le *et al.,* 2019).

$$RE(\%) = \left(\frac{C0 - Ct}{C0}\right) * 100 \quad (1)$$

Where, C0 is the initial concentrations and Ct is the final concentrations (after PEC purification) of the pollutants.

By applying the HSC chemistry software (version 5.1), we could provide detailed information on the solubility class, chemical species, and the oxidation state of the electrodeposited metals on the electrodes. This software needs distinct parameters such as pH, T, Eh, pressure, and the concentration of the element to draw Eh/pH diagrams (Alabdeh *et al*., 2019). The chemical dominant speciation diagrams of the rainwater after 120 min of treatment and during different redox potentials were drawn. Employing multivariate statistical methods such as cluster analysis could help to classify a large number of water quality factors into meaningful hydrochemical clusters. In the cluster analysis, no assumption was made about the number of groups or their structure and each sample could form a cluster itself (Johnson and Wichern, 2002). In this work, it was used to assess the validity of the results obtained from the Eh/pH diagrams. According to the correlation coefficient and similarities in the behavior of the physicochemical parameters and the pollutants,

Table 1: The summary of the experimental conditions and development of several quality parameters of rainwater (after PEC) with the initial anodic potential (2.5V); Ec (703 µs/cm); pH (7.3); electrode material: Ti/TiO_2- Gr

Experiment	Test	Initial redox potential (mV)	Gap between electrodes (cm)	NaCl electrolyte (g/L)	Eh mV	pH	DO mg/L	Ec µs/cm
1 st set	Test 1	+50	6	Not added	152	6.76	4.53	933
		+50	9	Not added	99	6.78	4.47	937
		+50	12	Not added	96	6.81	4.3	941
	Test 2	-50	6	Not added	-35	4.28	3.32	973
		-50	9	Not added	-44	4.67	3.29	976
		-50	12	Not added	-65	4.68	2.01	1063

the treatment mechanisms that took place through PEC were examined. Also, for effective water quality management, the parameters affecting the pollutant removal were identified. The Weighted pair group (WPG) approach, which is the most popular clustering technique in the environmental works, was employed in the current study. It was chosen due to its ability to identify the clustering tendencies among several samples (Karbassi *et al*., 2008(a)).

RESULTS AND DISCUSSIONS

The PEC efficient was affected by the redox potential and the gap between electrodes. To investigate the influence of different values of the redox potential and the gap between cathode and anode on the degradation of COD and metals by the PEC method, the first set was accomplished. This set had the same anodic potential (2.5 V), EC (703 µs/cm) and pH (7.3). Each test of the current set involved three separated analyses. Every three analyses had various gaps of 6, 9 and 12 cm, and the same redox potential +50 or -50 mV, in the tests 1 and 2, respectively. Table 1 summarizes the obtained experiments. These could show the impact of various redox potentials (different reduction conditions) and gaps between electrodes on EC, Eh, pH and DO. As a result, their impact on the oxidation-reduction reactions and mobility of the studied metals could be verified as well.

By examining the information in Table 1, it could be seen that in the test 1, with increasing the gap, pH was slowly raised from 6.76 to 6.81 because of the small decrease of DO from 4.53 to 4.3 and the considerable decrease of Eh from 152 to 96 mV, as well as the rise of conductivity from 933 to 941 µs/cm. Likewise, in the test 2, with increasing the gap, pH was increased from 4.28 to 4.68 because of the decrease of DO from 3.32 to 2.01 and Eh from -35 to -65 mV, as well as the rise of conductivity from 973 to 1063 µs/cm. By inspecting the values in tests 1 and 2, Eh values, especially for the gap of 12 cm, were declined as the initial redox potential was decreased. It could adversely affect the degradation rate of COD and some metals such as Fe, Pb, and Mn by discouraging the oxidizing potential (Chimonyo *et al*., 2017). A decline in the Eh values led to a great increase of the mobility of specific metals due to the prevalence of the reduction conditions in the system (Haratifar *et al*., 2011). In the six samples, the pH values at the end of the reactions were measured. They were decreased after treatment. The final pH depended on the initial redox potential: the lower the redox potential, the lower the pH, with clear variations between +50 and -50 mV. This could be attributed to the addition of sodium ascorbate to the samples before the PEC occurrence (Pareuil *et al*., 2008). The decrease of pH values could also be because of the increase of acidic products such as oxalic acid and formic acid generated by oxidizing the organic compounds (Li and Liu, 2005; Yurdakal *et al*., 2020). To get Eh= +50 and -50 mV conditions, 0.05 and 0.19 g/L sodium ascorbate were added, respectively. When more sodium ascorbate was added, the decrease of Eh, pH and DO was higher. So, Eh values could vary with varying the concentrations of the reluctant in solution (Li and Bishop, 2004). Based on Fig. 3, the variation of rainwater parameters with the variation of experiment variables could be observed. Also, the different removal performance of COD and metals by the PEC method is clearly shown.

Based on Fig. 3, the degradation rate of the pollutants was gradually decreased with increasing the

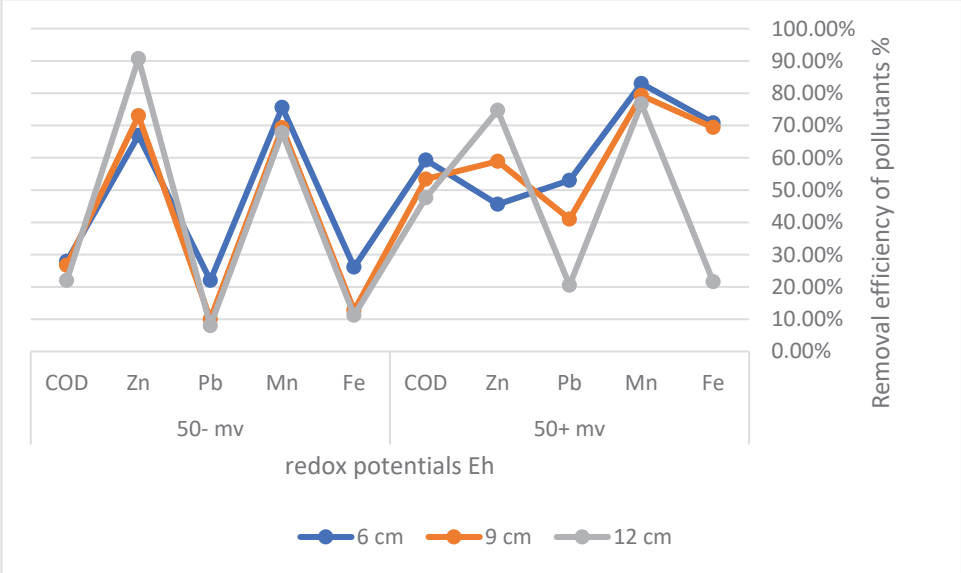


Fig. 3: Removal effectiveness of the pollutants by the PEC treatment according to the first set of analysis

gap between electrodes. This could be attributed to the decreasing current density with the gap decrease (Biswal *et al*., 2019). The experiments showed that Fe, Mn, Pb and COD concentrations were increased with decreasing the redox potential and raising the gap. The remaining concentrations of COD changed from 35 to 45 mg/L, of Fe from 3794 to 1071 µg/L, of Mn from 320 to 440 µg/L, and of Pb from 19.2 to 32.5 µg/L by raising the gap from 6 to 12 cm, respectively. This proposed that the most suitable effect of the integrated photo- and electrochemical catalysis for COD, Fe, Mn and Pb occurred at the positive redox potential (+50 mV). This was demonstrated by the fact that the Eh decrease indicated that the oxidation status of the rainwater samples had been altered from a higher oxidizing level to a lower oxidizing one. This caused the decline of the species oxidation. The opposite was also true (Haratifar *et al*., 2011). At this point, it is important to highlight that the oxygen whose concentrations in test 1 were higher than those in test 2, especially in the gap of 6 cm, is an electron acceptor. It serves an important role in the separation of the electron-hole pairs. It can react with two atoms of hydrogen and two electrons, being reduced to H_2O_2. That is the main reason for the production of ·OH. So, oxygen is responsible for the rise of the photooxidation rate of COD and Fe, Pb, and Mn in test 1 (Barrera-Díaz *et al*., 2014; Ensaldo-Rentería *et al*., 2018). Therefore, the positive redox potential of +50 mV and the cathode and anode gap of 6 cm could be suggested in the current work for the efficient removal of the COD, Fe, Pb and Mn. This was in agreement with the results obtained by Li and Bishop (2002) for the COD removal. Their findings showed that the redox potential and COD removal were following a good linear relationship. Additionally, Chimonyo et al. (2017) gave an account that at a constant pH, raising the Eh values resulted in a considerable increase in the removal efficiency of COD. By using appropriate chemicals, an increase of Eh in the range of 500–600 mV was achieved. The redox potential of -50 mV and the gap of 12 cm were suggested in this work for the Zn removal. This could be related to the low Eh and DO resulting from adding extra sodium ascorbate. As a result, sodium ascorbate elevated the reduction conditions in these experiments. The decrease in the Eh values can be illustrated by the fact that the operating foundation of a potential modifier is to produce the electrons required to reduce species. This has been confirmed by the findings of several researches (Smith and Pierson, 1979; Williams, 2006; Herbel *et al*., 2007).

Table 2: The summary of the experimental conditions and development of several quality parameters of rainwater (after PEC) with the initial anodic potential (2.5V); gap (12 cm); pH (7.3); electrode material: Ti/TiO_2- Gr

Experiment	Test	Initial redox potential (mV)	Gap between electrodes (cm)	NaCl electrolyte (g/L)	Eh mV	pH	DO mg/L	Ec µs/cm
2nd set	Test 1	+50	12	0.4	97	7.58	5.16	2180
		+50	12	0.65	88	7.65	4.69	3150
		+50	12	1	20	7.69	4.45	3360
	Test 2	-50	12	0.4	-20	6.15	2.85	1613
		-50	12	0.65	-28	6.59	2.67	2720
		-50	12	1	-33	6.88	2.1	3900

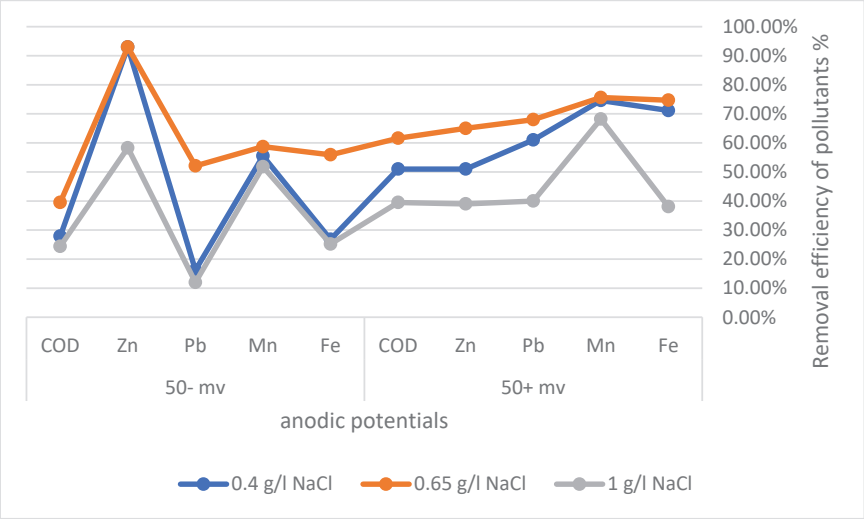


Fig. 4: Removal effectiveness of the pollutants by the PEC treatment according to the second set of analysis

The PEC efficiency affected by the redox potential and NaCl electrolyte concentrations

To investigate the impact of various values of redox potential and the concentration of electrolyte on the COD and metals removal by the PEC process, the second set was accomplished. This set had the same gap (12 cm), anodic bias potential (2.5 V), and initial pH (7.3). The two tests of the current set involved three analyses. Each of three analyses had various NaCl concentrations of 0.4, 0.65, and 1 g/L (showing variation in the initial ionic strength (EC) and the same redox potential of +50 or -50 mV in tests 1 and 2, respectively. The experimental conditions are presented in Table 2.

According to the data in Table 2, the conductivity after PEC treatment ranged from 1613 to 3900 µs/cm. In test 1, by adding a concentration of NaCl, pH was increased from 7.58 to 7.69. It was because of the decline of DO from 5.16 to 4.45, Eh from 97 to 20 mV, and the increase of conductivity from 2180 to 3360 µs/cm. Also, in test 2, by adding a higher concentration of NaCl, pH was raised from 6.15 to 6.88 because of the decline of DO from 2.85 to 2.1, Eh from -20 to -33 mV, and the increase of conductivity from 1613 to 3900 µs/cm. By comparing the data from tests 1 and 2, Eh and pH values were decreased as the sodium ascorbate concentrations were increased, which could adversely affect the removal rate of COD, Fe, Pb and Mn by reducing the oxidizing potential of the PEC technique. Conversely, it could improve the reduction potential of other metals such as Zn and Cd considerably; as shown in Table 2 and Fig. 4. When DO values in test 2 were lower than those in test 1, the change of Eh to the negative values occurred in

test 2. This linearly decreased COD, Fe, Mn, and Pb removal efficiencies in test 2. Also, an increase of the Zn removal efficiency in test 2 could be noticed. The decrease of the oxidation efficiency and the increase of the reduction efficiency could be attributed to the decrease of the redox potential. Based on Fig. 4, the experiments showed that the remaining COD, Pb, Fe, and Mn concentrations in test 1 declined, but the remaining Zn concentrations were elevated during the positive redox potential.

Based on Fig. 4, the increase was slight for Fe, Mn and Pb removal in test 1, with Eh= +50 mV; as a result, the higher the NaCl concentration, the greater the pollutant removal rate. This could be due to the increase of the ionic strength and production of the oxidants reagent electro-produced from the supporting electrolyte such as HOCl, $ClOH^{\bullet -}$, $Cl^{\bullet}$ and $Cl^{\bullet -}$. They were formed by the oxidation of Cl^- on the holes. They had the ability to indirectly oxidize the organic compounds and metals. They could also activate and speed up the migration rate of electrons and mass transfer between electrolyte and the surface of the electrode (Yao *et al.*, 2019). Similar findings were reported by Vahidhabanu *et al.* (2015), who proved the efficiency of adding 1 g/L NaCl as a supporting electrolyte to the PEC photo-reactor for pharmaceuticals oxidation. On the other hand, when the concentration of NaCl was raised from 0.65 to 1 g/L, the COD, Fe, Mn, Pb, and Zn removal was reduced. These phenomena could be attributed to the competition between Cl^- and H_2O or OH^- to oxidize on the photogenerated hole. It could reduce the generation of $^{\cdot}OH$. Also, it could be attributed to the RCS ability to participate in the decomposition of H_2O_2. They could negatively affect H_2O_2 and $^{\cdot}OH$ generation. This could lead to the loss of the oxidation potential of PEC, especially on the cathode (Park *et al.*, 2009). It is worth mentioning that the low concentrations of pollutants in the Tehran rainwater affected the efficiency of the PEC process. This is because of their impact on the number of oxidants produced on the anode and cathode. These pollutants could act as electron donors and acceptors, actively separating hole- electron pairs (Subramaniam *et al.*, 2019). The redox potential of +50 mV and the NaCl concentration of 0.65 g/L were recommended in this work for organic agents, Fe, Pb and Mn removal, with the same NaCl concentration, but a redox potential of -50 mV was found for the Zn removal. It should be noted that in tests 1 and 2 of the current set, adding 0.65 g/L of NaCl could make the studied samples reach the typical conductivity.

The HSC Chemistry results and the speciation of the studied metals in Tehran rainwater

Based on the Eh/pH diagrams obtained by applying the HSC chemistry software (Figs. 5 and 6), when the rainwater samples had an acidic pH, all of

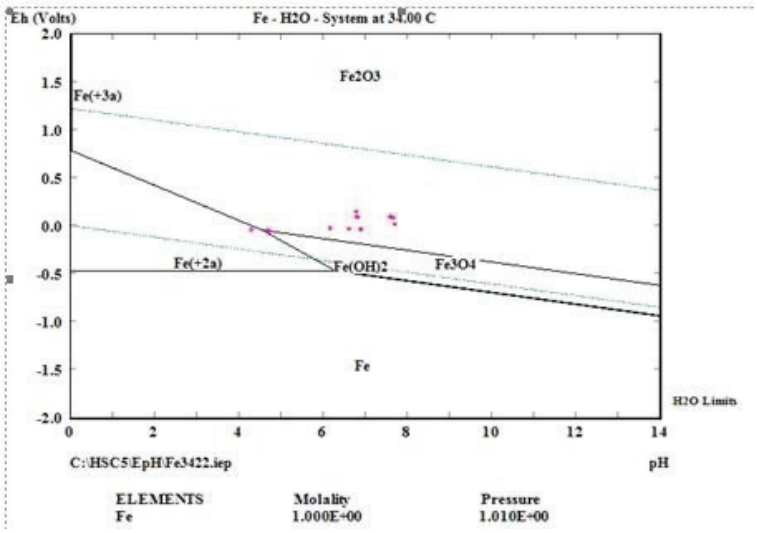


Fig. 5(a): Speciation of Fe in different Eh values in Tehran rainwater samples after the PEC process

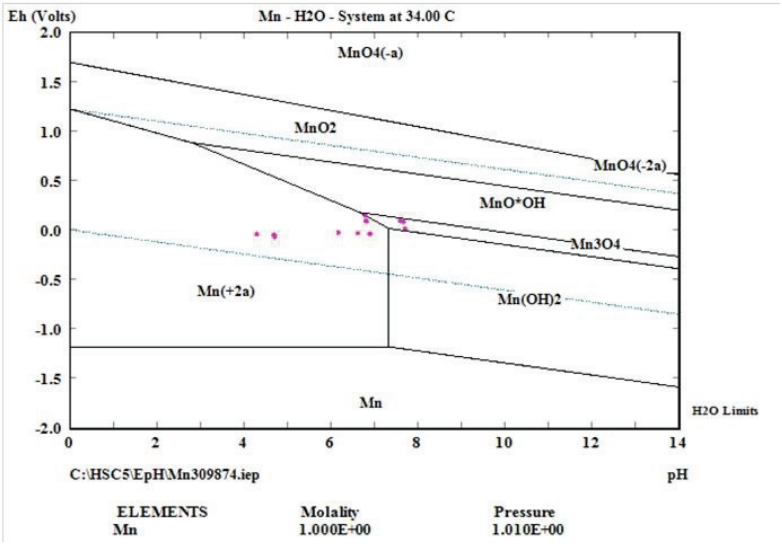


Fig. 5(b): Speciation of Mn in different Eh values in Tehran rainwater samples after the PEC process

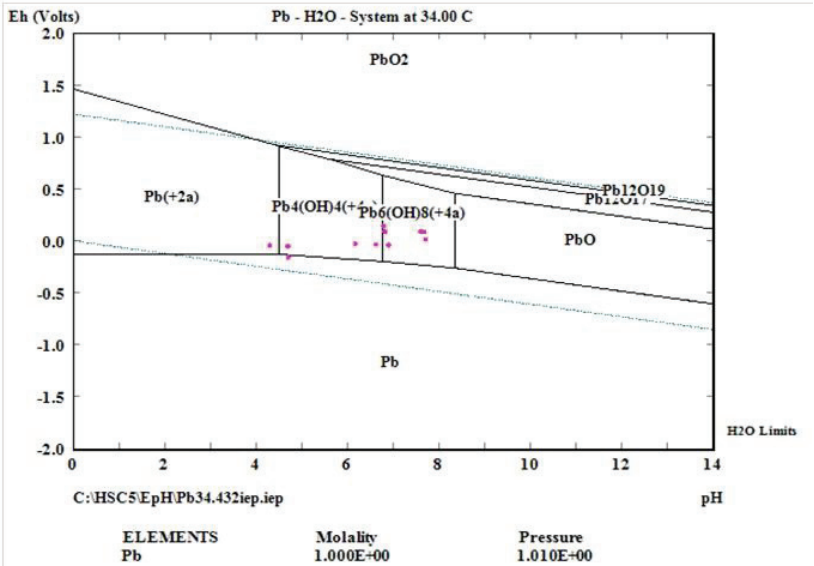


Fig. 5(c): Speciation of Pb in different Eh values in Tehran rainwater samples after the PEC process

the studied metals were present as bioavailable and soluble ions: Fe^{2+}, Mn^{2+}, Pb^{2+}, Zn^{2+} and Cd^{2+}. In the acidic conditions, especially lower than the pHpzc of TiO_2 (point of zero charge = 6.3), the adsorbent surface of TiO_2 was positively charged. A repulsion strength between cationic compounds and the photo-catalyst electrostatically predominated. This could reduce the removal extent. The polarity of the TiO_2 photo-anode surface changed according to the pH values. Hydroxyl groups on the surface of TiO_2 underwent a suilibrium reaction. It can be explained by Eq. 2 (Wahyuni *et al.*, 2015; Zarei, 2019).

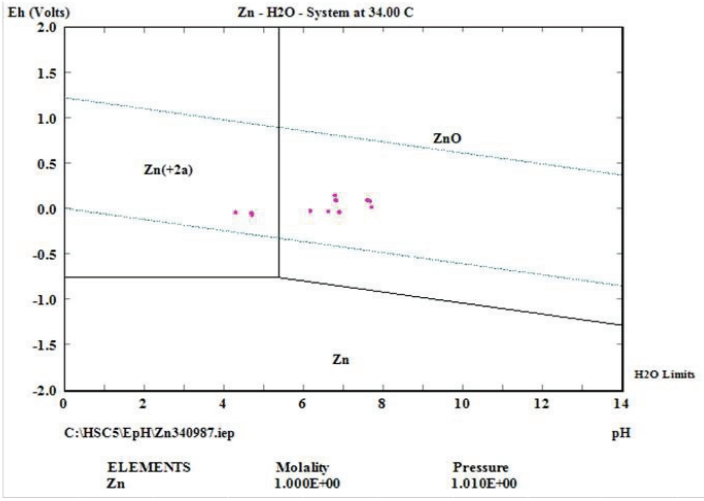


Fig. 6(a): Speciation of Zn in different Eh values in Tehran rainwater samples after the PEC process

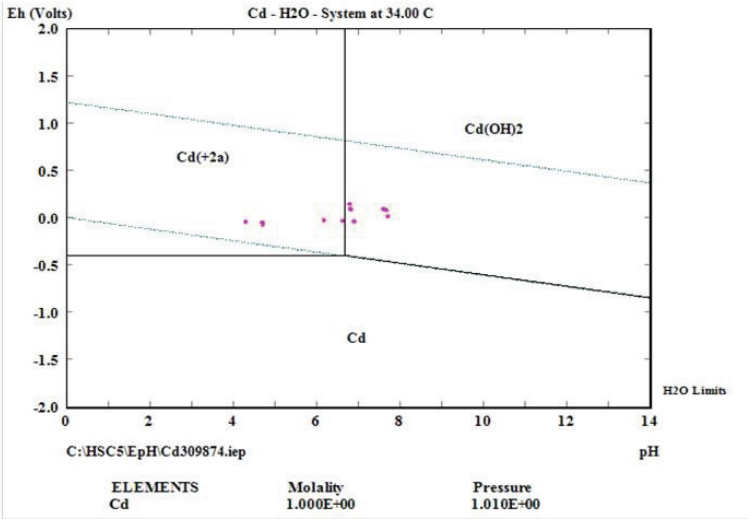


Fig.6 (b): Speciation of Cd in different Eh values in Tehran rainwater samples after the PEC process

$$pH < PZC \qquad TiOH + H^{+} \rightleftarrows TiOH_2^{+} \qquad (2)$$

In this situation, these ions, which have divalent oxidation states, cannot be absorbed by the positive TiO_2 surface. According to Eq. 2, TiOH on the TiO_2 surface is transformed to $TiOH_2^{+}$. So, TiOH is not enough to provide the electrons and ·OH needed to remove the pollutant through the PEC process. In alkaline conditions and higher pH values, especially near pHpzc, TiOH was abundantly formed. Here, adsorption, by charging the TiO_2 surface with negative charge, was enhanced. The equilibrium reaction of the hydroxyl groups can be explained by Eq. 3 (Zarei and Ojani, 2017).

$$pH > PZC \qquad TiOH + OH^{-} \rightleftarrows TiO^{-} + H_2O \qquad (3)$$

According to Figs. 5 and 6, Fe^{2+}, Mn^{2+} and Pb^{2+} at high pH were oxidized to iron oxide (Fe_2O_3), (Fe_3O_4), manganese oxide (Mn_3O_4), (MnO_2), manganese

oxohydroxide (MnO*OH) and lead oxide ($Pb_{12}O_{19}$), ($Pb_{12}O_{17}$); they were precipitated and converted to iron hydroxide ($Fe(OH)_2$), manganese hydroxide ($Mn(OH)_2$), lead hydroxyl complex ions ($Pb_4(OH)_4(+4)$) and ($Pb_6(OH)_8(+4)$). According to Figs. 5 (a), 5 (b), 5 (c), the dominant species of Fe, Pb, and Mn after PEC purification were Fe^{2+}, Fe_2O_3, Pb^{2+}, $Pb_4(OH)_4(+4)$, $Pb_6(OH)_8(+4a)$, Pb, Mn^{2+} and Mn_3O_4. This could be due to the ability of Fe, and Mn to oxidize on the photo-anode by ·OH at the positive Eh value (+50 mV). Pb not only existed as free and soluble ions, but also as $Pb_6(OH)_8(+4)$, $Pb_4(OH)_4(+4)$, and Pb that had an ability to precipitate on the surface of the cathode. In the case of Cd^{2+} and Zn^{2+} (Figs. 6 (a) and 6 (b)), at the high pH, they were reduced to Cd(s) and Zn(s) elements, precipitating as cadmium hydroxide ($Cd(OH)_2$) and zinc oxide (ZnO). The speciation of Cd and Zn after the PEC process fell within Cd^{2+}, $Cd(OH)_2$, Zn^{2+} and ZnO classes. This indicated the separation of these metals from rainwater by precipitation as happened in $Pb_6(OH)_8(+4)$, $Pb_4(OH)_4(+4)$, and Pb. In the rainwater treated by the PEC process, Cd and Zn never had the ability to oxidize by ·OH or the hole. Also, they never had the ability to reduce even in the reducing conditions. This was because Cd^{2+} and Zn^{2+} had a negative standard reduction potential (E° = -0.403 and -0.76V vs. NHE) to reduce to Cd^0 and Zn^0. These potentials were just below (-0.5 V vs. NHE) of the conduction band of TiO_2 at pH 7. Cd^{2+} and Zn^{2+} reductions were not thermodynamically reasonable, thus demanding sacrificial agents at the beginning of the process (Chowdhury *et al*., 2014). The removal rate of Cd and Zn could be because of the reaction with OH^- ions and oxygen, respectively, and the precipitation on the graphite cathode. The adsorption and precipitation of these ions occurred on the cathode surface that had more electrons. The removal of the Cd and Zn present in the solution could be attributed to the pH value (>6) required, as represented in the speciation diagrams. These findings are in agreement with those obtained by Le *et al*. (2019). They had proved that Cd could not be reduced by a reduction on the surface of the photo-catalyst; it could only be adsorbed. Although Zn and Cd were not reduced in the reduction conditions and at low Eh (-50 mV), these metals were removed at a high rate. These could be attributed to the increase in the ability of these elements to precipitate in anoxic conditions and the low Eh. Also, it has been proved that in the oxidation conditions, they can be released into a solution (Biati *et al*., 2010). The decline of Fe and Mn concentrations was due to the photocatalytic oxidation. Also, a number of free ions remained in the reducing conditions. It has been proved that these metals are released in low amounts and oxidized in the high Eh. The low redox potential supported the decline of the insoluble iron and manganese oxides, resulting in the rise of iron and manganese solubility (Nadaska *et al*., 2018). The initial pH (7.3) was monitored in rainwater samples, making the absorption of cationic metals such as Fe and Mn on the negative TiO_2 surface possible. The standard reduction potentials of Fe^{2+} and Mn^{2+} (E° = -0.77 and -1.7V vs. NHE) were to anodically oxidize to Fe^{3+} and Mn^{3+} (El Jamal, 2008; Khan *et al*., 2018). These potentials were less positive than (3.5 V vs. NHE) of the valence band of TiO_2 at pH 7. It indicated the thermodynamic ability of the photo-generated holes and ·OH to oxidize Fe^{2+} and Mn^{2+} on the TiO_2 surface. On the other hand, the standard reduction potential of Pb^{2+} (E° = -0.67V vs. NHE) to oxidize to Pb^{+4} should be noted (Wahyuni *et al*., 2015). This means that photo-generated holes and ·OH can oxidize Pb^{2+}. However, Pb^{2+} in Tehran rainwater after the PEC purification existed as free ions, precipitate hydroxide and element. These findings, therefore, seem to indicate that by adding sodium ascorbate, the anodic potential of 2.5 V and the obtained redox potentials of +50 mV and -50 mV were not appropriate for oxidizing the Pb^{2+} ions on the TiO_2 surface.

The results obtained by cluster analysis and MVSP software

This study attempted to investigate the findings obtained from Eh/pH diagrams by employing the cluster analysis method. This method by drawing a dendrogram could be a helpful tool to interpret the relationship between the studied parameters (DO, Eh, TDS, EC, and pH) and pollutants and their behaviors. The clustering results are graphically represented in the form of a dendrogram (Fig. 7).

As shown in Fig. 7, the dendrogram has two individual clusters, namely, A and B. Cluster ''A'' consists of Eh, Zn, DO and pH. It presents that pH and DO had a relatively strong (0.88) correlation coefficient and joined to Zn and Eh in lower (0.72 and 0.53) correlation coefficients. These parameters had a strong relationship, such that Eh and DO were

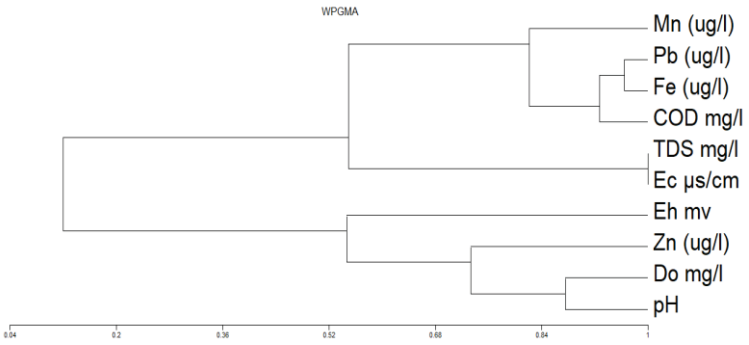


Fig. 7: The dendrogram obtained by the MVSP of Tehran rainwater after PEC treatment

decreasing along with the decline of pH. This was due to the addition of sodium ascorbate. It was in agreement with the results of one study (Deng, 1997). Also, they had a strong relationship with the Zn element. It means that pH and DO (with a higher impact), and Eh (with a lower impact) can control the Zn precipitation during the PEC method. This is also in agreement with the findings of some researches (Karbassi *et al*., 2008(b); Karbassi *et al*., 2011). These studies, based on cluster analysis, proved that pH could affect the Zn removal. Cluster ''B'' involves COD, Fe, Mn, Pb, TDS and EC. It showed that TDS and EC had the highest (1) correlation coefficient. Fe and Pb were joined in a lower (0.95) correlation coefficient. They were connected to COD and Mn in the correlation coefficients of 0.89 and 0.8. In this cluster, TDS and EC (as a result of NaCl concentrations) could control the Mn, Fe, COD, and Pb removal by the PEC method. COD, Mn, Fe, and Pb had similar behaviors. This is also in agreement with the findings of this study. Fe, Mn, Pb, and COD had the ability to oxidize by ·OH through PEC photooxidation. All these mentioned metals in this cluster had higher removal efficiency in the positive Eh value = +50 mV, and a higher ability to release in the negative Eh value= -50 mV. This was the opposite of what happened to Zn; this could explain why Zn fell into a cluster by itself. Importantly, the two clusters could joined at a positive and low (0.11) similarity coefficient. This means that the investigated pollutants in each cluster were influenced and controlled by the parameters in the other cluster through the PEC process. Cd concentrations before and after treatment were low, so Cd was not involved in the dendrogram.

CONCLUSION

Based on the results of the current study, one can conclude that the experimental arrangement is a powerful way to optimize the PEC conditions. Also, it can provide a better understanding of the parameters affecting the purification performance. This research emphasizes the significance of the knowledge of the Eh for correct risk estimation. Further, the ability of chemical potential modifier, sodium ascorbate, to create various redox environments in the rainwater samples was studied. The findings showed that the increase in the reducing conditions could display a decrease in the mobility of Zn and Cd. Conversely, the decline of these conditions could lead to a decline in the mobility of Fe, Mn and Pb during the PEC treatment. This study made an attempt to confirm the results by studying the speciation and mobility of the studied metals and by investigating the relationship with the behavior of them through cluster analysis. The results also proved the effectiveness of these approaches for assessing the removal mechanisms of the PEC purification. The mechanisms present in the removal of the COD, Fe and Mn from the Tehran rainwater, was oxidation in the positive Eh values, forming Fe_2O_3, and Mn_3O_4 on the photoanode. However, in the removal of Cd and Zn, the mechanism was precipitation in the negative Eh values, forming insoluble $Cd(OH)_2$ and ZnO, as realized by electrolysis. The Cd removal rate was low because of its low concentration in Tehran rainwater. The results of the dendrogram were identical to those obtained from the Eh/pH diagrams. Eh and pH had a strong effect on the studied pollutants, which had a similar behavior through changing Eh values during

PEC, except Zn. The present work tried to present an advanced treatment technique for the organic and metallic agents' removal. PEC process can also be employed for the removal of other metal ions such as Cr, Cu, Hg, etc, as well as other pollutants from Tehran rainwater.

AUTHOR CONTRIBUTIONS

Gh. Ebraheim conducted the literature review, planned the experimental design, and analyzed and interpreted the information, in addition to writing the manuscript. A.R. Karbassi and N. Mehrdadi supervised and helped in the literature review and the manuscript preparation.

ACKNOWLEDGEMENTS

The present study has been supported by the Ministry of Higher Education of Syria. Authors also thank the University of Tehran for providing the authors with the electro-flocculation laboratory to carry out the analysis. No funding was available.

CONFLICT OF INTEREST

The authors declare no potential conflict of interest regarding the publication of this work. In addition, the ethical issues including plagiarism, informed consent, misconduct, data fabrication and, or falsification, double publication and, or submission, and redundancy have been completely observed by the authors.

ABBREVIATIONS

OH	Hydroxyl radical
µs/cm	Microsiemens per centimeter
CA	Cluster analysis
CB	Conduction band
Cd	Cadmium
$Cd(OH)_2$	Cadmium hydroxide
COD	Chemical oxygen demand
DO	Dissolved oxygen
EC	Electrical conductivity
Eh, E	Redox potential
eV	Electron volt
Fe	*Iron*
Fe_2O_3	Iron oxide
H_2O_2	Hydrogen peroxide
ICP-MS	Inductively coupled plasma mass spectrometry
Mn	Manganese
Mn_3O_4, MnO_2	Manganese oxide
mV	Mele volte
MVSP	Multivariate statistical package
NaAsc	Sodium chloride
NaCl	Sodium chloride
NHE	The standard hydrogen electrode
OH^-	Hydroxides ions
Pb	Lead
PC	Photocatalyst
PEC	Photoelectrocatalytic
pzc	point of zero charge
RCS	Reactive chlorine species
RE	Removal efficiency
TDS	Total dissolved solids
Ti	*Titanium*
TiO_2	Titanium dioxide
UV	Ultraviolet
VB	Valence band
WPG	Weighted pair group
Zn	Zinc
ZnO	Zinc oxide

REFERENCES

Ab Aziz, N.A.B.; Palaniandy, P.; Abdul Aziz, H.; Aljuboury, D.A.D., (2018). Use of photocatalysis for conversion of harvested rainwater as an alternative source into drinking water. Global Nest. J., 20(2): 243-256 **(14 pages).**

Agarwal, S.K., (2009). Heavy metal pollution. Vol. 4. APH publishing.

ALabdeh, D.; Karbassi, A.R.; Omidvar, B.; Sarang, A., (2019). Speciation of metals and metalloids in Anzali Wetland, Iran. Int. J. Environ. Sci. Technol., 1-14 **(14 pages).**

Bai, Y.; Feng, X.; Xing, H.; Xu, Y.; Kim, B.K.; Baig, N.; Zimmerman, S.C., (2016). A highly efficient single-chain metal–organic nanoparticle catalyst for alkyne–azide "click" reactions in water and in cells. J. Am. Chem. Soc., 138(35): 11077-11080 **(4 pages).**

Barrera-Díaz, C.; Cañizares, P.; Fernández, F.J.; Natividad, R.; Rodrigo, M.A., (2014). Electrochemical advanced oxidation processes: an overview of the current applications to actual industrial effluents. J. Mex. Chem. Soc., 58(3): 256-275 **(20 pages).**

Berardo, A.; De Maere, H.; Stavropoulou, D.A.; Rysman, T.; Leroy, F.; De Smet, S., (2016). Effect of sodium ascorbate and sodium nitrite on protein and lipid oxidation in dry fermented sausages. Meat Sci., 121: 359-364 **(6 pages).**

Biati, A.; Karbassi, A.R.; Hassani, A.H.; Monavari, S.M.; Moattar, F., (2010). Role of metal species in flocculation rate during estuarine mixing. Int. J. Environ. Sci. Technol., 7(2): 327-336 **(10 pages).**

Biswal, H.J.; Vundavilli, P.R.; Gupta, A., (2019). Investigations on the effect of electrode gap variation over pulse-electrodeposition profile. IOP Conf. Ser.: Mater. Sci. Eng., 653(1): 012046 **(7 pages).**

Chatain, V.; Sanchez, F.; Bayard, R.; Moszkowicz, P.; Gourdon, R., (2005). Effect of experimentally induced reducing conditions on the mobility of arsenic from a mining soil. J. Hazard. Mater.,

122(1-2): 119-128 **(10 pages).**
Chen, X.; Huang, G.; Wang, J., (2013). Electrochemical reduction/ oxidation in the treatment of heavy metal wastewater. J. Metall. Eng (ME)**.,** 2(4) **(4 pages).**
Cheng, L.; Liu, S.; He, G.; Hu, Y., (2020). The simultaneous removal of heavy metals and organic contaminants over a Bi_2WO_6/ mesoporous TiO_2 nanotube composite photocatalyst. RSC Adv., 10(36): 21228-21237 **(10 pages).**
Chimonyo, W.; Corin, K.C.; Wiese, J.G.; O'Connor, C.T., (2017). Redox potential control during flotation of a sulphide mineral ore. Miner. Eng., 110: 57-64 **(8 pages).**
Chowdhury, P.; Elkamel, A.; Ray, A.K., (2014). Photocatalytic processes for the removal of toxic metal ions. Heavy Metals Water., 25-43 **(19 pages).**
Deng, Y., (1997). Effect of pH on the reductive dissolution rates of iron (III) hydroxide by ascorbate. Langmuir, 13(6): 1835-1839 **(5 pages).**
El Jamal, M.M., (2008). Experimental E-pH diagrams of Fe (III)/Fe (II) system in presence of variable concentration of different ligands. J. Chem. Technol. Metall., 43(1): 129-138 **(10 pages).**
Ensaldo-Rentería, M.K.; Ramírez-Robledo, G.; Sandoval-González, A.; Pineda-Arellano, C.A.; Álvarez-Gallegos, A.A.; Zamudio-Lara, Á.; Silva-Martínez, S., (2018). Photoelectrocatalytic oxidation of acid green 50 dye in aqueous solution using Ti/TiO_2-NT electrode. J. Environ. Chem. Eng., 6(1): 1182-1188 **(7 pages).**
Haratifar, S.; Bazinet, L.; Manoury, N.; Britten, M.; Angers, P., (2011). Impact of redox potential electrochemical modification and storage conditions on the oxidation reaction prevention in dairy emulsion. Dairy Sci Technol., 91(5):541-554 **(14 pages).**
Herbel, M.J.; Suarez, D.L.; Goldberg, S.; Gao, S., (2007). Evaluation of chemical amendments for pH and redox stabilization in aqueous suspensions of three California soils. Soil Sci. Soc. Am. J., 71(3): 927-939 **(13 pages).**
Igbinosa, I.H.; Aighewi, I.T., (2017). Assessment of the physicochemical and heavy metal qualities of rooftop harvested rainwater in a rural community. Glob Chall., 1(6): 1700011 **(7 pages).**
Jin, P.; Chang, R.; Liu, D.; Zhao, K.; Zhang, L.; Ouyang, Y., (2014). Phenol degradation in an electrochemical system with TiO_2/ activated carbon fiber as electrode. J. Environ. Chem. Eng., 2(2): 1040-1047 **(8 pages).**
Johnson, R.A.; Wichern, D.W., (2002). Applied multivariate statistical analysis. Upper Saddle River, NJ: Prentice hall. 5(8).
Karbassi, A.R.; Monavari, S.M.; Bidhendi, G.R.N.; Nouri, J.; Nematpour, K., (2008(a)). Metal pollution assessment of sediment and water in the Shur River. Environ. Monit. Assess., 147(1-3): 107 **(10 pages).**
Karbassi, A.R.; Nouri, J.; Mehrdadi, N.; Ayaz, G.O., (2008(b)). Flocculation of heavy metals during mixing of freshwater with Caspian Sea water. Environ. Geol., 53(8): 1811-1816 **(6 pages).**
Karbassi, A.R.; Torabi, F.; Ghazban, F.; Ardestani, M., (2011). Association of trace metals with various sedimentary phases in dam reservoirs. Int. J. Environ. Sci. Technol., 8(4): 841-852 **(12 pages).**
Khan, A.; Zou, S.; Wang, T.; Ifthikar, J.; Jawad, A.; Liao, Z.; Chen, Z., (2018). Facile synthesis of yolk shell Mn_2O_3@ Mn_5O_8 as an effective catalyst for peroxymonosulfate activation. Phys. Chem. Chem. Phys., 20(20): 13909-13919 **(11 pages).**
Komtchou, S.; Delegan, N.; Dirany, A.; Drogui, P.; Robert, D.; El Khakani, M.A., (2020). Photo-electrocatalytic oxidation of atrazine using sputtured deposited TiO_2: WN photoanodes under UV/visible light. Catal. Today., 340: 323-333 **(11 pages).**
Le, A.T.; Pung, S.Y.; Sreekantan, S.; Matsuda, A., (2019). Mechanisms of removal of heavy metal ions by ZnO particles. Heliyon., 5(4): e01440 **(27 pages).**
Li, B.; Bishop, P.L., (2004). Oxidation–reduction potential changes in aeration tanks and microprofiles of activated sludge floc in medium-and low-strength wastewaters. Water Environ. Res., 76(5): 394-403 **(10 pages).**
Li, B.; Bishop, P., (2002). Oxidation-reduction potential (ORP) regulation of nutrient removal in activated sludge wastewater treatment plants. Water Sci. Technol., 46(1-2): 35-39 **(5 pages).**
Li, X.Z.; Liu, H.S., (2005). Development of an E-H_2O_2/TiO_2 photoelectrocatalytic oxidation system for water and wastewater treatment. Environ. Sci. Technol., 39(12): 4614-4620 **(7 pages).**
Litter, M.I., (2015). Mechanisms of removal of heavy metals and arsenic from water by TiO_2-heterogeneous photocatalysis. Pure Appl. Chem., 87(6): 557-567 **(11 pages).**
Liu, L.; Li, R.; Liu, Y.; Zhang, J., (2016). Simultaneous degradation of ofloxacin and recovery of Cu (II) by photoelectrocatalysis with highly ordered TiO_2 nanotubes. J. Hazard. Mater., 308: 264-275**(12 pages).**
Montenegro-Ayo, R.; Morales-Gomero, J.C.; Alarcon, H.; Cotillas, S.; Westerhoff, P.; Garcia-Segura, S., (2019). Scaling up photoelectrocatalytic reactors: a TiO_2 nanotube-coated disc compound reactor effectively degrades acetaminophen. Water., 11(12): 2522 **(14 pages).**
Nadaska, G.; Lesny, J.; Michalik, I., (2018). Environmental aspect of manganese chemistry. 2012. HEJ.
Pareuil, P.; Pénilla, S.; Ozkan, N.; Bordas, F.; Bollinger, J.C., (2008). Influence of reducing conditions on metallic elements released from various contaminated soil samples. Environ. Sci. Technol., 42(20): 7615-7621 **(7 pages).**
Park, H.; Vecitis, C.D.; Hoffmann, M.R., (2009). Electrochemical water splitting coupled with organic compound oxidation: the role of active chlorine species. J. Phys. Chem. C., 113(18): 7935-7945 **(11 pages).**
Qin, Y.; Li, Y.; Tian, Z.; Wu, Y.; Cui, Y., (2016). Efficiently visible-light driven photoelectrocatalytic oxidation of As (III) at low positive biasing using Pt/TiO_2 nanotube electrode. Nanoscale Res. Lett., 11(1): 1-13 **(13 pages).**
Seibert, D.; Zorzo, C.F.; Borba, F.H.; de Souza, R.M.; Quesada, H.B.; Bergamasco, R.; Inticher, J.J., (2020). Occurrence, statutory guideline values and removal of contaminants of emerging concern by electrochemical advanced oxidation processes: a review. Sci. Total Environ., 141527 **(35 pages).**
Sharififard, H.; Ghorbanpour, M.; Hosseinirad, S., (2018). Cadmium removal from wastewater using nano-clay/TiO_2 composite: kinetics, equilibrium and thermodynamic study. AET., 4(4): 203-209 **(7 pages).**
Smith, M.V.; Pierson, M.D., (1979). Effect of reducing agents on oxidation-reduction potential and the outgrowth of clostridium botulinum type E spores. Appl. Environ. Microbiol., 37(5): 978-984 **(7 pages).**
Su, X.; Kushima, A.; Halliday, C.; Zhou, J.; Li, J.; Hatton, T.A., (2018). Electrochemically-mediated selective capture of heavy metal chromium and arsenic oxyanions from water. Nat. Commun., 9(1): 1-9 **(9 pages**).

Subramaniam, M.N.; Goh, P.S.; Lau, W.J.; Ismail, A.F., (2019). The roles of nanomaterials in conventional and emerging technologies for heavy metal removal: a state-of-the-art review. Nanomaterials., 9(4): 625 **(32 pages).**

Vahidhabanu, S.; Stephen, A.J.; Ananthakumar, S.; Ramesh Babu, B., (2015). Effect of ruthenium oxide/titanium mesh anode microstructure on electrooxidation of pharmaceutical effluent. Int. J. Waste Resour., 5(191): 2 **(5 pages).**

Wahyuni, E.T.; Aprilita, N.H.; Hatimah, H.; Wulandari, A.M.; Mudasir, M., (2015). Removal of toxic metal ions in water by photocatalytic method. Chem. Sci. Int. J., 194-201 **(8 pages).**

Wang, Q.; Shang, J.; Zhu, T.; Zhao, F., (2011). Efficient photoelectrocatalytic reduction of Cr (VI) using TiO_2 nanotube arrays as the photoanode and a large-area titanium mesh as the photocathode. J. Mol Catal. A: Chem., 335(1-2): 242-247 **(6 pages).**

Williams, J.L., (2006). An electrolytic technique to study the mobility of inorganic constituents in soils and waste materials (Doctoral dissertation) **(165 pages).**

Wilschefski, S.C.; Baxter, M.R., (2019). Inductively coupled plasma mass spectrometry: introduction to analytical aspects. Clin Biochem. Rev., 40(3): 115.

Yao, J.; Mei, Y.; Xia, G.; Lu, Y.; Xu, D.; Sun, N.; Chen, J., (2019). Process optimization of electrochemical oxidation of ammonia to nitrogen for actual dyeing wastewater treatment. Int. J. Environ. Res. Public Health., 16(16): 2931 **(13 pages).**

Yao, Y.W.; Cui, L.H.; Li, Y.; Yu, N.C.; Dong, H.S.; Chen, X.; Wei, F., (2015). Electrocatalytic degradation of methyl orange on PbO_2-TiO_2 nanocomposite electrodes. Int. J. Environ. Res., 9(4): 1357-1364 **(8 pages).**

Yurdakal, S.; Çetinkaya, S.; Şarlak, M.B.; Özcan, L.; Loddo, V.; Palmisano, L., (2020). Photoelectrocatalytic oxidation of 3-pyridinemethanol to 3-pyridinemethanal and vitamin B_3 by TiO_2 nanotubes. Catal. Sci. Technol., 10(1): 124-137 **(6 pages).**

Zarei, E., (2019). A strategy for degradation of 2, 5-dichlorophenol using its photoelectrocatalytic oxidation on the TiO_2/Ti thin film electrode. Iran. J. Catal., 9(2): 99-108 **(10 pages).**

Zarei, E.; Ojani, R., (2017). Fundamentals and some applications of photoelectrocatalysis and effective factors on its efficiency: a review. J. Solid State Electrochem., 21(2): 305-336 **(31 pages).**

Zhao, X.; Guo, L.; Hu, C.; Liu, H.; Qu, J., (2014). Simultaneous destruction of Nickel (II)-EDTA with TiO_2/Ti film anode and electrodeposition of nickel ions on the cathode. Appl. Catal., B., 144: 478-485 **(8 pages).**

Zhou, X.; Zheng, Y.; Zhou, J.; Zhou, S., (2015). Degradation kinetics of photoelectrocatalysis on landfill leachate using codoped TiO_2/Ti photoelectrodes. J. Nanomater., **(12 pages).**

Zou, X.; Sun, Z.; Hu, Y.H., (2020). G-C3N4-based photoelectrodes for photoelectrochemical water splitting: a review. J. Mater. Chem. A., **(30 pages).**

HOW TO CITE THIS ARTICLE

Ebraheim, Gh.; Karbassi, A.R.; Mehrdadi, N., (2021). Chemical reducing conditions through the photo-assisted electrochemical process in the treatment of an urban rainwater. Int. J. Hum. Capital Urban Manage., 6(3): 209-224.

DOI: 10.22034/IJHCUM.2021.03.01

url: http://www.ijhcum.net/article_239703.html

Int. J. Hum. Capital Urban Manage., 6(3): 225-236, Summer 2021

International Journal of Human Capital in Urban Management
(IJHCUM)

Homepage: http://www.ijhcum.net/

ORIGINAL RESEARCH PAPER

Domestic water consumption pattern and awareness of urban households

A. Narmilan[1,*], N. Puvanitha[2], G. Niroash[1], M. Sugirtharan[3], R. Vassanthini[1]

1Department of Biosystems Technology, Faculty of Technology, South Eastern University of Sri Lanka
2Department of Agriculture, Hardy, Sri Lanka Institute of Advanced Technological Education, Sri Lanka
3Department of Agricultural Engineering, Faculty of Agriculture, Eastern University, Sri Lanka

ARTICLE INFO

Article History:
Received 11 September 2020
Revised 01 January 2021
Accepted 03 January 3, 2021

Keywords:
Batticaloa
Water efficiency
Household
Water consumption
Water deficit

ABSTRACT

BACKGROUND AND OBJECTIVES: Increased demand for water has put pressure on the water supply system, which has led to environmental issues such as water resource over-exploitation and ecosystem balance breaks. This study aimed to examine household water consumption trends and management practices and compare the efficacy of various water management interventions to reduce the Batticaloa district's water deficit.

METHODS: The primary data was collected through a questionnaire survey from 300 households belonging to the urban area in Batticaloa District in Manmunai Pattu, Sri Lanka. The data were analyzed using correlation and linear regression analyses. A flow rate study was designed to assess the individual flow rate for each household.

FINDINGS: The overall domestic water use is negatively correlated ($p \leq 0.01$) with the household head's age and education level and positively associated with income level. As the household size, age, education level, number of taps, and household income showed statistical significance ($p \leq 0.05$), the Linear regression model was statistically essential. Together, they accounted for 96.5% of the difference in per capita water consumption in the wet season. Moreover, most of the people are not aware of the cost of water per cubic meter and only 26.7% are aware of the cost and 88% of the respondents are more concerned about the quality of water and very few respondents (12%) are not concerned about the water quality.

CONCLUSION: The results indicate that more water is used by people with higher incomes in urban areas than people with lower incomes. The use of water depends on household members' living standards, family size, age, education level, and the number of taps present in the household. Also, most household members are not aware of the efficient use of water in the study area.

DOI: 10.22034/IJHCUM.2021.03.02

NUMBER OF REFERENCES	NUMBER OF FIGURES	NUMBER OF TABLES
37	5	8

*Corresponding Author:
Email: *narmilan@seu.ac.lk*
Phone: +94761405474
Fax: +94761405474

Note: Discussion period for this manuscript open until October 1, 2021 on IJHCUM website at the "Show Article.

INTRODUCTION

A crucial role in the place, operation, and creation of communities has been played by water. Water is critical and forms the foundation of a nation's social and economic growth (Singh and Turkiya, 2013). The United Nations has predicted that the world population will increase by another two billion (2 x 10^9) people by 2030 (Postel, 2000). The World Health Organization (WHO) characterized domestic water as the water utilized for domestic purposes, including drinking, washing, and food arrangement. Household water utilization is a huge part of the water use, and it differs as indicated by the expectations for everyday comforts of the buyers in metropolitan and provincial zones (Mohammed and Sanaullah, 2017). Giving sufficient and improved drinking water is progressively massive, particularly in nations with quickly developing populaces. Improved drinking water alludes to water sourced from a tap situated inside premises or yard/plot, a public standpipe, a cylinder well, a secured burrowed well or spring, and precipitation (UNICEF/WHO, 2015). The consumption of household water is determined by several variables, such as environment, seasonality, socio-economic and socio-demographic characteristics. In this analysis, only socio-demographic factors are taken into consideration. Many exploration ventures have zeroed in on featuring the momentum water lack and the private area's expanded use. Most research initiatives have concentrated on highlighting the current scarcity of water and the increased consumption by the residential sector. Nevertheless, when meeting household water demand as one of the main goals of various policy interventions and program recommendations on drought reduction or domestic water management strategies, a lack of domestic water usage studies is noted. This research examines the influence of household socio-economic conditions on different aspects of urban domestic water consumption in Manmunai Pattu, Sri Lanka in 2019.

MATERIALS AND METHODS

Data collection

A survey was conducted on household water consumption in the urban Batticaloa district, Sri Lanka (Fig.1). A Simple random sampling technique was followed to select households so that each household has an equal probability of being included in the sample. Also, more than half of the respondent households are currently not engaged in water conservation because of continuous access to water through their water source. A detailed questionnaire was prepared with over 40 questions. Socio-demographic characteristics of respondents, such as the age of the household head, education level, living standard of the family, average monthly income of Household and family size and domestic water use behavior at the household level such as the source of water supply, source of irrigation and source of drinking water were investigated. Furthermore, questions regarding each water end-use (e.g., bathing, hand washing, toilet flushing, dishwashing, cleaning, cooking, and watering the garden) were also included. The flow rate study was designed to form the knowledge obtained from the literature review, and it was discovered that the flow rate (tap

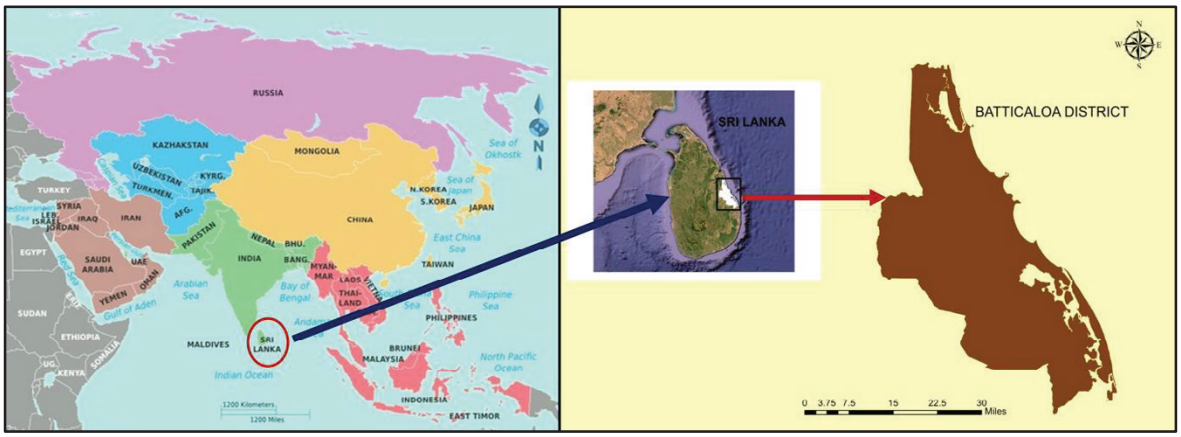


Fig. 1: Geographic location of the study area in urban Batticaloa area of Sri Lanka

and showerhead) could be estimated through a straightforward test. The test strategy depended on the Green Venture site: how to direct a stream rate test, 2007 (Green Venture, 2007). The test instruments incorporated a stopwatch (Mobile telephone), a holder with estimations as an afterthought, the most extreme estimation being 1.5 liters, and an adding machine. The principal techniques were as per the following: 1) The vacant holder was set under a tap or showerhead; the tap or the shower head was gone on to its most special stream rate. The stopwatch was begun simultaneously. When the water arrives at 1 liter, the watch was halted and the time was recorded; 2) The flow rate was calculated. For example, to fill one-liter container takes 5.8seconds, 5.8 sec= 0.1 min, the flow rate = 1 liter/ 0.1 minute= 10 liters/ minute; and 3) and this procedure was repeated twice obtain the average measurement.

Data analysis

The Statistical Kit for Social Sciences has integrated quantitative data on socio-demographic and water use characteristics (SPSS 25.0). To analyze the relationships between per capita intake of water and possible predictors, correlation and linear regressions were used. To evaluate the predictors of water use, a linear regression analysis was used. Each variable was entered in a sequence, and its value was assessed at the level of statistical significance.

RESULTS AND DISCUSSION

Demographic composition

The demographic composition of the sample households and the social status of farmers in the survey community is shown in Table 1. Around 30.7% of households' heads are aged between 56 to 65, and 28% are aged from 46 to 55 years while those aged

Table 1: Demographic composition

Age of the household head (years)	Number	Percentage	Education	Number	Percentage
Below 25	0	0	Primary	0	0
25-35	32	10.7	Intermediate	60	20.0
36-45	64	21.3	Advanced	144	48.0
46 -55	84	28.0	Higher	88	29.3
56-65	92	30.7	None	8	2.7
Above 66	28	9.3	Total	300	100.0
Total	300	100.0			
Ownership of the House			The living standard of the family		
Own	256	85.3	Poor	8	2.7
Rented	44	14.7	Medium	236	78.7
Total	300	100	Rich	56	18.7
			Total	300	100.0
Occupation of Household head			Average Monthly Income of Household		
Government	116	38.7	Below 10,000 LKR	0	0
Private/NGO	44	14.7	10,001-15,000 LKR	8	2.7
Business	28	9.3	15,001-20,000 LKR	8	2.7
Farmer	16	5.3	20,001-25,000 LKR	24	8.0
Day-wage labor	16	5.3	25,001-30,000 LKR	48	16.0
Others	80	26.7	30,001-40,000 LKR	44	14.7
Total	300	100.0	40,001-50,000 LKR	52	17.3
			Above 50,000 LKR	116	38.7
			Total	300	100.0
Family size					
2	8	2.7			
3	104	34.7			
4	108	36.0			
5	44	14.7			
6	24	8.0			
7	12	4.0			
Total	300	100			

*LKR (Sri Lankan Rupee), Around 1 LKR = 0.0054 US $

Table 2: Correlation between potential predictors – per-capita water usage

	Per-capita water usage	Correlation coefficient	Sig. (1-tailed)
Pearson Correlation	Family size	0.950	0.000
	Age	-0.944	0.000
	Education level	-0.873	0.000
	Number of taps	0.951	0.000
	Living standard	0.825	0.000
	Household income	0.968	0.000

36 -45 accounted for 16% of the total respondents. Regarding the household heads whose age between 25 -35 years and below 66 years were almost similar by having 8% and 7% respectively. However, there were no household heads observed below 25 aged groups. The survey showed that around half of the respondents (48%) had completed their advanced education level. In comparison, those who have received their higher education and intermediate level of education are 22% and 15% respectively. However, only 2% of them were uneducated, and there are no individuals who attained only primary education. Table 1 shows that 85.3% of household heads have their own house, while 14.7% of respondents reside in rented houses. In terms of living standards of the respondent's family, it was observed that a higher percentage (73.70%) of the family whose living standard is medium followed by wealthy families (18.7%). In comparison, the poor were accounted for 2.7%. The number of household size is one of the essential demographic characteristics of a household. According to household size, distribution of respondents shows that the majority (36 %) of the families had 3 to 6 members in their houses. In comparison, 14% of them had 5 members and those who have 6, 3, and 2 in 8%, 4%, and 2% respectively. According to the survey, the occupations of family heads found to be involved in the government sector (38.7%), other kinds of jobs (20%), private or Non-Governmental Organizations (NGOs) (14.7%), and the rest of them were engaged in business (9%), farming (5.3%) and daily labor work (5.3%).

Correlation between Demographic characteristics and water consumption pattern

Age of household member

Table 2 indicates that age is negatively correlated with total domestic water consumption and the correlation coefficient was -0.944 ($p<0.01$). The age of household members also influences the use of water. The behavior of water use can be very different among household members of different ages. It would be expected that households with children will use more water. Youngsters may use waterless wisely, such as taking more baths, laundering more often, whereas retired people maybe even more flourishing (Nauges and Thomas, 2000).

Living standards

Total domestic water intake is positively associated with living standards, p<001 (Table 2). This was supported by Syme *et al*. (2004) and Loh and Coghlan (2003), and the result is attributed to the use of modern appliances and a lack of knowledge of elders. In developing countries, people spend more money on products that use more water, such as dishwashers, washing machines, flushing toilets, and showers. As living standards rise, people also prefer to consume more meat, which requires more water in its processing. The number of people in residence (Hanke and Maré, 1982) is a variable that positively impacts household water consumption. The study population's total water usage was 12732.5 liters, and Per capita, water usage was 169.8 liters.

Income level

The correlation between water consumption and the income level of the survey community is shown in Table 2. It is shown that the total domestic water consumption is positively correlated with income level and the correlation coefficient was 0.968 ($p<0.01$). High water consumption may due to the high living standard of the survey community (Table 2), as a high level of income is associated with high living standards. This may mean a higher number of water-consuming appliances and a higher probability of high-water usage for watering large garden areas. Kennedy (2008) and Guhathakurta and Gober (2007) endorsed that increasing income results in corresponding water consumption

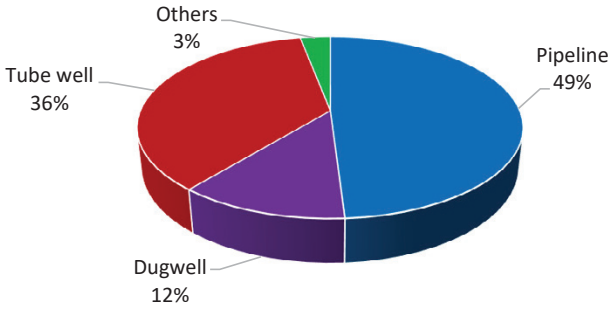


Fig 2: Different types of water supply

increment. Dalhuisen (2003) stated that though the water consumption is increased with income, it is not proportional. Usage of western-style bathtubs, dishwashers, and washing machines in high-income households also attribute to high-water consumption.

Education level

In a household, the level of education also affects water consumption. The overall domestic water intake was shown to be negatively correlated with the level of education, and the correlation coefficient was -0.873 (p<001) (Table 2). Educated people are more conscious about the increasing water scarcity, and they literate their younger generation to use water resources efficiently. The degree of education is positively associated with lower water use and higher water saving habits, which will minimize the household's overall water consumption (Millock and Nauges, 2010). Educational campaigns teach quick ways to save water and improve self-efficacy sensations. Collins et al. (2003), on the other hand, suggested that older people tend to use less water due to traditional patterns of water use (washing hands, showering, and sharing water between family members) and their unfamiliarity with water appliances.

Number of taps

The number of taps also influences the water consumption in a household. Table 2 shows that the total domestic water consumption is positively correlated with the number of taps and the correlation coefficient was 0.951 (p<0.01). It is proved from the results that there was a significant impact on water consumption due to the increased number of taps. Also, the increase in water consumption could be attributed to the pipe diameter and water flow rate (Englart and Jedlikowski, 2019).

Household size

Table 2 shows that household size is positively associated with overall domestic water use and the correlation coefficient was 0.95 (p<0.01). The amount of water used in a household determines the number of household members (Gaudin, 2006). Larger amounts of water are used for families with more family members. Arbus *et al*. (2004) found that, while this is not a proportional rise, water consumption increases with the household's size. Household size, however, was found to be an insignificant factor in the domestic level of water usage (Guhathakurta and Gober, 2007). A large household typically uses higher-frequency household appliances, resulting in higher water use than a small household. Many studies have shown a clear association between the age of the household leader and the net family size and the consumption of water (Arouna and Dabbert, 2010; Syme *et al*., 2004).

Water supply

Fig. 2 illustrates the different sources of the water supply of households. It was clear that around half of the households (49%) receive the pipeline water followed by tube well usage to a level of 36% while those who use water from dug well accounted for 12%. The lowest amount (3%) of respondents got water from other sources like lakes, rivers, and ponds. A similar result was reported by Tadesse *et al*. (2013) and Mahama *et al*. (2014). Several household characteristics strongly influence the choice of the water source. Local households seem to have adopted different practices for accessing

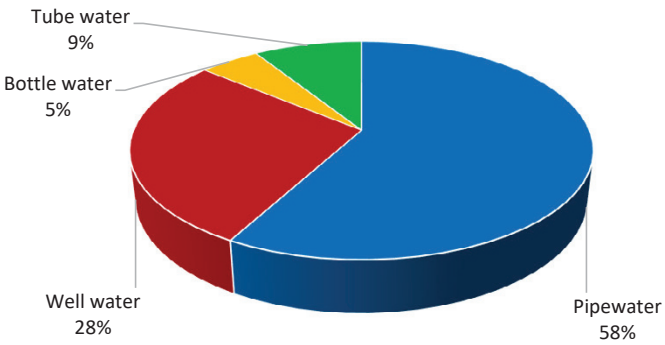


Fig 3: Different types of drinking water supply

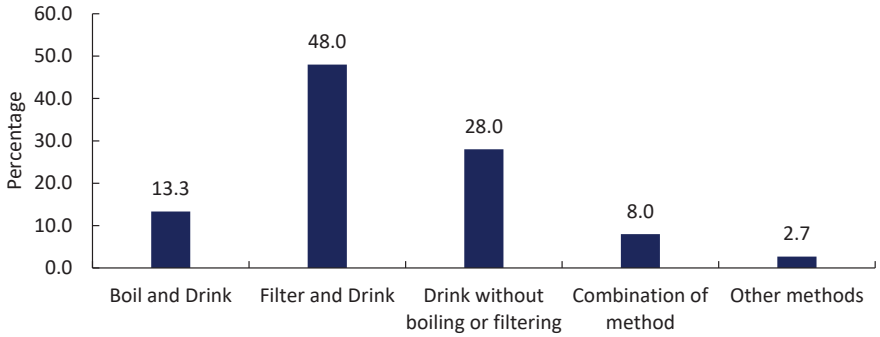


Fig. 4: Family practice adopted in the preparation of drinking water

alternative water sources rather than dug well alone to meet their diverse needs. Most households are dependent on private wells. But water sources and their uses changed significantly between the wet and dry seasons (Elliott *et al.*, 2017). The most common household water sources were taps and well (Casanova *et al.*, 2012).

Drinking water

Fig. 3 summarizes the percentage use of drinking water from a different source of water supply. Overall, the highest amount (58%) of drinking water was collected using the pipeline. Drinking water consumption from well water accounts for 28% of the total population. The tube well water and bottled water were the lowest water quantity, which is utilized for drinking purposes among the households for 9% and 5%. Piped water supply was the most common drinking-water source in urban areas. This parallels the Nketiah-Amponsah *et al*. (2009) observed that access to a pipeline drinking water source is higher than other types of drinking water sources. Bottled water consumption is low due to the high price. A study by Vásquez (2017) showed that bottled water consumption was positively linked to perceptions of health risk, household income, and education and market access. The probability of drinking bottled water has been adversely affected by household size.

The family practice adopted in the preparation of drinking water

Fig. 4 shows the family practice adopted in the preparation of drinking water. Most of the respondents (48%) were practicing filter and drinking methods, but 28% of the families were adopted to drinking the water without boiling or filtering. In terms of the boiling and drinking method, only about 13% of families used this method. However, only about 8% of respondents used the combination method, and 2.7% were using other methods when preparing the drinking water.

Boiling and filtering are the most common

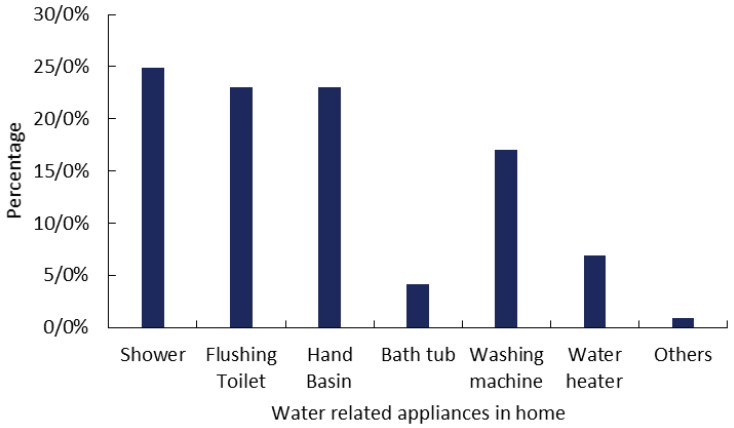


Fig. 5: usage of water-related appliances in the home

Table 3: Linear regression analysis

R	R Square	Adjusted R Square	Std. Error
0.982	0.965	0.962	23.8504

methods used in households for purifying water. Clasen *et al*. (2008) stated that boiling is a relatively expensive method, and Gilman and Skillicorn (1985) stated that boiling costs might be expensive for many low-income populations. Francis *et al*. (2015) observed the frequency of filtering water for children is higher than for adults. However, studies have shown that households do not regularly use Household Water Treatment when necessary and have potential health benefits (Brown and Clasen, 2012). Filtering was more common among user households than any form of treatment (Casanova *et al*., 2012).

Water-related appliances in the home

Fig. 5 illustrates the patterns of water use by households. It was clear that the highest amount (24.9%) of water has been used for showers for daily use by households while 23.0% of total water of household is used in toilet flushing and the same amount is used for personal hygiene, especially for hand washing. Nearly half of the proportion (17.1%) of water is utilized for washing machines. It was also found that small quantities needed for water heaters, bathtubs, and other needs using 6.9%, 4.1%, and 0.9% respectively.

Literature by Beal and Stewart (2011) argues that teenagers consume high volumes of water for showers. Shaban and Sharma (2007) found that bathing, washing dishes, washing clothes, and washing utensils are responsible for much higher water consumption in households. Modern lifestyle changes can increase water consumption when bathing and showering (Bello-Dambatta, 2014). Also, bathrooms and lifestyle changes contribute to the trend towards using significantly more water for showering (Shaban and Sharma, 2007).

Models Based on Linear Regression

Linear regression analysis was conducted to examine the potential predictors' effects on per capita water consumption in urban households. The model was statistically significant as household size, age, education level, number of taps and household income showed statistical significance ($p \leq 0.05$). Together they accounted for 96.5% of the variation in per capita water consumption in the wet season, R^2 = 0.965, F= 375.813.

Irrigation water management in households

Sources and methods of irrigation are shown in Table 4, A high percentage (88%) of people irrigate crops in their homes while a small percentage (12%) fail to irrigate. According to the results, the usage of well water for irrigation was found to be the highest, which is 66.7%, followed by pipeline (28.8%) and tube water (4.5%). This was supported

Table 4: Irrigation water management

Do you irrigate to crops in your home	Number	Percentage	Source of irrigation	Number	Percentage
Yes	264	88.0	Pipeline (National Water Supply and Drainage Board)	76	28.8
No	36	12.0	Well water	176	66.7
			Tube water	12	4.5
Total	300	100.0	Total	264	100.0
Irrigation time			Irrigation method		
Early morning	60	22.7	By hand (hose or bucket)	228	86.4
Late morning	8	3.0	Manual sprinkler	36	13.6
Evening	196	74.2			
Total	264	100.0	Total	264	100.0
Additional sources for irrigation water					
Rain barrel	12	4.5			
No	252	95.5			
Total	264	100.0			

Table 5: Awareness of water management

Awareness about the cost of water per cubic meter	Number	Percentage	The general belief about the current water rate	Number	Percentage
Aware	80	26.7	Too high	28	9.3
Not aware	220	73.3	Normal	248	82.7
Total	300	100.0	Do not know	24	8.0
			Total	300	100.0
Frequency of water supply (Pipeline)	Number	Percentage			
Regular	104	43.3			
Irregular	136	56.7			
Total	240	100.0			

by Das Bhowmik, *et al*. (2020). In terms of irrigation time, it was observed that the highest percentage (74.2%) of people irrigate in the evening followed by early morning irrigation (22.7%), and a noticeable low percentage (3%) was observed for late morning irrigation. This may be due to conserving the water by reducing evapotranspiration, as evapotranspiration is high in the day's hottest hours (Wonsook *et al.*, 2020). A significant amount (86.4%) of people irrigates by hand simultaneously, 13.6% irrigate by manual sprinkler method.

Awareness of water management at the domestic level

Awareness of respondents in regards to the water supply and conservation are shown in Table 5. According to the results, most people are not aware of the cost of water per cubic meter, and only 26.7% are aware of the cost. 82.7% of the total respondents believe that the current water rate is normal, while very few (9%) believe it is too high. This supports the results obtained for living standard and family income, as they are relatively high for most of the respondents (Table 1). The frequency of water supply results shows that more than half of the respondents face irregular water supply simultaneously, 43% face a regular supply of water.

Water management in households

Table 6 shows that 88% of the respondents are more concerned about the quality of water. However, very few respondents (12%) are not concerned about water quality. It can be seen that most of the people limit their water use because they think the amount of water in wells is low, 26.7% limit their water usage to reduce the electricity bill followed by 18.7% tend to conserve the water resource. To preserve the water, nearly a quarter (24%) of the respondents

Table 6: Linear regression analysis

Reasons for limited water use	Number	Percentage	Concern about the quality of water	Number	Percentage
Not sure well has enough water	136	45.3	Concerned	264	88.0
To keep the electrical bill down	80	26.7	Not concerned	36	12.0
Not sure the septic system can handle all wastewater	8	2.7			
To conserve water to protect the resource	56	18.7			
Others	20	6.7			
Total	300	100.0	Total	300	100.0
Actions were taken to conserve water	Number	Percentage	Measures are taken to avoid running or leaky toilets and other faucets	Number	Percentage
Take short showers	72	24.0	Never had the problem	116	38.7
Installed low-flow pumping fixtures	36	12.0	Repair running toilet immediately	116	38.7
Irrigating during early morning or evening	64	21.3	Call a plumber immediately	56	18.7
Installed water efficient irrigation system	12	4.0	Fix leaks within a week	12	4.0
Reduce irrigation land area	28	9.3			
Other	88	29.3			
Total	300	100.0	Total	300	100.0

Table 7: Different water usage

Usage	Percentage
Toilet usage	11.72
Bathing	45.02
Drinking	4.12
Clothes washing	15.06
Utensils cleaning	6.26
Cooking	2.84
Watering	11.42
House cleaning	3.04
Others	0.53

take short showers while a lesser amount of the survey population (4%) has installed a water efficient irrigation system. This may be due to the high cost of conservation devices Geller *et al*. (1983). According to the results shown for measures taken to avoid running or leaky toilets and other faucets, it is noticeable that most of the people (38.7%) repair the running toilet immediately and which is on par with respondents who never had any leakage problems. Despite this, very few (4%) fix leaks within a week. This may be due to the concern of people on the limited use of water for various reasons.

Total water usage and Cost of water per cubic meter

The study population's total water usage was 12.73 $m^{3,}$ and per capita water usage was 0.1698 m^3. And the monthly water consumption 381.98 m^3. According to Tables 7 and 8, households' total income is 2,703,410 LKR, and the total Bill usage is 65692.8 LKR. Therefore, the share of water usage cost in the overall income of families is 2.43%. Sadr *et al*. (2015) observed that a household's per capita water consumption was 183 litres/person/day. This is on par with the per capita water usage of the present study. Also, he found that the water used for bathing was

Table 8: Cost of water per cubic meter

No of Units	Usage Charge (LKR/Unit)	Monthly Service Charge (LKR)
0-5	12	50
6-10	16	65
11-15	20	70
16-20	40	80
21-25	58	100
26-30	88	200
31-40	105	400
41-50	120	650
51-75	130	1000
Over 75	140	1600

*unit, 1 unit = $1m^3$
(Waterboard.lk. 2021)

greater compared to other practices. A similar pattern was observed in the current study. The study in Indian urban areas showed that per capita water usage is negatively correlated with family size. However, the present study showed a positive correlation between water usage and family size (Sadr *et al*., 2015).

CONCLUSION

Increased demand for water has put pressure on the water supply system, which has led to environmental issues such as water resource over-exploitation and ecosystem balance breaks. This study showed that a high-income level and living standards increased total domestic water consumption. It was demonstrated that elder people use less water than younger people in general. Total domestic water consumption for household uses indicated that the highest amount of (72%) water has been used for showers and bath compared to toilet flushing, personal hygiene, and cloth washing. Family size and the number of taps in a household were found to be essential indicators in estimating household water consumption; it was shown that families with many members and a high number of taps have higher water consumption in general. The total domestic water consumption is negatively correlated ($p \leq 0.01$) with the household head's age and education level. However, positively correlated with income level. The Linear regression model was statistically significant as household size, age, education level, number of taps, and household income showed statistical significance ($p \leq 0.05$). Together, they accounted for 96.5% of the variation in per capita water consumption in the wet season. Moreover, most of the people are not aware of the cost of water per cubic meter and only 26.7% are aware of the cost and 88% of the respondents are more concerned about the quality of water and very few respondents (12%) are not concerned about the water quality. This study's findings concluded that the socio-economic condition of the households' impacts various aspects of domestic water consumption in urban Batticaloa in Manmunai Pattu, Sri Lanka. These findings would help manage the water demand and help reduce their consumption in urban areas.

AUTHOR CONTRIBUTIONS

A. Narmilan prepared the manuscript text, and manuscript edition, N. Puvanitha performed the experiments and literature review, G. Niroash analyzed and interpreted the data, M. Sugirtharan performed some of the remained experiments and R. Vassanthini performed the survey with urban households.

ACKNOWLEDGMENTS

The authors express their sincere gratitude to the National Water Supply and Drainage Board for their contribution and to the anonymous referees of this journal for helpful comments.

CONFLICT OF INTEREST

The authors declare no potential conflict of interest regarding the publication of this work. The authors have also entirely witnessed the ethical issues, including plagiarism, informed consent, misconduct, data fabrication and, or falsification, double publication and, or submission, and redundancy.

ABBREVIATIONS

%	Percentage
NGO	Non-Governmental Organization
LKR	Sri Lankan Rupee

REFERENCES

Arbus, F.; Barbern, R.; Villana, I., (2004). Price impact on urban residential water demand: A dynamic panel data approach. Water Resour. Res., 40(11): **(9 pages)**.

Arouna, A.; Dabbert S., (2010). Determinants of domestic water use by rural households without access to private improved water sources in Benin: A seemingly unrelated Tobit approach. Water Resour. Manage., 24: 1381-1398 **(18 pages)**.

Beal, C.; Stewart, R.A., (2011). South East Queensland residential end use study: final report. Urban Water Security Research Alliance Technical Report No. 47, **(174 pages)**.

Bello-Dambatta, A.; Kapelan, Z.; Butler, D., (2014). Impact assessment of household demand saving technologies on system water and energy use, Br J Environ Clim Change., 4(2): **(18 pages)**.

Brown, J.; Clasen, T., (2012). High adherence is necessary to realize health gains from water quality interventions. PLoS One, 7: 1-9 **(9 pages)**.

Casanova, L.M.; Walters, A.; Naghawatte, A.; Sobsey, M. D., (2012). Factors affecting continued use of ceramic water purifiers distributed to tsunami-affected communities in Sri Lanka. Trop. Med. Int. Health, 17(2): 1361-1368 **(8 pages)**.

Clasen, T.; McLaughlin, C.; Nayaar, N.; Boisson, S.; Gupta, R.; Desai, D.; Shah, N., (2008). Microbiological effectiveness and cost of disinfecting water by boiling in semi-urban India. Am J Trop Med Hygiene. 79: 407-413 **(7 pages)**.

Collins, J.; Thomas, G.; Willis, R.; Wilsdon, J.M., (2003) Carrots, sticks and sermons: influencing public behaviour for environmental goals. Report version 4.0. Demos and Green Alliance. DEFRA. **(56 pages)**.

Dalhuisen, J.M.; Florax, R. J. G. M.; de Groot, H.L.F.; Nijkamp, P., (2003). Price and income elasticities of residential water demand: a meta-analysis. Land Econ., 79(2): 292-308 **(17 pages)**.

Elliott, M.; MacDonald, M. C.; Chan, T.; Kearton, A.; Shields, K. F.; Bartram, J. K.; Hadwen, W. L., (2017). Multiple household water sources and their use in remote communities with evidence from Pacific Island Countries. Water Resour. Res., 53: 9106-9117 **(12 pages)**.

Englart, S.; Jedlikowski, A., (2019). The influence of different water efficiency ratings of taps and mixers on energy and water consumption in buildings. SN Appl. Sci., 1: 525.

Francis, M.R.; Nagarajan, G.; Sarkar, R.; Mohan, V.R.; Kang, G.; Balraj, V., (2015) Perception of drinking water safety and factors influencing acceptance and sustainability of a water quality intervention in rural southern India. BMC Public Health., 15: 731 **(9 pages)**.

Gaudin, S., (2006). Effect of price information on residential water demand. Appl. Econ., 38(4): 383-393 **(11 pages)**.

Geller, E.S.; Erickson, J.B.; Buttram B.A., (1983) Attempts to promote residential water conservation with educational, behavioral and engineering strategies. Popul. Environ. 6(2): 96-112 **(17 pages)**.

Gilman, R.H.; Skillicorn P., (1985). Boiling of drinking-water: can a fuel-scarce community afford it?. Bull World Health Organ., 63: 157-163 **(7 pages)**.

Guhathakurta, S.; Gober, P., (2007). The impact of the Phoenix urban heat island on residential water use. J Am Plann Assoc., 73(3): 317-329 **(13 pages)**.

Green Venture. 2007. How to conduct a flow rate test.

Hanke, S.H.; Mare, L., (1982). Residential water demand: A pooled, time series, cross-section study of Malmo, Sweden. Water Resour. Bull, 18(4) **(5 pages)**.

Kenney, D.S.; Goemans, C.; Klein, R.A.; Lowrey, J.; Reidy, K., (2008). Residential water demand management: lessons from Aurora, Colorado. J Am Water Resour Assoc., 44 (1): 192-207 **(16 pages)**.

Seelen, L.M.; Flaim, G.; Jennings, E.; Domis, L.N.D.S., (2019). Saving water for the future: Public awareness of water usage and water quality. J. Environ. Manage., 242: 246-257 **(12 pages)**.

Loh, M.; Coghlan, P., (2003). Domestic water use study: In Perth, Western Australia 1998–2001. Water Corporation of Western Australia, Australia, **(36 pages)**.

Mahama, A. M.; Anaman, K.A.; Osei-Akoto, I., (2014). Factors influencing householders' access to improved water in low-income urban areas of Accra, Ghana. J. Water Health., 12(2): 318-331 **(14 pages)**.

Millock, K.; Nauges, C., (2010). Household adoption of water-efficient equipment: the role of socio-economic factors, environmental attitudes and policy. Environ. Resour. Econ., 46: 539-565 **(27 pages)**.

Mohammed, A.H.; Sanaullah, P., (2017). An empirical analysis of domestic water sources, consumption and associated factors in Kandahar City, Afghanistan. Resour. Environ. J., 7(2): 49-61 **(13 pages)**.

Nauges, C.; Thomas, A., (2000). Privately operated water utilities, municipal price negotiation, and estimation of residential water demand: the case of France. Land Econ., 76(1): 68-85 **(18 pages)**.

Nketiah-Amponsah, E.; Aidam, P.W.; Senadza, B., (2009). Socio-economic determinants of sources of drinking water: Some insight from Ghana. Paper presented at the Conference on International Research on Food Security, Natural Resource Management and Rural Development, University of Hamburg, Germany **(4 pages)**.

Postel, S.L., (2000). Entering an era of water scarcity: The challenges ahead. Ecol. Appl, 10(4): 941-948 **(8 pages)**.

Das Bhowmik, R.; Seo, S.B.; Das, P.; Sankarasubramanian, A., (2020). Synthesis of Irrigation Water Use in the United States: Spatiotemporal Patterns. J. Water Resour. Plan. Manage., 146(7) **(9 pages)**.

Sadr, S.; Memon, F.; Duncan, A.; Jain, A.; Gulati, S.; Hussien, W.; Savic, D.; Butler, D., (2015). An investigation into domestic water consumption and water use habits in Indian urban areas (**12**

pages).
Shaban, A.; Sharma, R.N., (2007). Water consumption patterns in domestic households in major cities in India. Econ Polit. W., 42(23) **(9 pages)**.
Singh, O.; Turkiya, S., (2013). A survey of household domestic water consumption patterns in rural semi-arid village, India. Geo J., 78: 777-790 **(14 pages)**.
Syme GJ.; Shao, Q.; Po, M.; Campbell, E., (2004) Predicting and understanding home garden water use. Landscape Urban Plan., 68: 121-128 **(8 pages).**
Tadesse, A.; Bosona, T.; Gebresenbet, G., (2013). Rural water supply management and sustainability: The case of Adama area, Ethiopia. J. water resour. prot., 5: 208–221 **(14 pages)**.
UNICEF/WHO., (2015). Progress on sanitation and drinking water-2015 Update and MDG Assessment. WHO Library Cataloguing-in-Publication Data, Geneva, Switzerland **(90 pages)**.
Vásquez, W.F., (2017), Understanding bottled water consumption in a high-poverty context: empirical evidence from a small town in Guatemala. Int. J. Consum. Stud. 41: 199-206 **(8 pages)**.
Waterboard.lk. (2021). Water Bill Calculation for 30 Days.
Wonsook, S.H.; George R.D.; Witold F.K., (2020). Estimating near real-time hourly evapotranspiration using numerical weather prediction model output and GOES Remote Sensing Data in Iowa. Remote Sens. 12: 2337 **(25 pages)**.

HOW TO CITE THIS ARTICLE

Narmilan, A.; Puvanitha, N.; Niroash, G.; Sugirtharan, M.; Vassanthini, R., (2021). Domestic water consumption pattern and awareness of urban households, Int. J. Hum. Capital Urban Manage., 6(3): 225-236.

DOI: 10.22034/IJHCUM.2021.03.02

url: http://www.ijhcum.net/article_241309.html

Int. J. Hum. Capital Urban Manage., 6(3): 237-252, Summer 2021

International Journal of Human Capital in Urban Management
(IJHCUM)

Homepage: http://www.ijhcum.net/

CASE STUDY

Dimensions of social resilience in urban areas

E. Jalalian*, E. Nasiri Hendekhaleh, N. Eizadbin

Department of Geography and Urban Planning, University of Payame Noor, Tehran, Iran

ARTICLE INFO

Article History:
Received 05 June 2020
Revised 22 August 2020
Accepted 14 September 2020

Keywords:
Karaj city
Resilience
Social cohesion
Structural equations
Urban neighborhoods

ABSTRACT

BACKGROUND AND OBJECTIVES: Social resilience is one of the ways to reduce social problems and is a factor for the success of social welfare programs, increasing trust and social capital; therefore, in recent years, more attention has been paid to the issue of social resilience. The present study deals with theoretical and experimental analysis of social resilience.

METHODS: The aim of this study was to investigate the level of social resilience in region one of Karaj city by descriptive-analytical method. The statistical population consisted of residents of District one of Karaj city, 384 of whom were randomly selected. The researcher-made questionnaire was confirmed by face validity and Cronbach's alpha of 0.85.

FINDINGS: Data analysis was performed using descriptive and inferential statistics in SPSS software. The results showed that the confidence component was 2.53, 1.73, 2.52, 4.14, 4.01 and 8.86 that all coefficients were higher than 2.59 at the significance level of 0.01. For the social capital component was 1.65, 6.14, 07.03,-1.01, and-0.35, which showed that all coefficients were higher than 2.59 (14, 15) at the significance level of 0.01. For the component of commonalities between residents component was 7.87, 11.74, 7.21, 0.85-1.17, 2.93, showing that all coefficients were higher than 2.59 at the significance level of 0.01. Also, the structural model of social cohesion, the criteria of goodness of fit index and the adjusted fit index were equal to 0.79, which indicates that the model has a moderate fit.

CONCLUSION: The purpose of this study was to investigate and measure the criteria of social resilience among the four dimensions of resilience in the settlement. As one of the most important ideas in urban planning is to create resilient cities that are resilient to social crises, therefore, paying attention to the dimensions of social cohesion, including: trust, social capital and commonalities between residents can ensure that a high level of social resilience is created and effectively operates in accordance with sustainability in society.

DOI: 10.22034/IJHCUM.2021.03.03

NUMBER OF REFERENCES	NUMBER OF FIGURES	NUMBER OF TABLES
41	5	9

*Corresponding Author:
Email: *jalaliyan_e@yahoo.com*
Phone: +989123600492

Note: Discussion period for this manuscript open until October 1, 2021 on IJHCUM website at the "Show Article.

INTRODUCTION

Cities are complex and interdependent systems and are very vulnerable to natural, man-made and terrorist threats (Salehi *et al*., 2011). Accidents have always threatened the life of human societies for many centuries (Dadashpour and Adeli, 2015). Resilience includes the conditions under which individuals and social groups adapt to environmental changes and in fact expresses the ability of society to respond to crises (Partovi *et al*., 2016). Resilience has different dimensions such as social, economic, political, physical and cultural resilience. The purpose of this study is to investigate and measure the criteria of social resilience among the four dimensions of resilience in the settlement. The concept of social resilience is introduced as the ability of communities to adapt to tensions and disturbances, to perform recovery activities to reduce social disruption (Rafieian *et al*., 2013). Considering that countries around the world are increasingly becoming urbanized, and given that by 2050 it is likely that more than 80% of the world's population will live in cities; Thus, cities represent dense and complex systems of interconnected services, which will become the main location of many potential disasters. Among the factors that increase the risk of disasters in urban areas can be: Unplanned cities, poverty, population growth, population overflow, and apartment living (Kavian and Salmani Moghadam, 2014). Overcrowding in cities, infrastructure and services have made people very vulnerable in cities. One of the most important ideas in urban planning is to create resilient cities that are resilient to social crises. Tolerance is a feature that varies from person to person and can grow over time. Or be reduced and formed on the basis of human intellectual and practical self-correction in the process of life trial and error. Resilience and its search is one of the most important human motivations. But resilience is not an issue that can be achieved only by formal and governmental organizations, but it is an issue that all members of society can provide the ground for it (Dalake *et al*., 2017). Citizens can contribute to its provision through social support, social solidarity, trust, social relations, etc., which is referred to as social capital. The significant role of social dimensions of resilience and how it is present in the lives of social actors is considered as a solution to social problems (Keck and Sakdapolrak, 2013). Social dimensions can affect other economic, cultural and political dimensions, etc.; in this way, it forms networks of neighbors, friends and colleagues and achieves mutual understanding about the methods of social trust and agreement, and also improves the situation of the community for solidarity, cooperation, collaboration and social participation of people in the community. This creates private and public interests (Graham *et al*., 2016). The rapid growth of urban population and the increasing expansion of large cities, especially the city of Karaj, is due to the intense rural-urban and urban-urban migration, which has led to the formation of an unbridled and unplanned atmosphere in the city of Karaj. Social problems in the District 1 of Karaj, such as social delinquency, unemployment, incoherence of citizens and ethnic diversity have reduced the degree of social resilience in the region; therefore, in this study, District 1 of Karaj city has been selected as a case study. Social problems in the under study district, such as social delinquency, unemployment, incoherence of citizens and ethnic diversity have reduced the degree of social resilience in the region. Therefore, in the current study, District 1 of Karaj city has been selected as a case study. The reason for addressing this issue in the study area and the need for knowledge and understanding of social resilience factors and creating a context for resilience of these factors in the study area has been strongly needed; In addition, this district has a multi-ethnic composition and has caused heterogeneity of the social context, and as a result, these factors have caused vulnerability and, consequently, posed threats to the social security of the region. Identifying social vulnerability factors in this area can be a step towards increasing the resilience of the district. Given what has been mentioned, it is necessary to examine the issue of resilience in the study area with its biodiversity, culture, ethnicity, its various challenges, from different perspectives. Considering that the study area has a multi-ethnic composition and has caused heterogeneity of social context, in the present study, by identifying the factors of social resilience, the step to increase the resilience of the study area can be taken. In this regard, questions are raised as follows:

What is the relationship between social capital and social resilience in the District 1 of Karaj?

What is the relationship between the dimensions of social capital and social resilience in the District 1 of Karaj city?

In line with the above questions, the following hypotheses are raised:

There seems to be a significant relationship between social capital and social resilience in the District 1 of Karaj city.

It seems that the existing social capacity in the study area to meet resilience does not fully meet the needs of residents in this area.

Research purposes

Identifying the most effective indicators of social resilience in Diustrict one of Karaj city;

Investigating the relationship between social cohesion and resilience in region one.

Theoretical foundations and background of research

The word (Resilience) in the dictionary has various synonyms. Ability to recover or recover quickly, change; Buoyancy and elasticity, as well as spring and elasticity can be good equivalent, but of course these words do not have the necessary reach and eloquence to convey the meaning of this word. For this reason, the word self-resilience, which means continuity in sustainability, can be considered the best synonym (Rezai, 2010). The root of the word resilience in Latin resilio means "going back to the past" (oxford, 2005). Striving for social resilience can improve living standards by increasing income, education, prenatal care, health, housing, employment, legal rights, crime safety, ethics in the local community, favorable population density, and Increase building resistance to hazards and accidents and diseases, quality of life or the ability to live in local communities. Preservation of values, cultural-local heritage, urban identity, collective memory of the city and education are other components of quality of life that lead to maintaining a sense of belonging to the place and restoring the spirit of life (Lak, 2013). Colburn and Seara (2011), consider social resilience to be related to the changeable part of social systems such as adaptability and variability, and has identified two characteristics for it: social capital and adaptive capacity . Social capital is concerned with the quality of relationships between members of society. The benefits of social capital appear when faced with adversity, war, and other changes. In another definition, social capital is related to the share that trust, norms and social network can have in solving common problems of society (Piran *et al*., 2017). Social resilience has different stages and significantly increases the durability and strength of society. The level of flexibility of different groups in a community varies, and their reactions vary in critical situations. The existence of social groups with different social and economic conditions and the degree of vulnerability in a society means that the resilience of different groups in a society is different from an accident. Social conditions cause some members of society to be less affected by the disasters and some more (Partovi *et al*., 2016). This approach is useful for understanding how society responds positively to change. Therefore, since change is inevitable in any society, it considers it what society needs to reach its original state. In other words, in their own society, individuals are able to shape the trajectory of change (transition) and play a central role in the amount of effect created by change (Zaker Haghighi and Akbarian, 2015). In summarizing the concepts of social resilience, social resilience can be known and seen in a national perspective. Social resilience represents a paradigm shift in people's minds about their own problems, the perception of others, and as a result, the need for a new perspective in determining interventions against problems and has different levels of individual and family (Ebadollahzadeh *et al*., 2017).

The concept of social resilience

Individuals and their interactions with the city as groups and categories are influenced by patterns arising from the social order of society. Social order has three main pillars for social functioning: individual identity (including age or gender), norms (behavioral rules), and social hierarchy (e.g. wealth and power). The relationship between social order, the functioning of social systems, and the power of social capital. Indicates social dynamism and resilience. For example, communities with dense social networks seem to have a greater capacity to respond to and adapt to environmental change. In recent years, social commentators have warned of declining employment and mutual trust in urban areas (Sapirstein, 2006). The experience of crises such as the 1995 Kobe earthquake and the 2011 earthquake, tsunami and nuclear attack in Japan shows that informal relations, especially with neighbors, are the first support and help in times of crisis (Lucini, 2013). Giddens (2009b) considers the strengthening of social networks as a way to promote the resilience

Table 1: Characteristics of resilient societies from the perspective of researchers (Dadashpour and Adeli, 2015)

Characteristics of resilient communities	Authors
Frequency, diversity, efficiency, internal independence, strength, correlation, adaptability and cooperation	Godschalk (2003)
Strength, redundancy, resourcefulness and speed	Bruneau *et al*., (2003)
Resistance, recovery, creativity	Kimhi shamai (2004)
Reaction, self-organization, learning	Sapirstein (2006)
Coordination and readiness of organizational capacities, rapid alert systems for possible reactions and reconstruction	Twigg (2007)

of communities. Because of the complex division of labor, all members are dependent on each other and face excellent solidarity, which is the result of this social progress and development (Durkim, 2002). Networks and social capital provide access to various types of assistance, including information, assistance, financial resources, child care through emotional and physical support, etc., when necessary, and it can be concluded that social aspects in societies are just as important if not more important than improving the physical infrastructure in crisis management (Lucini, 2013). Hence, the concept of ecological resilience can continue in social systems (Adger, 2000). Of course, it should be noted that there is a significant difference in behavior and structure between social and environmental systems in resilience (Mayunga, 2007). Table 1 illustrate characteristics of resilient societies from the perspective of researchers

Turner *et al*., (2003) equate community resilience with vulnerability and see it as the system's ability to respond to risks, and this response can be spontaneous or designed, public or private, individual or institutional, be predicted or reactive. Glavovic *et al*., (2003) defined social resilience as the capacity of societies to absorb change and the ability to cope with surprise and adapt to disorder. In the next stage, the definitions of social resilience became broader and the combination of the two words learning and adaptation in the definitions was considered. Pelling (2003) considers social resilience as an idea of urbanization and risk, a spontaneous or predetermined adjustment in response to a sense of danger, including relief and rescue. Cutter *et al*., (2008) consider social resilience as the ability of a social system to respond to and rebuild after the hazards, and include conditions that allow the system to absorb effects and adapt to events, and post-traumatic adaptation processes that Uses the ability of the social system to easily reorganize, change, and learn to respond to risk. As the definitions suggest, both researchers focus on the capacity to anticipate, prepare for risk, and learn social actors and the social system in order to better deal with future risks.

Research Background

Akbari (2018) in an article entitled "The study of urban social resilience with the study of Ilam city" has concluded that social resilience in Ilam city is at an undesirable level. Also, among the selected neighborhoods, Saadi neighborhood with an average rank of 1.10 has the highest resilience and Banbarz neighborhood with an average rank of 1.46 has the lowest social resilience. Roosta *et al*., (2018) in an article entitled "Assessing the rate of urban social resilience" by examining the city of Zahedan found that, inappropriate mental atmosphere in urban areas of Zahedan (especially in Districts 3 and 4) and endangered the development of these areas and caused vulnerability and lack of social resilience in the city and, consequently, social security, inappropriate mental space is the threat to the resilience of the city. Ahmadinia (2017) in a dissertation entitled "Resilience in the old and new neighborhoods of Tabriz metropolis" concluded that, physically, resilience is desirable in more than half of Valiasr neighborhood, while only 30% of Shotorban neighborhood Has desirable physical capacities to withstand earthquake resistance; Therefore, the most and the least differences in these neighborhoods have been in the economic and social fields, respectively. Partovi *et al*., (2016) in a study entitled "Urban design and social resilience by examining Jolfa neighborhood of Isfahan" found that, considering the factors of quality of living environment, identity, flexibility, learning, central justice (inclusiveness) and improving communication between residents together with residents and officials, it promotes social resilience in urban design. Zaker Haghighi and Akbarian (2015) in an article entitled "Deductive analysis of social resilience in historical-residential

areas and the development of a strategic-operational plan by examining the neighborhoods of Burj Ghorban and Charchereh in Hamadan" concluded that the strategy adopted based on assessing the internal and external factors of historical-residential neighborhoods of Hamedan is an aggressive strategy; Accordingly, the existing capabilities of historical-residential neighborhoods and the opportunities ahead should be used effectively to increase the resilience of neighborhoods. "Urban resilience measurement indices" is the title of a study conducted by Schlör *et al*., (2017) and concluded that the ability to meet challenges depends significantly on the resilience of the urban area, which is largely aimed at by institutions. Protecting social cohesion and minimizing environmental pressure, and urbanization has put pressure on social cohesion by increasing social vulnerability and the adverse impact of marginalization. Justice and equality are basic preconditions for the evolution of resistance urban concepts and should be consider a comprehensive management approach. Suárez *et al*., (2016) conducted a study entitled "Towards urban social resilience indicators", which provides a framework for measuring urban resilience indicators and its application in the provincial centers of Spain as a case study. Research shows that most cities are far from social resilience. Therefore, in order to achieve resilience, measures such as reducing resource consumption, promoting local experiences, creating an atmosphere of citizen participation and diversifying the local economy in the study areas should be increased. Wikström (2013) has conducted a study entitled "The challenge of planning changes for urban social resilience. The purpose of this study is to analyze the goals of contemporary planning and methods of adaptation and resilience of social change in cities. The findings of this study show that urban resilience is in line with social change with social capital and social cohesion. The current study has been carried out in Karaj in 2020).

MATERIALS AND METHODS

The present study is a descriptive-analytical study which have been performed in two forms: documentary-library studies and the use of a questionnaire. Thus, in order to clarify the literature on the subject of research and compile theoretical foundations, as well as research records, theoretical studies have been used, which have been written by referring to libraries and using books, dissertations and articles. In the survey method, a questionnaire was used. In the survey method, a questionnaire was used. The questionnaire was used as a data collection tool that contained a number of open and closed questions related to the research topic. The validity of the questionnaire was obtained by the opinions of professors and experts and the reliability of the questionnaire due to the use of Likert scale in the questionnaire was obtained by Cronbach's alpha in SPSS software with a value of 0.85%. SPSS and LISREL software were used for data analysis. The structural equation model has been used to test the conceptual model of the research. The statistical population includes citizens of District one of Karaj city and the sample size adapted from Cochran's formula is 384 people

Geographical location of the study area

Karaj city with a longitude of 51 degrees and 0 minutes and 30 seconds east and a latitude of 35 degrees and 48 minutes and 45 seconds north (Karaj historical bridge, entrance of Karaj-Chalous road), with an altitude of 1297 meters above sea level (railway station) , Is located 48 km northwest of Tehran. This city with an area of 175.4 square kilometers and an surroundings of 178.9 square kilometers is located at the foot of the Central Alborz mountain range and is the center of Karaj city and Alborz province. District 1 of Karaj is located in the geographical coordinates of 35 degrees and 49 minutes north latitude and 51 degrees and 1 minute east longitude, in the northeast of Karaj city. The eastern part of the region is mostly mountainous, which is actually part of the Alborz mountain range; and the western part of it is plain and semi-plain. This part of Karaj city is located at the foot of Alborz Mountains, and for this reason, compared to other districts of the metropolis, it has uneven surfaces and sometimes steep slopes (Fig. 1). The population of this district in 2016 was estimated, 145,041 people (fourth place in the city).

RESULTS AND DISCUSSIONS

The descriptive findings of the study show that in terms of gender, 151 people (39.3%) are men and 233 people (60.7%) are women. Also in terms of age, 47 people (12.2%) are under 25 years old, 135 people (35.2%) are between 26-35 years old, 117 people

Table 2: Description of research variables based on mean and standard deviation

Variables		Number of items	Theoretical average	Obtained average	Standard deviation
social Solidarity		17	51	45.32	5.45
social solidarity	Trust	6	18	16.89	2.51
	Social capital	5	15	13.30	2.37
	Commonalities between residents	6	18	13.50	2.62
Resilience		7	21	18.12	3.21

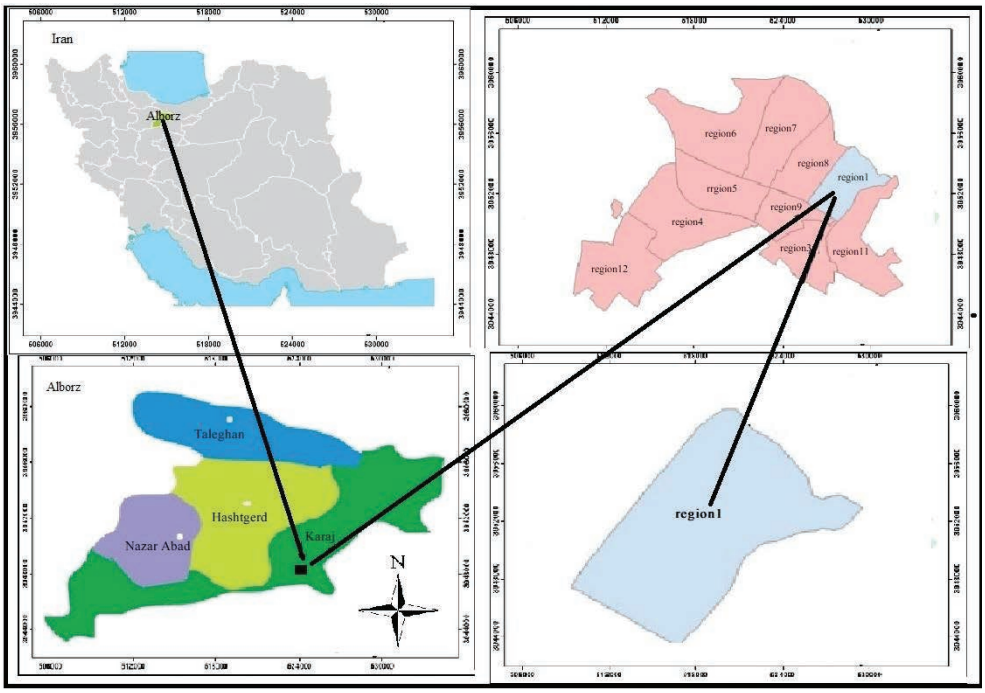


Fig. 1: Geographical location of the study area

(30.5%) are between 36 and 45 years old, and 85 people, equivalent to 22.1%, were over 46 years old. In terms of education, 171 (27.9%) were illiterate and low-literate and 152 (39.6%) had a diploma, 92 (24%) had a bachelor's degree, 30 (7.8%) had a master's degree and 3 (8/8%) had a doctorate.

Description of research variables

Due to the need to have an overview of the status of research variables based on respondents' responses, Table 2 describes the research variables based on mean and standard deviation to measure their status relative to the theoretical average of the questionnaire.

Based on the information in Table 2, it is considered; the mean of social cohesion is lower than the theoretical mean (51 >35.32). Also, the average of components of social cohesion such as trust is lower than the theoretical average (18>16.89). The average component of social capital is lower than the theoretical average (15>13.30). The average component of commonalities between residents is lower than the theoretical average (18>13.50), and the average resilience is lower than the theoretical average (21>18.12).

Measurement model

In this study, a questionnaire was used to collect data. Therefore, using confirmatory factor analysis, the general structure of research questionnaires has

Table 3: KMO and Bartlett test for questionnaire questions

KMO Test	0.676
X Test	2650,024
df	383
Sig	0,000

been validated. In order to assess the validity, there are various methods that in this study, considering that the research variables are composed of several dimensions (components), the confirmatory factor analysis test have been used. In performing factor analysis, it must be ensured whether the available data can be used for analysis or not. In other words, is the number of data required for factor analysis is appropriate or not. For this purpose, KMO index, "Kaiser-Mir-Olkin sampling adequacy index" and Bartlett test were used. Based on these two data tests, they are suitable for factor analysis when the KMO index is greater than 0.6 and close to one and the sig Bartlett test is less than 0.05. The output of these tests is presented in Table 3.

According to Table 3, the values of KMO and Bartlett index and its significance are reported. KMO indices and Bartlett test are used to check the appropriateness of the amount of data in the analysis. KMO is used to determine the adequacy of the number of samples, which is suitable if it is more than 0.6 and not suitable if it is less than 0.6. The KMO index was equal to 0.676 and above the value of 0.6, which is an acceptable figure and indicates that the selected sample is sufficient to perform factor analysis. Bartlett examines whether the correlation matrix is a single matrix or not. If the matrix is equal to one, there is no significant relationship between the variables, i.e. new factors cannot be identified based on the correlation of the variables. Bartlett index is significant in examining the adequacy of the matrix at the level of P <0.01 (error level). In this sense, the obtained matrix is sufficient and the data of this research have the ability to be factorized. This allows factor analysis to be performed.

Confirmatory factor analysis of data

To enter the structural equations, research tools must be validated to determine the validity of the structure, therefore factor analysis is used to confirm the variables and their related items. In this model, in which the researcher begins the research with a previous hypothesis and is based on an empirical foundation, the correlated factors are determined. Also, in order to investigate the hypotheses raised in the research and the relationship between each of the factors and the significance of the research model, the path analysis method is used based on factor analysis of data.

Confirmatory factor analysis of the second order of social solidarity

The basic structural model for the quality management index is shown in Fig. 2. The strength of the relationship between hidden variables and visible variables is indicated by the factor load, which is less than 0.3 is weak relation, factor load between 0.3 to 0.6 acceptable ratio and factor load greater than 0.6 is very desirable. Social capital has 3 sub-criteria of trust, social solidarity, and commonalities between residents. The factor load of these three variables on social capital are 0.24, 0.83 and 0.91 respectively, which is shown in Fig. 2. Trust, has 6 questions with loads of 0.16, 0.11, 0.16, 0.26, 0.25 and 0.70; Social solidarity, has 5 questions with loads of 0.11, 0.41, 0.53, 0.07 and 0.02 (delete questions 16 and 15); The commonalities between the residents have 6 questions with loads of 0.45, 0.67, 0.41, -0.05, 0.19 and 0.17 (delete question 21), all of which are acceptable and approved coefficients.

The output of T-coefficients in the social capital component is shown in Fig. 3. The output of T-coefficients for the trust component is 2.53, 1.73, 2.52, 4.14, 4.01 and 8.86, all coefficients higher than 2.59 except the coefficient of question 2 (non-natives and immigrants are living in Our neighborhood) was at the significance level of 0.01 (T-coefficients were between 1.96, 2.58 at the 0.05 level and trust coefficients were higher than 2.85 at the significance level of 0.01). The value of the t-coefficient was 1.73 only in question 2. For the social solidarity component, the T-coefficient was equal to 1.65, 6.14, 7.03, -1.01, -0.35, all coefficients were higher than 2.59 for questions 12, 14 and 15 at the significance

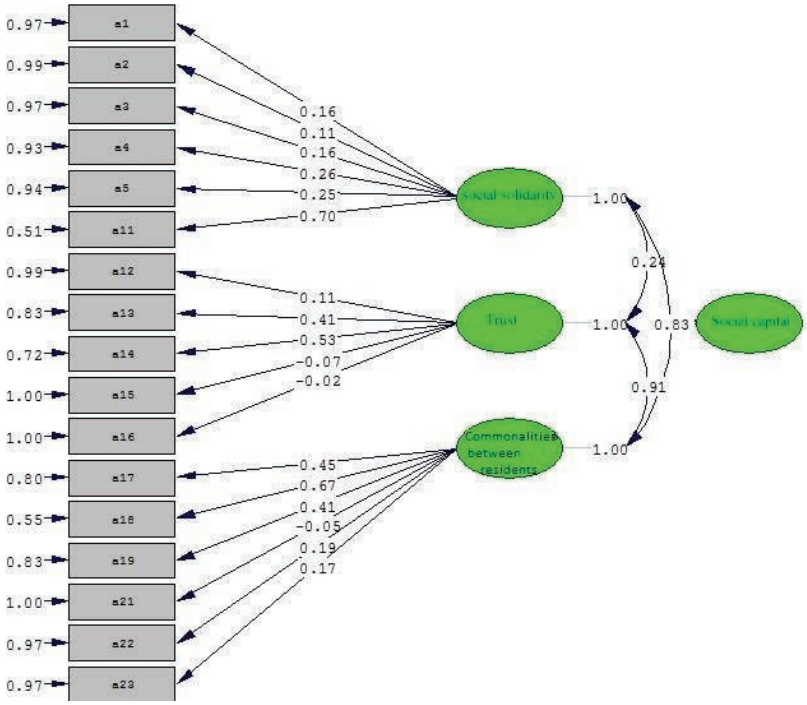


Fig. 2- The output of the coefficients of the second order factor analytical model of social capital

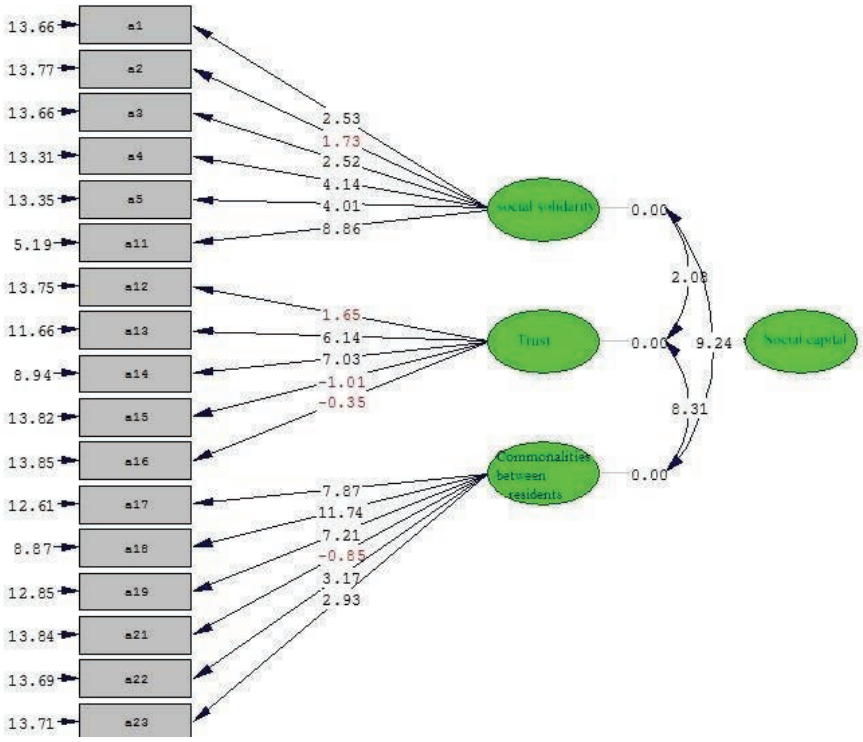


Fig. 3: The output of the coefficients of the second order factor analytical model of social capital

Table 4: General fit indicators of the tested model of social capital

Characteristic	Estimation	Criterion
Chi-square ratio to the degree of freedom	1.002	/df>3x^2
Root Mean Square Error of Approximation (RMSEA)	0.009	0<RMSEA<0.08
Goodness of Fit Index (GFI)	0.79	0.9 <GFI < 1
Adjusted Goodness of Fit Index (AGFI)	0.75	0.9 <AGFI < 1
Comparative Fit Index (CFI)	0.87	0.9<CFI < 1
Adjusted Goodness of Fit Index (AGFI)	0.63	0.9<NFI < 1

level of 0.01. (Trust coefficients ranged from 1.96 to 2.58 at the 0.05 level and trust coefficients were higher than 2.85 at the significance level of 0.01). Only in questions 12 (Do you help to strengthen trust among neighbors), 14 (Do you trust your neighbors in times of problems and crises), 15 (Does your family feels identity and belonging to the neighborhood), Trust had the lowest coefficients of 1.73, -1.01, -0.35 and 1.65. For the component of commonalities between the residents, the coefficients showed 7.87, 11.74, 7.21, 0.17-1.85, 2.93, respectively in which that all coefficients were higher than 2.59 (except the coefficient for the question 21) in the level of significance was 0.01 (trust coefficients between 1.96. 2.58 at the level of 0.05 and trust coefficients above 2.85 at the significance level of 0.01) and only regarding question 21 (people in the neighborhood in case of having a request or a problem, they can convey their request to the authorities), trust had the lowest value of -0.85 coefficient.

The general characteristics of the tested model of social capital are given in Table 4. The criteria of goodness of fit index and adjusted fit index indicate that the model has a moderate fit. Also, the results of Fig. 3 show the appropriateness of factor loads of indicators (questions) related to each component and also at a relatively appropriate level, and there is a factor load of each component as an indicator of social capital in predicting this variable.

As it can be observed in Table 4, the Goodness of Fit Index in the social capital model is calculated to be 0.79, which according to the estimate made for the Goodness of Fit index, the closer the values obtained to 1, the more acceptable the fit model is. To adjust the weight, the adjusted Goodness of Fit Index was used. The adjusted Goodness-of-Fit Index adjusts the Goodness-of- Fit of the model in relation to the sample size and degrees of freedom of the model, which, like the Goodness-of-Fit Index, fluctuates between 0 and 1. Each structure is rated at a relatively good level. So that the root means of the index of the mean power of the approximation error for all sub-components of social capital is less than 0.07, the Comparative Fit Index is 0.87 and the Adaptive Fit Index is 0.63, which indicates that the closer it is to 1, the more acceptable and relatively fit moderate-good model.

Confirmatory factor analysis of the second order of resilience

The basic structural model for the resilience index is shown in Fig. 4. The strength of the relationship between the hidden and the visible variables by the factor load shows that the factor load of less than 0.3 is a weak relation, the factor load between 0.3 to 0.6 is acceptable and the factor load greater than 0.6, is desirable. The resilience did not have any sub criteria. Therefore, accuracy in the operating loads of this variable shows that all factor loads and their output were more than 0.3, which indicates that all items are acceptable and approved.

Accuracy in resilience output also showed that all resilience coefficients were higher than 2.58 at the significant level of 0.01, which indicates that the coefficients are confirmed. The accuracy of the outputs also showed that in all 20 items (People in the neighborhood agree on controlling and solving neighborhood problems), 6 (In our neighborhood, people are sometimes harassed outside the home), 7 (If a car is parked in the alley at night, it will be stolen), 8 (In our neighborhood, people move around alone during the day and night), 9 (Does not leave the house for a long time due to theft) and 10 (Access to police in our neighborhood is easily possible), 24 (Access to recreation and welfare centers is easy), all coefficients were higher than 2.58 but only in question 8 (In our neighborhood, people move around alone during the day and night), the fit factor was low (Fig. 4).

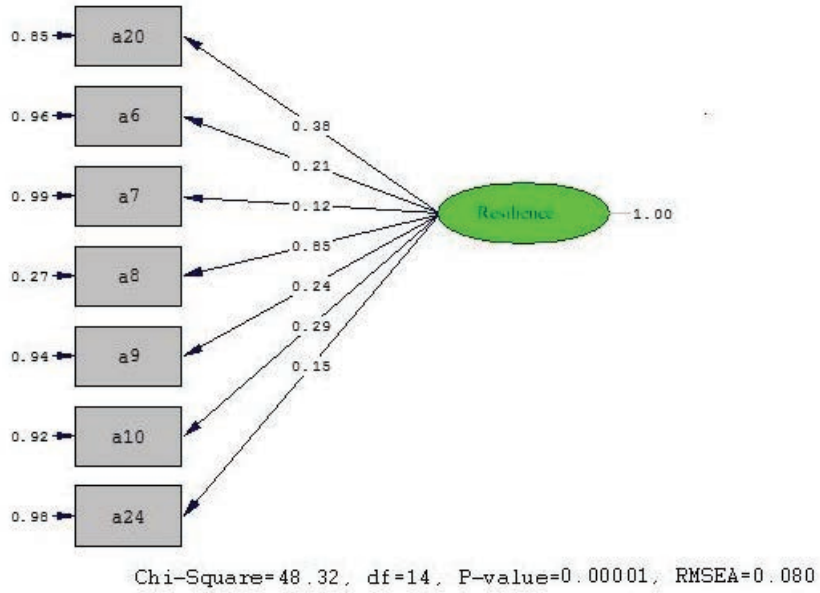


Fig. 4: The output of the coefficients of the second-order resilience factor analytical model

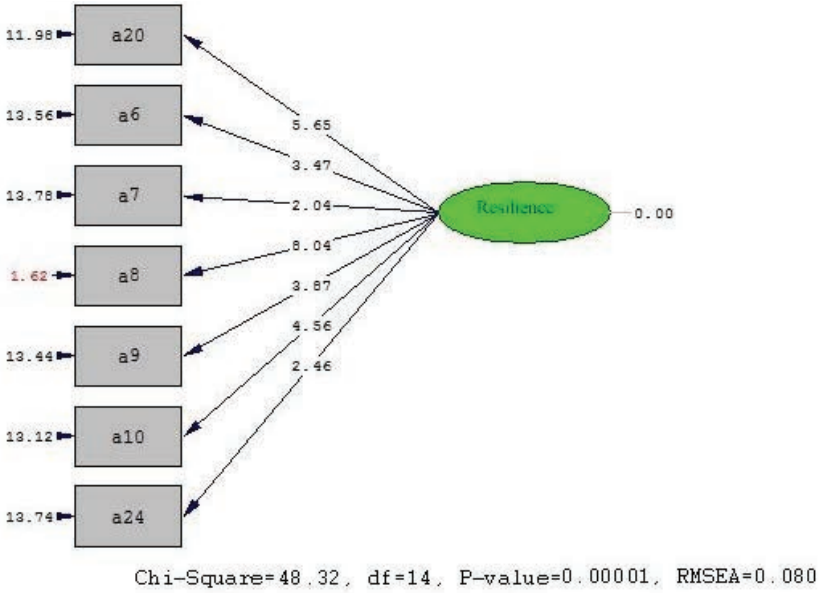


Fig. 5: Output of coefficients of the analytical factor analysis model

The general characteristics of the tested resilience model are given in Table

As it can be seen in Table 5, the Goodness-of-Fit Index in the resilience model is calculated to be 0.448. According to the estimate made for the Goodness-of-Fit Index of the model, the closer the values obtained to 1, the better and acceptable model fit is. The Adjusted Fitness Index was used to adjust the weight. The adjusted Goodness-of-Fit Index adjusts the Goodness-of-Fit Index of the model in relation to the sample size and degrees of freedom of the model, which, like the Goodness-of-Fit Index,

Table 5: General fit indices of the tested resilience model

Characteristic	Estimation	Criterion
Chi-square ratio to the degree of freedom	1.004	/df>3x^2
Root Mean Square Error of Approximation (RMSEA)	0.408	0<RMSEA<0.08
Goodness of Fit Index (GFI)	0.448	0.9 <GFI < 1
Adjusted Goodness of Fit Index (AGFI)	0.270	0.9 <AGFI < 1
Comparative Fit Index (CFI)	0.757	0.9<CFI < 1
Adjusted Goodness of Fit Index (NFI)	0.451	0.9<NFI < 1

Table 6: Results of Pearson-Social Capital Test on Social Resilience

cohesion	Social Resilience
Social capital	0.350
Sig: 0.000	

Table 7: Results of correlation test (Pearson) for social capital and social resilience dimensions

Social resilience		The amount of correlation	Significance level
Resilience dimensions	Trust	0.448	0.000
	Social cohesion	0.263	0.000
	Commonalities between residents	0.298	0.000

fluctuates between 0 and 1. Each of the structures is evaluated at a relatively good level so that the root mean of the mean power of the approximate error for all the subcomponents of resilience is less than 0.07. The closer it is to 1, the fit of the model would be average and acceptable.

Test the hypotheses

Hypothesis 1: It seems that there is a relationship between social capital and social resilience in region one of Karaj city.

The findings of Table 6 show that the relevant statistical activities indicate that there is a significant relationship between social cohesion and social resilience in District 1 of Karaj city (sig = 0.000). The positive relationship directions indicate that as the social capital increases, social resilience will increase too in District 1 of city of Karaj. That is, for the amount of r= 350 when added to social capital, the value of r=350 is added to the social resilience.

Hypothesis 2: There is a relationship between the dimensions of social capital and social resilience in District 1 of city of Karaj.

The findings in Table 7 show that the relevant statistical activities indicate that there is a significant relationship between the dimensions of social cohesion and social resilience in District 1 of Karaj (Sig. = 0.000). The positive relationship direction indicates that to the extent that the dimensions of social capital, trust (0.448), social cohesion (0.263), commonalities between residents (0.298) increases, social resilience also increases in District 1 of Karaj city.

Results of multivariate regression analysis of social resilience

Investigating the effect of social capital and social resilience in region one of Karaj city

The precondition for using regression is the non-multicolinearity assumptions and error independence:

Lack of non- multicolinearity (tolerance parameter)

Co-linearity is a state in which there is a strong correlation between two predictor variables. Multiple multicolinearity is a state in which more than two

Table 8: Multicolinearity regression test and error independence

Model		Tolerance statistics	Durbin-Watson Test
Social capital	Trust	0.891	
	Social cohesion	0.930	1.961
	Commonalities between residents	0.898	

predictor variables are strongly correlated with each other. Multicolinearity can distort the interpretation of multiple regression results (Kalnins, 2018). When more than two variables are considered, the non-multicolinearity parameter is used. This parameter allows this method to be protected against multicolinearity hazards by expelling predictor variables that are highly correlated with other independent variables. Conceptually, the tolerance parameter is the amount of variance of the predictor variable that is not explained by other predictor variables. The range of values of the tolerance parameter is from 0 to 1 and the lower values of the tolerance parameter show that there is a stronger relationship between the predictor variables (Kalnins, 2018). The closer the value of the tolerance parameter is to 1, the lower the probability of multicolinearity would be. It should be noted that the tolerance parameter is provided for all predictor variables and the tolerance parameter of each variable should be evaluated separately.

In Table 8, the results of the tolerance statistics column show the coherence of independent variables. According to the obtained results, the amount of tolerance statistics among the 3 independent variables is more than 0.4 and the minimum value of tolerance statistics is equal to 0.891. The results show that the degree of co-linearity between the independent variables is not a concern.

Error independence (Durbin-Watson)

Another assumption required for regression analysis is that the value of one observation is not too specific to the value of another observation. When data is collected consecutively, not being independent can be a serious problem, therefore in this situation the Durbin- Watson test can be used. The value of this statistic varies between 0 and 4. If there is no correlation between consecutive residues, the value of the Watson camera statistic should be close to 2, and if the value of this statistic is close to zero, it indicates a positive correlation between consecutive residues. If the value of this statistic is close to 4, it indicates a negative correlation between consecutive observations. As a general rule, if the Durbin-Watson observed value is between 1.5 and 2.5 it indicates the independence of the observations, which according to Table 9, the value of the Durbin-Watson is equal to 1.961. To show the effect of the contribution of each of the independent variables on the dependent variable of social resilience in the present study, stepwise multivariate regression analysis has been used. In order to estimate the effect of the contribution of each of the independent variables on the dependent variable of social resilience in the present study, stepwise multivariate regression analysis has been used. The results of regression show that the relationship between independent and dependent variables based on one-way analysis of variance is linear with respect to the level of significance obtained and show that the set of independent variables can explain the changes of social resilience dependent variable and thus the regression model is confirmation.

The correlation coefficient (R) is the dimensions of the variables of social cohesion, trust (0.448), social capital (0.263), commonalities between residents (0.298), which shows that there is a high correlation between the set of independent variables and the dependent variable; The value of the adjusted coefficient (R2), which is equal to 0.503, shows that 50% of the changes in the social resilience variable are explained by the remaining variables in the regression model which include the variables of trust, social capital, commonalities between residents. All remaining variables in the model are directly related to the dependent variable. Among these, the level of trust has had the greatest impact on the social resilience variable of District 1 of Karaj city.

The correlation coefficient (R) is the dimensions of the variables of social cohesion: trust (0.448), social capital (0.263), commonalities between residents

Table 9: Multivariate regression analysis statistics of social resilience

Variables		Beta	T Value	Sig	Analysis of variance		Multiple correlation ®coefficient	Coefficient of determination(2)	Modified Coefficient of determination	Standard Error of Estimate
					F Value	Sig				
Social Capital	Trust	0.448	9.792	0.000	95/89	0.000	0.448	0.201	0.199	2.87
	Social cohesion	0.263	5.338	0.000	28.49	0.000	0.263	0.069	0.067	3.10
	Commonalities between residents	0.298	6.095	0.000	37.155	0.000	0.298	0.089	0.089	3.07
	Total				42.87	0.000	0.503	0.253	0.247	2.78

(0.298), which shows that there is a high correlation between the set of independent variables and the dependent variable. The value of the adjusted coefficient (R2), which is equal to 0.503, shows that 50% of the changes in the social resilience variable are explained by the remaining variables in the regression model which include the variables of trust, social capital, commonalities between residents. All remaining variables in the model are directly related to the dependent variable. Among these, the level of trust has had the greatest impact on the social resilience variable of District 1 of city of Karaj. The type of attitude towards resilience and the way it is analyzed play a key role in how resilience is identified and its causes, and influence risk reduction measures. For this reason, resilience against threats and reducing its effects is of great importance given the results it will have and the emphasis that this analysis has on the resilience dimension. Trust with 6 questions with loads of 0.16, 0.11, 0.16, 0.26, 0.25 and 0.70; Social capital, with 5 questions with loads of 0.11, 0.41, 0.53, 0.07 and 0.02; communalities between residents with 6 questions with loads of 0.45, 0.67, 0.41, -0.05, 0.19 and 0.17 have acceptable and approved coefficients. The output of T-coefficients is in the social cohesion component. The output of t- coefficients for the trust component are 2.53, 1.73, 2.52, 4.14, 4.01 and 8.86, all coefficients above 2.59 at the significance level of 0.01 (Trust coefficients between 1.96, 2.58 at the level of 0.05 and coefficients above 2.85 at the significance level are 0.01). The output of T-coefficients for the social capital component are 1.65, 6.14, 7.03, -1.01 and -0.35, all coefficients are higher than 2.59 (14, 15) at the significance level of 0.01 (Trust coefficients are between 1.96 and 2.58 at the 0.05 level and trust coefficients are higher than 2.85 at the significance level of 0.01). The output of T-coefficients for the component of commonalities between residents is 7.87, 11.74, 7.21, 0.17-1.85 and 2.93, all coefficients are higher than 2.59 at the significance level of 0.01 (Trust coefficients between 1.96 and 2.58 at the level of 0.05 and T-coefficients above 2.85 at the significance level of 0.01). The structural model of social cohesion, the criteria of goodness-fit index and the adjusted fit index were equal to 0.79, which indicates that the model has a moderate fit. Also, the confirmation factor analysis of the second order of resilience shows that all coefficients of resilience are higher than 2.58 at the significant level of 0.01, which indicates that the coefficients are approved. The criteria of goodness of fit index and adjusted fit index of 0.448 indicate that the model has a moderate fit. According to the results of the statistical tests of the research and also according to the theories presented in the current research, social resilience enables people to work together to achieve common goals, also people are able to communicate with each other and together they will be able to do things that they are not able to do individually. The most important functions of the capital component and social resilience are to reduce crime and problems, and increase security and peace of mind. In such a situation, relying on common values and norms resulting from social capital, a sense of security, trust, mutual commitment, participation and cooperation of members of society to access mutual resources, which is social resilience, is provided. According to the research findings, increasing motivation to raise social awareness, expanding adherence to generalized norms, strengthening social cohesion and solidarity, and increasing areas of citizen participation and social trust of citizens can lead to increased

resilience in the social dimension. The results of the present study are in line with the results of Godschalk (2003), who believes that trust between people in a community and the relationships between them can help the increase of social cohesion. The results of the present study are also consistent with the results of Twigg (2007) research, which concluded that resilience is a function of an individual's interaction with changes in the environment over time and the degree of resilience between humans, Cultures, geographical conditions, religions and organizations, etc. are different. The results of the present study are also in line with the results of the Kimhi Shamai (2004) study, which states that the degree of social participation in the face of events, measuring the degree of social solidarity in the current conditions of metropolises and measuring ongoing programs regarding possible reactions of citizens to increasing resilience and helps building the communities.

CONCLUSION

Cities are complex and interdependent systems and are highly vulnerable to natural, man-made and terrorist threats. Resilience has different dimensions such as social, economic, political, physical and cultural resilience. The purpose of this study was to investigate and measure the criteria of social resilience among the four dimensions of resilience in the settlement. The concept of social resilience is defined as the ability of communities to adapt to stress and turmoil, to perform recovery activities to reduce social disruption. The present study is a descriptive-analytical study that is in the form of documentary-library studies and the use of a questionnaire. In this research, a questionnaire, which its validity was confirmed by the experts and the scholars, was used as a data collection tool that contained a number of open and closed questions related to the research topic. The reliability of the questionnaire was 0.85% by Cronbach's alpha in SPSS software due to the use of Likert scale in the questionnaire. SPSS and LISREL software were used for data analysis. The structural equation model has been used to test the conceptual model of the research. The results showed that the confidence component was 2.53, 1.73, 2.52, 4.14, 4.01 and 8.86 that all coefficients were higher than 2.59 at the significance level of 0.01. For the social capital component was 1.65, 6.14, 07.03, -1.01, and -0.35, which showed that all coefficients were higher than 2.59 at the significance level of 0.01. For the component of commonalities between residents component was 7.87, 11.74, 7.21, 0.85-1.17, 2.93, showing that all coefficients were higher than 2.59 at the significance level of 0.01. Also, the structural model of social cohesion, the criteria of goodness of fit index and the adjusted fit index were equal to 0.79, which indicates that the model has a moderate fit. The results of regression show that the relationship between independent and dependent variables based on one-way analysis of variance is linear with respect to the level of significance obtained and show that the set of independent variables can explain the changes of social resilience dependent variable and thus the regression model is confirmation. Also, the confirmation factor analysis of the second order of resilience shows that all coefficients of resilience are higher than 2.58 at the significant level of 0.01, which indicates that the coefficients are approved. The criteria of goodness of fit index and adjusted fit index of 0.448 indicate that the model has a moderate fit

Suggestions

- Improving the residential satisfaction In the District 1 of Karaj city, which increases social resilience;
- To provide empowerment, social, educational and cultural programs to improve the resilience and living and cultural level of citizens by the district Municipality;
- Creating social security and eliminating crime grounds by strengthening the neighborhood-oriented spirit;
- Increasing the level of trust and cooperation between residents and city officials through the presence of officials in different gatherings of local people in order to solve the problems of the region district;
- Prevent migration to strengthen district and social cohesion.

AUTHOR CONTRIBUTIONS

E. Jalalian prepared theoretical foundations and introduction, E. Nasiri Hendeh Khaleh prepared the analysis of research findings and research methodology, N. Ezadbin Prepared the abstract and performed the data collection and summarizing and concluding the research.

ACKNOWLEDGMENT

The author is very much grateful to the personnel of District 1 of Municipality of Karaj for their participation in data gathering.

CONFLICT OF INTEREST

The authors declare that there is no conflict of interest regarding the publication of this manuscript. In addition, the ethical issues, including plagiarism, informed consent, misconduct, data fabrication and/or falsification, double publication and/or submission, and redundancy has been completely observed by the authors.

REFERENCES

Ahmadinia, L., (2017). Resilience at the level of old and new neighborhoods of Tabriz metropolis (Case study: Shatarban and Valiasr neighborhoods), Master Thesis, Geography and Urban Planning, University of Tabriz. (122 pages). (In Persian)

Akbari, T., (2018). Investigating the rate of urban social resilience Case study: Ilam city. Q. J. Urban Dev. Stut., 5: 51-62 (**12 pages**). (In Persian)

Adger, N., (2000). Social and ecological resilience: are they related, progress in human geography. 24(3): 347-364 (**18 pages**).

Bruneau, M.; Chang, S.E.; Eguchi, R.T.; Lee, G.C.; O'Rourke, T.D.; Reinhorn, A.M.; Shinozuka, M.; Tierney, K.; Wallace, W.A.; Von Winterfeldt, D., (2003). A framework to quantitatively assess and enhance the seismic resilience of communities. Earthquake spectra, 19(4): 733-752 (**10 pages**).

Cutter, S.L.; Barnes, L.; Berry, M.; Burton, C.; Evans, E.; Tate, E.; Webb, J., (2008). Community and regional resilience: Perspectives from hazards, disasters, and emergency management. Geography. 1(7): 2301-2306 (**6 pages**).

Colburn, L.; Seara, T., (2011),. September. Resilience, vulnerability, adaptive capacity, and social capital. In 2nd National Social Indicators Workshop.

Dalake H.; Beigi, M.; Shahivandi, A., (2017). Measuring the rate of social resilience in urban areas of Isfahan, Q. J. Sociol. So. Inst., 4(9): 227-252 (**26 pages**). (In Persian)

Durkim, D.E., (2002). On the division of social work, translated by Parham, Tehran, Markaz Publishing. (In Persian)

Dadashpour, H.; Adeli, Z., (2015). Measuring resource capacities in Qazvin Municipal Complex, Bi-Q. J. Crisis Manage., 4(8): 73-84 (12 pages). (In Persian)

Ebadollahzadeh Maleki, SH.; Khanlou, N.; Ziari, K.; Shali Amini, V., (2017). Measuring and evaluating social resilience to deal with natural crises; Case study: Earthquake in historical neighborhoods of Ardabil. 263-270 (**8 pages**). (In Persian)

Giddens, A., (2009 b). The politics of climate change. In A. Giddens (Ed.), the politics of climate change, Cambridge: Polity Press Foke.

Godschalk, D.R, (2003). Urban hazard mitigation: Creating resilient cities, Natural Hazards Review. 4(3): 136-143 (**8 pages**).

Glavovic, B.; Scheyvens, R.; Overton, J., (2003). Waves of adversity, layers of resilience. Exploring the sustainable livelihoods approach. In, D, J. Overton and B. Nowak (Eds) Contesting development: Pathways to better practice.

Kavian, F.; Salmani Moghadam, M., (2014). Application of land use planning in increasing urban resilience, Q. J. Arid Geogr. Stud., 5(17): 17-34 (**18 pages**). (In Persian)

Kimhi, S.; Shamai, M., (2004). Community resilience and the impact of stress, adult response to Israel's withdrawal from Lebanon. J. Community Psychol., 32(4): 439-451 (**13 pages**).

Kalnins, A., (2018). Multicollinearity: How common factors cause Type 1 errors in multivariate regression. Strat. Manage. J., 39(8): 2362-2385 (**24 pages**).

Keck, M.; Sakdapolrak, P., (2013). What is social resilience? Lessons learned and ways forward. Erdkunde, 5-19 (**15 pages**). (In Persian)

Lak, A., (2013). Resilient urban design, Sofeh Magazine, 23(1). (In Persian)

Lucini, B., (2013). Social capital and sociological resilience in megacities context, Catholic University of Sacred Heart, Milan, Italy., Int. J. Disaster Resilience Built Environ., 4(1): 58-71 (**14 pages**).

Mayunga, J.S., (2007). Understanding and applying the concept of community disaster resilient: A capital-based approach, a draft working paper prepared for the summer academy for social vulnerability and resilience building. 1(1): 1-16 (**16 pages**).

Graham, L.; Debucquoy, W.; Anguelovski, I.,)2016(. The influence of urban development dynamics on community resilience practice in New York City after Super storm Sandy: Experiences from the Lower East Side and the Rockaways. Global Environ. Change, 40: 112-124 (**13 pages**).

OXFORD advance learners' dictionary (7th ed). (2005), Oxford university press

Pelling, M., (2003). The Vulnerability of Cities: Natural Disasters and Social Resilience, Earthscan Publications Ltd, London, Sterling, VA

Partovi, P.; Behzadfar, M.; Shirani, Z., (2016). Urban design and social resilience. Case study: Jolfa neighborhood of Isfaha. J. Archit. Urban Plann., 17: 99-117 (**19 pages**). (In Persian)

Piran, P.; Asadi, A.; Dadgar, N., (2017). Investigating the role of social resilience in the success of the reconstruction process. Case Study: Rural Communities of Darb-e-Astaneh and Babapashman after the 1979 Earthquake in Silakhor Plain, Lorestan Province. J. Housing Rural Environ. 157: 87-100 (**14 pages**). (In Persian)

Roosta, M.; Ebrahimzadeh, I.; Istgoldi, M., (2017). Evaluation of social resilience in a known urban area, Zahedan city. Res. urban plann., 9(32): 1-14 (14 **pages**). (In Persian)

Rezai, M.R., (2010). Explaining the resilience of urban communities to reduce the effects of natural disasters (earthquakes); Case study: Tehran metropolis.

Rafieian, M.; Parvaresh, Z.; Matavaf, Sh., (2013). Assessing the resilience of new urban communities in the face of natural hazards Case study: New urban cities of Isfahan. Master Thesis, Shahid Beheshti University. (In Persian)

Schlör, H.; Venghaus, S.; Hake, J.F., (2018). The FEW-Nexus city index–Measuring urban resilience. Appl. Energy, 210: 382-392 (**11 pages**).

Salehi, I.; Aghababaei, M.T.; Sarmadi, H; Farzad Behtash M.R., (2011). Investigation of environmental resilience using causal network model. Environ. Sci., 37(59): 99-112 (**14 pages**). (In Persian)

Suárez, M.; Gómez-Baggethun, E.; Benayas, J.; Tilbury, D., (2016). Towards an urban resilience index: a case study in 50 Spanish

cities. Sustainability, 8(8): 774.
Sapirstein, G., (2006). Social resilience: the forgotten dimension of disaster risk reduction. Jàmbá: J. Disaster Risk Stud., 1(1): 54-63 (**10 pages**).
Turner, B. L.; Kasperson, R.; Matson, P; McCarthy, J.; Corell, R.; Christensen, L.; Eckley, N.; Kasperson, J.; Luers, A.; Martello, M.; Polsky, C.; Pulsipher, A. and Schiller, A., (2003). A framework for vulnerability analysis in sustainability science. Proceedings of the national academy of sciences, 100(14): 8074-8079 (**6 pages**).
Twigg, J., (2007). Characteristics of a disaster-resilient community: a guidance note. Department for International Development (DFID).
Wikström, A., (2013). The Challenge of Change: Planning for social urban resilience. An analysis of contemporary planning aims and practices.
Zaker Haghighi, K.; Akbarian, Z., (2015). Deductive analysis of social resilience in historical-re
sidential neighborhoods and development of a strategic-operational plan for its promotion (Case Study: Hamedan, Charchereh and Ghorban Borj Mahallat). J. Discip. Geogr., 3(12): 23-48 (**26 pages**). (In Persian)

HOW TO CITE THIS ARTICLE

Jalalian, E.; Nasiri Hendekhaleh, E.; Eizadbin, N., (2021). Dimensions of social resilience in urban areas. Int. J. Hum. Capital Urban Manage., 6(3): 237-252.

DOI: 10.22034/IJHCUM.2021.03.03

url: http://www.ijhcum.net/article_239707.html

Int. J. Hum. Capital Urban Manage., 6(3): 253-262, Summer 2021

International Journal of Human Capital in Urban Management
(IJHCUM)

Homepage: http://www.ijhcum.net/

ORIGINAL RESEARCH PAPER

Comparison and analysis of tariff reduction of infrastructural sectors and its economic impact: ACGE approach

S.Sh., Hossain, H. Delin*

The Institute of Agricultural Economics and Development, The Chinese Academy of Agricultural Sciences, Beijing, China

ARTICLE INFO

Article History:
Received 11 December 2020
Revised 28 March 2021
Accepted 08 April 2021

Keywords:
Economic growth
Global trade analysis project
Infrastructure
Regions

ABSTRACT

BACKGROUND AND OBJECTIVES: The reduction of tariffs in Public infrastructure sectors is believed to be one of the key factors in addressing the socio-economic challenges of high unemployment, income inequality, and poverty. The primary objective of this paper is to design a general equilibrium model for infrastructural sectors among Germany, France, Italy, United Kingdom, China, USA, Australia, Japan and Korea, and evaluate potential economic impact of tariff reduction.

METHODS: The research method of this paper was to construct a Computational General Equilibrium model to assess the economic effects. The global trade analysis project model was calibrated and discussed in this paper. The global trade analysis project database was used to validate the model.

FINDINGS: Simulation result showed that tariff removal in infrastructure has the most significant effects in China, Japan, and Korea's economic growth and employment than other countries. Gross Domestic Product, output price, and social welfare increase significantly in China compared to other countries. Gross Domestic Product increases in China by 616%, decreases in Japan and Korea 77% and 7% after mutual tariff reduction on infrastructure sectors. Meanwhile, China's export on infrastructural sector increases by 1.71%, Japan and Korea's export increases by 0.75% and 0.05%. On the other hand, export decreases in Germany, France, Italy, UK, USA and Australia. Finally, social welfare increases in China by $2.26 billion and Japan by $239 million.

CONCLUSION: The presence of tariff reduction in infrastructure sectors will likely strengthen the market share of most of the simulated regions. These findings may provide policy-makers with crucial information for better understanding about new tariff policy. Computable General Equilibrium analysis in infrastructure sectors had paid little attention in past and this paper tries to fill the gaps and attempts to find the benefit of mutual tariff policy among countries based on global trade analysis project model.

DOI: 10.22034/IJHCUM.2021.03.04

NUMBER OF REFERENCES	NUMBER OF FIGURES	NUMBER OF TABLES
31	0	9

*Corresponding Author:
Email: *huangdelin@caas.cn*
Phone: : + 86-186-1210-5186
Fax: (010)62187545

Note: Discussion period for this manuscript open until October 1, 2021 on IJHCUM website at the "Show Article.

INTRODUCTION

Infrastructure plays a significant part in the economic development of a country and can be divided into economic and social sectors. Infrastructure projects such as transport, electricity, water, and other systems promote the prosperity and economic growth of a country. Economic infrastructure typically includes transports, utilities, communication, and renewable energy, and social infrastructure including schools and other facilities such as education, healthcare, defense and so on. Investment in infrastructure can improve the regional economic performance of the economy by improving international trade. Tariff removal on infrastructure increases production facilities that stimulate overall economic activities of a country. Computable General Equilibrium (CGE) model can capture the economic benefit of each economic agent and policymakers can easily understand the economic change after a shock (i.e. a new policy) by computer-generated numeric results. There are numerous studies that have been employed in previous literature to examine the infrastructural investment contribution to national or regional economic growth. A portion of these studies have discovered public infrastructure investment has a positive relationship in national or regional economic growth, while different investigations found no solid connection between public investment and economic growth (Garcia-Mila *et al.,* 1996; Ferreira *et al*., 2006).There are lots of studies in previous literature that provides regional CGE models to investigate regional economic policies. Other study builds a recursive dynamic CGE model to analyze the effects of public infrastructure investment on productivity for the province of Quebec in Canada and their result suggests that infrastructure investments by the public sector have positive contributions on the productivity of private sectors (Boccanfuso *et al.,* 2014; Arman *et al.,* 2015; Annala *et al.,* 2008; Stewart and Yermo, 2012). Crescenzi and Rodríguez-Pose, 2012),use a competitive general equilibrium model to investigated financing schemes for public infrastructure investment and finds that other variables and parameters remain unchanged after reducing public consumption and increase public investment in infrastructures. Esfahani and Ramírez (2003), utilize cross-country panel regressions and found that infrastructure services' commitment to Gross domestic product (GDP) is significant and surpasses the expense of their arrangement. Rioja (2001), developed a dynamic general equilibrium model and analyzed the impact of infrastructure investment on Brazil, Mexico, and Peru, and finds a positive effect of infrastructure investment on welfare. Limão and Venables (2001) directly investigate the relationship between infrastructure, transportation cost, and trade volume. They found that the relationship between trade volume and transportation cost is negative. Partridge and Rickman (1998) present a useful discussion of the contributions of regional CGE models which explain the strengths and weaknesses of the regional CGE model. Besides the CGE model, Graham (2000) found infrastructure plays a significant role between flow, movement, and exchange in modern cities and towns. Improved infrastructure plays a significant role in quicken urbanization and local reconciliation which has been the motor for development in many nations. Liu (2015) find that investment in transportation infrastructure has a positive development in China economy. Zou *et al.* (2008) affirmed that the transportation framework assumed a significant part in China by investigating panel data from 1994 to 2002 and time-series data from 1978 to 2002. They suggested that the most important reason for the high growth rate of Central and East China is the investment in transportation infrastructures. Bougheas *et al.,* (1999) separately analyzed two datasets and finds that improvements in infrastructures can increase the volume of trade and this relationship is statistically significant. Démurger (2001) inspects the role of infrastructure in development performance across 24 regions in China and presumes that infrastructure investment significantly affects development across regions. Jalan and Ravallion (2002) find that expansion street thickness has a significant beneficial outcome on rural farm households in poor regions of China. Fan and Chan-Kang (2004) use provincial-level data for 1982-1999 and finds road infrastructure to increase economic growth and reduce poverty in China. On the other hand, Haynes *et al.,* (2004) discovered investment in telecommunications framework (both

fixed and portable) increments territorial economic growth in China for the period 1986-2002. Investment in physical infrastructure can play a significant role of all inputs in the production process. Another examination done by Bronzini and Piselli (2009) found that a 1 percent expansion in public infrastructure prompts a 0.11 percent increment in total factor productivity in Italy. Démurger (2001) discovered transport facilities reduces the burden of isolation in a country. Other study finds that infrastructure investment has direct impact on economic growth (Stewart and Yermo, 2012; Sloboda and Yao, 2008; Sahoo *et al.,* 2010; Savard, 2010).The improvement of transport framework builds the availability of weaker regions to developed regions which makes the economic benefit in regions. Infrastructure investments reduce transaction costs between agents, reduced transportation costs (Seung and Kraybill, 2001; Walmsley, 2006). The improvement of transport infrastructure generates the mobility of people which, thusly, may prompt more prominent advancement, knowledge circulation, and economic efficiency. Garcia-Mila and McGuire (1992) discovered high yield flexibility of public infrastructure investment. Canning and Pedroni (2004) accentuate that there is an ideal degree of framework that amplifies the development rate. Public infrastructure positively affects in economy of a region. Growing urbanization will help boost the investment infrastructure in sectors. Reduction in tariff will enormously impact of a country economy. Based on above analysis, this paper utilizes a Computable general equilibrium (CGE) model, to examine the impacts of a change in infrastructure sectors on Gross domestic product (GDP), sectoral output, regional output, and household welfare. The primary goal of this paper is to estimate the economic effects of infrastructural sectors tariff removal in various nations by analyzing computable general equilibrium model. The current study has been carried out in largest economies countries in the world in 2021 based on the computable general equilibrium model. The model in this paper is static, and the remainder of the paper dissects the principle model and the result of the examination.

MATERIALS AND METHODS

The GTAP Model

Johansen set up a multi-sectoral growth model in 1960 to consider the economic development in Norway, which implies the start of the CGE model. From that point forward, practically all the developed and developing nations have established their own CGE model among those the GTAP model is one of the most favorite models universally. GTAP model is a CGE model created by the Center for Global Trade Analysis, Purdue University, and this model can catch all economic linkages through value system (Hertel 1999; Rutherford 1998; Aguira *et al.,* 2016). The computable general equilibrium models like GTAP utilize the Armington structure (McDaniel and Balistreri, 2002). Hence, Armington elasticity is a proportion of the level of replacement among home and imported products and furthermore differentiation by exporting nation. There are two Armington elasticity's for every product in the model named ESUBD and ESUBM. GTAP model makes linkage among production, consumption, global savings, and investment. Most of its behavioral and identity equations of the GTAP model represents in percentage-change form rather than in level-form. Household expenditures are governed by a utility function that allocates private, government, and savings expenditures. Cobb-Douglas function assures constant budget shares in the standard closure of regional households. The simulation pattern in the model catches linkages across various nations and markets. In addition, the GTAP model in this paper is explicitly picked because of its broad treatments of interregional trade which is esteemed to be appropriate for conducting global trade policy analysis.

Model Database

The model of this paper used the Global Trade Analysis Project (GTAP) database version 9 (Aguira *et al*., 2016). The information base in the model covers 140 territorial units and 57 sectors with three reference years, for example, 2004, 2007, and 2011. The reference year 2011 has been utilized for the outcome investigation of this paper. In this paper

Table 1: Aggregation used in the Model

Regions	Sectors	Factors
Germany	Infrastructure	Land
France	Agriculture	Unskilled Labor
Italy	Process Food	Skilled Labor
United Kingdom	Manufacturing	Capital
China	Service	Natural Resources
USA		
Australia		
Japan		
Korea		
Rest of the World		

Note: Rest of the world means countries included in the GTAP database (excluded above mentioned simulated regions).

reference year 2011 has been chosen in order to avoid unexpected simulation error of the model.

The Methods of this Paper

This study aggregated 140regions in the GTAP 9A database into ten regions: Germany, France, Italy, UK, China, USA, Australia, Japan, Korea, and the Rest of the World. Ten regions have been chosen because those countries are the giant economic countries in the world. However, there is no independent infrastructural sector in the GTAP 9A database and it is necessary to separate the infrastructural sector from other sectors. With this GTAP database, this study added a new sector (infrastructural) into the GTAP 9A database because individual infrastructural sectors database not included in the main GTAP database. The new aggregated infrastructural sector includes manufactures, construction, transport equipment, electronics, electricity, transport necessary, communication, water transport and air transport. Rail and road transport are not included in the model because those database are not included in the main database file. Sectors are aggregated into infrastructure; agriculture; process food; manufacture and service. Other sectors not included into the model because of the limitation of the study. Factors of production are aggregated into Land, Skilled Labor, Unskilled Labor, Capital, and Natural Resources category. Land and natural resources are limited mobility across sectors (Table 1). Aggregation of the model has been done by the GTAP aggregation software tools.

The variable that simulates the effect of the policy change in the GTAP database is tms (i,r,s), which will impacts the policy scenario by decreasing infrastructural sectors. For the policy shock this paper decrease infrastructural sectors tariff by 25 percent among Germany, France, Italy, UK, USA, China, Australia, Japan, Korea and the rest of the world. This study utilized 25 percent tariff reduction as an experiment purpose to know what will be the impact of the economy if reduces tariff. This diminishing on infrastructural sectors tariff deliberately impacts in trade balance, import and export prices, which thusly influences the domestic market price and the volume of imports and exports. Eqs. 1 to 7 shows the policy change formulae:

$$pms(i,r,s)=tm(i,s)+tms(i,r,s)+pcif(i,r,s); \quad (1)$$

$$tms(i,r,s)=pms(i,r,s)- tm(i,s)-pcif(i,r,s); \quad (2)$$

$$pcif(i,r,s)=FOBSHR(i,r,s)*pfob(i,r,s)+TRNSHR(i,r,s)*ptrans(i,r,s); \quad (3)$$

$$pfob(i,r,s)=pm(i,r)-tx(i,r)- txs(i,r,s); \quad (4)$$

$$pim(i,s)=sum(k,REG,MSHRS(i,k,s)*[pms(i,k,s)-ams(i,k,s)]); \quad (5)$$

qxs(i,r,s)=-ams(i,r,s)+qim(i,s)-ESUBM(i)[pms(i,r,s)-ams(i,r,s) - pim(i,s)]*; (6)

*go(i,r) = SHRDM(i,r)*qds(i,r)+ sum(s,REG,SHRXMD (i,r,s)* qxs(i,r,s)+tradslack(i,r)*; (7)

Where pms represents the domestic market price; pcif represents the landed price of the goods; pfob represents the FOB price of the commodity; pim represents the market price of the imported commodity; qxs represents the commodity Export volume; qo represents the output of the commodity. This study does not utilize intangible assets because of the database limitation. Based on the above, this paper established a static global CGE model whose benchmark scenario is calibrated according to the GTAP9A database. This study is a static model so there is no baseline scenario in the model calibration. In this paper run GTAP software was used to perform the GTAP model simulations andGragg'*s*2-4-6 steps solution method taken consideration to get the maximum result accuracy.

RESULTS AND DISCUSSION

In this study, all simulation results are in changes in the economy in the year 2011 because economic shock has been created in the year 2011. Simulation result shows that the tariff reduction into infrastructural sectors results in changes to trade balances. Most countries experience a decrease and increase in its trade balance. As shown in Table 2, trade balance decreases in China by $US currency 1088 million, Australia by $US currency 14 million, Japan by $US currency 130 million, Korea by $US currency 12 million, and the rest of the world by $US currency 211 million. Interestingly, Germany, France, Italy, UK, and the USA experiences a $US currency 39 million, $US currency 254 million, $US currency 125 million, $US currency 126 million, and a $US currency 911 million increase in its trade balance. China's trade balance decreases significantly, on the other hand, the USA trade balance increases rapidly (Table 2).

As presented in Table 3, the infrastructure sector trade balance falls $US currency 556 million in Germany, $US currency 433 million in France, $US currency 231 million in Italy, $US currency 341 million in the UK, $US currency 822 million in the USA, $US currency 7 million in Korea, and $US currency 142 million in Australia. The infrastructure sector trade balance rises in China and Japan by $US currency 8418 million and $US currency 1605 million. China and Japan remain the highest trade balance increase in infrastructural sectors. Meanwhile, the agricultural sector trade balance decreases in China and Japan by $US currency 200 million and $US currency 20 million. The process food sector trade balance decreases in Germany, China, and Japan and by $US currency 9 million, $US currency 170 million, and $US currency32 million. The manufacturing sector trade balance in China and Japan decreases more significantly by $US currency 8638 million and $US currency 1504 million, where, service sectors decrease by $US currency 497 million and $US currency 180 million (Table 3).

As shown in Table 4, real Gross domestic product (GDP) decreases most regions. Decrease in real GDP indicates a decrease in average interest rates in the economy. Real GDP decreases in Germany, France, Italy, USA, Australia, Japan, and Korea by 1.2%, 19%, 18%, 80%, 9%, 77%, and 7%. France, Italy, and Japan's real GDP decrease remains high compared to other countries. The decrease in real GDP impacts customer purchasing power and spending patterns, which in turn affect the overall business of the economy. Nevertheless, China's real GDP increases significantly by 616% compared to pre simulation scenario (Table 4).

Export in infrastructure sectors decreases in most countries, where, in China and Japan export increases by 1.7% and 0.7%. On the other hand, agriculture sectors and process food sector export increases in France, Italy, the UK, and the USA; the manufacturing and service sectors export increases in France, UK, and the USA. Increases in exports bring money into the country and increase the GDP of the country. Meanwhile, China's export in agriculture, process food, manufacturing, and service sectors decreases rapidly compared to other countries (Table 5).

Changes in aggregate imports reflect the increasing patter in China, Germany, Australia, and Japan. Infrastructural sectors import increases in China by 1.3%, Japan, and Korea by 0.1% both followed by a

Table 2: Change in trade balances (millions of dollars)

Regions	Change
Germany	39.1
France	254.66
Italy	125.19
UK	126.55
China	-1088.37
USA	911.83
Australia	-14.28
Japan	-130.71
Korea	-12.17
Rest of the World	-211.79

Table 3: Change in trade balances by sector (millions of dollars)

Sectors	Germany	France	Italy	UK	China	USA	Australia	Japan	Korea	ROW
Infrastructure	-556.4	-433.32	-231.5	-341.56	8418.5	-822.73	-142.42	1605.14	-7.16	-7545.6
Agriculture	0.48	14.79	3.81	8.4	-200.72	47.19	-1.19	-19.68	0.53	136.96
Process Food	-9.33	25.2	1.41	12.22	-170.75	32.06	-1.54	-31.13	0.66	145.45
Manufacturing	625.43	596.69	343.14	390.13	-8638.43	1552.52	136.62	-1504.69	15.24	6545.5
Service	-21.08	51.29	8.33	57.35	-496.98	102.79	-5.75	-180.35	-21.44	505.85

Note: Infrastructure sectors include manufacturers, construction, transport equipment, electronics, electricity, transport, communication, water transport, and air transport

Table 4: Real gross domestic product changes (% change)

Regions	% Change
Germany	-1.25
France	-19.25
Italy	-18
UK	0.5
China	616.5
USA	-80
Australia	-8.88
Japan	-77.5
Korea	-6.88
Rest of the World	22

slight decrease in France and Italy. Agricultural and process food sectors import increases slightly in China, Australia, and Japan by 0.1% to 0.2%. On the other hand, the manufacturing and service sectors import increases in China by 0.2% and 0.3% compared to other countries (Table 6).

Table 5: Change in aggregate exports by sector (%)

Sectors	Germany	France	Italy	UK	China	USA	Australia	Japan	Korea	ROW
Infrastructure	-0.17	-0.25	-0.29	-0.17	1.71	-0.17	-0.36	0.75	0.05	-0.22
Agriculture	-0.01	0.05	0.01	0.04	-0.46	0.05	0	-0.24	-0.01	0.03
Process Food	-0.01	0.05	0.01	0.03	-0.39	0.04	-0.02	-0.19	0.01	0.03
Manufacturing	0.07	0.14	0.08	0.11	-0.61	0.1	0.07	-0.22	0.01	0.1
Service	-0.01	0.05	0	0.03	-0.49	0.03	-0.01	-0.21	-0.06	0.03

Table 6: Change in aggregate imports by sector (%)

Sectors	Germany	France	Italy	UK	China	USA	Australia	Japan	Korea	ROW
Infrastructure	0.04	-0.07	-0.03	0.05	1.31	0.01	0.13	0.1	0.1	0.18
Agriculture	0	-0.01	0	-0.01	0.18	-0.01	0.02	0.05	0.01	-0.01
Process Food	0.01	-0.01	0	-0.01	0.2	-0.02	0.01	0.06	-0.01	-0.01
Manufacturing	0.01	-0.02	-0.01	-0.01	0.21	-0.04	0	0.04	0	-0.01
Service	0.01	-0.02	0	-0.01	0.26	-0.02	0.02	0.1	0.02	-0.02

Table 7: Change in output volume by sector (%)

Sectors	Germany	France	Italy	UK	China	USA	Australia	Japan	Korea	ROW
Infrastructure	-0.05	-0.06	-0.04	-0.05	0.21	-0.03	-0.02	0.08	0	-0.07
Agriculture	-0.01	0.02	0	0.01	-0.05	0.01	0	-0.03	0	0.01
Process Food	-0.01	0.02	0	0	-0.04	0	-0.01	-0.01	0	0.01
Manufacturing	0.04	0.07	0.03	0.05	-0.14	0.03	0.04	-0.09	0.01	0.05
Service	0	0	0	0	0	0	0	0	0	0
CGDS	-0.01	-0.04	-0.03	-0.02	0.08	-0.03	0	0.01	0	0

Note: CGDS stands for Capital goods. Capital goods are physical assets that a company uses in the production process to manufacture products and services. This includes buildings, machinery, equipment, vehicles, and tools.

Output in infrastructural sectors decreases in Germany, France, Italy, UK, and Australia from 0.02% to 0.06%, where, output in China increases by 0.2%. In France, total domestic production increases in agriculture, process food, manufacturing, and service sectors, where, in Italy and the UK increases a slight amount. The results are presented in Table 7.

Changes in output and trade reflect changes in market prices. Market prices decrease in Germany, France, Italy, UK, USA, Australia, and Korea from 0.01% to 0.03% in infrastructure, agriculture, process food, manufacturing, and service sectors, where, domestic output in China and Japan increase by 0.03% to 0.1% (Table 8).

At long last, an essential inquiry for any shock to the economy is the overall welfare impact on the residents of that area. China is the biggest winner compared to other regions by rising welfare index $US currency 2.26 billion. The welfare index falls in Germany, France, Italy, UK, USA, Australia, Korea, by $US currency 26 million, $US currency 154 million, $US currency 55 million, $US currency 102 million, $US currency 615 million, $US currency 16 million,

Table 8: Change in market price by sector (%)

Sectors	Germany	France	Italy	UK	China	USA	Australia	Japan	Korea	ROW
Land	-0.03	0.04	-0.01	0.01	-0.07	0.02	-0.01	-0.05	-0.02	0
UnSkLab	-0.01	-0.04	-0.02	-0.03	0.13	-0.02	-0.01	0.04	0	-0.03
SkLab	-0.01	-0.03	-0.02	-0.02	0.13	-0.02	-0.01	0.05	0	-0.03
Capital	-0.02	-0.04	-0.02	-0.03	0.13	-0.02	0	0.04	0	-0.02
NatRes	0.02	0.03	0.01	0.03	-0.02	0.01	0.04	-0.05	0.01	0.04
Infrastructure	-0.02	-0.03	-0.02	-0.02	0.08	-0.02	-0.01	0.04	0	-0.03
Agriculture	-0.02	-0.03	-0.02	-0.02	0.08	-0.02	-0.01	0.03	-0.01	-0.02
Process Food	-0.02	-0.03	-0.02	-0.02	0.09	-0.02	-0.01	0.03	0	-0.02
Manufacturing	-0.01	-0.02	-0.02	-0.02	0.08	-0.02	0	0.03	0	-0.02
Service	-0.01	-0.03	-0.02	-0.03	0.11	-0.02	-0.01	0.04	0	-0.02
CGDS	-0.02	-0.03	-0.02	-0.02	0.07	-0.02	-0.01	0.03	0	-0.03

Note: CGDS stands for Capital goods. Capital goods are physical assets that a company uses in the production process to manufacture products and services. This includes buildings, machinery, equipment, vehicles, and tools

and $US currency 18 million. On the other hand, the welfare index in Japan increases by $US currency 239 million. The biggest winner in the welfare index is China (Table 9).

CONCLUSION

For the economic growth and poverty reduction, infrastructure investment is an important determinant. Investment in infrastructure assumes a significant function in the economic improvement of a nation. In the long-term, infrastructure investment boosts the economic growth of an economy by increasing the potential supply capacity. This study employs a regional static CGE model to analyze the effects of tariff reduction in infrastructural sectors. The results of simulations show that a decrease of tariffs in the infrastructure sectors has the greatest impact on the economic growth, job-creating, and reduction of the general level of prices in China, Japan, and Korea. The tariff reduction in infrastructure improved the living standard for people and affect economic growth much more than other modes. Meanwhile, tariff reduction harms trade volume and welfare. The result finds that the tariff removal leads to reductions in trade volume and household welfare in most countries. The consequences of this experiment recommend that all simulated regions should consider adopting a balanced approach to development. While infrastructural sector tariff reduction decreases the welfare of its citizens. China, Japan, Korea gains more economic benefits from this policy, an increase in productivity, and a significant improvement in its GDP, export, imports, and domestic output. In conclusion, all regions should continue their pursuit of common tariff policy and utilize their laws, policies, and development strategies to support its other sectors like agriculture, food processing, manufacturing, and service.

AUTHOR CONTRIBUTIONS

S.Sh. Hossain performed the literature review, experimental design, analyzed and interpreted the data, prepared the manuscript text, and manuscript edition. H. Delin performed the literature review, compiled the data, manuscript preparation and review.

ACKNOWLEDGEMENTS

The Authors would like to thank the project named “Open Laboratory of national agricultural policy analysis and decision support system” and “Construction of Portal and Platform of Agricultural Economic Theory, Policy Analysis and remote Scientific Research Environment” for the grant (grant No. Y2018PT31, 2018; 161005201902-1, 2019).

CONFLICTS OF INTEREST

The authors declare no potential conflict of interest regarding the publication of this work. In addition, the ethical issues including plagiarism, informed consent, misconduct, data fabrication and, or falsification, double publication and, or submission, and redundancy have been completely witnessed by the authors.

ABBREVIATIONS

CGE	Computable General Equilibrium
CGDS	Capital Goods
ESUBD	Elasticity of substitution between domestic and imported goods
ESUBM	Elasticity of substitution among imports from different destinations
GDP	Gross domestic product
GTAP	Global Trade Analysis Project
NATRES	Natural Resources
SKLAB	Skilled labor
TMS (i,r,s)	Import tariff
UNSKLAB	Unskilled labor

REFERENCES

Aguira, A.; Narayanan, B.; Mcdougall, R., (2016). An outline of the GTAP 9 database. J. Global Econ. Anal., 1(1): 181- 208 **(28 pages)**.

Arman, S.A.; Manesh, A.S.; Izady, A.T., (2015). Design of a CGE model to evaluate investment in transport infrastructures: an application for Iran. Asian Econ. Financ. Rev., 5(3): 532-545 **(14 pages)**.

Annala, C.N.; Batina, R.G., Feehan, J.P., (2008). Empirical impact of public infrastructure on the Japanese economy. Jpn. Econ. Rev., 59(4): 419-437 **(19 pages)**.

Boccanfuso, D.; Joanis, M.; Richard, P.; Savard, L., (2014). A comparative analysis of funding schemes for public infrastructure spending in Quebec. Appl. Econ., 46(22): 2653–2664 **(13 page)**.

Bougheas, S.; Demetriades, P.O.; Morgenroth, E.L.W., (1999). Infrastructure, transport costs and trade. J. Int. Econ., 47(1): 169-189 **(21 pages)**.

Bronzini, R.; Piselli, P., (2009). Determinants of long-run regional productivity with geographical spillovers: The role of R&D, human capital and public infrastructure. Reg. Sci. Urban Econ., 39(2): 187-199 **(13 pages)**.

Canning, D.; Pedroni, P., (2004), The Effect of infrastructure on long run economic growth. Department of economics working papers. Williams College **(30 pages)**.

Crescenzi, R.; Rodríguez-Pose, A., (2012). Infrastructure and regional growth in the European Union. Pap. Reg. Sci., 91 (3): 487-513 **(27 pages)**.

Démurger, S., (2001). Infrastructure development and economic growth: an explanation for regional disparities in China? J. Comp. Econ, 29(1): 95-117 **(23 pages)**.

Esfahani, H.S.; Ramírez, M.T., (2003). Institutions, infrastructure, and economic growth. J. Dev. Econ., 70(2): 443-477 **(35 pages)**.

Ferreira, P.C.; Vargas, F.G.; Do Nascimento, L.G., (2006). Welfare and growth effects of alternative fiscal rules for infrastructure investment in Brazil **(40 pages)**.

Fan, S.; Chan-Kang, C., (2004). Returns to investment in less-favored areas in developing countries: a synthesis of evidence and implications for Africa. Food Policy, 29(4): 431–444 **(14 pages).**

Garcia-Mila, T.; McGuire, T.J.; Porter, R.H., (1996). The effect of public capital in state-level production functions reconsidered. Rev. Econ. Stat., 78(1): 177-180 **(4 pages).**

Garcia-Milà, T.; McGuire, T.J., (1992). The contribution of publicly provided inputs to states' economies. Reg. Sci. Urban Econ., 22(2): 229-241 **(13 pages).**

Graham, S., (2000). Constructing premium network spaces: reflections on infrastructure networks and contemporary urban development. Int. J. Urban Reg. Res., 24(1):183-200 **(18 pages).**

Hertel, W.T., (1999).Future Directions in global trade analysis. Working papers 283437, Purdue University, center for global trade analysis, global trade analysis project **(20 pages)**.

Haynes, K.E.; Xie, Q.; Ding, L., (2004). Political geography, public policy and the rise of policy analysis. Appl. Geogr., 69-93 **(25 pages)**.

Jalan, J.; Ravallion, M., (2002). Geographic poverty traps? A micro model of consumption growth in rural China. J. Appl. Econ., 17(4): 329-346 **(18 pages).**

Li, Y., (2015). Public infrastructure investment in China: a recursive dynamic CGE analysis **(67 pages)**.

Limão, N.; Venables, A.J., (2001). Infrastructure, geographical disadvantage, transport Costs, and trade. World Bank Econ. Rev., 15(3): 451-479 **(29 pages).**

McDaniel, C.A.; Balistreri, E.J., (2002). A discussion on Armington trade substitution elasticities. USITC Office of Economics Working Paper, (2002-01).

Partridge, M.D.; Rickman, D.S., (1998). Regional computable general equilibrium modeling: a survey and critical appraisal. Int. Reg. Sci. Rev., 21(3): 205-248 **(44 pages).**

Rioja, F.K., (2001). Growth, welfare, and public infrastructure: a general equilibrium analysis of Latin American economies. J. Econ. Dev., Dev., 26(2): pages 119-130 **(12 pages)**.

Rutherford, T.F., (1998). GTAP in gams: the dataset and static model **(40 pages).**

Stewart, F.; Yermo, J., (2012).Infrastructure investment in new markets: challenges and opportunities for pension funds, OECD working papers on finance, insurance and private pensions,

No. 26, OECD publishing **(29 pages).**

Sloboda, B.W.; Yao, V.W., (2008). Interstate spillovers of private capital and public spending. Ann. Reg. Sci., 42(3): 505-518 **(14 pages).**

Sahoo, P.; Dash, R.K.; Nataraj, G., (2010). Infrastructure development and economic growth in China. Ide discussion paper No. 261 **(34 pages).**

Seung, C.K.; Kraybill, D.S., (2001). The effects of infrastructure investment: a two sector dynamic computable general equilibrium analysis for Ohio. Int. Reg. Sci. Rev., 24(2): 261–281 **(21 pages).**

Savard, L., (2010). Scaling up infrastructure spending in the Philippines: a CGE top-down bottom-up microsimulation approach. International Journal of Microsimulation, 3(1): 43-59 (**17 pages**).

Zou, P.X.W.; Wang, S.; Fang, D., (2008). A life-cycle risk management framework for ppp infrastructure projects. J. Financial Manag. Prop. Constr., 13(2): 123-142 **(20 pages)**.

Walmsley, T.L., (2006). A baseline scenario for the dynamic GTAP Model. Revised paper for the GTAP 6 database **(14 pages).**

HOW TO CITE THIS ARTICLE

Hossain, S.Sh.; Delin, H.,(2021).Comparison and analysis of tariff reduction of infrastructural sectors and its economic impact: A CGE approach. Int. J. Hum. Capital Urban Manage., 6(3): 253-262.

DOI: 10.22034/IJHCUM.2021.03.04

url: http://www.ijhcum.net/article_242960.html

Int. J. Hum. Capital Urban Manage., 6(3): 263-276, Summer 2021

International Journal of Human Capital in Urban Management
(IJHCUM)

Homepage: http://www.ijhcum.net/

ORIGINAL RESEARCH PAPER

Critical analysis of rural waste management weaknesses

Z. Omidi Saravani[1], M. Kavoosi Kalashami[1], A. Bakhshipour[2,*], I. Bagheri[2], C. Psomopoulos[3]

[1] *Department of Agricultural Economics, Faculty of Agricultural Sciences, University of Guilan, Rasht, Iran*

[2] *Department of Agricultural Mechanization Engineering, Faculty of Agricultural Sciences, University of Guilan, Rasht, Iran*

[3] *Department of Electrical and Electronics Engineering, University of West Attica, Athens, Greece*

ARTICLE INFO

Article History:
Received 30 July 2020
Revised 04 December 2020
Accepted 16 December 2020

Keywords:
Analytical hierarchy methods
Expert opinions
Paired comparisons
Waste management

ABSTRACT

BACKGROUND AND OBJECTIVES: Establishing a good sound waste management system for a community requires a comprehensive knowledge of the current status and issues involved in present waste management system. This research was conducted to identify and prioritize waste management weaknesses in Saravan village of Guilan province, Iran.
METHODS: Data were gathered through a descriptive-analytical approach using a purposive sampling and researcher-made questionnaire method. Waste management weaknesses were prioritized by Analytic Hierarchy Process (AHP), Fuzzy Analytic Hierarchy Process (FAHP), and Analytic Network Process (ANP).
FINDINGS: The most important weakness of rural waste management in the study area was waste management structure, equipment, and infrastructures weakness (index C) with relative importance values of 38.1% in AHP, 37.3% in FAHP, and 38.2% in ANP approaches. The village inhabitants' weakness (index B) with relative importance values of 16.5% in AHP, 17.2% in FAHP, and 1.4% in ANP had the lowest priority among studied weaknesses. Workforce weakness (index A), and educational and cultural weakness (index D) were the second and third important weaknesses, respectively. The most important sub-indices weakness of these weakness indices were non-compliance of Rural Municipality Manager (RMM) with waste management standards, rules, and regulations; Waste disposal by the village inhabitants at the nearest site; failure to establish a solid waste fix station in the village; and lack of training and awareness of villagers about waste management.
CONCLUSION: In order to establish a successful waste management system in rural areas, it is recommended to develop a comprehensive strategy that involves aspects such as; establishing proper waste management infrastructures, employment of skilled staff, and conducting training plans and motivational programs for staff and inhabitants.

DOI: 10.22034/IJHCUM.2021.03.05

NUMBER OF REFERENCES	NUMBER OF FIGURES	NUMBER OF TABLES
53	5	7

*Corresponding Author:
Email: *abakhshipour@guilan.ac.ir*
Phone: +981344085085
Fax: +9813133690281

Note: Discussion period for this manuscript open until October 1, 2021 on IJHCUM website at the "Show Article.

INTRODUCTION

Environmental and population health are the pre-requisites for sustainable development. There is an undeniable relationship between man and the environment (Van der Zwiep, 1994). In today's world, environmental crises such as global warming, habitat and natural resource destruction, pollutions rise, population growth, etc. cannot be overlooked, as each of these crises somehow affects human life (Kaiser *et al*., 1999). Waste management is an important issue worldwide especially for its importance in global environmental issues (Michael-Agwuoke, 2017). Daily waste production in Iran is reported to be 48,000 tons where 10,000 tons of which is rural waste, with a per capita daily waste production of 450 g in the country's villages (OMVMC, 2018). Since the beginning of human life, waste production has been an indispensable part of man's life in various household waste, agricultural, medical, sanitary, and industrial sectors. Hence, the production of these diverse materials in various forms has led to many environmental problems. Over the years, such materials have been discharged into recipient lands and waters with maximum neglect and disregard of engineering and environmental principles, which in turn causes water, soil, and air pollution and thereby endangering the health of human and other living organisms. The quantity and quality of waste produced at different locations are highly heterogeneous and are affected by environmental conditions, season, geographical location, as well as economic, social, and cultural factors, and other factors (Russell, 1988). Wastes are typically solid substances that are created by the activity of living organisms to survive due to environmental, industrial, agricultural, mineral and urban plans and issues. Waste is referred to as all unnecessary and economically unusable materials produced by human activities that are intentionally or accidentally released into the environment (Kamara, 2006). Wastes generated in rural areas can be classified into two large groups of household wastes and agricultural wastes. The former is generally the waste generated by common household activities (Pakpour *et al*., 2014). According to the definition by the European Union, agricultural wastes are those produced from various agricultural operations, including harvesting wastes, pesticide residues entering water, air or soil, crop residues in the farms, etc. (Nagendran, 2011). Waste Management is defined as a series of coherent and systematic regulations for controlling the generation to dispose of wastes in accordance with the principles of public health, economics, engineering, conservation, aesthetics, and other environmental considerations (Sujauddin *et al*., 2008). Wastes are directly associated with climate change. Most scientists believe that climate change is a serious threat to society as it has a great impact on human health, including increasing Cerebellar strokes, respiratory and cardiovascular problems (Mohan *et al*., 2006). Different wastes inevitably result from the widespread use of chemicals, and industrial and agricultural products in everyday life. Global experience has shown that improper waste management by inadequate disposal or inappropriate conversion of wastes into less risky materials, may become source of many potential hazards and threats (Tchobanoglous and Frank, 2002). In the past waste management was not considered as a problem due to the low population density, and lack of food product diversity and available lands for waste disposal. Nowadays, however, with rapid population growth, changing patterns of household consumption, changes in the quantity and quality of wastes, high costs, and insufficient land for waste disposal, it is necessary to pay more attention to waste management, especially in rural environments (Mohan *et al*., 2006). Changes of the pattern of consumption and lifestyle of rural households have led to generation of a significant quantity of perishable and unperishable leftover materials and increased production of wastes (Demirbas, 2011). More emphasis is now placed on the crucial role and also the urgent need for more attention to waste management in the rural area. With population growth, lifestyle development in villages and subsequent changes in consumption pattern, which increases waste generation that subsequently creates problems for today's societies. In addition to human and animal health problems, it also causes ecological adversity and disrupts the economic resources of rural societies (Sharholy *et al*., 2008). Today, the environmental hazards resulting from improper waste management are one of the major problems in Iran, and this problem is more pronounced in rural areas than in the cities. Considering the importance of the rural community and the challenges facing this community in its development process, understanding

the characteristics of rural development planning and addressing all aspects of it is essential. Therefore, protection of the rural environment cannot be abandoned, rather, it is necessary to pay special attention to their waste management in national plans (Saffari, 2013). This matter is more important in villages with rich environmental and natural resources, such as those in Guilan province. Although these days more attentions are paid to the issues of rural environmental pollution and aesthetic features in most villages of Iran. However, the problems relating to improper waste management such as water and soil pollution, and landscapes ugliness of villages, are not still well-known or are less considered among villagers. As a result, rural waste management is not yet perceived as a necessity by the Iranian rural people. Waste management plays an important role in public and individual health and the environment. In order to plan for a proper waste management system in a region, it is primarily required to understand issues such as the current conditions of waste generation and management, existing problems, and weaknesses and strengths of the current waste management systems. Analytic Hierarchy Process (AHP) is a multi-indices decision support method which is used by decision makers when faced with a problem involving multiple objectives and indices (Al-Hawari *et al*., 2011). Literature review shows that Analytic Hierarchy Process (AHP) method has been successfully used in studies focusing on the evaluation of different waste management related options (Chen *et al*., 2014; Babalola, 2015; Sahil, 2017; Gusmerotti *et al*., 2019). Analytic Network Process (ANP) is a generalized form of AHP. It overcomes the limitations of AHP and provides the ability to handle the dependencies and interactions across the elements at various levels (Zhang *et al*., 2015). Applications of ANP have been reported for analysis of waste management (Khan and Faisal, 2008; Bottero *et al*., 2011; Aung *et al*., 2019). Fuzzy Analytical Hierarchy Process (FAHP) is a combination of the traditional AHP and fuzzy theory which can be applied for vague decisions and minimize uncertainties (Wang *et al*., 2012; Istianto and Sugiantoro, 2018). FAHP has been used for decision making and analysis in the fields of waste management (Che, 2010; Ho, 2011; Kuznichenko *et al*., 2018; Khoshand *et al*., 2019; Ocampo, 2019). So far, many studies have been conducted on the conditions of waste generation and management in various locations (Beigl *et al*., 2008; Saeed *et al*., 2009; Thi *et al*., 2015; Mian *et al*., 2017; Omran *et al*., 2018; Bourtsalas *et al*., 2019). However, reviewing the literature did not show any research being conducted on the weaknesses of waste management. Information acquisition on the current status and waste-related problems in a region can help in providing solutions for improving regional waste management so that local municipalities can achieve an acceptable level of waste management. Therefore, the present research seeks to identify waste management weaknesses in villages. Saravan village (near Rasht city, Guilan province) has been chosen for a case study. Inadequate and improper management of wastes in northern Iran has caused serious public health and environmental problems in these regions. Therefore, in order to find appropriate solutions, it is necessary to analyze the existing weaknesses of waste management. The AHP, ANP and FAHP decision support approaches were comparatively applied in this study for investigating and ranking waste management weaknesses. The current study has been carried out in Saravan village of Rasht city, Guilan province of Iran from July to September, 2019.

MATERIALS AND METHODS

This is an applied research and is a methodologically qualitative study. Field information was gathered by a descriptive-analytic approach. The statistical sample of this research included 15 technicians, and scientific and executive experts in the field of rural waste management, whom were interviewed in 2018. The research instrument was a researcher-made questionnaire containing paired comparisons of the three indices. The main indices (n = 4), first-level sub-indices (n = 7), and second-level sub-indices (n= 53) had six, four, and 176 paired comparisons, respectively. The questionnaire was validated by authorized experts in Guilan waste management industry who worked in different public organizations, and University of Guilan. Thirty experts were selected as study samples by purposive sampling technique. Face-to-face interviews were used for accomplishing pairwise comparisons of weaknesses. In order to determine the importance and compare the weight of each weakness, the experts' answers to pairwise comparisons were ranked using AHP, FAHP, and ANP approaches. In this

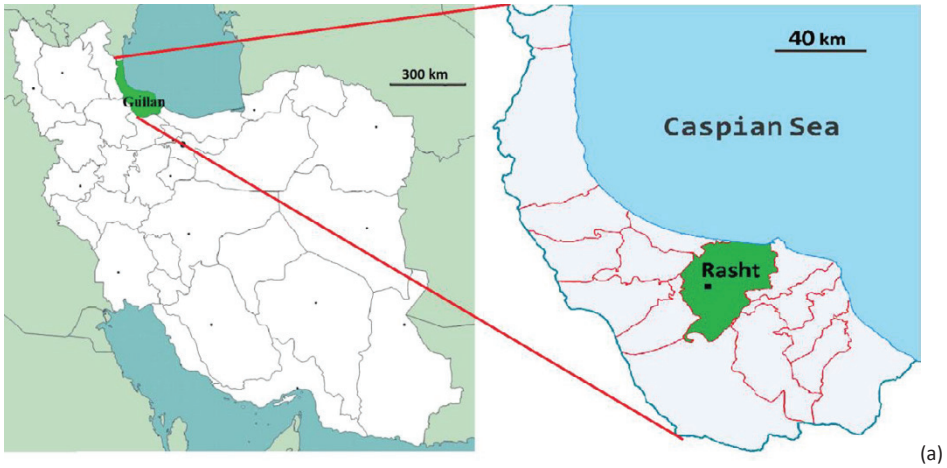
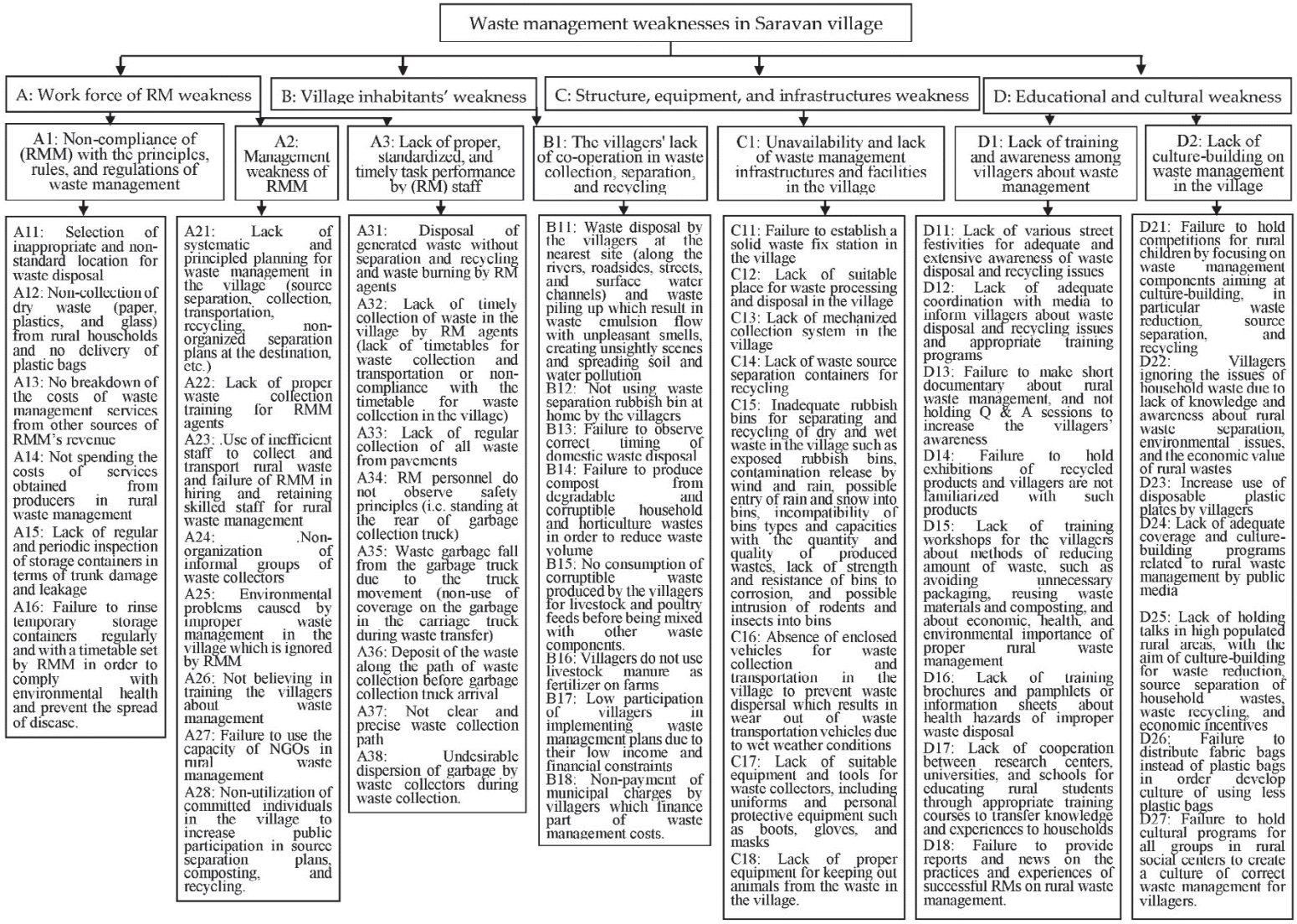


Fig. 1 Study area: a) Rasht County of Guilan Province in northern Iran, b) Saravan village in Saravan rural district of Rasht county

study, information was obtained from Saravan village located in Rasht district, Guilan province. The Saravan village is one of the seven villages of Saravan rural district. The Saravan rural district which is limited to Lakan and Sangar rural districts to the west and north, respectively, and Rudbar city to the south and southeast, has seven villages, including Ghazian, Saravan, Jokol Bandan, Kacha, Golsarak, Mushenga, and Imamzadeh Hashem (Fig. 1). This rural district has an area of 98.69 km^2 and is located between plain and mountains. The population of this area was 14837 in 1996, which decreased to 13989 in 2006, but the number of households increased by 572 families during this period (GPMPO, 2006). In 2011, the district had 14,041 inhabitants and 4,233 families (GPMPO, 2011). The population of Saravan district has decreased again to 12586 (4233 families) from which 5542 (1837 families) lived in Saravan village (GPMPO, 2016). Field surveys, expert interviews, and literature review showed that waste management in Saravan village has four main indices, including A- workforce of rural municipality (RM) weakness, B- village inhabitants' weakness, C- structure, equipment, and infrastructures weakness, and D- educational and cultural weakness.

The first index (A) was divided into three first-level sub-indices A1, A2 and A3. A1: non-compliance of rural municipality manager (RMM) with the principles, rules, and regulations of waste management (with six second-level sub-indices

Fig. 2: Hierarchical decision tree



A11-A16). A2: management weakness of RMM (with eight second-level sub-indices A21-A28). A3: lack of proper, standardized, and timely task performance by rural municipality (RM) staff (with eight second-level sub-indices A31-A38). The second main index (B) had one sub-index, B1: the villagers' lack of co-operation in waste collection, separation, and recycling (with eight second-level sub-indices B11-B18). The third main index (C) had one sub-index, C1: unavailability and lack of waste management infrastructures and facilities in the village (with eight second-level sub-indices C11-C18). The fourth main index included two first-level sub-indices, namely, D1: lack of training and awareness among villagers about waste management (with eight second-level sub-indices D11-D18), and D2: lack of culture-building on waste management in the village (with seven second-level sub-indices D21-D27). Accordingly, the hierarchical tree of this research is presented in Fig. 2.

RESULTS AND DISCUSSION

The responses of 15 waste management experts with the consistency rate of below 0.1 were compared to determine the relative weights at different levels. At the first level, four main weakness indices were compared, including workforce (A), villagers (B), waste management structure, equipment, and infrastructure (C), and education and culture (D). The inconsistency rates in AHP, FAHP, and ANP were 0.01%, 0.03%, and 0.01%, respectively. AHP results showed that the main index C had the highest priority with a relative importance of 38.1%. The second, third, and fourth ranks were attributed to A (24.6%), D (20.8%), and B (16.5%), respectively, based on the relative importance values in AHP. Application of FAHP and ANP approaches also generally yielded similar results. Considering the obtained relative importance values in AHP, FAHP, and ANP approaches, the priorities were the same in all approaches (Fig. 3). Results showed that the weakness of waste management structure, equipment, and infrastructures (C) had the highest priority among the first-level indices with relative importance values of 38.1% in AHP, 37.3% in FAHP, and 38.2% in ANP approaches. Meanwhile, the villagers' weakness (B) with relative importance values of 16.5% in AHP, 17.2% in FAHP, and 16.4% in ANP had the lowest priority among the first-level indices. Inadequate waste management infrastructure causes a number of health impacts, affecting schools, hospitals, and public squares, especially in the poorest areas (da Paz *et al.*, 2020).

A comparison was made among three second-level sub-indices of A, the inconsistency rates were 0.02%, 0.05%, and 0.01% in AHP, FAHP, and ANP, respectively. AHP results showed that the sub-index of A1 (non-compliance of RMM with waste management standards, rules, and regulations) had the highest priority with a relative importance of 48.1%. The second and third ranks belonged to A2 (29.4%) and A3 (22.6%), respectively, based on the

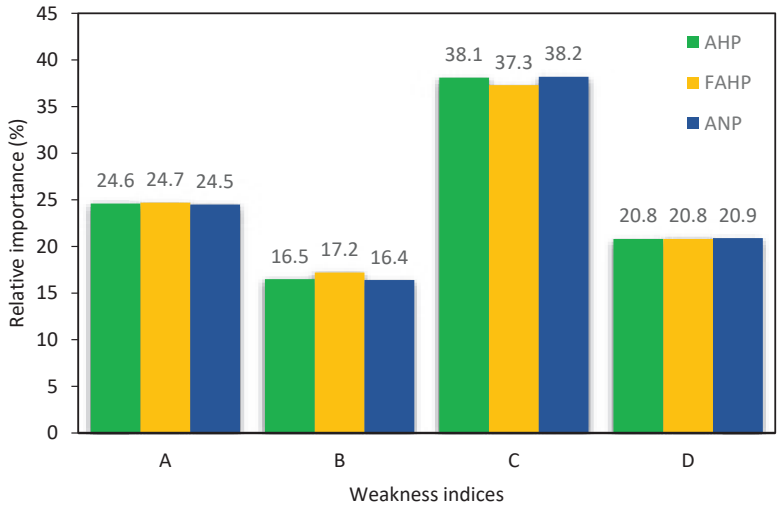


Fig. 3: Comparison of relative importance (weights) of first-level weakness indices using AHP, FAHP, and ANP approaches

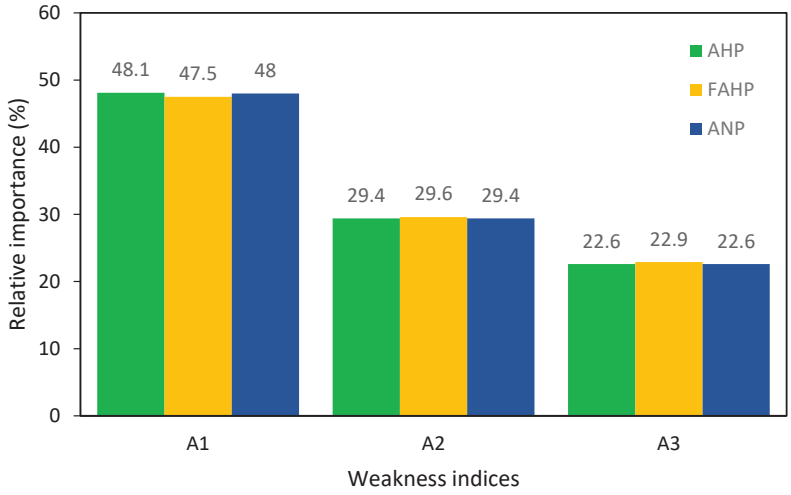


Fig. 4: Comparison of relative importance (weights) of second-level weakness indices of A using AHP, FAHP, and ANP approaches

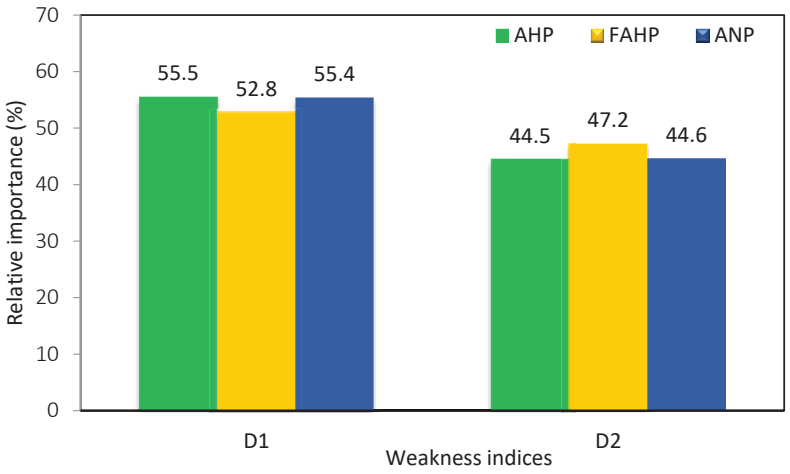


Fig. 5: Comparison of relative importance (weights) of second-level weakness indices of D using AHP, FAHP, and ANP approaches

relative importance values in AHP. With regard to the relative importance values obtained in AHP, FAHP, and ANP approaches, the priorities were the same in all three approaches (Fig. 4).

A comparison was also made between two sub-indices of D. The inconsistency rates were 0.00%, 0.01%, and 0.00% in AHP, FAHP, and ANP, respectively. AHP results revealed that D1 sub-index had the highest priority among the sub-indices of D, with a relative importance of 55.5%. D2 was ranked second with a relative importance of 44.5%. Also, similar priorities were obtained given the relative importance values resulted by FAHP, and ANP approaches (Fig. 5).

The results of this study are consistent with those of (Yoada *et al*., 2014), which concluded that public educations and training workshops are constructive measures toward proper rural waste management. The results showed that the lack of training and awareness of villagers about waste management (D1) had the highest priority among second-level indices, with relative importance values of 55.5% in AHP, 52.8% in FAHP, and 55.4% in ANP. The lack of proper, standard, and timely task performance by RM staff (A3) had the lowest priority among second-level indices, with relative importance values of 22.6% in AHP, 22.9% in FAHP, and 22.6% in ANP. At the third

Table 1: Prioritization of weaknesses and relative importance values of the sub-indices of the A1 index based on AHP, FAHP, and ANP

Priority	Second-level sub-indices	Symbol	AHP	FAHP	ANP
			Relative importance (%)	Relative importance (%)	Relative importance (%)
1	Selection of inappropriate and non-standard location for waste disposal	A11	24.3	24.2	24.7
2	Non-collection of dry waste (paper, plastics, and glass) from rural households and no delivery of plastic bags	A16	20.3	20.2	20.3
3	No breakdown of the costs of waste management services from other sources of RMM's revenue	A12	16.5	16.4	16.5
4	Not spending the costs of services obtained from producers in rural waste management	A13	14.3	14.4	14.3
5	Lack of regular and periodic inspection of storage containers in terms of trunk damage and leakage	A14	13.7	13.8	13.4
6	Failure to rinse temporary storage containers regularly and with a timetable set by RMM in order to comply with environmental health and prevent the spread of disease	A15	10.9	11	10.8
AHP inconsistency rate = 0.00 , FAHP inconsistency rate = 0.01, ANP inconsistency rate = 0.00					

Table 2: Prioritization of weaknesses and relative importance values of the sub-indices of the A2 index based on AHP, FAHP, and ANP

Priority	Second-level sub-indices	Symbol	AHP	FAHP	ANP
			Relative importance (%)	Relative importance (%)	Relative importance (%)
1	Lack of systematic and principled planning for waste management in the village (source separation, collection, transportation, recycling, non-organized separation plans at the destination, etc.)	A21	14.5	14.4	14.5
2	Lack of proper waste collection training for RMM agents	A22	13.7	13.6	13.7
3	Use of inefficient staff to collect and transport rural waste and failure of RMM in hiring and retaining skilled staff for rural waste management	A24	13.1	13.1	13.1
4	Non-organization of informal groups of waste collectors	A23	12.7	12.6	12.7
5	Environmental problems caused by improper waste management in the village which is ignored by RMM	A26	12.2	12.2	12.2
6	Not believing in training the villagers about waste management	A25	12.1	12.1	12.1
7	Failure to use the capacity of NGOs in rural waste management	A27	11.1	11.3	11.1
8	Non-utilization of committed individuals in the village to increase public participation in source separation plans, composting, and recycling	A28	10.6	10.7	10.6
AHP inconsistency rate = 0.00, FAHP inconsistency rate = 0.01, ANP inconsistency rate = 0.00					

level, six sub-indices of A1 sub-level were compared using different approaches. AHP results showed that the second sub-index A11 with a relative importance of 24.3%, and A15 with a relative importance of 10.9% had the highest and lowest priorities, respectively. The application of FAHP and ANP approaches also yielded similar results in priorities (Table 1).

Eight sub-indices of A2 index were compared and the AHP results showed that the second-level sub-indices A21 and A28 with relative importance values of 14.5% and 10.5% had the highest and the lowest priorities, respectively. Considering the relative importance values obtained in AHP, FAHP and ANP approaches, the priorities were the same among all approaches (Table 2).

Also, eight sub-indices from the A3 index were

Table 3: Prioritization of weaknesses and relative importance values of the sub-indices of the A3 index based on AHP, FAHP, and ANP

Priority			Second-level sub-indices	Symbol	AHP	FAHP	ANP
AHP	FAHP	ANP			Relative importance (%)	Relative importance (%)	Relative importance (%)
1	1	1	Disposal of generated waste without separation and recycling and waste burning by RM agents	A33	16.1	15.9	16
2	2	3	Lack of timely collection of waste in the village by RM agents (lack of timetables for waste collection and transportation or non-compliance with the timetable for waste collection in the village)	A35	15.1	14.8	15
3	3	2	Lack of regular collection of all waste from pavements	A32	14.3	14	14.4
4	5	4	RM personnel do not observe safety principles (i.e. standing at the rear of garbage collection truck)	A37	12.3	12.4	12.5
5	4	5	Waste garbage fall from the garbage truck due to the truck movement (non-use of coverage on the garbage in the carriage truck during waste transfer)	A38	12.1	12.2	12
6	6	6	Deposit of the waste along the path of waste collection before garbage collection truck arrival	A34	10.6	10.7	10.7
7	7	7	Not clear and precise waste collection path	A36	10.4	10.5	10.4
8	8	8	Undesirable dispersion of garbage by waste collectors during waste collection	A31	9.1	9.5	9

AHP inconsistency rate = 0.00, FAHP inconsistency rate = 0.02, ANP inconsistency rate = 0.00

evaluated and the results of AHP, FAHP, and ANP showed that the second-level sub-index A33 had the highest priority with relative importance values of 16.1% in AHP, 15.9% in FAHP, and 16% in ANP. The A31 index with relative importance values of 9.1% in AHP, 9.4% in FAHP, and 9% in ANP had the lowest priority (Table 3).

At the third level, eight sub-indices were compared from indices B1. The results of AHP, FAHP, and ANP indicated that the second-level sub-index B11 had the highest priority with relative importance values of 18.1% in AHP, 17.7% in FAHP, and 17.7% in ANP. The second-level sub-index B18 had the lowest priority with relative importance values of 7.4% in AHP, 7.7% in FAHP, and 6.7% in ANP (Table 4). Eight sub-indices were compared from the C1 index. AHP results showed that the second-level sub-indices C13 and C18 with relative importance values of 14.9% and 9.3% had the highest and the lowest priorities, respectively. The application of FAHP and ANP approaches also yielded similar priorities (Table 5). Results from the evaluation of eight sub-indices of D1 are presented in Table 6. AHP results showed that the second-level sub-indices D17 and D18 with relative importance values of 15.2% and 10.1% had the highest and the lowest priorities, respectively. The application of FAHP and ANP approaches also yielded similar results. The results of the present study are in line with that of Apostol and Mihai (2012). They found that awareness and holding workshops could attract the participation of villagers in proper waste management. The results of the present research also corresponds to those of Wang *et al*., (2014), Barr *et al*., (2001), Bayard and Jolly (2007), and Frick *et al*., (2004), who emphasized the impact of knowledge on the environmental-related behaviors of the community. Therefore, it seems necessary to develop suitable programs to increase the knowledge and awareness of villagers about rural waste management. This is because of the fact that the knowledge and awareness of people is an important and influential factor in waste management behaviors which facilitate program implementation and ensuring its success to a large extent (Sujauddin *et al*., 2008; Purcell and Magette, 2010; Maddox *et al*., 2011; Bortoleto *et al*., 2012). The final evaluation was done on seven sub-indices of D2. AHP results showed that the second-level sub-indices D23 and D26 with relative importance values of 16.9% and 11.7% had the highest and the lowest

Table 4: Prioritization of weaknesses and relative importance values of the sub-indices of the B1 index based on AHP, FAHP, and ANP

Priority			Second-level sub-indices	Symbol	AHP	FAHP	ANP
AHP	FAHP	ANP			Relative importance (%)	Relative importance (%)	Relative importance (%)
1	1	1	Waste disposal by the villagers at the nearest site (along the rivers, roadsides, streets, and surface water channels) and waste piling up which result in waste emulsion flow with unpleasant smells, creating unsightly scenes and spreading soil and water pollution	B11	18.1	17.7	17.7
2	3	2	Not using waste separation rubbish bin at home by the villagers	B12	14.1	14.1	16.6
3	2	3	Failure to observe correct timing of domestic waste disposal	B13	14.1	13.9	13.9
4	4	4	Failure to produce compost from degradable and corruptible household and horticulture wastes in order to reduce waste volume	B14	13.8	13.7	13.6
5	5	5	No consumption of corruptible waste produced by the villagers for livestock and poultry feeds before being mixed with other waste components.	B16	11.9	12	11.6
6	6	6	Villagers do not use livestock manure as fertilizer on farms	B15	10.4	10.6	10
7	7	7	low participation of villagers in implementing waste management plans due to their low income and financial constraints	B17	10.2	10.3	9.9
8	8	8	Non-payment of municipal charges by villagers which finance part of waste management costs	B18	7.4	7.7	6.7
AHP inconsistency rate = 0.01, FAHP inconsistency rate = 0.02, ANP inconsistency rate = 0.02							

Table 5: Prioritization of weaknesses and relative importance values of the sub-indices of the C1 index based on AHP, FAHP, and ANP

Priority	Second-level sub-indices	Symbol	AHP	FAHP	ANP
			Relative importance (%)	Relative importance (%)	Relative importance (%)
1	Failure to establish a solid waste fix station in the village	C13	14.9	14.9	14.9
2	Lack of suitable place for waste processing and disposal in the village	C12	14.2	14.1	14.2
3	Lack of mechanized collection system in the village	C11	13.7	13.6	13.4
4	lack of waste source separation containers for recycling	C14	13	13	12.9
5	Inadequate rubbish bins for separating and recycling of dry and wet waste in the village such as exposed rubbish bins, contamination release by wind and rain, possible entry of rain and snow into bins, incompatibility of bins types and capacities with the quantity and quality of produced wastes, lack of strength and resistance of bins to corrosion, and possible intrusion of rodents and insects into bins	C15	11.8	11.8	11.9
6	Absence of enclosed vehicles for waste collection and transportation in the village to prevent waste dispersal which results in wear out of waste transportation vehicles due to wet weather conditions	C16	11.6	11.8	11.7
7	Lack of suitable equipment and tools for waste collectors, Including uniforms and personal protective equipment such as boots, gloves, and masks	C17	11.4	11.4	11.5
8	Lack of proper equipment for keeping out animals from the waste in the village	C18	9.4	9.4	9.5
AHP inconsistency rate = 0.00, FAHP inconsistency rate = 0.01, ANP inconsistency rate = 0.00					

priorities, respectively. The application of FAHP and ANP approaches also yielded similar results with the same priorities (Table 7). Studies by Åberg (2000) and Zhu *et al.*, (2007) revealed that participation required sufficient motivation for the general public. Therefore, it is better for the community to benefit

Table 6: Prioritization of weaknesses and relative importance values of the sub-indices of the D1 index based on AHP, FAHP, and ANP

Priority	Second-level sub-indices	Symbol	AHP	FAHP	ANP
			Relative importance (%)	Relative importance (%)	Relative importance (%)
1	Lack of various street festivities for adequate and extensive awareness of waste disposal and recycling issues	D17	15.2	15.2	15.1
2	Lack of adequate coordination with media to inform villagers about waste disposal and recycling issues and appropriate training programs	D16	14.1	13.9	14.2
3	Failure to make short documentary about rural waste management, and not holding Q & A sessions to increase the villagers awareness	D14	13.4	13.4	13.4
4	Failure to hold exhibitions of recycled products and villagers are not familiarized with such products	D12	13.3	13.3	13.3
5	Lack of training workshops for the villagers about methods of reducing amount of waste, such as avoiding unnecessary packaging, reusing waste materials and composting, and about economic, health, and environmental importance of proper rural waste management	D11	12.8	12.6	12.8
6	Lack of training brochures and pamphlets or information sheets about health hazards of improper waste disposal	D13	10.6	10.9	10.6
7	Lack of cooperation between research centers, universities, and schools for educating rural students through appropriate training courses to transfer knowledge and experiences to households	D15	10.5	10.5	10.5
8	Failure to provide reports and news on the practices and experiences of successful RMs on rural waste management	D18	10.1	10.2	10.1

AHP inconsistency rate = 0.01, FAHP inconsistency rate = 0.02. ANP inconsistency rate = 0.00

Table 7: Prioritization of weaknesses and relative importance values of the sub-indices of the D2 index based on AHP, FAHP, and ANP

Priority	Second-level sub-indices	Symbol	AHP	FAHP	ANP
			Relative importance (%)	Relative importance (%)	Relative importance (%)
1	Failure to hold competitions for rural children by focusing on waste management components aiming at culture-building, in particular waste reduction, source separation, and recycling	D23	16.9	16.7	16.9
2	Villagers ignoring the issues of household waste due to lack of knowledge and awareness about rural waste separation, environmental issues, and the economic value of rural wastes	D24	16.4	16.4	16.4
3	Increase use of disposable plastic plates by villagers	D21	14.5	14.7	14.5
4	Lack of adequate coverage and culture-building programs related to rural waste management by public media	D25	14.4	14.4	14.4
5	Lack of holding talks in high populated rural areas, with the aim of culture-building for waste reduction, source separation of household wastes, waste recycling, and economic incentives	D27	13.6	13.4	13.7
6	Failure to distribute fabric bags instead of plastic bags in order develop culture of using less plastic bags	D22	12.4	12.5	12.4
7	Failure to hold cultural programs for all groups in rural social centers to create a culture of correct waste management for villagers	D26	11.7	11.9	11.7

AHP inconsistency rate = 0.01, FAHP inconsistency rate = 0.02, ANP inconsistency rate = 0.01

from the advantages of waste reduction and waste management at the source separation point, and it can be beneficial to provide discounted waste costs, baggage endowment, and prizes. Investigations conducted in Iran and other developed, developing, and underdeveloped countries, such as China, India, Guatemala (Ye and Qin, 2008; Tian *et al*., 2012), revealed that various indices including: significant effects of rural and urban waste management on the environmental pollution and problems, changing public opinion of villagers through public media, awareness of the society about the environmental pollution of the wastes and their management, strengthening waste management system to protect the natural environment, the importance of source separation plans, and recycling due to its low cost and high revenue are the most important factors in waste management. Finally, the results showed that the weakness of inappropriate and non-standard site selection for waste disposal (A11) with relative importance values of 24.3% in AHP, 24.2% in FAHP, and 24.7% in ANP had the highest priority among the third-level indices. The lowest priority among the third-level indices belonged to the weakness indices B18, which was; waste disposal by the villagers at the nearest site (along the rivers, roadsides, streets, and surface water canals) and waste piling up (flow of latex with unpleasant smells creating unsightly views and increasing soil and water pollution) with importance values of 4.7% in AHP, 7.7% in FAHP, and 6.7% in ANP.

CONCLUSION

Proper rural waste management is one of the most important components of rural sustainable development, which requires the establishment of necessary infrastructures, including cultural and social background, facilities and equipment, and financial provisions. The growing trend of rural waste generation and its role in environmental protection in developing countries requires urgent and serious attention. The results from the ranking of weaknesses in rural waste management in Saravan village by AHP, FAHP, and ANP approaches demonstrated that the most important weakness of rural waste management was waste management structure, equipment, and infrastructures weakness with relative importance values of 38.1% in AHP, 37.3% in FAHP, and 38.2% in ANP approaches. The village inhabitants' weakness had the lowest priority among studied weaknesses with relative importance values of 16.5% in AHP, 17.2% in FAHP, and 1.4% in ANP. The second and third important weaknesses were workforce weakness, and educational and cultural weakness, respectively. In order to implement the findings of this research in an area such as Saravan village, a comprehensive plan with sufficient budgets and correct managements should be considered. This strategic plan should include aspects such as providing waste treatment infrastructures, employment of skilled staff in the field of waste management and specific training of current staff, and conducting on-site or virtual training programs along with providing incentives for villagers and private waste management companies.

AUTHOR CONTRIBUTIONS

Z. Omidi Saravani performed the literature review, questionnaire initial preparation, face-to-face interviews, and prepared the manuscript initial text. M. Kavoosi Kalashami performed experimental design, questionnaire edition, analyzed and interpreted the data, and manuscript technical check. A. Bakhshipour helped in the literature review and questionnaire edition, analyzed the data, prepared the manuscript, and performed manuscript edition. I. Bagheri helped in the experimental design, and manuscript preparation and edition. C. Psomopoulos helped in experimental design and manuscript edition.

ACKNOWLEDGEMENT

The authors would like to thank the University of Guilan and Municipality of Rasht for cooperation in data collection process.

CONFLICT OF INTEREST

The authors declare no potential conflict of interest regarding the publication of this work. In addition, the ethical issues including plagiarism, informed consent, misconduct, data fabrication and, or falsification, double publication and, or submission, and redundancy have been completely witnessed by the authors.

ABBREVIATIONS

AHP	Analytic Hierarchy Process
FAHP	Fuzzy Analytical Hierarchy Process

ANP	Analytic Network Process
RM	Rural Municipality
RMM	Rural Municipality Manager

REFERENCES

Åberg, H., (2000). Sustainable waste management in households-from international policy to everyday practise. Experiences from two Swedish field studies (Doctoral dissertation).

Al-Hawari, T.; AL-B'ool, S.M.; Momani, A., (2011). Selection of temperature measuring sensors using the analytic hierarchy process. 451-459 (**9 pages**).

Apostol, L.; Mihai, F., (2012). Rural waste management: challenges and issues in Romania. Pre. Environ. Sustain. Dev., 6(2): 105-114 (**10 pages**).

Aung, T.S.; Luan, S.; Xu, Q., (2019). Application of multi-criteria-decision approach for the analysis of medical waste management systems in Myanmar. J. Cleaner Prod., 222: 733-745 (**13 pages**).

Babalola, M.A., (2015). A multi-criteria decision analysis of waste treatment options for food and biodegradable waste management in Japan. Environments, 2(4): 471-488 (**18 pages**).

Barr, S.; Gilg, A.W.; Ford, N.J., (2001). Differences between household waste reduction, reuse and recycling behaviour: A study of reported behaviors, intentions and explanatory variables. Environ. Waste Manage., 4(2): 69-82 (**14 pages**).

Bayard, B.; Jolly, C., (2007). Environmental behaviour structure and socio-economic conditions of hillside farmers: A multiple-group structural equation modeling approach. Ecol. Econ., 62(3-4): 433-440 (**8 pages**).

Beigl, P.; Lebersorger, S.; Salhofer, S., (2008). Modelling municipal solid waste generation: A review. Waste Manage., 28(1): 200-214 (**15 pages**).

Bortoleto, A.P.; Kurisu, K.H.; Hanaki, K., (2012). Model development for household waste prevention behaviour. Waste Manage., 32(12): 2195-2207 (**13 pages**).

Bottero, M.; Comino, E.; Riggio, V., (2011). Application of the analytic hierarchy process and the analytic network process for the assessment of different wastewater treatment systems. Environ. Modell. Software, 26(10): 1211-1224 (**14 pages**).

Bourtsalas, A.T.; Seo, Y.; Alam, M.T.; Seo, Y.C., (2019). The status of waste management and waste to energy for district heating in South Korea. Waste Manage., 85: 304-316 (**13 pages**).

Che, Z.H., (2010). Using fuzzy analytic hierarchy process and particle swarm optimisation for balanced and defective supply chain problems considering WEEE/RoHS directives. Int. J. Prod. Res., 48(11): 3355-3381 (**27 pages**).

Chen, T.; Jin, Y.; Qiu, X.; Chen, X., (2014). A hybrid fuzzy evaluation method for safety assessment of food-waste feed based on entropy and the analytic hierarchy process methods. Expert Syst. Appl., 41(16): 7328-7337 (**10 pages**).

da Paz, D.H.; Lafayette, K.P.; de Oliveira Holanda, M.J.; Sobral, M.D.C.M.; de Castro Costa, L.A., (2020). Assessment of environmental impact risks arising from the illegal dumping of construction waste in Brazil. Environ. Dev. Sustain., 22(3): 2289-2304 (**16 pages**).

Demirbas, A., (2011). Waste management, waste resource facilities and waste conversion processes. Energy Convers. Manage., 52(2): 1280-1287 (**8 pages**).

Frick, J.; Kaiser, F.G.; Wilson, M., (2004). Environmental knowledge and conservation behavior: exploring prevalence and structure in a representative sample. Pers. Indiv. Differ., 37(8): 1597-1613 (**17 pages**).

GPMPO. (2006). report of Guilan province management and planning organization (GPMPO): statistical yearbook of Guilan province.

GPMPO. (2011). Report of guilan province management and planning organization (GPMPO): statistical yearbook of Guilan province.

GPMPO. (2016). Report of Guilan province management and planning organization (GPMPO): statistical yearbook of Guilan province.

Gusmerotti, N.M.; Corsini, F.; Borghini, A.; Frey, M., (2019). Assessing the role of preparation for reuse in waste-prevention strategies by analytical hierarchical process: suggestions for an optimal implementation in waste management supply chain. Environ. Dev. Sustain., 21(6): 2773-2792 (**20 pages**).

Ho, C.C., (2011). Optimal evaluation of infectious medical waste disposal companies using the fuzzy analytic hierarchy process. Waste Manage., 31(7): 1553-1559 (**7 pages**).

Istianto, Y.; Sugiantoro, B., (2018). Design of decision support system selection of beach tourism object in Gunungkidul using fuzzy AHP method. Int. J. Inf. Dev., 6(2): 12-17 (**6 pages**).

Kaiser, F.G.; Wölfing, S.; Fuhrer, U., (1999). Environmental attitude and ecological behaviour. J. Environ. Psychol., 19(1): 1-19 (**20 pages**).

Kamara, A.J. (2006). Household participation in domestic waste disposal and recycling in the Tshwane Metropolitan area: an environmental education perspective (Doctoral dissertation).

Khan, S.; Faisal, M.N., (2008). An analytic network process model for municipal solid waste disposal options. Waste Manage., 28(9): 1500-1508 (**9 pages**).

Khoshand, A.; Rahimi, K.; Ehteshami, M.; Gharaei, S., (2019). Fuzzy AHP approach for prioritizing electronic waste management options: A case study of Tehran, Iran. Environ. Sci. Pollut. Res., 26(10): 9649-9660 (**12 pages**).

Kuznichenko, S.; Kovalenko, L.; Buchynska, I.; Gunchenko, Y., (2018). Development of a multi-criteria model for making decisions on the location of solid waste landfills. East. Eur. J. Enterp. Technol., 2(92): 21-30 (**10 pages**).

Maddox, P.; Doran, C.; Williams, I.; Kus, M., (2011). The role of intergenerational influence in waste education programmes: The THAW project. Waste Manage., 31(12): 2590-2600 (**11 pages**).

Mian, M.M.; Zeng, X.; Nasry, A.A.; Al-Hamadani, S.M., (2017). Municipal solid waste management in China: A comparative analysis. J. Mater. Cycles Waste Manage., 19(3): 1127-1135 (**9 pages**).

Michael-Agwuoke, M.U. (2017). Approaches to improving data quality in municipal solid waste management in New Zealand. Auckland University of Technology.

Mohan, R.; Spiby, J.; Leonardi, G.; Robins, A.; Jefferis, S., (2006). Sustainable waste management in the UK: the public health role. Public Health, 120(10): 908-914 (**7 pages**).

Nagendran, R., (2011). Agricultural waste and pollution. Paper presented at the Waste. Academic Press, 341-355 (**15 pages**)

Ocampo, L.A., (2019). Applying fuzzy AHP–TOPSIS technique in identifying the content strategy of sustainable manufacturing

for food production. Environ. Dev. Sustain., 21(5): 2225-2251 (**26 pages**).
Omran, A.; Altawati, M.; Davis, G., (2018). Identifying municipal solid waste management opportunities in Al-Bayda city, Libya. Environ. Dev. Sustain., 20(4): 1597-1613 (**17 pages**).
OMVMC. (2018). Report of the organization of municipalities and village managers of the country (OMVMC). Last accessed: 25/02/2014 (in Persian).
Pakpour, A.H.; Zeidi, I.M.; Emamjomeh, M.M.; Asefzadeh, S.; Pearson, H., (2014). Household waste behaviours among a community sample in Iran: an application of the theory of planned behaviour. Waste Manage., 34(6): 980-986 (**7 pages**).
Purcell, M.; Magette, W., (2010). Attitudes and behaviour towards waste management in the Dublin, Ireland region. Waste Manage., 30(10): 1997-2006 (**10 pages**).
Russell, C.S., (1988). Economic incentives in the management of hazardous wastes. Columbia J. Environ. Law, 13: 257-274 (**18 pages**).
Saeed, M.O.; Hassan, M.N.; Mujeebu, M.A., (2009). Assessment of municipal solid waste generation and recyclable materials potential in Kuala Lumpur, Malaysia. Waste Manage., 29(7): 2209-2213 (**5 pages**).
Saffari, A., (2013). Environmental risk assessment and waste management strategies at rural areas, case study: central Ojaroud district, Germi city. Rural Econ. Spatial Dev., 2(1): 71-91 (**11 pages**). (In Persian)
Sahil, F.M., (2017). Integrated solid waste management and development of analytical hierarchy process (AHP) method for collection and transportation in Kandahar city, Afghanistan. Int. J. Sci. Eng. Res., 8: 1095-1102 (**8 pages**).
Sharholy, M.; Ahmad, K.; Mahmood, G.; Trivedi, R., (2008). Municipal solid waste management in Indian cities–a review. Waste Manage., 28(2): 459-467 (**9 pages**).
Sujauddin, M.; Huda, S.; Hoque, A.R., (2008). Household solid waste characteristics and management in Chittagong, Bangladesh. Waste Manage., 28(9): 1688-1695 (**8 pages**).
Tchobanoglous, G.; Kreith, F., (2002). Handbook of solid waste management. New York: McGraw Hill (**832 pages**).
Thi, N.B.D.; Kumar, G.; Lin, C.Y., (2015). An overview of food waste management in developing countries: current status and future perspective. J. Environ. Manage., 157: 220-229 (**10 pages**).
Tian, M.; Gao, J.; Zheng, Z.; Yang, Z., (2012). The study on the ecological footprint of rural solid waste disposal-example in Yuhong district of Shenyang. Procedia Environ. Sci., 16: 95-101 (**7 pages**).
Van der Zwiep, K., (1994). Public participation as an instrument for environmental protection. Manual on public participation in environmental decision making.
Wang, J.; Li, Z.; Tam, V.W., (2014). Critical factors in effective construction waste minimization at the design stage: A Shenzhen case study, China. Resour. Conserv. Recycl., 82: 1-7 (**7 pages**).
Wang, X.; Cao, Y.; Zhong, X.; Gao, P., (2012). A new method of regional eco-environmental quality assessment and its application. J. Environ. Qual., 41(5): 1393-1401 (**9 pages**).
Ye, C.; Qin, P., (2008). Provision of residential solid waste management service in rural China. China World Econ., 16(5): 118-128 (**11 pages**).
Yoada, R.M.; Chirawurah, D.; Adongo, P.B., (2014). Domestic waste disposal practice and perceptions of private sector waste management in urban Accra. BMC Public Health, 14(1): 697-706 (**10 pages**).
Zhang, X.; Deng, Y.; Chan, F.T.; Mahadevan, S., (2015). A fuzzy extended analytic network process-based approach for global supplier selection. Appl. Intell., 43(4): 760-772 (**13 pages**).
Zhu, D.; Asnani, P.U.; Zurbrugg, C.; Anapolsky, S.; Mani, S., (2007). Improving municipal solid waste management in India: A sourcebook for policymakers and practitioners: The World Bank (**176 pages**).

HOW TO CITE THIS ARTICLE

Omidi Saravani, Z.; Kavoosi-Kalashami, M.; Bakhshipour, A.; Bagheri, I.; Psomopoulos, C., (2020). Critical analysis of rural waste management weaknesses. Int. J. Hum. Capital Urban Manage., 6(3): 263-276.

DOI: 10.22034/IJHCUM.2021.03.05

url: http://www.ijhcum.net/article_239875.html

Int. J. Hum. Capital Urban Manage., 6(3): 277-290, Summer 2021

International Journal of Human Capital in Urban Management
(IJHCUM)

Homepage: http://www.ijhcum.net/

ORIGINAL RESEARCH PAPER

Analysis of factors affecting entrepreneurship development in rural areas in the light of jihadi management

M. Jamal[1], Y. Vakil Alroaia[2,*]

[1] *Department of Public Administration, Firuzkuh Branch, Islamic Azad University, Firuzkuh, Iran*

[2] *Entrepreneurship and Commercialization Research Center, Department of Management, Semnan Branch, Islamic Azad University, Semnan, Iran*

ARTICLE INFO

Article History:
Received 08 October 2020
Revised 29 December 2021
Accepted 5 January 2021

Keywords:
Entrepreneurship development
Jihadi Management
Rural entrepreneurship

ABSTRACT

BACKGROUND AND OBJECTIVES: There are two basic reasons, namely, the country's preparedness for the leap and economic pressure, it proves that rural areas need effort and entrepreneurship, more than any other era. The objective of this study was to identify the effective factors in the development of entrepreneurship in rural areas with emphasis on Jihadist management indicators.

METHODS: The study is a descriptive research based on the method and an applied in terms of purpose and is of the correlation type. The population include all social, cultural, and economic and management experts were considered. The sampling method is stratified random and the sample size of 93 people which are selected by random stratified method. To conduct this research, 100 questionnaires were distributed among 100 members of the community, of which 93 questionnaires could be returned. The Structural Equation Model was used for inferential analysis.

FINDINGS: The results of the study shows that geographical factors, scientific-technological and Jihadi Management factors with coefficients of 36.1%, 27.2% and 67% (respectively) have related with entrepreneurship development significantly, in rural regions. Also, economic, socio-cultural and individual factors with coefficients have affected entrepreneurship development less than 5% and have a weak relationship with entrepreneurship in the research areas.

CONCLUSION: Findings show that jihadi entrepreneurship includes three components of jihadi spirit, jihadi motivation and jihadi movement as a central category of rural entrepreneurship and the categories of causal, contextual, interventionist, strategic and consequences are in line with jihadi entrepreneurship.

DOI: 10.22034/IJHCUM.2021.03.06

NUMBER OF REFERENCES	NUMBER OF FIGURES	NUMBER OF TABLES
43	0	8

*Corresponding Author:
Email: *y.vakil@semnaniau.ac.ir*
Phone: +98 912 231 6247
Fax: +98 23 3365 4231

Note: Discussion period for this manuscript open until October 1, 2021 on IJHCUM website at the "Show Article.

INTRODUCTION

Management styles and patterns of different countries are designed and compiled according to their indigenous and national (cultural, social, economic, political and human resources) characteristics, therefore it is basically impossible to apply management patterns of a specific country with a certain culture to another in an imitative way (Wiles Kimball, 1997). Managing organizations is a complex, complete task that requires a full understanding of the dynamic relationships in the internal and external environment with which the organization is constantly interacting (Tahani *et al.,* 2017). Two main reasons including country preparation for development and economic pressure conform that Iran needs effort and entrepreneurship more than any other period. Since not all communities or all individuals within the country are in equal position to achieve entrepreneurial conditions, the necessary conditions must be created for development of entrepreneurship in the country (Farahani and Hajihosseini, 2014). One of the main problems of Iran in recent years has been villager's backwardness and their migration to urban areas. This cause several problems in cities, marginalization, decreased quality of life, lack of employment and crime increase. On the other hand, decrease of agriculture growth in rural areas and a 23.4 prevent drop in employment alone will not guarantee economic growth in the country's village and cannot eradicate poverty; therefore, it is necessary to pay attention to other sectors along with agriculture (Najafikani *et al.,* 2015). So, in order to empower, develop capacities and increase the fields of participatory activities in rural areas, it is necessary to identify factors affecting the success of rural people and the areas of increasing entrepreneurship to improve the economic conditions of rural people in rural areas (Eftekhari *et al.,* 2010). Performed evaluations suggest that low familiarity of villagers with primary ways of entrepreneurship increase is due to special conditions of rural environment namely geographical isolation, deprivation, limitation of opportunities and facilities, basic and essential infrastructure and communication services. Therefore, it is very important to prepare and improve social, cultural and economic environments of rural areas, because provision and increasing access of villagers to different facilities and services such as new communicational and media facilities have an important role in the rise of entrepreneurship (Rezvani and Najjarzadeh, 2009). From Alison's (1990) point of view, the role and position of villages in political, social, and economic processes in a local, regional, national and international scale and consequences of underdevelopment of rural areas have raised attentions to rural development and even its precedence over urban development (Poortaheri and Taghavi, 2012). Influenced by various factors such as personal characteristics and motivations, education, culture, customs, laws, policies and technical knowledge, an entrepreneurial activity can have different effects and results in terms of economic and social patterns of behavior and the like. Lordkipanidze *et al.* (2005) believes that rural entrepreneurship development depends on socio-cultural, environmental, infrastructural, economic and organizational factors. One of the most important factors affecting entrepreneurship in any society is the culture which govern that society. A culture that values entrepreneurial people encourages many to be entrepreneurs. Regarding entrepreneurial culture, societies can develop strategies to encourage entrepreneurial behaviors', there is a strong relationship between people's culture and their tendency toward entrepreneurship. Entrepreneurship have many social benefits and positive affect rural society, it benefits the society through the government, which in a way reflects socioeconomic development of society. The more a society participates in entrepreneurial activity, the faster reach socioeconomic development (Behkish, 2011). There are three basic strategies to develop rural entrepreneurship, first, to attract businesses from other areas (especially urban areas) to villages, this strategy is not considered useful from national point of view. Second, to support and develop present available businesses through supportive policies, but policymakers and managers do not generally pay attention to this strategy. Third, to create and generate have the new businesses raised from the heart of rural areas. This is usually government favorite strategy but requires long term systematic planning (Morshedizad, 2014). In two separate studies, Patrin and Gannon (1997) and Levitas (2000) suggest that essentially there is no difference between rural and urban entrepreneurship except that rural entrepreneurship must be imagined in the rural context. Hosseininia and Fallahi (2017) believe that the concept of rural entrepreneurship is not just limited to agriculture and its related activities such as food

industries, rather it includes industrial development too. This concept is not limited to villages merely but includes small cities and their adjacent areas as well. It seems that despite these efforts, structural changes in political economy of Iran have failed and rentier economic nature still holds true in Iranian government. The idea and notion of resistive economy as a pattern of Jihadi Management (JM) were expressed in response to this economic tactic by leader of Islamic revolution (Hazaveii and Ziraki Heydary, 2004). All great leaders of the world have learned how to see and believe in self-confidence before anyone else and first of all from within themselves (Anthony Robbins, 2005). Any managerial transformation must form from the inside and JM is also the kind that begins from the inside of each person and organization and requires an internal transformation. This kind of management that begins from the inside of each person and organization requires an internal transformation. This kind of JM must have a distinction from common management of west world. As Druker (1999) state that Management problems always become people's problems. It should be considered that JM must not convert its problems to problems of an organization or its followers. The territory of JM is not limited to main and major section rather includes all aspects and fields at all levels. It is applicable at all categories and requires its own structures and issues (Ashuri and Ghaed Ali, 2002). According to Badri *et al.,* (2019), the weakness of the ideological and theoretical foundations of rural policy in Iran and the lack of integration of policies formulated from an institutional and territorial perspective and the lack of coherence and coordination in the process of developing and implementing rural development programs, including the challenge which show the need to review rural development policy in the current situation. The problems of rural areas in Semnan Province are due to two main issues: one is the weakness of infrastructure and the other is the weakness of the economy. Although the government has made extensive and costly plans to improve this infrastructure, observations show that this alone has not been able to solve the problems of rural life and lift them out of poverty and reduce the flood of migration from rural to urban areas. With above mentioned concepts and necessities regarding entrepreneurship development in the country and performed studies, the concept of JM in the field of entrepreneurship seems to have great importance for the development of entrepreneurship especially in rural areas. Because as is clear from the evidence, promoting entrepreneurship in underdeveloped areas is not effective only with for profit short-term perspective and it seems that efforts taken from motivations and spiritual attitudes can be very effective in this field so, in this regard issues such as JM can be considered one of the most obvious approaches. The main goal of this study is to identify the effective factors in the development of entrepreneurship in rural areas based on JM in rural areas. The current study have been carried out in Semnan Province in 2019.

Theoretical framework

Entrepreneurship

Entrepreneurship as a popular phenomenon which plays a vital role in the economy can help to shape a resistant economy by its revolutionary development. Entrepreneurship in resistance economy has three levels: individual, organizational and industrial. In individual role, job creation entrepreneurship, individual income generation, work spirit and the vitality of the people of Community are studied. In organization role it deals with issues such as qualitative and quantitative development of products, organization. In regional-industrial role it considers industrial development and reconstruction, shaping new and competitive industrial (Vakil Alroaia and Aminbeidokhti, 2018). The role of the Entrepreneurs in rural area, on the one hand, are looking for the optimal use of available resources, and on the other hand, by creating diversity in rural activities, they can prevent the excessive use and pressure on natural resources. Moreover, social entrepreneurship can solve social problems and protect social responsibility (Mouksch and Rowe, 2016). Also, economists consider entrepreneurship as the most important driving force of rural economic development, politicians regard it as a key strategy to prevent disturbance and chaos in area. Farmers describe it as an instrument to improve their income, women see it as a possibility to employ nearby their habitats which can lead to autonomy, independence and reduction of their social need (Vazife, 2016).

Rural entrepreneurship

Rural entrepreneurship includes introducing a new method of production process, opening a new market, finding new resources and developing any

industrial, agricultural and service organization in rural areas. it can occur in different fields such as trade, converting and agricultural industries and all these fields can help economic development as well (Vakil Alroaia *et al.,* 2013). Rural entrepreneurship is of endless important resources of human societies which is related to human power and creativity. economists consider it, the most important and politicians regard it as a key strategy to prevent disturbance and chaos in villages and villagers and farmers describe it as instrument for improvement of their income, woman see it as possibility to employ near their habitats which lead to autonomy. Independence and reduction of their social needs (Laukhanen, 2003).

Jihad Management

It is defined as endless effort to effectively use and control people's activities based on struggle in all scientific, cultural, diplomatic and economic fight divine intention to obtain society dignified goals and overcome present barriers. With love and belief in God, with insight and enemy recognition, JM removes present obstacles one by one and its goal is to develop Islamic civilization (Khan Ahmadi and Kheibari, 2015). Emphasis on rationality of doctrines which to use the latest and most up-to-date managerial methods but with a value and revolutionary orientation is another component of JM. On the other hand it is important in jihadi discussion to pay attention to other component such as voluntary and unconditional, transformational, dynamic and flexible management this kind of management causes the practical methods of management be valued and the understanding of the needs of society along with the spiritual, religious and revolutionary spirit to be considered and practiced by managers (Armand and Zabihitaheri, 2009). Jihadi management is offered as a macro strategy and practical solution for all managers and officials, and familiarity with the quantity and quality of this management style can help managers at different levels in optimizing the management of movement affairs, solving movement problems and overcoming Problems and crises (Mobini, 2016).

Literature review

Many studies have been performed in the field of JM and resistance economics, some of which are mentioned below, but the researcher did not find a study in the field of JM in rural areas. Dabson *et al.,* (2002) in order to design entrepreneurial activities and collect information about organizations, programs and activities supporting entrepreneurship in rural areas concluded that the four main factors to revitalize the entrepreneurial spirit in rural areas Needs include creating activities tailored to the identified needs of the local community, adequate production tailored to local scale, resources and skills, focusing on entrepreneurship, and continuous learning through changing previous teachings. Vakil Alroaia and Aminbeydokhti (2018), studied the role of resistance economy and empowering managers in production cooperative with characteristics and components such as resistance economy, dynamic, organizational profile, personal profile, managers dynamic competence , this study showed that using participatory, organizational and managerial planning and structural approach and personals operation, managers should identify their capabilities in production invest weaknesses to attain their goals completely. Using knowledge management effect on managers skills Sabokro *et al*., (2018), identified that knowledge management has a positive and significant effect on human, operational and perceptual skills of Shiraz Municipality managers. Dos (2014), determines the roles of rural entrepreneurship in economic employment, improving life standards, per capita income increase, national self-reliance and proper economic power distribution and defined the advantages such as prevailing job opportunities, restraining immigration of villagers, balanced regional growth, promotion of artistic activities, preventing social harm and youth awareness. Using data-based theory, Shamaei Kopai (2014), identified and determined aspects of JM and concluded that JM have individual dimensions as value, attitude and behavior and organizational dimensions as culture, structure and process as well, and all of them are divided in to sub-categories. According to results obtained and by use of data-based theory, he extracted causal conditions, contest, strategies, intervening conditions and consequences of JM. Hosseini *et al.,* (2020) believe that the development of relationship between entrepreneurial skills on job performance of managers and deputy mayors of Hormozgan province improves the competitive performance of organizations. Raeessadi *et al*., (2015) studied the role of culture and jihad: management in

entrepreneurship and economic jihad. The result of this study shows that using jihadi spirit and thoughts a manager can be also a successful manager in modern economic front means entrepreneurship. Chitsaz *et al.,* (2019) examined two kinds of capital, human and social, on entrepreneurial activities. This evolution is accompanied by the presentation of new ideas and methods to solve existing and future problems, thereby improving farmers' economic conditions. The results of this study showed the significant effect of dimensions of human and social capital on entrepreneurial activities. Jelodari, (2015) studied the effects of individual and inner aspects on entrepreneurship and its role in resistance economy and concluded that to activate in resistance field requires to investigate and obscene internal economy space. Results of this study suggests that in the study organization, there is a significant relationship between all internal and individual dimensions and entrepreneurship, in which culture has the most relationship with entrepreneurship and also in this regard there is a mutual causal relationship between entrepreneurship and resistance economy . It means when entrepreneurship which is considered as economic development engine, hero of industrial development, stimulus and incentive for invest meant, the main Factor of technology transfer, remedy for market disruption and bottle necks and the main factor in creating employment (job creation) increases, growing trend of the country is maintained and its vulnerability decreases and also increase in stability of resistive economy increases entrepreneurship in the country. Beik Mohammed Loo and Esmaeelian, (2015), examined useful entrepreneurial skills of industrial engineers regarding resistive economy. The results show that from industrial engineers' point of view to enter the business arena academic, individual management and teamwork skills are ranked respectively. Also, in relation to significant relationship between resistance economy and entrepreneurial orientation, production support, maximum use of facilities, popularize economy, knowledge-based rank respectively. Soleymani *et al., (2014),* presented the local model of resistive economy considering the existing potentials in Ilam province with emphasis on the national determination and jihadi spirit. Beside doing library research about the existing capacities of Ilam province, using the opinions of a number of experts of this field which is obtained in the form of Delphi model a local model is presented to explain the concept of resistance economy according to the existing capabilities in the Ilam province and with emphasis on the role of national decision (determination) and JM. Ebadi (2014), identified the process of entrepreneurship education as the most important strategy for the development of JM. IDEF structural modeling technique is a managerial instrument for identifying and examining a process. Using this technique in present study graphic models of entrepreneurship are provided. These models help to identify the limitations, problems, facilities and information and to understand this process and its implementation as a suitable approach of JM more easily. Abdollahial et al. (2014), identified entrepreneurial management indicators with the support of Islamic and jihadi. With the emphasis on Supreme leader's speeches about jihadism of management, this research tried to identify indicators of entrepreneurial management with support of Islamic and JM in the society for progress in all fields. Data collection was performed through library method. Entrepreneurial management with an Islamic and jihadi perspective Seeks to train managers who try to serve not to rule. Mikaelo and Karamipour (2014), examined economy prosperity and entrepreneurship with national decision and JM. According to the results of this study , participants have a positive and desirable attitude toward the impacts of national will (decision) and JM components on economic prosperity and entrepreneurship development, ie work conscience , diligence and seriousness at work , careful production , consumption of domestic goods, committed management , applying elite academic forces , relationship between industry and academia and government support for domestic production have positive impact on economic development. Morshedizad (2014), has evaluated the relation of Islamic management and JM and its role in entrepreneurship culture. The results showed that there is a significant relationship between Islamic management and JM and its effect on relationship culture. Farsiani *et al*., (2014), determined the position and managerial role of entrepreneur women in economic growth Angie Hardy management development. Woman's entrepreneurship, especially who could earn a degree of awareness and expertise via academic education,

Table 1: the studied population and sample size

Name of organization	Job position	Population size	Sample size
Agricultural Jihad	Managerial and expert	15	15
Natural Resources & Watershed Management	Managerial and expert	31	19
Technical and professional education	Managerial and expert	25	16
Ministry of cooperatives, labor and social welfare	Managerial and expert	28	22
Planning and management organization	Managerial and expert	20	18
Provincial government	Managerial and expert	4	3
Total		123	93

Table 2: the average of combined reliability and convergent validity

Variable	Combined reliability	Convergent validity (average variance AVE > 0.5)
Economic factors	0.931	0.628
Social- cultural factors	0.714	0.565
Scientific technological factors	0.810	0.516
Geographical factors	0.903	0.651
Individual factors	0.941	0.843
JM Factors	0.927	0.810

is very important in a developing society as Iranian population. Using these skillful forces, a society solve economic, social and cultural problems and in improvise economic growth and JM development will be possible. To realize these goals, special attention is paid to women and tasks such as self-belief, religion belief, indigenous modelling, creativity and innovation, priority to use Iranian goods culture developing. In this article, there is a significant relationship between the managerial role of women entrepreneurs and economies growth. According to the background of research on the rural area and jihadi management, most studies have been in the field of culture analysis and jihadi management and explaining its dimensions and components.__In addition, the main focus of some studies is dedicated to pathology and evaluation of the effects of jihadi culture and management, but the researcher did not find much work on the development of entrepreneurship in rural areas based on jihadi management.

MATERIALS AND METHODS

The present study is applied in terms of purpose and its data collection method is descriptive correlation, because it examines and explains the synchronic relation between variables using correlation analysis and structural equation modelling. Population and statistical sample: The statistical population of this study includes 123 managers and experts from some key organizations residing in Semnan such as the following organizations: Agricultural jihad, natural resources and watershed management, Technical and professional education, ministry of cooperatives, labor and social welfare, planning and management and Provincial government. The sampling method of this study was stratified random sampling. Table 1 shows the population size and sample used. To conduct this research, 100 questionnaires were distributed among 100 members of the sample and 93 questionnaires were returned finally.

To analyze observations the questionnaire was used, the validity of which has been measured by experts. To measure the entrepreneurship development variable, the standard 5 point likert scale questionnaire of Nowruzi (2016) with 24 questions has been used. The validity of this questionnaire is confirmed by experts and its reliability has been reported by Nowruzi to be 0.836. Table 2 shows combined reliability and convergent validity of this study.

Since proper amount of combined reliability is 0.7 (Nannally, 1978) and this amount for mean extractive variance is 0.5. (Fornell and Larcker, 1981) According to Table 2, all of these criteria regarding mentioned variables have proper amount, so it can be confirmed that the present study is reliable and valid. In this study, the partial least squares (PLS) structural equations modeling, has been used for test of research objectives and determine measurement error. The following assumptions hold respectively in

Table3: Description of research main variables

Variable	No.	Min	Max	Mean	S. D	Var.	SK	Kurtosis
Economic F.	93	2.5	4.8	4.230	0.453	0.173	-0.32	-0.456
Social- cultural F.	93	3	4.71	4.0108	0.416	0.173	-0.22	-0.433
Scientific technological F.	93	2.75	4.63	3.836	0.373	0.140	-0.24	-0.116
Geographical F.	93	1.8	4.56	3.752	0.473	0.224	-0.72	+1.989
Individual F.	93	2.31	4.20	4.062	0.365	0.111	-0.33	-0.490
JM F.	93	2.29	4.88	4.117	0.419	0.136	-0.27	-0.209

Table 4: Results of KS test for research variables

Variable	No.	Z-score*	Sig.
Economic F.	93	1.136	0.151
Social- cultural F.	93	1.224	0.1
Scientific technological F.	93	0.974	0.299
Geographical F.	93	1.207	0.119
Individual F.	93	1.521	0.330
JM F.	93	0.886	0.543

Z-scores* are a way to compare results to a “normal” population

this method:

- Expressing the model
- Estimating the model
- Testing hypotheses
- Interpreting the model

LISREL software has been used for this purpose.

RESULTS AND DISCUSSION

The data collected from questionnaires were categorized in SPSS software and then transferred it to Partial Least Squares (PLS). Descriptive statistics show that out of a total of 93 respondents, 2.2% Were between 30 and 35 years old, 23% were 35-40 years old, 68.8% were above 40 years old. In terms of education 16.2% of respondents were graduate of basic science, 30.2% of technical-engineering, 36.61 of humanistic, 16.1% of agriculture and 1.1% were of other fields. The description of the research main variables is given in Table 3.

As Table3 shows, according to respondents the average score of the variable of economic factor is 4.230, standard deviation is 0.45321 and variance is 0.173. Obtained average is higher than expected one and the lowest score belongs to variable of geographical factor namely 3.753 skewness and kurtosis of all variables are normal and it confirms that variables distribution is normal. Investigating the normality of main variables of research: In order to determine the normality of research main variables, Kolmogorov-Smirnov (KS) test was used. The test results are shown in Table 4.

It is observed from Table 4 that significance level earned for each variable is more than 0.05, so it can be state that the studied variables follow the normal approximation. Kaiser Mayer-Olkin (KMO) index and Bartlett test are used to determine the appropriateness of data number for factor analysis. The minimum amount is determined to be 0.70, so if the value of KMO is move than this value and the closer it is to 1, it is considered appropriate to perform analysis. Also, if the amount of Bartlett m significance level is less than 0.05, use of factor analysis is approved. Outputs of this test are given in Table 5.

In this section, the relationships between latent variable and obvious variables in the model are examined. Also, in preset study, the power of latent and observable variable relation is shown by factor loading. Outputs of PLS software determined factor loading of model indices. Factor loading is a value between 0 and 1. If factor load is less than 0.3, the relationship will be considered weak and can be ignored. Factor Load (FL) between 0.3 to 0.6 is acceptable and above 0.6 is verge desirable. T- test is used to evaluate the significance is evaluated at 0.05 error level, if observed loading factor values via T- test is higher than 1.96, the relation will be significant. Table 6 shows the estimated relationships and model parameters based on the structural equation model (SEM).

Considering obtained values in Table 5, the

Table 5: KMO and Bartlett's Test of research variables

Variable	KMO	Bartlett	df	Sig.
Economic F.	0.718	1421.518	66	0.001
Socio- cultural F.	0.777	1576.289	66	0.001
Scientific technological F.	0.729	4384.699	171	0.001
Geographical F.	0.811	4474.306	171	0.001
Individual F.	0.791	362.967	120	0.001
JM F.	0.768	943.240	28	0.001

Table6: summary confirmatory factor analysis results of research scale

Index		Norm	Q	FL	R^2	T-Value
		Improve the production chain, competitiveness	Q_1	0.777		
		Employment, internal resources	Q_2	0.756		
		Production, development of knowledge-based Co.	Q_3	0.856		
C_1	Economic F.	Improving the value chain of Co.	Q_4	0.821	0.044	0.254
		Productivity, Fair distribution	Q_5	0.693		
		Financial System	Q_6	0.788		
		production improvement	Q_7	0.800		
		tax incentives	Q_8	0.884		
		work force empowerment	Q_9	0.798		
		Creating and developing jihadi culture	Q_{10}	0.856		
C_2	Socio- cultural	Economic trans patency	Q_{11}	0.433	0.18	0.254
		Skill, consumption and cost pattern improvement	Q_{12}	0.345		
		Breaking the monopoly	Q_{13}	0.406		
		Commercialization	Q_{14}	0.818		
	Scientific technology	Production share promotion	Q_{15}	0.523		
C_3		Development of academic discipline regarding entrepreneurship	Q_{16}	0.440	0.272	4.570
		Innovation	Q_{17}	0.653		
		Export share promotion	Q_{18}	0.859		
		Utilizing diverse geographical capacities	Q_{19}	0.771		
	Geographical F.	Utilizing sense of patriotism	Q_{20}	0.832	0.361	2.117
C_4		Develop strategic connections with other regions	Q_{21}	0.820		
		Development of cooperation between cities	Q_{22}	0.858		
		Develop partnership with other provinces	Q_{23}	0.747		
		Creativity and self-belief	Q_{24}	0.928		
C_5	Individual F.	self-confidence	Q_{25}	0.917	0.07	1.521
		Trust in divine help	Q_{26}	0.908		
	JM F.	Management improvement	Q_{27}	0.830		
C_6		Improving organizational culture	Q_{28}	0.926	0.67	4.819
		Improving social and organizational structure	Q_{29}	0.939		

accuracy of relationship between variables with T-test values higher than 1.96 is confirmed. According to this, Geographical factors and JM T-test values are 4.570 and 4.819 respectively, so their T-test values are more than 1.96 and their relations with variable of entrepreneurship development are confirmed, but individual, economic, cultural and social factors gave values less than 1.96.

Research variable correlation

After ensuring the accuracy of the measure's fitness with research dimensions and variables, by performing a confirmatory factor analysis, Pearson correlation was used to determine the type and degree of relationship between are quantitative variable and another quantitative variable. The results are reported in Table 7. It is observed that geographical and economic variables (P<0.001, r=0.506), scientific-technological factors and cultural factors (P<0.001, r=0.836), individual variable and scientific-technological variable (P<0.001, r=0.797) individual variable and geographical one (P<0.001, r=0.881) and managerial variable and individual (P<0.001, r=0.807) have the highest correlation and the relationship among all variable is significant.

Table7: Research variable correlation

variable	Eco	Socio-cult	Tech	Georg	Indi
Economic F.	1				
Socio- cultural F.	0.427**	1			
technological F.	0.423**	0.836**	1		
Geographical F.	0.506**	0.553**	0.759**	1	
Individual F.	0.477**	0.463**	0.797**	0.882**	1
JM F.	0.365**	0.464**	0.763**	0.763**	0.807**

Table 8: one-sample T-test of research variables

Index	Mean	SD	Norm Score	t-value	df	Sig.
Economic F.	3.99	0.503		25.68		0.001
Socio- cultural F.	4.25	0.549		29.52		0.001
Scientific technological F.	4.11	0.579		24.90		0.001
Geographical F.	4.05	0.705	3	19.33	169	0.001
Individual F.	3.99	0.640		20.23		0.001
JM F.	4.19	0.705		22.09		0.001

What is the importance of rural entrepreneurship development?

A-One-sample T-test was used to evaluate the importance of rural entrepreneurship development. Table 8 shows the average dimensions of the rural entrepreneurship development model and compares it with the average criteria. Based on results, the average of economic, Social-cultural, scientific-technological, individual and managerial factors are significantly higher than acceptable level (criterion score3). So, it can be said that policy makers can give a special advantage to implementation of JM.

Thus, to answer the research question it can be said that geographical factors, JM and scientific-technological factor are factors affecting rural entrepreneurship development. Considering obtained results, effective indices to overcome barriers of rural entrepreneurship development are commercialization, innovation, production and export share promotion, developing entrepreneurship academic resources, utilizing diverse geographical capacities, utilizing sense of patriotism, creating strategic geographical connections, management improvement, improving organizational culture and improving social/ organizational structure. Research model fitness: In this research, GOF criterion is used to examine the extent to which independent variables were able to explain their dependent variables. Wetzel's et al (2009), introduced three values of 0.36, 0.25, 0.01 as weak, medium and strong values of GOF. This means that if calculated value is 0.01 or close to it, it can be concluded that total fitness of model is weak, values equal to 0.25 and 0.36 indicate medium and strong fitness respectively. Therefore, GOF index is;

$$\sqrt{0.311\times 0.}403 = 0.3540$$

Comparing calculated GOF index value with 0.01, 0.25, 0.36 which are standard values approvers' proper total fitness.

CONCLUSION

Considering potentials and capacities of these rural areas and due to low employment rate in the province and up-to-datedness of entrepreneurship issues, the present research intends to identify effective factors and barriers of entrepreneurship development and turn this great to an opportunity in the province the results of research shows that geographical factors, scientific-technological and JM factors with coefficients of 36.1% , 27.2% and 67% (respectively) have related with entrepreneurship development significantly, and among these factors is the most effective one Also, economic, socio-cultural and individual factors with coefficients have affected entrepreneurship development less than 5% and have a weak relationship with entrepreneurship in the research areas. So, they can be mentioned as entrepreneurship development barriers which requires improvement. This study was conducted

to identify factors affecting the development of entrepreneurship in rural areas of Semnan province with emphasis a JM indicator. The results showed that among the 6 factors studied in rural areas of Semnan province, geographical factors, scientific and technological factors and JM factors are effective on entrepreneurship development in these areas. JM is an approach raised from native thinking in accordance with cultural and social requirements of Iran. Some of characteristics of this management are: providing service with divine intention, indefatigability, training managers, endurance at work, speed of action, creativity and innovation, courage, responsibility along with faith, sincerity and humility, JM is nothing but scientific management, which is based on formulas and rules proposed in management knowledge. Of course, the difference of this kind of management described by Islamic or jihadi adjectives with management is that jihadi or Islamic management is based on Islamic value system and its components. In fact, the main difference of JM with other kinds of management lies in its assumptions and intellectual foundations adopted from Islamic management. Examining the results of economic factors: this variable refers to gents such as creating SMEs, increasing economic competitiveness, creating job for job seekers especially young people, organizing financial system toward productive activities at province level, export of knowledge-based products by businesses formed in entrepreneurship process in rural areas, formation and participation of entrepreneurial enterprises.

Review of geographical factors

This variable includes factors such as developing various businesses in different sectors of the province by entrepreneurs of these areas, creating regional and provincial relations between entrepreneurs and entrepreneurial companies of Semnan province and those of other areas. This variable with coefficient of 36.1% and with T-value >1.96 (2.117), and with significance coefficient 0.034 shows that the relationship between geographical factors and entrepreneurship development in Rural areas of the province is not weak and it is a kind of amplifier. So, it can be called an effective factor for developing this type of entrepreneurship. The results of this study are consistent with the research of other scholars, (Vakil Alroaia, and Aminbidokhti, 2018; Raeessadi *et al*., 2015; Mikaelo and Karamipour, 2014). To illustrate these results, it can be said that efforts have been made to use diverse geographical capacities and capabilities of eighties of Semnan province as their advantages by planning and clustering entrepreneurial industries. Also, the scope of action, of the special economic zones of the province has been developed to facilitate the development of transfer of advanced technologies, the expansion and facilitation of the production and export of goods and services, and the provision of essential needs and financial resources.

Reviewing results of JM factors

this factors includes modification and changing the present management pattern to JM desirable pattern, solving unexpected economic difficulties and problems, responsibility, preventing loss of resources in the management improvement index, empowering civil society, social foundations and understanding environmental conditions latent capacities and institutional support, using voluntary and transformational management, construction mobilization, morals and religions values in the index of organizational culture, leadership style of the optional type, new arrangement of structure and human resource, activities efficiency, increasing social capitals and self- sufficiency in the socio-organizational improvement index. This variable with coefficient of 67 percent, T-value of 4.819 which is greater than 1.96 and significance coefficient less than 0.05 indicates that there is a positive relationship between JM factors and entrepreneurship development in Semnan Province and it is an amplifying factor of entrepreneurship JM should be set as desirable managerial entrepreneurship development model in thinking system of economic and political principles of the province. Participation is obtained through civil society empowerment, social foundations and understanding environmental conditions, attracting public reliance. The results of this study are consistent with the research of other scholars, (Armand and Zabihitaheri, 2009; Mobini, 2016; Khan Ahmadi and Kheibari, 2015). However, studies in line with the approach of jihadi management and rural development can rarely be found. In addition to preventing the waste of resources, responsibility of provincial managers can lead to achieving goals. Identifying and activating latent capacities and institutional support based on

the centrality of the community institutional support based on the centrality of the community living in rural areas should be considered. Voluntary management, dynamic, transformational, flexible work force should be used in the mission related to entrepreneurship development. Ethics are religious values should be set in the workplace. Leadership style should have optional, supportive and guiding features and be less inclined to imperative style. Structure and work force get a new arrangement. Social capital increase through increasing socio-organizational trust should be on the agenda.

Reviewing results of scientific-technological factor

This variable contains the factors such as: commercialization of products, relating different sections of innovation system of Semnan through entrepreneurs of these areas, production and export of knowledge-based products, utilizing the capacities of entrepreneurship disciplines and businesses to explain all dimensions of resistive economy in this area. This variable with coefficient of resistive economy in this area. This variable with coefficient of 7.2% and T-value of 2.213 (>1.96) and significance coefficient less than 0.05 which is 0.027, shows that there is a significant relationship between scientific technological factors and entrepreneurship development. This variable can be considered as an amplifying and effective factor of it. The results of this study are consistent with the research of other scholars, (Hosseini *et al.,* 2020; Raeessadi et al., 2015; Vakil Alroaia and Aminbidokhti, 2018). To explain these results it can be said that human and scientific resources of Semnan province especially in desert areas have been largely activated and innovation system has been organized to develop entrepreneurship. Entrepreneurs of this area have tried to relate different sections of innovation system of Semnan province. The strengths and weaknesses of all dimensions of resistive economy have been studies by use of the capacities of entrepreneurship business disciplines in scientific and academic societies of Semnan province. Attempts have been made to increase the share of productions and export of knowledge-based products and services and to use economic, scientific and technical capacities to access the ability to export goods and services to other parts of Iran and beyond it. In addition, the results of this study showed that with the spirit, motivation and jihadi movements, significant achievements can be achieved in rural areas of Semnan province by adopting appropriate strategies. These strategies include: Sensitization and education activities, development of spiritual and motivational attitude and infrastructural activities. One of the effective factors in the development of rural entrepreneurship is sensitization and educational activities. Sensitization and educational activities can include the use of local media and education and promotion of rural entrepreneurial culture. Another effective strategic factor is the development of spiritual and motivational attitudes. This strategy includes promoting the spirit of jihadi among the youth and encouraging the rural by presenting new ideas. The third effective strategic factor is proper preparation. This strategy includes identifying and attracting creative and innovative villagers, creating an environment for cultivating entrepreneurial ideas, and creating brainstorms in local communities.

SUGGESTIONS

1. Considering results of economic variable, it is proposed to make more use of internally produced resources and inputs of the province, reform and reinforce financial system for productive production, and support the export of goods and services of entrepreneurial firms of the province in proportion to their added value. Economy of SP is relatively productive and this is competitiveness advantages of this province, in this case all factors of production to consumption chain get fair share according to the value produced. In order to increase the share production and export of knowledge-based products and services, a knowledge-based economy must be expanded by knowledge-based business development. The added of entrepreneurial industries of the province should increase and private sector must participate in products disposition. Meanwhile, in centers should be provided for tax revenues from these industries.

2. According to the results of social variable it is suggested that the majority of residents of rural areas of SP participate in economic activities by facilitating and encouraging collective cooperation order for different classes to reach a suitable level of income in this way. New workforce should be empowered by education, skill, creativity and experience. With focus an internal raw material consumption required by entrepreneurial industries, a new consumption

pattern must be formed and saving money should be considered in public costs. In general. JM should take added value, richness, productivity, investment and productive employment. The distribution system, pricing and updating of market surveillance practices should be clear and all products of rural entrepreneurial industries should be standard.

3. Regarding the results of scientific and technological variable there are some suggestion activating scientific and human resource of the province especially in rural areas to develop entrepreneurship, reforming innovative system of the province, increasing production and export share of knowledge-based products and goods in these areas, increasing scientific, technical and economic capacities to access goods and services export identifying and performing related measures, explaining all aspects of persisted economy in scientific and academic communities and identifying strengths and weaknesses a fit.

4. due to the results of geographical variable related suggestions are utilizing diverse capacities and capabilities of geographical advantages of the province, developing scope of action of special economic regions of the province to transport advanced technologies, developing and facilitating production and export of goods and services, providing necessary needs and financial sources of SP. Considering patriotism of entrepreneurs living in each area of the province, relative advantages of different parts of province should be identified and formed. Strategic connections and cooperation between different cities of the province and between them and other provinces should be developed.

5. According to the conclusions of individual variable some approaches are suggested: to attract skilled efficient human forces, to achieve goals with the help of willful people, to believe in his own capabilities. Self-confidence is nothing but believe in one's innate capacities, abilities and potentialities & believe in God's help in developing and growing them. Trust in reaching the goals with goal's help has the greatest impact on the speed of dynamic and struggling human movement.

6. The results of JM suggest to set JM as desirable management model for entrepreneurship development in the intellectual system of political and economic basis of the province. New system with maintained previous potentials and redness should be created to solve unforeseen problems in economic issues. The responsibility of provincial managers can, in addition to preventing the loss of resources, lead to achieving goals. Attracting participation through strengthening civil society, social foundations and understanding environmental conditions and gaining public trust. Identifying and activating latent capacities and institutional support based on the society living in the rural areas. Voluntary, transformative, dynamic and flexible management in the missions related to entrepreneurship development should be used. Ethics and religious values should be established. Leadership style must be optional, supportive and less commanding the structure and manpower should be reorganized, more emphasis should be placed on effective activities, increasing social capitals by increasing the level of social and organizational trust should be on the agenda and promoting confidence in independence and the need for self-sufficiency should be promoted. According to the issues raised and the results of this study, it is suggested that part of future research be dedicated to measuring the status of current research strategies in the villages of Semnan province. And then, evaluate and measure the compliance of the output of this study with what actually exists in the villages. One of the limitations of this research is the small number of studies in the field of rural entrepreneurship development based on jihadi management. Although significant studies can be obtained in the field of rural entrepreneurship, foreign studies in the field of jihadi management that are required by religious teachings by the researcher have not been found. The novelty of this theory, even in domestic studies, has made a small contribution to rural development. In any case, the researchers tried to select studies that are close and consistent and with acceptable scientific validity.

AUTHOR CONTRIBUTIONS

Y. Vakil Alroaia performed conceptualization, methodology, software, and literature review and manuscript preparation. Vakil Alroaia and Jamal performed data collection and correction, writing original draft preparation, writing reviewing and editing references.

ACKNOWLEDGEMENT

The authors wish to thank all the managers and experts of Agricultural Jihad, Natural Resources and

Watershed Management, Technical and Professional Education, Ministry of cooperatives, labor and social welfare, Planning and management organization and Provincial government for their cooperation, his dedication and support. Also, the authors would like to thank the editor and the two anonymous reviewers for the constructive comments on improving an early version of this paper.

CONFLICT OF INTEREST

The authors declare that there is no conflict of interest regarding the publication of this manuscript. In addition, the ethical issues, including plagiarism, informed consent, misconduct, data fabrication and/or falsification, double publication and/or submission, and redundancy have been completely observed by the authors.

ABBREVIATIONS (NOMENCLATURE)

df	Degree of Freedown
Eco	Economic Factor
FL	Factor load
Georg	Geographical Factor
IF	Individual Factor
JM	Jihadi Management
KS	Kolmogorov-Smirnov
KMO	Kaiser Mayer-Olkin
PLS	Partial Least Squares
R2	Coefficient of Determination
Socio-Cult	Socio- Cultural Factor
Sig	Significante
SD	Standard Deviation
SEM	Structural Equation Model
Tech	Technological Factor

REFERENCES

Abdolhian, M.; Abdolhian, Z.; Abdolhian, A., (2014). Identifying indicators of entrepreneurial management with the support of Islamic and jihadi management, 1st National Conference on Futurology, Management and Development, Tehran - Iran Modern Education Development Center (METANA). (In Persian)

Alison, M., (1990). Entrepreneurship: An international perspective. Oxford: Linacre House.

Armand, P.; Zabihi Tari, R., (2009). A study of jihadi management style and other management styles, 2nd National Conference on Jihadi Culture and Management, Tehran, Ministry of Jihad Agriculture. (In Persian)

Ghaedali, H.R.; Ashouri, M., (2014). Jihadi management methods realized from Islamic management (a case study of constructive jihad in the first decade of the Islamic Revolution of Iran). Cult. Eng. Q., 9(82): 67-83, (**17 Pages**). (In Persian)

Behkish, M.M., (2001). Iran's economy in the context of globalization, Tehran, Ney Publishing. (In Persian)

Beik Mohammad Lu, Kh.; Ismailian, Gh., (2015). Investigating the useful entrepreneurial skills of industrial engineers in the direction of resistance economics, International Conference on New Research Findings in Science, Engineering and Technology with a Focus on Need-Based Research, Tehran, Payame Noor University. (In Persian)

Chitsaz, E.; Tajpour, M.; Hosseini, E.; Khorram, H.; Zorrieh, S., (2019). The Effect of human and social capital on entrepreneurial activities: a case study of Iran and implications, J. Entrepre. Sustainability, 6(3): 1393-1403, (**11 Pages**).

Dabson, B.; Malkin, J.; Matthews, A.; Pate, K.; Stickle, S., (2003). Mapping rural entrepreneurship. Washington, DC: Corp. for Enterprise Development.

Das, D.C., (2014). Prospects and challenges of rural entrepreneurship development in NER-A study. Int. J. Hum. Soc. Sci. Stud., 1(3): 178-182 (**15 pages**).

Drucker, P. F.; Machiarlo, J.E., (1991). Drucker and six decades of management thought. Translated by Seyed Reza Eftekhari. (2009) Mashhad: Marandiz Publications. (In Persian)

Eftekhari, A.R.; Taherkhani, M.; Sojasi Ghidari, H., (2009). Dimensions and factors affecting the development of agricultural entrepreneurship in rural Iran: A case study of khodabandeh county, J. Village Dev., 12 (3): 27-43 (**17 Pages**). (In Persian)

Farahani, H.; Hajihosseini, S., (2014). An evaluation about potentials of rural areas for entrepreneurship and developing empowerment in villagers: Shawl district in Buin Zahra. J. Rural Res., 4(4): 715-748 (**34 Pages**). (In Persian)

Farsiani, H.; Saeedi, S.; Mehrani, H., (2014). The position and managerial role of women entrepreneurs in economic growth and development of jihadi management, National Conference on the position and role of women in jihadi management, Torbat Heydariyeh, Torbat Heydariyeh University. (In Persian)

Fornell, C.; Larcker, D., (1981). Evaluating structural equation modeling with unobserved variables and measurement error, J. Mark. Res., 18(1): 39-50 (**12 Pages**).

Hazave'I S M; Ziraki Haydari, A., (2014). Resistive economy; a symbol of jihadi management in Iran's political economy. J. Islamic Rev. Stu., 11(37): 9-26 (18 Pages). (In Persian)

Hosseini, E., Tajpour, M., Lashkarbooluki, M., (2020). The impact of entrepreneurial skills on manager's job performance. Int. J. Hum. Capital Urban Manage., 5(4), 361-372 (**12 Pages**).

Hosseininia, G.; Fallahi, H., (2017). Factors affecting the development of rural entrepreneurship: A case study on the rural areas of Manoojan County. J. Rural Res., 8(1): 22-37 (**16 Pages**). (In Persian)

Jelodari, A., (2015). A study of individual and internal dimensions on entrepreneurship and its role in resistance economy (case study: Saipa Larestan Company), 1st International Conference on Management, Economics, Accounting and Educational Sciences, Qeshm, Qeshm Higher Education Institute. (In Persian)

Khanahmadi, E.; Kheibari, S., (2015). Jihad management charter

according to Imam Khamenei's defense- mind. World J. Exten. Manage., 1(1): 71-80 (**20 Pages**). (In Persian)
Laukkanen, M., (2003). Exploring academic entrepreneurship: drivers and tensions of university-based business. J. S. Bus. Enterprise Dev., 10(4): 372-382 (**11 Pages**)·
Levitas, R., (2000). Community, utopia and new labour. J. Local Eco., 15(3): 188-97 (**10 Pages**).
Lordkipanidze, M.; brezet, H.; backman, M., (2005). The entrepreneurship factor in sustainable tourism development. J. Cleaner Pro., 13(8): 787-798 (**12 Pages**).
Mauksch, S.; Rowe, M., (2016). Austerity and social entrepreneurship in the United Kingdom: a community perspective. In: new perspectives on research, policy and practice in public entrepreneurship. Emerald Group Publishing Limited, 173-193 (**21 pages**).
Mikaelo, Gh. H.; Karamipour, M.R., (2014). Economic prosperity and entrepreneurship development with national determination and jihadi management, National Conference on New Approaches in Business Management, Tabriz, (In Persian)
Mobini, M., (2016). Designing Islamic-Iranian model for Jihadi Management for the actualization of the motherland of the Islamic World. J. Islamic Manage., 24(4): 137-160 (**24 Pages**). (In Persian)
Morshedizad, F., (2014). The relationship between Islamic management and jihadi management and its role in entrepreneurial culture, The First National Conference on Research and Development in the Third Millennium, Aliabad Katoul, Islamic Azad University, Aliabad Katoul branch. (In Persian)
Najafi Kani A.; Hesam M; Ashor H., (2015). The assessment of entrepreneurship status in rural areas - Case: Southern Astarabad in Goragan. J. Space Eco. Ru. Dev., 4(11): 37-56 (**20 Pages**). (In Persian)
Nowruzi, F.; Yargholi, A.R., (2017). A Look at the challenges facing jihadi culture and management in Iran. J. Hum. Islamic Stra. Stu. 1(7): 35-47 (**13 Pages**). (In Persian)
Nunnally, J.C., (1978). Psychometric theory (2nd Ed.). New York: McGraw-Hill.
Petrin, T.; Gannon, A., (1997). Rural development through entrepreneurship. Rome: REU Technical Series (FAO).
Pourtaheri M.; Naghavi M.R., (2012). Physical development of rural settlements with sustainable development approach (Concepts, theories, strategies). J. Housing Ru. Environ. 31(137): 53-70 (**18 Pages**). (In Persian)
Robbins, A., (2008). The secret of success. Translated by Masoud Shirazian and Javad Klouti, Tehran: New Generation Publications.
Reies Saadi, H.; Fahim Duin, H.; Parvaneh, A.; Salarnejad, Z., (2015). The role of jihadi culture and management in entrepreneurship and economic jihad, International Conference on Management, Culture and Economic Development, Tehran, Payame Noor University (In Persian).
Rezvani, M.; Najjarzadeh, M., (2009). Study and analysis of villagers, background knowledge on entrepreneurship in the process of rural development case study: South Baraan District (Isfahan Province). J. Entrepre. Dev., 1(2): 161-182 (**22 Pages**). (In Persian)
Sabokro, M.; Tajpour, M.; Hosseini, E., (2018). Investigating the knowledge management effect on managers' skills improvement. Int. J. Hum. Capital Urban Manage., 3(2): 125-132, **(8 Pages**). Shahbazi Soltani, M.; Salavatian, S., (2017). Identification of the characteristics of a jihadi manager by meta-combination method. Islamic Manage. Q., 25(1): 199- 230 (**27 Pages**). (In Persian) https://journals.ihu.ac.ir/article_201894.html?lang=en
Shamaei Kopai, M., (2014). Paradigm model of jihadi management using grand theory, Pub. Admin. Pers., 19 (3): 119-150 (**32 Pages**). (In Persian)
Soleimani, S.; Gholamif S.; Abgineh, M., (2014). Presenting a local model of resistance economy according to the existing potentials in Ilam province with emphasis on national determination and jihadi spirit, 2en International Conference on Economics under Sanctions, IAU, West Islamabad Branch. (In Persian)
Tanhai, A.; Rahmani, H.; Saboori, G., (2017). Key factors contributing to management development in future NAJA. NAJA Strategic Stud. J., 1(2): 25-53 (**29 pages**). (In Persian)
Vakil Alroaia, Y.; Aminbidokhti, A., (2018). Managers' empowerment dimensions based on resistive economics of manufacturing cooperatives. Co-Opera. Agri., 7(26): 29-58 (**30 Pages**). (In Persian)
Vakil Alroaia, Y.; Irvani, M.R.; Aqwami, F., (2013). Principles of entrepreneurship, IAU Press. (In Persian)
Vazifeh, Z., (2016). Study of entrepreneurship of women heads of households, 5th International Conference on Accounting and Management and 2nd Conference on Entrepreneurship and Open Innovation, Tehran. (In Persian)
Wetzels, M.; Schroder, G.O.; Oppen, V.C., (2009). Using PLS path modeling for assessing hierarchical construct models: Guidelines and empirical illustration, MIS Q., 33 (1): 177-195 (**19 Pages**).
Wiles, K., (1997). Educational management and leadership, translated by Tusi, M.A.,Public Management Training Center Publications. (In Persian)

HOW TO CITE THIS ARTICLE

Jamal, M.; Vakil Alroaia, Y., (2021). Analysis of factors affecting entrepreneurship development in rural areas in the light of jihadi management. Int. J. Hum. Capital Urban Manage., 6(3): 277-290.

DOI: 10.22034/IJHCUM.2021.03.06

url: http://www.ijhcum.net/article_241427.html

Int. J. Hum. Capital Urban Manage., 6(3): 291-304, Summer 2021

International Journal of Human Capital in Urban Management
(IJHCUM)

Homepage: http://www.ijhcum.net/

CASE STUDY

Development of Eco-Park in flood prone areas using green technologies

C.M. Torres Navas[1,*], J.C. Musa Wasil[1], K. Malave Llamas[2], C. Morales Agrinzoni[3]

[1] *Department of environmental planning, Ana G. Méndez University, Virtual Campus, San Juan, Puerto Rico*

[2] *Department of sciences and technology, Ana G. Méndez University, Carolina Campus, Carolina, Puerto Rico*

[3] *Department of sciences and technology, Ana G. Méndez University, Cupey Campus, San Juan, Puerto Rico*

ARTICLE INFO

Article History:
Received 02 November 2020
Revised 12 February 2021
Accepted 20 February 2021

Keywords:
Cities; Geographic information system (GIS)
Land use
Strengths
Weaknesses
Opportunities and Threats (SWOT)
Urban planning

ABSTRACT

BACKGROUND AND OBJECTIVES: The destruction of urban areas has caused environmental, social and economic problems. One of these areas was identified in the Municipality of Humacao, on the east coast of Puerto Rico. This land is vast and unused, Fulladosa farm, located in the urban area of the Municipality of Humacao. It is suggested to create an eco-park in this place to restore this green space and help improve the environment.

METHODS: The collection of information through public documents offered information related to the study area. Through a physical spatial analysis, the strengths, weaknesses, opportunities and threats of the study area could be obtained. This technique made it possible to identify areas with development potential to create an eco-park. Management strategies were developed for the development of the eco-park. Sustainable aspects were analysed to assess the viability of establishing an eco-park on the Fulladosa farm.

FINDINGS: The Fulladosa farm, located on Almodóvar Final Street in Barrio Cataño, has a high-density residential rating. According to the joint regulation, the use of parks in classified plots as high-density housing is not allowed. Therefore, a location query must be used to submit the project to the Licensing and Approval Office. Finally, it was found that the study area is prone to flooding. Flood insurance is also required, and the municipality must obtain the elevation certification required by the Federal Emergency Management Agency.

CONCLUSION: The creation of this eco-park can provide environmental education, community interaction and recreational spaces. Completion of this project will generally provide environmental, social and economic benefits to the community.

DOI: 10.22034/IJHCUM.2021.03.07

NUMBER OF REFERENCES	NUMBER OF FIGURES	NUMBER OF TABLES
38	6	2

*Corresponding Author:
Email: *cieloymar1999@hotmail.com*
Phone: +787-354-0087
Fax: +787-733-1012

Note: Discussion period for this manuscript open until October 1, 2021 on IJHCUM website at the "Show Article.

INTRODUCTION

Currently there are abandoned urban areas causing economic, environmental and social problems. Several examples of these problems are: clandestine landfills, urban sprawl, contamination of natural resources, vandalism, sedimentation of water and vectors. Urban pollution also affects people's health (Bergoglio, 2015). The lack of environmental awareness produces a series of conflicts that can be resolved by identifying territorial and economic strategies. It is necessary to integrate the community in environmental matters to create initiatives in the educational area. The development of eco-parks and urban planning of green areas play a long-term role in cities. Eco-parks are areas of recreation, conservation, environmental education and ecological tourism (Darío *et al*., 2018). They promote social well-being and family integration. According to Paul Davidoff, urban planner, urban development and the social integration of cities are necessary (Luengo, 2015). An eco-park is a place where biodiversity and environmental awareness are preserved. They are green spaces suitable for environmental education and recreation. Knowledge about recycling, plants, conservation of animal species and other aspects associated with nature can be offered. They can be built with recycled materials and are usually found within protected areas (INFOBAE, 2016). The origin of eco-parks is related to the culture they represent. For example, in 1984, the place where the Xcaret eco-park is located in Mexico, was a private property. The architect Miguel Quintana Pali, lover of nature, discovers rivers, lagoons and remains of an ancient Mayan city. This discovery led him to make the decision to convert the place from a private residence to a public place, where it is currently visited by millions of visitors per year (Loco Gringo, 2018). Another example is the Eco-park of Buenos Aires, Argentina, which was originally a zoo. The old zoological garden was used from 1888 to 2016. This zoo was transformed into a modern and innovative eco-park, which contributes to environmental education, recreation and the conservation of biodiversity. This eco-park has a Wild Animal Rescue Center, including marine fauna, amphibians and reptiles (BAT, 2021). On the other hand, many parks are not really green. This is the case with New York's Central Park, which was designed by Fredrick Law Olmsted and built with great expense and effort. It is a place where thousands of trees were replanted, as it was designed to create a natural landscape within the stressful urban life (Refaat, 2014). The International Federation of Parks and Recreation Administration is an organization that represents parks and recreation services. Among the findings of studies carried out through this federation, it was found that urban parks have a number of benefits, among them, biodiversity, health and well-being, cooling of the environment, quality of air and water, tourism and social interaction (Konijnendijk *et al*., 2013). Eco-parks are of great international importance, since thanks to their existence it is possible to control our waste, reduce soil and water pollution. Based on research results, eco-parks have been used to offer a better quality of life to citizens (Refaat, 2014). In addition to being able to participate in its beauty and recreation, eco-parks contribute to solving ecological and urban problems such as traffic noise, pollution air and urban runoff. They also maintain the habitats of flora and fauna, minimize environmental impacts and maintain ecological diversity (Refaat, 2014). The objective of this project is to determine the feasibility of creating an eco-park at Fulladosa farm in the Municipality of Humacao, Puerto Rico in 2019.

MATERIALS AND METHODS

The first step in the methodology was the collection of information through public documents that offered information related to the study area and the performance of a physical-spatial analysis to carry out the SWOT matrix technique (strengths, weaknesses, opportunities and threats). The SWOT matrix made it possible to identify areas with development potential for the creation of the eco-park.

Once these results were obtained, we proceeded with the second step: the management strategies for the development of the eco-park were established. Finally, in the third step, the sustainable aspects were analysed within the parameters of urban development, to evaluate the viability of creating the eco-park on the Fulladosa farm. Fig. 1 shows the geographic location of the study area.

Public document information

Information was obtained related to the land registry number, owner of the parcel, qualification of the property, permitted uses in the zoning maps,

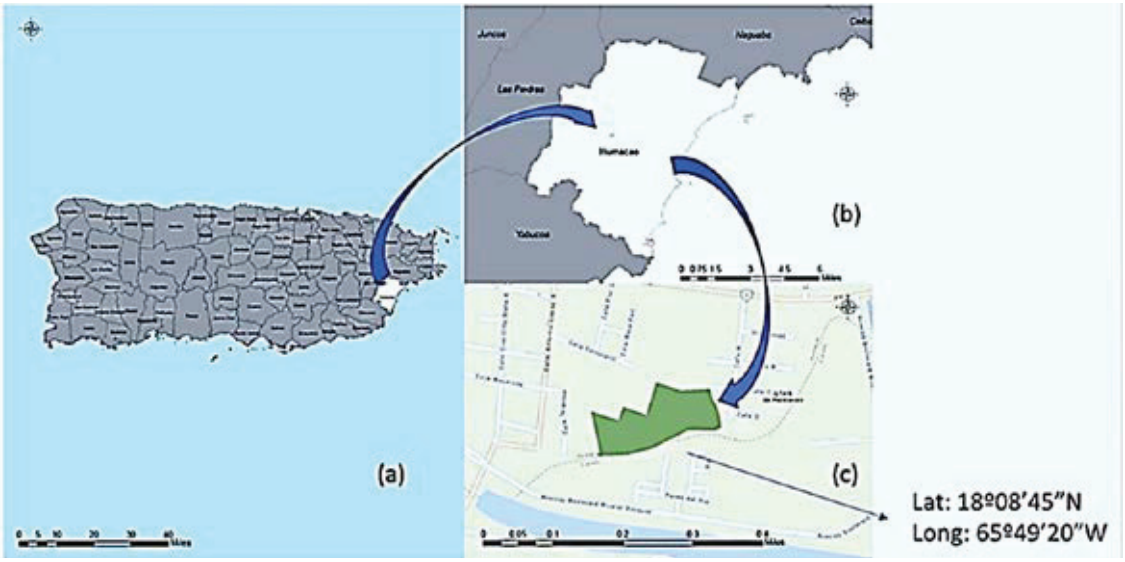


Fig. 1: Geographic location of the study area; (a) Puerto Rico, (b) Humacao city, (c) Fulladosa farm in Humacao, Puerto Rico

biophysical elements of the area and low-impact development practices. Wildlife conservation, location inquiries, permits issued near the area, and permits related to the project were studied. In addition, information related to the minimum requirements to develop management plans was reviewed and the presence of endangered species was verified. The Joint Regulation of Permits for Construction Works and Land Uses was analyzed and the applicable environmental regulations and laws were studied.

Geographic information system

The GIS 10.5 system from 2016 was used to perform a physical-spatial analysis, through which the maps of the land surface of the study area were analyzed from 1996 to 2019. Areas susceptible to flooding were identified through the map of levels of recommended base flooding from FEMA (Federal Emergency Management Agency). Information related to soil properties was studied to define the limitations that affect land uses. Information was also obtained on the geological formation of the study area.

SWOT matrix technique

With this technique the opportunities, threats, strengths and weaknesses that the study area presents were identified. Through the SWOT matrix technique, the internal and external factors that participate in the study area was analyzed (D´Inca *et al*., 2015). A visual inspection of the study area was carried out through several field visits in order to evaluate the structures and lands adjacent to the site. To perform the SWOT matrix technique, the information from the public documents of various aforementioned government entities and the result of the physical-spatial analysis were used.

Management strategy recommendation

These strategies are focused on the protection and conservation of the property. The results obtained in the SWOT matrix were used to identify the areas suitable to make the activities to be carried out in the eco-park.

Analysis of sustainability aspects

This analysis was carried out within the parameters of urban development, to evaluate the viability of creating the eco-park on the Fulladosa farm. Sustainable elements were identified that will be developed through activities for the enjoyment of the general public. It is planned to develop the Fulladosa farm in terms of planning and conservation, applying sustainable elements to the proposal.

RESULTS AND DISCUSSION

Public document information

The land registry number of the Fulladosa farm is 304-029-161-08-000 (PRPB, 2021). It is located at latitude 18◦08'45'' North and longitude 65◦49'20'' West. This farm is located on Almodóvar Final Street, Barrio Cataño. It was acquired by the Municipality of Humacao on the date of July 1, 2000. Its area is 32,379.73 m². Under the land registry number of the farm there is no location query. Nor is there any kind of project through the Puerto Rico Planning Board (PRPB) and the Office of Management of Permits and Endorsements. The study area does not require a management plan to carry out the project. It was determined that the farm has a Residential qualification four (R-4) and is classified as Urban Land. The R-4 Zoning District belongs to a high density residential (R-A) rating. According to the Joint Regulations, the use of parks is not allowed on plots which are classified as high density residential areas. A location query is necessary to present the project (PRPB, 2010a). The eco-park parking lots will be carried out in accordance with the provisions of Chapter 24 of the Joint Regulation of November 29, 2010 (PRPB, 2010a). Thus, the Planning Board evaluates and establishes the process in the Office of Management of Permits and Endorsements digital system. This process requires several stages of evaluation, so it can take approximately one year, until the proposal for an eco-park can be approved. The process will include the preliminary development stages, urbanization works, construction of the structures, required utilities and the regulatory use permit. The Autonomous Municipality of Humacao must pay the expenses to recruit a professional with a degree in architecture or engineering to represent the case. The process involves associated expenses for the preparation of an environmental document, Determination of Environmental Assessment and the regulatory phases of the Environmental Recommendation Letter since the project cannot be analyzed under Resolution R-11-17, List of Categorical Exclusions (EQB, 2011). Since the study area is susceptible to flooding, the Municipality must establish the Elevation Certification required by the Federal Agency for Emergency Management (FEMA, 2015). In addition, Regulation Number 13 on Special Flood Risk Areas of the Planning Board should be used to delineate the plans of the buildings that can be established (PRPB, 2010b). This Regulation establishes the following commands and laws: Organic Law of the Administration of Regulations and Permits, Law of Uniform Administrative Procedure of the Commonwealth of Puerto Rico and Organic Law of the Puerto Rico Planning Board. Regulations of the National Flood Insurance Program of the Federal Agency on Emergency Management, part 44 CFR, section 60.3 and Law for the control of buildings in areas susceptible to flooding (PRPB, 2010b) are also estabilished. These floods, caused by surface runoff water, cause soils to become saturated. The calculator for rain catchment is a method of determining the amount of runoff water. This system, presented by the Office of Research and Development of the Environmental Protection Agency, suggests that low impact development practices (Low Impact Development) be used to encourage the natural movement of water. These practices are also known as efficient management of green infrastructure (US EPA, 2018).

Geographic information system

The following information was collected from the physical-spatial analysis using GIS

10.5, 2016 System. Through this system, data related to the property was analyzed. The following maps and photos show the increase in urban development over time. Figs. 2 and 4 presents the maps of the land surface of the study area from 1996 to 2019 provided by the Planning Board of Puerto Rico. These maps show how, over the years, the increase in the construction of infrastructures has been affecting the Fulladosa farm, reducing its green areas.

The increase in urban development pressure is due to the excessive construction of roads, houses and buildings. Besides, it was determined that the study area is zone A, an area susceptible to flooding. Fig. 5 presents this area.

SWOT matrix technique

The field visits helped to identify the access areas to the Fulladosa farm and the conditions in which it is located. Through these visits it was possible to evaluate the ecotourism potential, the natural attractions and the infrastructures in the surroundings. All this information was used to determine the activities that will be carried out in the eco-park. After performing

Fig. 2: Map of Fulladosa farm in the Municipality of Humacao, Puerto Rico in 1996 (Rodríguez, 2019)

Fig. 3: Map of Fulladosa farm in the Municipality of Humacao, Puerto Rico in 2006 (Rodríguez, 2019)

Fig. 4: Map of Fulladosa farm in the Municipality of Humacao, Puerto Rico in 2019 (Rodríguez, 2019)

the SWOT matrix, the information shown in Table 1 was obtained, which presents the opportunities, strengths, threats and weaknesses in the study area.

Strengths

Environmental and physical strengths

Being close to the Humacao River, the property has a biodiversity of both aquatic and terrestrial species.

Social and economic strengths

Possibility of promoting the local economy through social activities. Recreation, educational development, and landscape appreciation are examples of these activities.

Institutional and legal strengths.

With the help from state and federal organizations, these green spaces can be developed in urban areas.

Threats

Environmental and physical threats

Poor government management: The Municipality has not maintained the property for conservation purposes. On the contrary, there was a proposal to make a parking lot in this place.

Extensive urban development: The lots adjacent to the property cause development pressure that does not favor the conservation of natural resources or the protection of the Humacao River. These lots include residences, businesses, and the Jacinto Hernández Park.

Pollution and sedimentation: The pressure of urban development increases pollution and sedimentation towards the Humacao River. This includes motor vehicle oils and solid waste that affects this body of water through runoff.

Inappropriate use of space: The Fulladosa farm is an open space that can be used improperly, becoming a public nuisance or a clandestine landfill, producing vectors that affect public health.

Social and economic threats

Tourism costs: The tourism development in the areas adjacent to the property makes it easier for consumers to pay a little more in these nearby businesses to obtain more innovative benefits and enjoy greater comfort.

Gentrification: In order to increase the value of properties adjacent to Fulladosa farm, residents may be displaced. This increase is aimed at tourism development in the area.

Impact on the economy: The development of the property implies certain costs that in the long term are cost-beneficial. However, Puerto Rico is experiencing

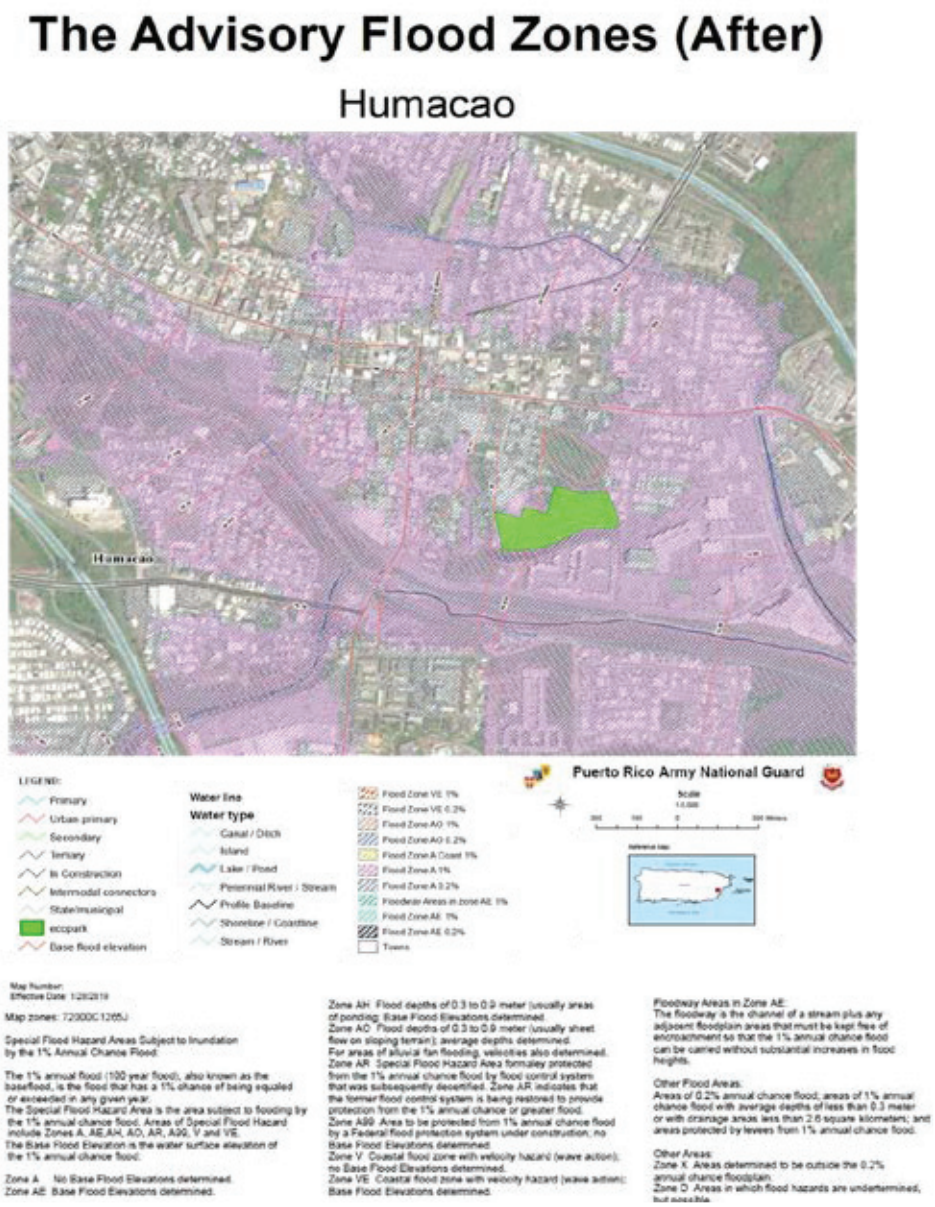


Fig. 5: Map of recommended base flood levels, zone A in Fulladosa farm in the Municipality of Humacao, Puerto Rico in 2019 (Rodríguez, 2019)

an economic crisis, which is incorporated into the situation associated with the high investment due to the destruction of the passage of Hurricane María (Mazzei and Williams, 2018).

Institutional and legal threats

Investment and development vision: The property was considered to make a parking lot for the Jacinto Hernández Park. Since the Municipality of Humacao owns the farm, this implies a limiting development vision.

Weaknesses

Environmental and physical weaknesses

Flood zone: All construction that is carried out on the property will be according to the Regulation on

Table 1: SWOT analysis framework

Indicators	Strengths	Opportunities	Weaknesses	Threats
Environmental-physical	1. Biodiversity	1. Green technologies 2. Possibility of low investment 3. Improves public health	1. Flood zone 2. Flood rate 3. Soil type 4. Soil qualification	1. Extensive urban development 2. Sedimentation
Social-economic	1. Recreational potential	1. Job creation 2. Intervention of groups of interest 3. Biological Corridors	1. Absence of academic programs 2. Absence of collective transport 3. Little commercial activity 4. Unemployment	1. Gentrification 2. Impact on the economy
Institutional-legal	1. Incentives for the development of green spaces	1. Aid programs from some agencies	1. Lack of government support	1. Investment and vision of development

Special Areas of Flood Risk (PRPB, 2010b) since said place is a flood zone.

Poor soil management: The soils that surround the bodies of water near the property must be protected, since they have been affected due to urban sprawl.

Low water quality: The Environmental Quality Board (EQB) carried out an evaluation in which it was pointed out that the water quality standards are not in compliance, due to turbidity and coliforms generated by sedimentation (EQB, 2013).

Flood rate: The study area is prone to flooding. This involves purchasing flood insurance (FEMA, 2011).

Soil type: It contains alluviums, which carry sediments to the Humacao River. These materials easily infiltrate contaminants (US GS, 2016).

Qualification: The use of parks is not allowed in lots classified as high density residential. The project would be presented through a location query (PRPB, 2010a).

Social and economic weaknesses

Absence of academic programs: In the Municipality of Humacao, no programs have been developed aimed at conserving natural resources. However, the Carmen Pilar Santos School (elementary level) and The Palmas Academy (preschool to higher level) are under the Maria Montessori system. This system is aimed at the appreciation of natural and environmental resources. The existence of eco-parks would be adequate for the personnel trained in this system.

Absence of collective transportation system: Since the property does not have enough space for parking, trolley-type transport can be implemented to take visitors from the Jacinto Hernández Park to the eco-park.

Little commercial activity: There is little commercial activity in the urban center of the Municipality, so the creation of the eco-park contributes to the development of local businesses, such as pharmacies, ice cream parlors and restaurants.

Unemployment: Corresponding estimates reflect a decrease in employment for all areas of the labor market (DLHR, 2019). The eco-park will provide jobs to the Municipality of Humacao.

Institutional and legal weaknesses

In the Municipality there are no projects dedicated to environmental education due to the lack of support from government companies and the private sector.

Opportunities

Environmental and physical opportunities.

Restoration of natural systems: To solve the sedimentation problem in the Humacao River, a retention pond can be created, which retains runoff water for long periods. This pond can also be used as a recreational area, by renting boats.

Green technologies: The Solid Waste Authority (SWA) incentive program offers financial aid through various entities when green technology is used (SWA, 2019). The eco-park in the Fulladosa farm presents the opportunity for the use of this technology, including permeable paths, recycled rubber, plastic wood, among others.

Low investment possibility: Among the buildings to be lift up in the eco-park are: the visitor center (where educational talks will be held for students), bathrooms and an area for the sale of snacks and refreshments. Consequently, a high investment will not be required.

Tourist interest area: The Fulladosa farm is located in an area of great tourist interest. We can mention the residential and hotel complex of Palmas Del Mar, the Natural Reserve of Santa Teresa and Mandry lagoons, the Forests of Pterocarpus and the Beach of Punta Santiago.

Improves public health: The creation of the eco-park improves public health in several aspects: it prevents the place from becoming a clandestine landfill or public nuisance, increases the quality of life of people and promotes the safety of nearby residents.

Social and economic opportunities

Generation of funds and jobs: It encourages the increase of jobs for the development and conservation of the area, as well as to increase the local economy.

Intervention of interest groups: There are several groups interested in conserving natural and environmental resources, including: the Planning Board, the Department of Natural and Environmental Resources and the Forest Service of the United States Department of Agriculture.

Educational, recreational and environmental benefits: The development of the eco-park will promote the good management of natural resources, recreational and environmentally educational activities.

Biological corridor: The development of a biological corridor contributes to the learning and exploration of visitors through routes designated by the Municipality. The areas of tourist interest are: the children's water park and the camping areas at Punta Santiago Beach, the Mandry and Santa Teresa Lagoons Natural Reserve, the fishing village of Palmas Del Mar, the Pterocarpus forest, the boardwalk of the Municipality of Naguabo and the museums of Humacao.

Community improvement and the surrounding areas: Outdoor activities such as exercises, walking groups, workshops for agricultural gardens, the biological corridor, and rental for boats and bicycles, among others, are aimed at promoting community improvement and environmental education.

Multisectoral alliances: There are several multi-sector alliances that can promote social, economic and educational development in the eco-park project. Among them is the Community Delivery and Service Education Program, aimed at promoting environmental education (Oriental, 2018). The Conservation Trust has also managed to protect a large amount of land on the Island of Puerto Rico (Para la Naturaleza, 2019). These alliances, together with the Department of Natural and Environmental Resources, can strengthen the development of the eco-park in terms of the conservation of its lands and the Humacao River.

Benefits: The creation of the eco-park will result in economic, social and educational benefits for the Municipality of Humacao. In addition, the conservation of natural resources will be promoted.

Real estate: The Municipality could increase its tourism development and consequently, the residences and buildings surrounding the eco-park would increase their value.

Institutional and legal opportunities

Previous proposals: Among the proposals carried out by the Municipality are to make a parking lot in this place. To carry out this project the property does not require a management plan.

Compendium and applicable incentives: The Solid Waste Authority promotes a tax exemption in its recycling project, in which the eco-park proposal can participate.

Recommendation of management strategies

Recommendation of management strategies for

Table 2: Management strategies focused on conservation and protection

Strategy	Examples	Results
Installation of technologies	Porous pavements Cisterns Pocket wetlands Vegetated swales Rain gardens Green roofs Mangrove conservation Protection of riparian buffers Educational signs	Protection and conservation of natural resources
Trained personnel for eco-park maintenance	Water analysis and maintenance of the areas	Security for visitors
Planning of activities to be carried out in the eco-park	Activities: Outside the eco-park In the visitors center Outdoors In the Amphitheater	Community integration

the development of the eco-park in the study area focused on conservation and protection. Table 2 presents these strategies.

These strategies promote environmental education, community integration, conservation of natural resources and visitor safety. Green technologies and their maintenance preserve the operation of the project in the long term (D'Inca *et al*., 2015). The first strategy consists of the installation of technologies, also known as green infrastructure or low-impact development, with the purpose of conserving and protecting natural resources. Said technologies are the following: ditches with vegetative cover, retention pond, permeable pavements, rainwater cistern and green roofs. Mangrove conservation will be promoted, since they contribute to flood mitigation. Arrangements will also be made to protect riparian buffers and rain gardens will be installed as bio retention systems. The second strategy is based on hiring trained personnel for the maintenance of the eco-park. To meet federal and state standards, these staff will conduct a periodic analysis of recyclable materials, technologies, and water quality. Among the water quality standards are: pH, coliforms, dissolved oxygen, turbidity, enterococci, color, substances that cause odor or taste, sulfates, total nitrogen and total phosphorus (EQB, 2019). Measurements of Total organic carbon (TOC), Biochemical oxygen demand (BOD) and Chemical oxygen demand (COD) determine the amount of organic matter and the impact of wastewater (Raffo and Ruiz, 2014). To prevent deterioration, a periodic inspection of the green infrastructure will be carried out, including playgrounds, solar panels, educational signs, restrooms and vegetation. This periodic maintenance will ensure that the project is maintained in the long term (US EPA, 2017). The third strategy consists of planning the activities to be carried out in the eco-park. These activities will be the following: Activities at the visitor center. Educational workshops, recycling activities, projection of videos related to fauna and flora and sale of snacks will be offered. Activities on the platform or amphitheater. Children's performances, music, troubadours, yoga, folk dances, among others. Activities outside the eco-park. The biological corridor will be carried out, in which visitors will have the opportunity to appreciate and enjoy cultural and tourist places near the eco-park. Outdoor activities within the eco-park. Hikes, bicycle and boat tours, excursions and appreciation of the landscape.

Analysis of sustainability aspects

Sustainable aspects were analyzed. These aspects include: biodiversity conservation, recreation, environmental education, photographic adventure, recycling activities, educational workshops, and technological knowledge and guided tours for groups (CSA, 2016). All these elements can be incorporated into the Fulladosa farm eco-park. The eco-park in the Fulladosa farm will have Observation towers for birds, similar to the Tortuguero Lagoon (Vásquez *et al*., 2011). In the visitor center there will be a small store similar to La Marquesa Park in the Municipality

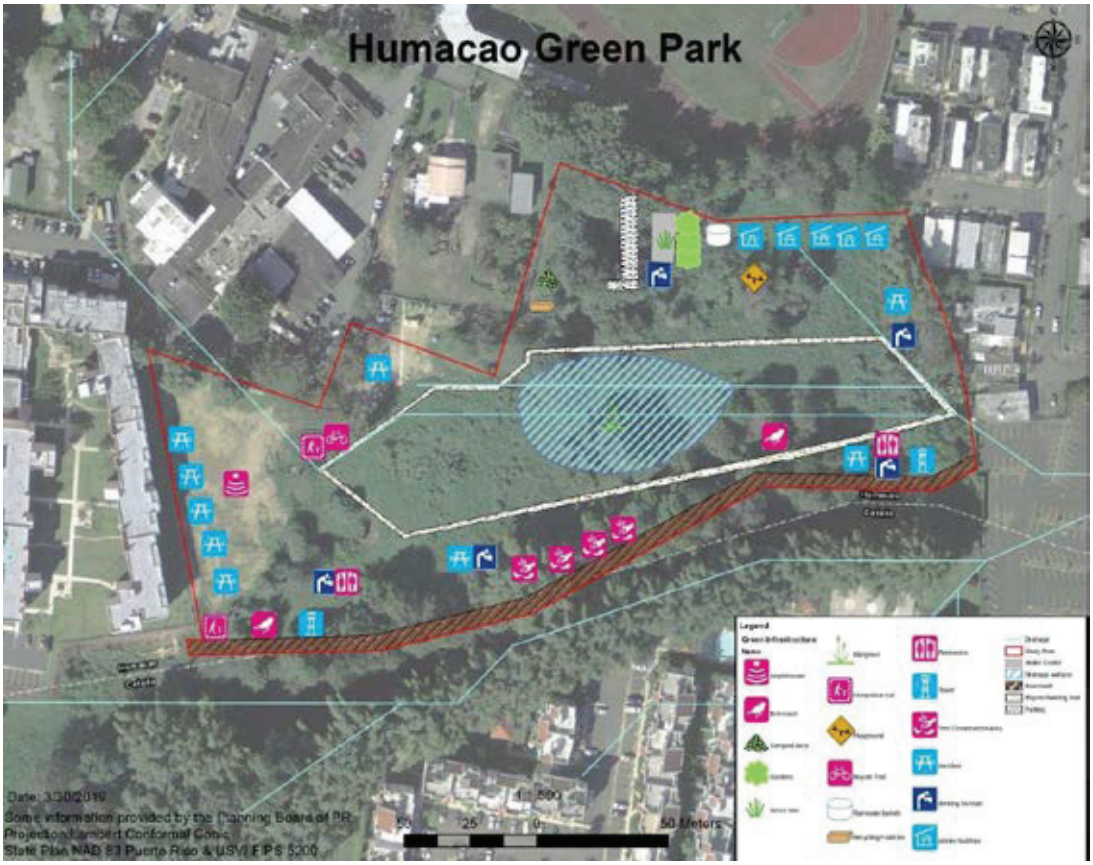


Fig. 6: Map of the future eco-park in the Fulladosa farm in the Municipality of Humacao, Puerto Rico

of Guaynabo, for the sale of toys and educational items (GPR, 2019). In this store, a method will be carried out in which envelopes with vegetable seeds will be delivered in the absence of coins (Rodríguez, 2019). A demonstration garden of vegetables and fruits can be considered in a section of the property, avoiding the use of pesticides and inorganic fertilizers. This can be achieved with the collaboration of the Department of Agriculture of Puerto Rico, Agricultural Extension Service of the University of Puerto Rico. The Green Contact Program was carried out on October 14, 2015 so that students from the educational system can complete contact hours per semester carrying out activities related to nature (GPR, 2015). In the Fulladosa farm eco-park, students can comply with these hours by participating in the planting of vegetables and fruits in the orchards, thus also allowing the communities to integrate. Various community members have made efforts in the last decade to ensure that projects are carried out outside the classrooms (López and Bastida, 2018). The Fulladosa farm can offer this type of project, since education is a great development opportunity in this place. Both the Gurabo Recreational Park and the Luis Muñoz Marín Park have been built in flooded areas. Despite this, they have multiple attractions, among them: a pavilion for activities, a walking track, a playground, artificial lakes, areas for recycling and gazebos (López, 2016). These sustainable aspects can be applied to the eco-park in the Fulladosa farm as this is also a flood zone. The Humacao Natural Reserve and the Hacienda Esperanza in Manatí have resources that are used for the appreciation of the landscape through walks and excursions. These places are: interpretive trails, mangroves, wetlands and forests (Rodríguez, 2019). The Fulladosa farm, as it also has these ecological resources, can be considered for the application of these sustainable aspects.

Scheme of the future eco-park

Fig. 6 shows a summary of the future eco-park on the Fulladosa farm, which would include various green technologies or efficient management practices. Among the efficient management practices are: areas for the conservation of trees and mangroves, the green roof in the visitor center, collection of rainwater through cisterns, gardens and the retention pond, which helps to capture the runoff waters. To avoid power lines, the amphitheater will have solar panels. Educational activities will be carried out in the visitor center, such as the projection of videos related to the environment, endangered species and the different habitats that exist. Restrooms will be found in the visitor center, as well as a small educational supply store. The visitor center will have facilities for the consumption of nutritious vegetarian food. The eco-park will have picnic facilities, fountains to drink water, boardwalk near the river, benches, playgrounds, two composting toilets for educational purposes, interpretive paths for cyclists and an amphitheater or platform for activities. It will also have two towers for bird watching, a ranger station, composting areas, and recycling facilities, 10 parking spaces for cars and 2 parking spaces for public buses. The installation of photovoltaic luminaires, a security booth at the entrance and a warehouse for the maintenance team can be considered. The parking lots for the eco-park will be implemented in accordance with Chapter 24 of the Joint Regulation of November 29, 2010 (PRPB, 2010a). Any construction carried out in the area of the property will be carried out according to the Regulation on Special Flood Risk Areas (PRPB, 2010b).

CONCLUSION

The study area is located in an area susceptible to flooding, causing limitation for the development of buildings. In addition, there is urban sprawl around it, which causes sedimentation towards the Humacao River, which is close to the lot. The support of government entities is recommended to avoid public health problems on the property, as it can become a clandestine landfill or public nuisance. However, this characteristic of flooding is an opportunity to conserve the property for recreational uses and as an educational element. Being in a wetland area, the creation of this eco-park can mitigate the problem of flooding because green technologies are designed to protect floodplains and reduce stormwater runoff. During times of constant rain, wetlands absorb large amounts of water. Green infrastructure absorbs rainfall, preventing water from accumulating in the streets. The terrain should not be disturbed with pavements, as this would also decrease the populations of flora and fauna species. It is recommended to carry out a study of fauna and flora in the farm to recognize the existing biological diversity. Development opportunities in the study area can diminish many of the threats and weaknesses that arise. Through the recommended strategies, strengths and opportunities will be reinforced, while weaknesses and threats will be reduced. These strategies will also help protect and conserve the future eco-park. The installation of green technologies and their maintenance is recommended, as they contribute to mitigating flood areas, which would be of great benefit to the development of the eco-park. The periodic monitoring of green technologies contributes to the reduction of environmental pollution and sedimentation. Despite the limitations that arise in the study area, the creation of this eco-park can provide spaces for recreation, community interaction and environmental education. The activities that will be carried out will help integrate the community and promote environmental education and awareness and conserve natural resources. Therefore, this project will be useful for the Municipality of Humacao, in a social, environmental and economic way.

AUTHOR CONTRIBUTIONS

C. Torres carried out the research, analyzed the results and prepared the manuscript. J.C. Musa, C. Morales and K. Malavé helped in editing, reviewing the literature, and analyzing the data.

ACKNOWLEDGMENT

The author is very grateful to M. Miranda and V. Suazo for their collaboration with the SWOT matrix. In addition, to R. Rodríguez for having collaborated with the maps of the study area.

CONFLICT OF INTEREST

The authors declare no conflict of interest regarding the publication of this manuscript. The ethical issues, including misconduct, plagiarism, fabrication or falsification of data, informed consent, redundancy and double publication or submission, have been completely witnessed by the authors.

ABBREVIATIONS

BAT	Buenos Aires travel
BOD	Biochemical oxygen demand
CFR	Code of federal regulations
COD	Chemical oxygen demand
DLHR	Department of Labor and Human Resources
EQB	Environmental Quality Board
et al.	"and others" in latin
FEMA	Federal Emergency Management Agency
Fig.	Figure
Figs.	Figures
GIS	Geographic information system
GPR	Government of Puerto Rico
IFPRA	International federation of parks and recreation administration
INFOBAE	Information of Buenos Aires economy
PRPB	Puerto Rico Planning Board
R-A	High density residential rating
R-4	Residential qualification four
R-11-17	List of categorical exclusions
SWA	Solid Waste Authority
SWOT	Strengths, weaknesses, opportunities and threats
TOC	Total organic carbon
US EPA	United States Environmental Protection Agency
US GS	United States Geological Survey
Zone A	Susceptible to flooding area

REFERENCES

BAT, (2021). Eco-park. Buenos Aires City.

Bergoglio, J., (2015). Laudato sí. Palabra Editions.

CSA, (2016). International ideas competition: Interactive eco-park, Argentina. Central Society of Architects.

Darío, I.; Escobar, D.; Mejía, M., (2018). Success factors and lessons learned from the management of a Public-Private Partnership (PPP) in a protected area in Manizales, Colombia. Contemp. Eng. Sci., 11(20): 959-972 **(14 Pages).**

D´Inca, V.; Bastias, L.; Rodríguez, J., (2015). Recovery strategies of urban areas in the framework of Sustainability. Architecture, urbanism and design.

DLHR, (2019). Unemployment statistics by municipalities. Department of Labor and Human Resources.

EQB, (2011). Amendment to list of categorical exclusions (R-11-17). Environmental Quality Board.

EQB, (2013). Integrated report 305 (b) / 303 (d). Environmental Quality Board.

EQB, (2019). Puerto Rico water quality standards regulation. Environmental Quality Board.

FEMA, (2011). Answers to questions about the National Flood Insurance Program. Federal Emergency Management Agency.

FEMA, (2015). Elevation certificate and Instructions. Federal Emergency Management Agency.

GPR, (2015). Promotion of green contact in the country's schools. Government of Puerto Rico.

GPR, (2019). La Marquesa in Guaynabo City: hidden treasure. Government of Puerto Rico.

INFOBAE, (2016). What is an eco-park and which are the best in the world. INFOBAE News Website.

Konijnendijk, C.C.; Annerstedt, M.; Nielsen, A. B.; Maruthaveeran, S., (2013). Benefits of Urban Parks. IFPRA.

Loco Gringo, (2018). History lesson, the story of xcaret eco-park. Loco Gringo News Website.

López, B., (2016). The Luis Muñoz Marín Park comes back to lifestyle. El Nuevo Día.

López, R.; Bastida, D., (2018). The importance of non-formal environmental education in rural areas: the case of Palo Alto, Jalisco. Dialogues on education.

Luengo, A., (2015). The right to the city and its juridical-urban nature. Complutense University of Madrid, Spain.

Mazzei, P.; Williams, M., (2018). The crisis in Puerto Rico continues: it will not be able to pay its debt until 2022. The New York Times.

Oriental, (2018). The Community Education Program of Delivery and Service celebrates the first anniversary of its Community Sustainability Center in Humacao, Puerto Rico. Oriental News Website.

Para la Naturaleza, (2019). The Puerto Rico Conservation Trust was born 43 years ago. Conservation Trust Website.

PRPB, (2010a). The Joint Regulation of Permits for Construction and Land Use (JP-RP-31). Puerto Rico Planning Board.

PRPB, (2010b). Regulation 13 on special flood risk areas. Puerto Rico Planning Board.

PRPB, (2021). Geolocator. Puerto Rico Planning Board.

Raffo, E.; Ruiz, E., (2014). Characterization of wastewater and biochemical oxygen demand. J. Fac. Ind. Eng., 17(1):71-80 **(10 pages).**

Refaat, M. H., (2014). Sustainable landscapes; the use of eco-parks as a tool for sustaining the living landscape. Int. J. Educ. Res. 2(7): 571-586 **(16 pages).**

Rodríguez, F., (2019). Ecovuelto, a growing trend in Mendoza. Sitio Andino Digital Diary.

Rodríguez, N., (2018). A local guide's insights about kayaking on Humacao Nature Reserve's lagoons. Ecotreasures.

Rodríguez, R., (2019). Map of Fulladosa farm in the Municipality of Humacao, Puerto Rico in 1996 [online map]. 1:5,000.

Rodríguez, R., (2019). Map of Fulladosa farm in the Municipality of

Humacao, Puerto Rico in 2006 [online map]. 1:5,000.
Rodríguez, R., (2019). Map of Fulladosa farm in the Municipality of Humacao, Puerto Rico in 2019 [online map]. 1:5,000.
Rodríguez, R., (2019). Map of recommended base flood levels, zone A in Fulladosa farm in the Municipality of Humacao, Puerto Rico in 2019 [online map]. 1:5,000.
SWA, (2019). Economic incentives. Solid Waste Authority.
US EPA, (2017). Green Infrastructure in parks. United States Environmental Protection Agency.
US EPA, (2018). National stormwater calculator user's guide. United States Environmental Protection
Agency.
US GS, (2016). Puerto Rico geology. United States Geological Survey.
Vásquez, R.; Adrover, G.; Carrero, C.; Ortiz, E., (2011). Critical issues to the management of the
Laguna Tortuguero National Reserve. Department of Natural and Environmental Resources.

HOW TO CITE THIS ARTICLE

Torres, C.M.; Musa Wasil, J.C.; Malave Llamas, K.; Morales Agrinzoni, C., (2021). Development of Eco-Park in flood prone areas using green technologies. Int. J. Hum. Capital Urban Manage., 6(3): 291-304.

DOI: 10.22034/IJHCUM.2021.03.07

url: http://www.ijhcum.net/article_242546.html

Int. J. Hum. Capital Urban Manage., 6(3): 305-322, Summer 2021

International Journal of Human Capital in Urban Management
(IJHCUM)

Homepage: http://www.ijhcum.net/

ORIGINAL RESEARCH PAPER

Where are the urban poor? The spatial distribution pattern of urban poverty

M.J. Nouri*, E. Zebardast

School of Urban Planning, University of Tehran, Tehran, Iran

ARTICLE INFO

Article History:
Received 08 September 2020
Revised 08 January 2021
Accepted 24 January 2021

Keywords:
Concentration of urban poverty
F'ANP model
Isfahan metropolis
Spatial distribution pattern of poverty
Urban poverty index

ABSTRACT

BACKGROUND AND OBJECTIVES: One of the issues that have been evident in previous researches on urban poverty is the existence of a methodological gap in identifying spatial representation of urban poverty. This paper suggests a methodology for identifying the spatial representation of urban poverty and applies it to Isfahan Metropolis in Iran.

METHODS: A hybrid model of exploratory factor analysis and analytical network process was used with urban poverty indicators. Using the model, the compiled database consisted of 27 indicators with 12196 specific data per indicator was analyzed to determine the domains of urban poverty and relational importance coefficient of each indicator. A composite index of urban poverty was then constructed to evaluate urban poverty in each urban block. Also, the autocorrelation test and cluster and outlier analysis were used to find the spatial distribution pattern and concentrations of urban poverty in the metropolis.

FINDINGS: Seven domains of urban poverty in Isfahan metropolis were extracted which cumulatively explain about 57.3 percent of the data variance including "general poverty (13.25%), crowdedness in the housing unit (10.09%), economic poverty (9.462%), intrinsic poverty (8.23%), infrastructure poverty (6.243%), migrant's poverty (5.276%) and unhealthy living condition (4.173%). Classifying urban blocks based on the composite index has shown that 9.8% of the population and 15.7% of urban blocks had the highest poverty rate. The autocorrelation test (Moran's index=0.459; p-value=0.000) has indicated that urban poverty was clustered. Using Cluster and outlier analysis, it was determined that 70% of urban poverty concentrations were located in suburbs and peripheral districts.

CONCLUSION: Urban policymakers can adopt relevant policies in relation to various types of urban poverty identified in metropolises and determine policy priorities based on the weight calculated for each indicator. They can also suggest policies at the macro-micro levels using the urban poverty distribution pattern and concentration map.

DOI: 10.22034/IJHCUM.2021.03.08

NUMBER OF REFERENCES	NUMBER OF FIGURES	NUMBER OF TABLES
47	13	5

*Corresponding Author:
Email: *mj.noori1992@ut.ac.i*
Phone: +989136416983

Note: Discussion period for this manuscript open until October 1, 2021 on IJHCUM website at the "Show Article.

INTRODUCTION

For the first time in the world history, the world urban population outpaced its rural population in 2007 and now about 55 percent of world population is urbanized (United Nation, 2015). This milestone shows the increasing growth of urbanization in the 21th century (Watson, 2009). The world population now is more than seven billion and this population is expected be about nine billion by the year 2040 (Teitz and Chapple, 2013). Against this background, in 2004, about one in five people in the developing world, or about 1 billion people, were deemed to be poor by the 1 dollar a day standard (Ravallion *et al.,* 2007). Urban poverty has become one of the most important issues in current planning efforts. Scholars in variety of fields have concentrated their efforts to the study of urban poverty as an important issue in human development processes. Studies show that poverty increasingly exists in urban contexts and urban poor are in the core of the urbanization process (Lemanski, 2016). Scholars employ several concepts such as "social exclusion", "inequality", "vulnerability" and "underdevelopment" as alternative concepts of urban poverty (Lok-Dessallien, 1999). Lok-Dessallien (1999) tried to clarify the distinctions among these concepts by emphasizing that these are interrelated concepts. Changes in poverty concept and definition has led to changes in the definition of the urban poor. The evolutions in the poverty/urban poverty definitions and their indicators include a spectrum from absolute poverty as the first point of evolutions to the adoption of multidimensional approaches towards urban poverty phenomenon (Niemietz, 2011). Urban poverty indicators can be divided into two procedural and substantive indicators (Lemanski, 2016; Wratten, 1995). While procedural indicators implicate on those indicators related to different procedures such as political, economic, social and legal procedures that cause urban poverty, substantive indicators relate to people's attributes and their life circumstances especially in the household scale. Absolute poverty (substantive indicators) implicates on physical indicators such as food, shelter, clothing resources and monetary indicators such as income resources. Relative poverty considers poverty and urban poor based on comparing individuals in any aspect of their life. Emergence of capability poverty (procedural indicators), indicates a shift from high focus on substantive indicators to procedural indicators. By this definition, policy makers have attempted to address those procedures that are aggravating the urban poverty. Ultimately, by consensus on the multidimensional trait of poverty, both substantive and procedural indicators have drawn the scholars' attentions simultaneously (Niemietz, 2011). Although the magnitude of urban poverty may be known, the question of the whereabouts of the urban poor in the cities of the third world countries has become a planning challenge to be addressed. Therefore, the main challenge here is about the methodology of identifying the urban poor and their spatial distribution in the cities of the developing countries. Each concept of urban poverty are equipped with a methodology. That is to say, that complicated urban contexts need methodologies that are more complicated in order to investigate urban poverty contextually. In absolute poverty, the methodology was clear because there was a standard indicator (such as poverty line) to calculate urban poverty. In comparison with absolute poverty, those concepts of urban poverty formulated based on relative poverty definition, have more complicated methodologies in which individuals are compared with each other. Furthermore, relative concept of poverty is contextual which means that in different urban scales and areas the result of any methodology could be different from one other. What makes this challenge more highlighted is the multidimensional nature of urban poverty, which includes a wide spectrum of criteria and indicators in order to identify the urban poor and calculate a composite urban poverty index. Therefore, there is a need to frame a methodology to calculate urban poverty and to identify the urban poor in the urban complexity era. In this paper based on the Wilson's "concentration effect" in the theory of "truly disadvantaged", it is assumed that urban context is not just a container of the urban poverty but that they underpin each other. Wilson (1987) affirms that the concentration effect of urban poverty leads to reproduce urban poverty. According to this theory, first, a methodology has been suggested based on substantive indicators of urban poverty, in order to calculate a multidimensional urban poverty index, identify urban poor contextually and define those urban districts that reproduce urban poverty (based on the concentration effect). The objective here is to add a spatial dimension to Wilson's theory. Second, substantive indicators mentioned in the

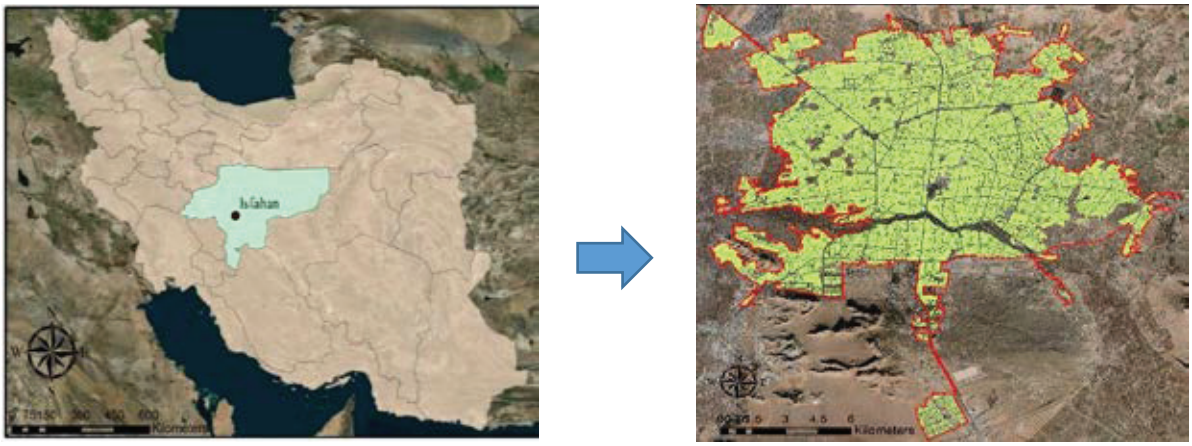


Fig. 1: the location of Isfahan metropolis in Isfahan province, Iran (a); Boundary and urban blocks of Isfahan Metropolis located in Isfahan province, Iran (b)

literature for urban poverty indicators and its similar concepts including "multi-dimensional poverty" ,"social vulnerability", "social exclusion", "inequality" and "under development" were determined. These indicators were used to compute a composite Urban Poverty Index (UPI). The UPI for each urban blocks was computed and used in the identification of the Urban Poverty Reproduced Districts (UPRDs). Third, a methodological gap in poverty research has been identified. In order to measure substantive indicators, scholars consider equal Relational Importance Coefficient (RIC) for indicators while there are various RIC for each indicator based on the different urban contexts. F'ANP model has been employed to calculate RICs contextually in order to fill this methodological gap. The current study has been carried out in Isfahan metropolis as the third largest city located in Iran in 2017. There are different spatial representations of urban poverty such as marginal informal settlements, a large number of declined urban fabrics, increasing rate of immigrants and unemployment rate of simple workers, and a huge number of female-headed households in Isfahan metropolitan area. These different kinds of urban poverty have made it difficult to accurately identify where the urban poor in Isfahan metropolis are.

MATERIALS AND METHODS

Description of the study area

The metropolis of Isfahan, the capital of Isfahan province in Iran, has been selected as a case study in this paper (Fig. 1a). Isfahan Metropolis (Fig. 1b) is the third largest city in Iran and had a population of 1,961,260 people in the 2016 census (SCI, 2016).

In this paper 12,196 urban blocks of Isfahan Metropolis were analyzed, however, in order to examine the main question of the paper implicated on "where the poor are", urban blocks have been classified based on their location in different areas developed through the evolution of Isfahan Metropolis (Fig. 2). These areas include: the historical district (developed before 1920) located at the center of Isfahan Metropolis; inner city area (between developed 1920 to 1964) that includes the old urban fabric; middle district (developed between 1964 to 1975) located between the historical and inner city area of Isfahan and peripheral districts; two peripheral districts developed in two different period (first one developed between 1975 to 1982 and the second developed between 1982 to 1996); annexed villages, towns and cities (annexed in 2003).

Development of the model

In order to identify and address the urban poverty, the applied methodology is composed of the following three phases (Fig. 3):

Phase 1. The urban poverty indicators were identified and extracted from the literature review (27 indicators). Excel and ArcMap software were used to join the data extracted from the population and housing census data (SCI, 2016) at the urban blocks level (12,169 blocks).

Phase 2. The F'ANP model (Zebardast, 2013) is a hybrid model consisting of an Exploratory Factor

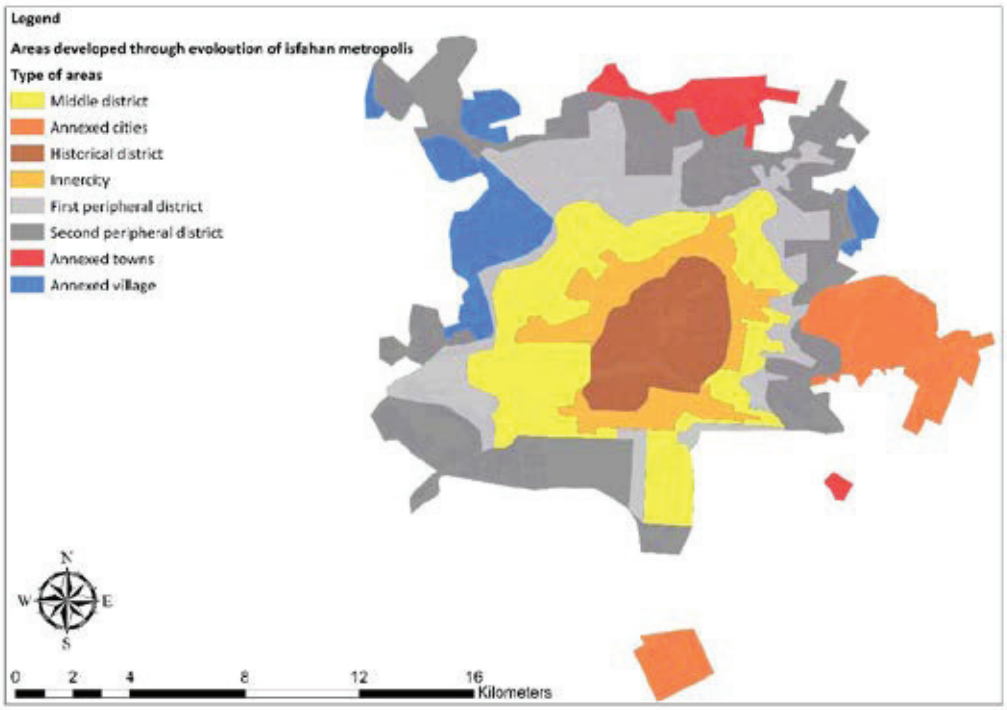


Fig.2: Areas developed through the evolution of Isfahan Metropolis; adapted from Atlas of Isfahan Metropolis (Atlas of Isfahan Metropolis, 2017)

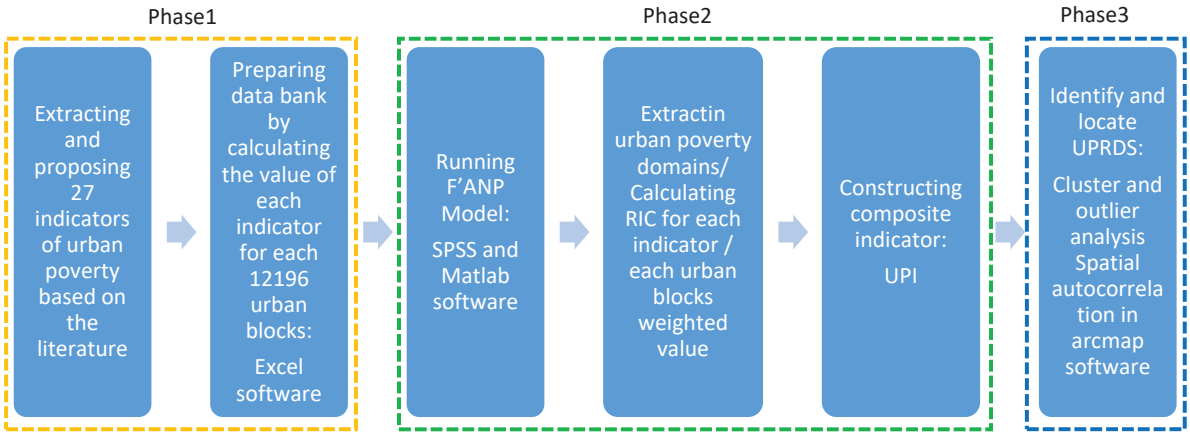


Fig.3: The research methodology and its process

Analysis (EFA) model and an Analytical Network Process (ANP). At first, the EFA model in SPSS 22 software has been run which forms the first stage of the F'ANP model process. Then, the outputs of the exploratory factor analysis model enter the analytical network process, using MATLAB 2016a software. The F'ANP model were used to compute the RIC of each indicator. Each indicator's status in Isfahan Metropolis were determined, the UPI for each urban block was calculated, and the urban poverty status in the Isfahan Metropolis was then evaluated.

*Phase 3***.** Cluster and outlier analysis and spatial

autocorrelation (Moran's I) were used in order to identify and locate UPRDs.

Data collection

This study was made at metropolitan area scale and therefore the study area includes 12196 urban blocks. The value of each urban poverty indicator extracted from literature review was obtained from the population and housing census 2016. The compiled information allowed the elaboration of a database of 27 indicators, with 12196 specific data per indicator, coming from all the urban blocks of the Isfahan metropolis (Table 1). This is the phase 1 of proposed methodology. The database was analyzed with the SPSS V22, MATLAB V2016a and ArcMap software version 10.4.1 in further phases.

Table 1: Urban poverty substantive indicators

Name of the variable	Symbol	Background research
Household Size	HHS	(Armaş, 2012; de Oliveira Mendes, 2009; Finch *et al.,* 2010; Guimarães, 2013; Wood *et al.,* 2010)
Population density	POPDEN	(Armaş, 2012; Borden *et al.,* 2007; Chakraborty *et al.,* 2005; de Oliveira Mendes, 2009; Labonté *et al.,* 2011; Lee, 2014; Martínez, 2009; Myers *et al.,* 2008; Tate, 2013)
Percentage of housing units with a room	PHWOR	(Cutter *et al.,* 2003; Myck *et al.,* 2015; Zebardast, 2013)
Percentage of the population under 5 years of age	PO5	(Nelson *et al.,* 2015; Zebardast, 2013)
Percentage of persons with disabilities	PDIS	(Cutter *et al.,* 2003; Lee, 2014; Nelson *et al.,* 2015; Zebardast, 2013)
Percentage of rented residential units	PRH	(Cutter *et al.,* 2003; Nelson *et al.,* 2015; Zebardast, 2013)
Percentage of housing units in form of sheds, huts and slums ...	PQH	(Labonté *et al.,* 2011)
Unemployment rate	UER	(Azpitarte, 2012; Bjarnadottir *et al.,* 2011; Flanagan *et al.,* 2011; Guimarães, 2013; Khan, 2012; Labonté *et al.,* 2011; Martínez, 2009; Myck *et al.,* 2015; Nelson *et al.,* 2015; Popay *et al.,* 2010; Schmidtlein *et al.,* 2008; Zebardast, 2013)
Percentage of illiterate population	ILR	(Armaş, 2012; Azpitarte, 2012; Guimarães, 2013; Labonté *et al.,* 2011; Myck *et al.,* 2015)
Percentage of the population over 65 years old	PO65	(Armaş, 2012; Esnard *et al.,*2011; Finch *et al.,* 2010; Flanagan *et al.,* 2011; Lee, 2014; Nelson *et al.,* 2015; Schmidtlein *et al.,* 2008; Tate, 2013; Van Zandt *et al.,* 2012)
Actual dependency ratio	DER	-
Percentage of old housing units	POH	(Azpitarte, 2012; de Oliveira Mendes, 2009; Labonté *et al.,* 2011; Nelson *et al.,* 2015)
Percentage of housing units with unstable structure	PHWWS	-
Percentage of households without a own car	PHWCAR	(Kis and Gábos, 2016; Labonté *et al.,* 2011)
Kind of households settled in housing unit(female-headed)	KHSHNFH	(Labonté *et al.,* 2011; Nelson *et al.,* 2015; Zebardast, 2013)
Percentage of simple workers	PSW	(Borden *et al.,* 2007; Nelson *et al.,* 2015; Zebardast, 2013)
Percentage of housing units with an area of 50 m2 or less	PHWAU	(Zebardast, 2013)
Percentage of housing units with access to piped water, electricity, telephone and gas plumbing	PHWF	(Alkire *et al.,* 2014; Alkire and Santos, 2010; Cutter *et al.,* 2003; De Oliveira Mendes, 2009; Martínez, 2009; Menoni *et al.,* 2012; Zebardast, 2013)
Percentage of housing units with access to kitchen, bathroom and toilet	PHWB	(Cutter *et al.,* 2003; de Oliveira Mendes, 2009; Menoni *et al.,* 2012; Zebardast, 2013)
Percentage of housing units with public or private sewer network	PHWSW	(Alkire *et al.,* 2014; Alkire and Santos, 2010; Martínez, 2009)
Percentage of households with access to computer	PHWCOM	(Labonté *et al.,* 2011; Martínez, 2009; Myck *et al.,* 2015)
Child mortality rate	CHDER	(De Oliveira Mendes, 2009)
Migration rate	PIMH	(Popay *et al.,* 2010; Wood *et al.,* 2010)
Persons per housing unit	PHU	(Flanagan *et al.,* 2011; Myck *et al.,* 2015)
Unemployment rate of men	UEMR	(Zebardast, 2013)
Unemployment rate of women	UEWF	(Cutter *et al.,* 2003; de Oliveira Mendes, 2009; Nelson *et al.,* 2015; Zebardast, 2013)
Percentage of households without motorcycles	PHWMO	(Kis and Gábos, 2016; Labonté *et al.,* 2011)

Table 2: Factors explaining poverty in Isfahan Metropolis

Name of Extracted factor	Explained variance	Factor loading	symbol
General poverty	13.25	0.794	PHWOR
		0.785	PHWCAR
		0.777	PHWCOM
		0.625	PSW
		0.603	ILR
		0.586	PHWAU
Crowdedness in housing unit	10.09	0.958	HHS
		0.955	PHU
		-0.602	KHSHNFH
Economic poverty	9.462	0.961	UER
		0.881	UEMR
		0.662	DER
		0.540	UEWF
Intrinsic poverty	8.23	0.684	POH
		0.581	PO65
		0.477	PHWWS
		0.416	PDIS
Infrastructure poverty	6.243	0.725	PHWB
		0.705	PHWF
		0.446	PHWSW
Migrant's poverty	5.276	0.582	PRH
		0.543	PHWMO
		0.500	POPDEN
		0.458	PIMH
Unhealthy living	4.713	0.735	CHDER
		-0.518	PO5
		0.462	PQH

RESULTS AND DISCUSSION

Running the F'ANP model (Phase 2 of the methodology) and Determining UPRDs (phase 3 of the methodology) have been addressed and discussed in this section.

Phase 2: running the F'ANP model

In order to run the F'ANP model, this phase was divided to two main interrelated sections including "Running EFA model" and the "The ANP part of the model".

Running EFA

EFA requires that the data used needs to be normally distributed. Skewness and kurtosis coefficients were calculated to check for normality of the data set. The results indicated the input data of the model, which was composed of 27 indicators in 12,169 urban blocks, follows a normal distribution. The Kaiser-Meyer-Olkin Measure of Sampling Adequacy (KMO) and "Bartlett's Test of Sphericity" were calculated to check the adequacy of using an exploratory factor analysis. The KMO of 0.714 and the Bartlett's Test of Sphericity being significant (Sig. =0.0001), meant that the data set was suitable for factor analysis. The Kaiser criterion (Kaiser, 1960) was used to determine the number of factors to extract. Under this criterion factors with eigenvalues greater than or equal to 1.0 were extracted. Using this criterion, seven factors were extracted which cumulatively explain about 57.3 percent of the data variance. Varimax rotation was used in order to achieve a simple structure to explain the urban poverty in Isfahan Metropolis (Table 2).

The seven extracted factors were named as

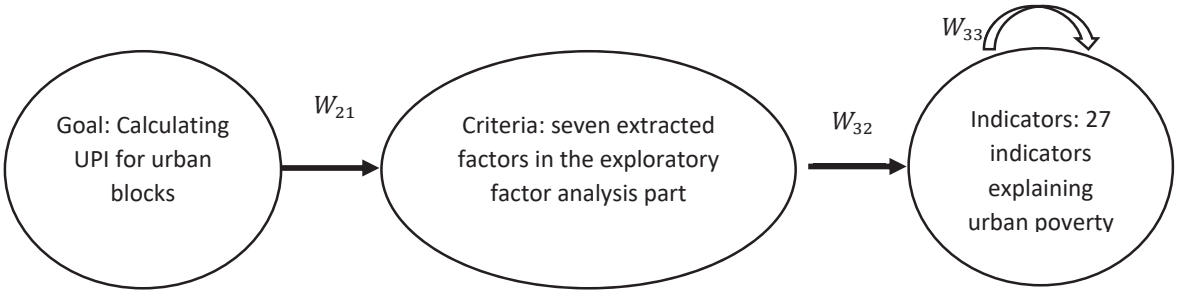


Fig. 4: External and internal relations among the indicators and the criteria

follows

Factor 1: General poverty in Isfahan. This factor includes the following indicators: "percentage of housing units with just one room", "percentage of households without a own car", "the number of households with access to computer" and "the percentage of housing units with an area of 50 m2 or less", "the percentage of simple workers" and "the percentage of illiterate population". It depicts the general poverty aspects in the city.

Factor 2: Crowdedness in housing units in Isfahan. "Household size", "persons per housing units" and "Kind of households settled in housing unit (female-headed)" are suitable indicators for showing the crowdedness in housing units in the city and the kind of households experiencing crowdedness in their housing unit.

Factor 3: Economic poverty in Isfahan. This factor includes the following indicators: "unemployment rate", "unemployment rate of men", "unemployment rate of women" and "actual dependency ratio". They show that the economic poverty in Isfahan has interrelation with population and household's structure.

Factor 4: Intrinsic poverty in Isfahan. This factor implicates on social and physical vulnerability. The former was about the weak structure of those households that include old individuals (percentage of the population over 65 years old) or/and disabled persons (percentage of Persons with disabilities). These two mentioned indicators make the household vulnerable against the external threat and shocks. Furthermore, physical aspect of intrinsic poverty implicates on the fragile physical structure of housing units ("percentage of old housing units" and "percentage of housing units with unstable structure"). This characteristic of housing units make them vulnerable for external threats especially natural disasters. That is to say, both the vulnerability aspect of urban poverty were embedded in intrinsic poverty, which means urban poor in Isfahan, can be both socially and physically vulnerable. In fact, they are intrinsically poor.

Factor 5: Infrastructure poverty in Isfahan. This factor includes "the percentage of housing units with access to kitchen, bathroom and toilet", "the percentage of housing units with access to piped water, electricity, telephone and gas plumbing" and "the percentage of housing units with public or private sewer network". It is related to the facilities of housing units and their accessibility to urban infrastructures networks.

Factor 6: Migrant poverty in Isfahan. This factor comprises "the percentage of rented residential units", "The percentage of households without motorcycles", "the migrant rate" and "Population density".

Factor 7: Unhealthy living in Isfahan. "Child mortality rate", "percent of the population under 5 years of age" and "the percentage of housing units in form of sheds, huts and slums" are indicators of this factor. It shows the child vulnerability, informal settlements and that they are interrelated.

The ANP part of the model

Constructing the model Network and identification of the internal and external relationships

In this step, the seven factors extracted from the exploratory factor analysis part of the model and their selected indicators were considered as the three distinct clusters in the ANP part of the model (Fig. 4). In this figure, the external and internal

relations among the indicators and the criteria were identified. The task of the F'ANP model in this step was to determine the RIC of each indicator. Making a three-level network (Fig. 5), the connections among the goal (UPI), the criteria (7 factors) and the sub-criteria (27-selected indicators) were defined.

Constructing single-entry matrices of initial super-matrix

The initial super-matrix that consists of three single-entry matrices was shown in figure 6. This matrix displays the connections through the three-level network. Using the F'ANP model, instead of using pair-wise comparison judgements (unlike the ANP), the matrices were computed in the following manner (Zebardast, 2013):

- Matrix W_{21} indicating the connection between the goal and the criteria, was obtained by normalizing the value of variance explained by each extracted factor;

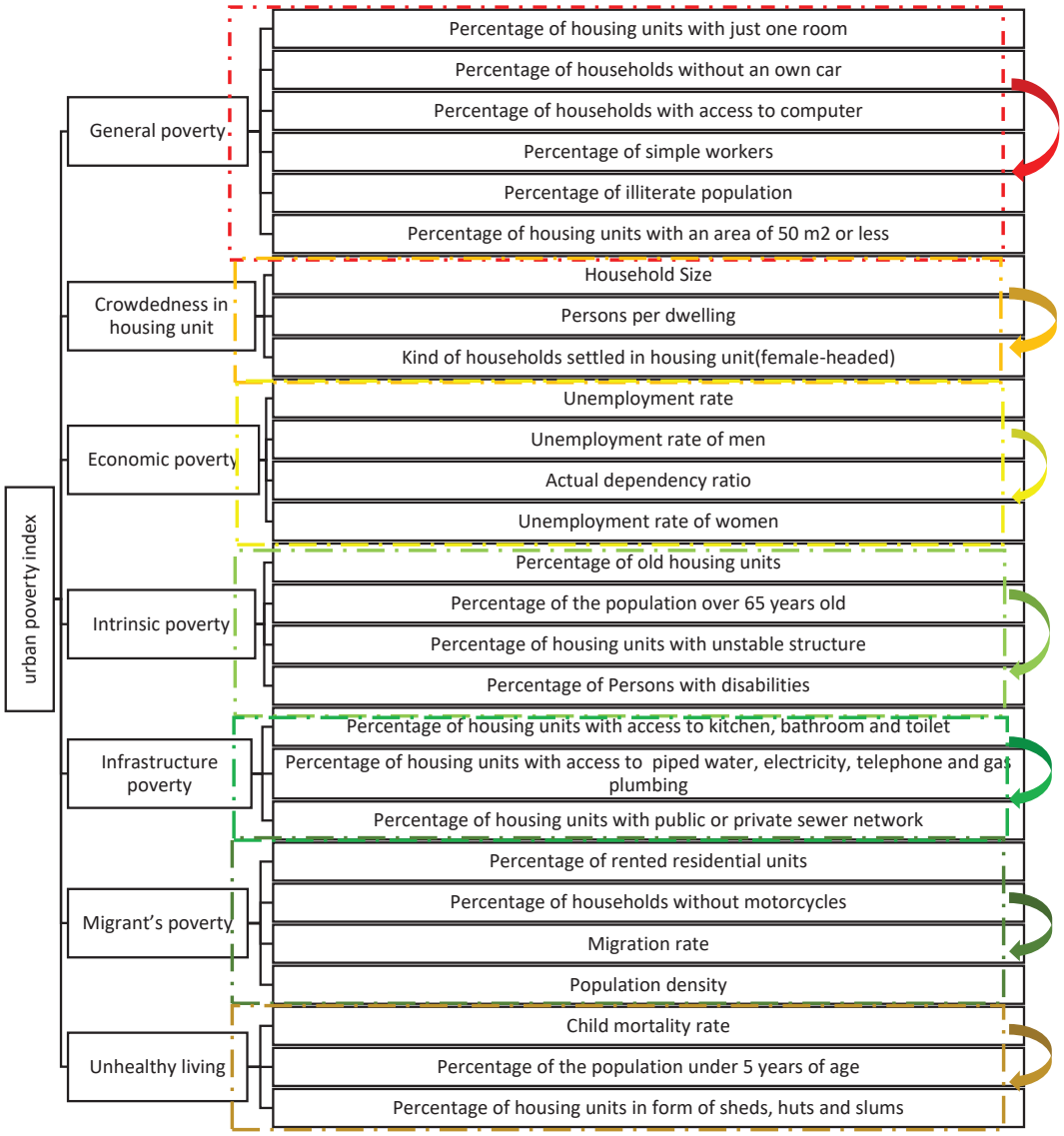


Fig. 5: The three-level network showing relationships among the indicators, criteria and goal

Table 3: Relational importance of indicators

Indicator symbol	RIC	Indicator symbol	RIC	Indicator symbol	RIC	Indicator symbol	RIC
HHS	0.064	POH	0.040	PSW	0.036	PDIS	0.029
PHU	0.063	PHWF	0.040	PHWWS	0.034	PRH	0.024
UER	0.051	PO65	0.040	PHWSW	0.032	POPDEN	0.024
KHSHNFH	0.049	PHWOR	0.039	UEWF	0.032	PHWMO	0.023
UEMR	0.045	ILR	0.039	PHWAU	0.031	PQH	0.023
PHWCOM	0.044	DER	0.037	PO5	0.030	PIMH	0.021
PHWCAR	0.043	PHWB	0.036	CHDER	0.029		

- Matrix W_{32} which shows the connection between the criteria and the sub-criteria (indicators), is equal to the normalized "factor loadings" of each indicator; and

- Matrix W_{33} which refers to interconnection among indicators themselves, was computed from the absolute normalized values of the correlation coefficient among the indicators of each factor.

Calculating RIC

After constructing the single-entry matrixes: W_{21}, W_{32} and W_{33}, they were entered into in the initial super- matrix to obtain the weighted super-matrix. The weighted super-matrix was then raised to a power of an arbitrarily large number (40 in this case) to obtain a convergence on the importance weights. The new matrix was called the limit matrix. The goal column of the obtained limit matrix shows the importance or weights of the 27 indicators selected for the purposes of this study. These weights were normalized to obtain the relative RIC of the indicators (Table 3).

Constructing urban poverty index (UPI)

There was a need for a composite index in order to show the urban poverty of each block cumulatively. The RIC related to each indicator was obtained through normalizing the indicators values and multiplying them by their corresponding weights. The normalization of indicators was done by application of the following normalization Eq. 1:

$$NVI_{ij} = 0.8\left[\frac{x_{ij} - x_{j-min}}{x_{j-max} - x_{j-min}}\right] + 0.1 \quad (1)$$

Where, x_{ij} is the value of block i for indicator j; x_{j-max} and x_{j-min} are the maximum and minimum values for indicator j, respectively. This formula sets the values of each indicator in the range of 0.1 to 0.9. Then, by applying Eq. 2, the urban poverty index is obtained by multiplying the weights of each indicator obtained from the F'ANP model ($W_{F'ANP\ j}$) by its normalized value (NVI_{ij}).

$$UPI_i = \sum_{j=1}^{J} W_{F'ANP\ j}\, NVI_{ij} \quad (2)$$

Analyzing urban poverty spatial pattern

The UPIs for the city's 12,169 urban blocks is calculated. Fig. 7 shows that UPI amounts of Isfahan Metropolis area are approximately normal (Skewness=0.681 and Kurtosis=0.861). Using Arc Map software, the UPI has been attached to the urban blocks. In the other words, the UPI has been georeferenced (Fig. 7).

Standard deviation method is used to classify the urban blocks based on their UPI (Table 4). Five classes of urban blocks have been identified based on their UPI. Class 1 refers to those urban blocks that have the lowest amount of UPI (about 42% of urban blocks with about 18 % of the city's population); The second class which covers about 14.48% of city's urban blocks and about 16.45% of the population) shows those urban blocks with low amount of UPI. The average class (class 3) comprises most of the city's urban blocks (about 69.73%) with 73.75 % of the population. About 11.57% of urban blocks with a population of 8.19% fall into class 4: urban blocks with high amount of UPI. The highest amount of urban poverty is in class five. It contains about 3.6% of urban blocks, and 1.61% of the city's population. Combining classes 1 and 2 (lesser amount of UPI: Group A) and classes 4 and 5 (more

$$W = \begin{matrix} \\ Goal \\ Criteria \\ Sub-criteria \end{matrix} \begin{matrix} \begin{matrix} Goal & Criteria & Sub-criteria \end{matrix} \\ \begin{bmatrix} 0 & 0 & 0 \\ W_{21} & 0 & 0 \\ 0 & W_{32} & W_{33} \end{bmatrix} \end{matrix}$$

Fig. 6: The primary super-matrix structure; the situation of single-entry matrices

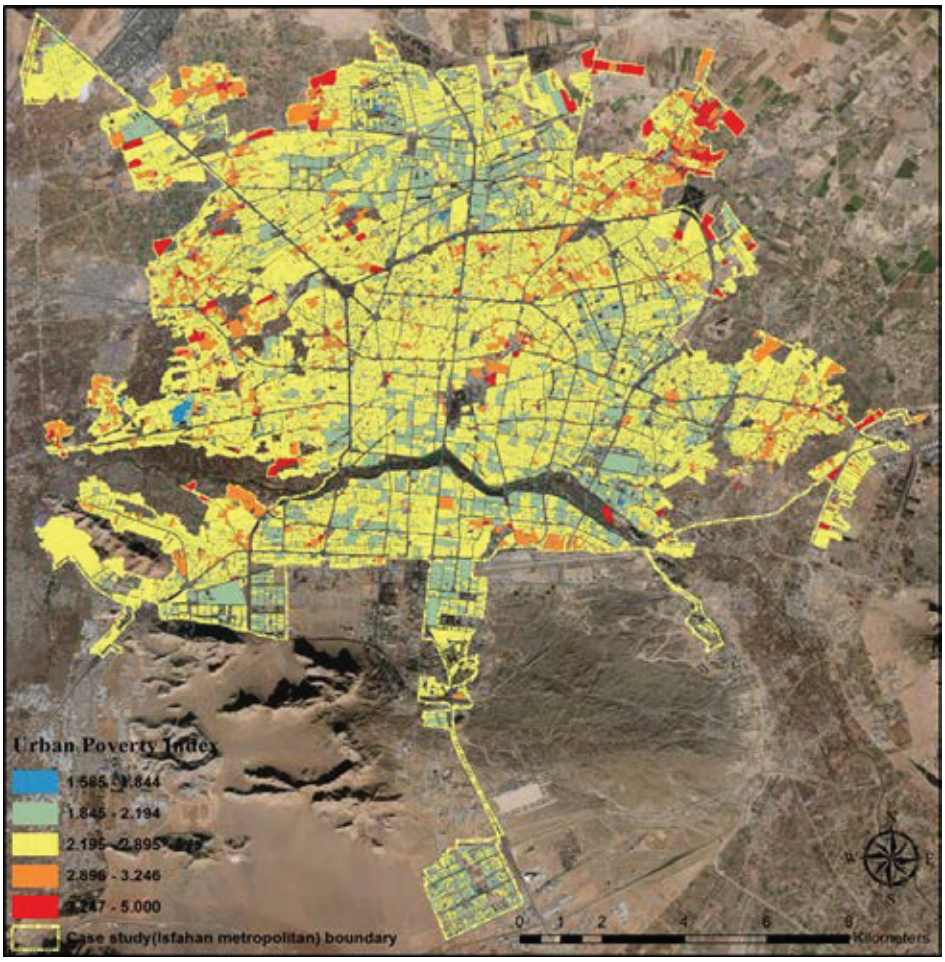


Fig. 7: UPI spatial distribution pattern in Isfahan Metropolitan area

Table 4: The condition of urban blocks and population in face of urban poverty

Urban blocks condition in face of urban poverty	Number of urban blocks	Number of urban blocks (percentage)	Population in urban blocks	Population in urban blocks (percentage)
Lowest (1.585-1.844)	52	0.42	3243	0.18
Low (1.845-2.194)	1762	14.48	299553	16.45
Average (12.195-2.895)	8510	69.93	1339356	73.57
High (2.896-3.246)	1408	11.57	149112	8.19
Highest (3.247-5.00)	437	3.60	29368	1.61
Total	12169	100	1820632	100

Table 5: Lesser poverty and more poverty group statistics

urban poverty group	Number of urban blocks	Number of urban blocks (percentage)	Population in urban blocks	Population in urban blocks (percentage)
Lesser poverty (Group A)	1814	14.899	302796	16.631
Average	8510	69.93	1339356	73.57
More poverty(Group B)	1845	15.170	178480	9.803
Total	12169	100	1820632	100

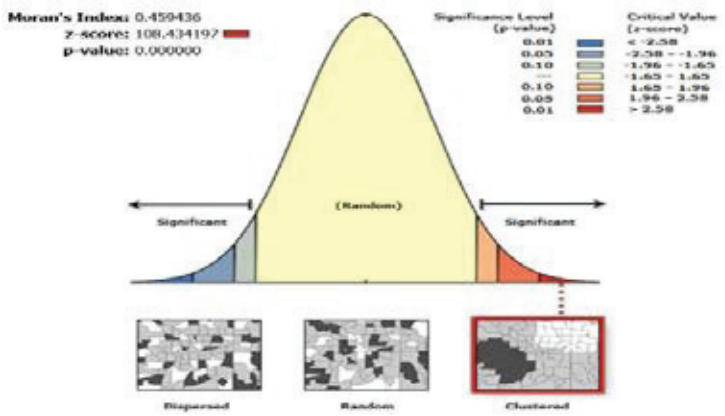


Fig. 8: The result of autocorrelation test indicating the spatially clustered pattern of UPI in Isfahan metropolis

amount of UPI: Group B) shows the regular conceptual pattern of the relationships among the amount of UPI, the number of urban blocks and their population. The number of urban blocks in these two groups are approximately equal. However, the urban blocks area of group A is 1.3 times more than the group B and the population of group A is 1.7 times more than that of group B (Table 5).

Phase 3: Determining UPRDs

In order to determine whether urban poverty in Isfahan Metropolis is concentrated in sporadic in nature (based on Wilson theory of poverty concentration), the Moran's "Spatial Autocorrelation index" has been employed. The outputs of the Moran's I indicate that the UPI is clustered and there are UPRDs in Isfahan (Fig. 8). In order to determine UPRDs, the spatial distribution pattern of UPIs shown in the Figure 7 is so general, because in some districts probably there are a mix of the three mentioned group (Group A; average group; group B). Using cluster and outlier analysis (Anselin local Moran I), UPRDs have been determined. "High-High" clusters show high values (UPRDs) explicitly referring to concentration of urban poverty. Poverty has been reproduced in these clusters. That is why it is important to give priority in policy making to them. "Low-Low" clusters show the concentration of those urban blocks with low UPI value. "High-Low" refers to those blocks wrestling with urban poverty while surrounded by those urban blocks, which have low value of UPI. "Low-High" implicates to those urban blocks with low value of UPI however surrounded by poor urban blocks (Fig. 9).

Where are the urban poor in Isfahan Metropolis?

By calculating UPI and determining UPRDs, it is possible to explain the spatial distribution of urban poor in different areas developed through the evolution of Isfahan Metropolis. It is likely to determine concentration of urban poverty in different kind of metropolis districts (Crowder, 2014). There are eight areas in Isfahan Metropolis where urban poor are concentrated. Historical district of Isfahan contains 74 HH urban blocks (3.9%). Most of these urban blocks surround the historical square of the

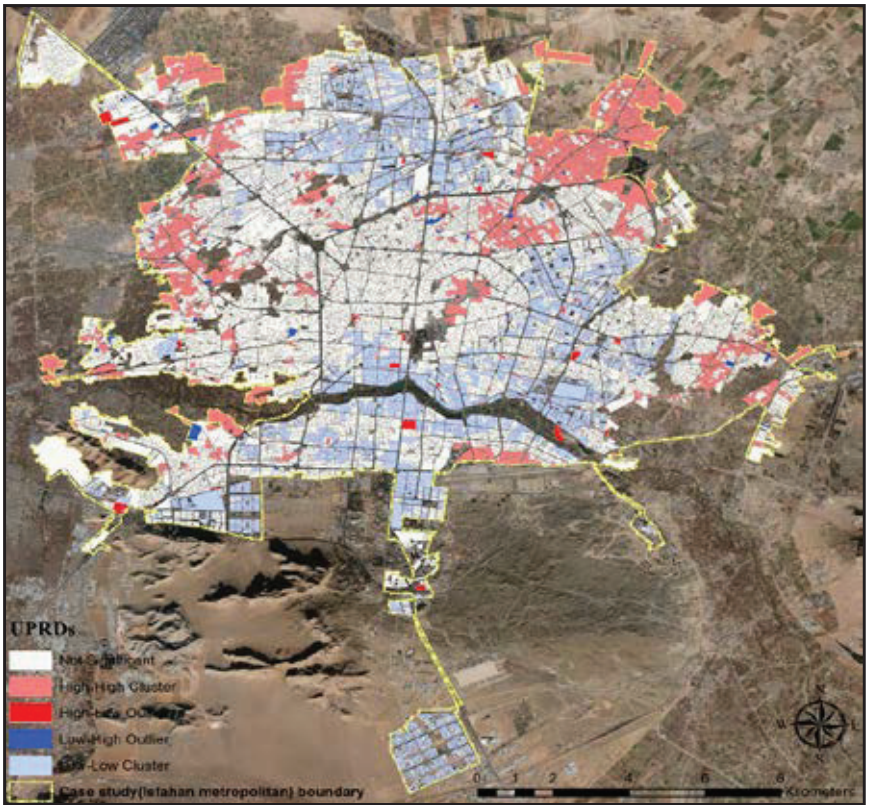


Fig. 9: Determining UPRDs through cluster and outlier analysis

city called “Imam Ali square”. Additionally, they are located at northeast of the “Naqshe Jahan Square”. It shows that urban poor surround the link path between two historical squares of Isfahan city (Fig. 10a). As Crowder (2014) affirms, urban old and historical districts may face with increasing of urban poverty by passing time. What can be concluded is that there is no need to be more concerned about urban poverty in historical district of Isfahan metropolitan. Inner city district includes 202 HH urban blocks (10.7%). There are three main concentrations of urban poor in this district. The first is located at northeast of inner city district called “Touqchi” neighborhood. The second is located at west of the inner city named “Afaran” neighborhood. The third is located at the southeast of inner city called “Hemet Abad” (Fig. 10b). These kind of districts as Anderson(2007) explained are faced with urban poverty specially in field of housing conditions and tenure security, inequalities in wages and employment opportunity, economic segregation and urban gentrification caused by urban redevelopment. The concentration of urban poverty in inner city district is truly importance to public policy because they face a unique set of circumstances (Crowder, 2014).

Middle district comprise 275 HH urban blocks (14.5%). There are six main areas where urban poor are located in. These areas are as follows (Fig. 11):

1) Northeast of middle district, the area attached to the east section of “Touqchi” neighborhood named “Zarab-Khane” neighborhood;

2) “Qaleh Shams Abad” neighborhood located in the north of the middle area;

3) North-west of middle district and the west section of “Fordavan” neighborhood;

4) West part of middle area called “Valladan” neighborhood;

5) South-west of the middle district;

6) Southern part of “Hemet Abad” neighborhood and southeast of middle district.

Urban poor who have located in this kind of district are those low-income households that the

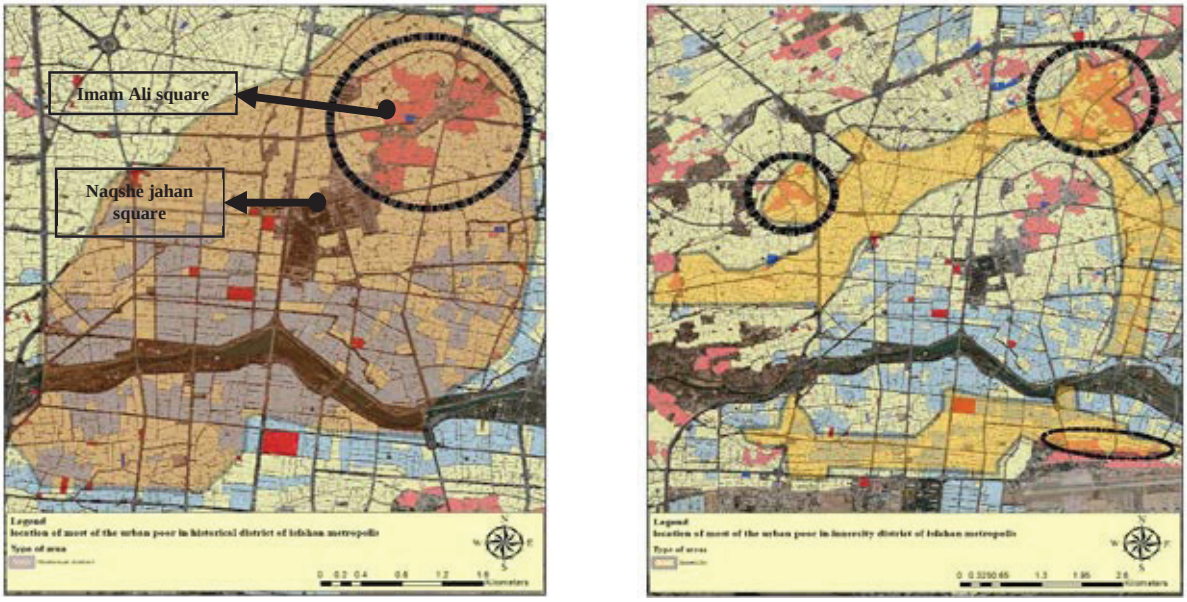


Fig. 10: The spatial concentrations of urban poor (UPRDS) poor in historical district (a) and inner city area (b)

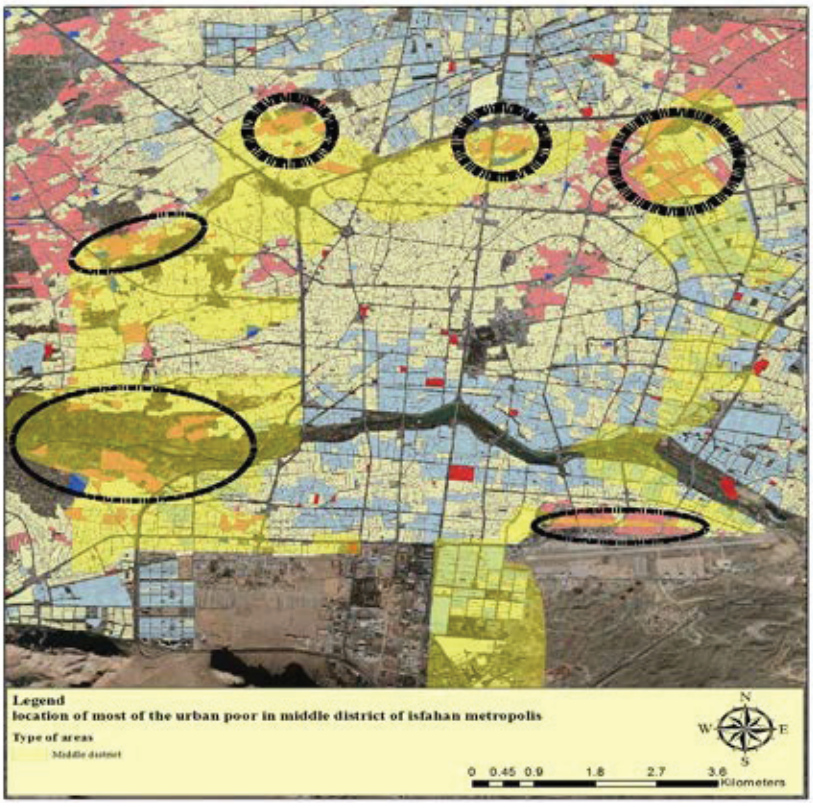


Fig. 11: The spatial concentrations of urban poor (UPRDS) in the middle district

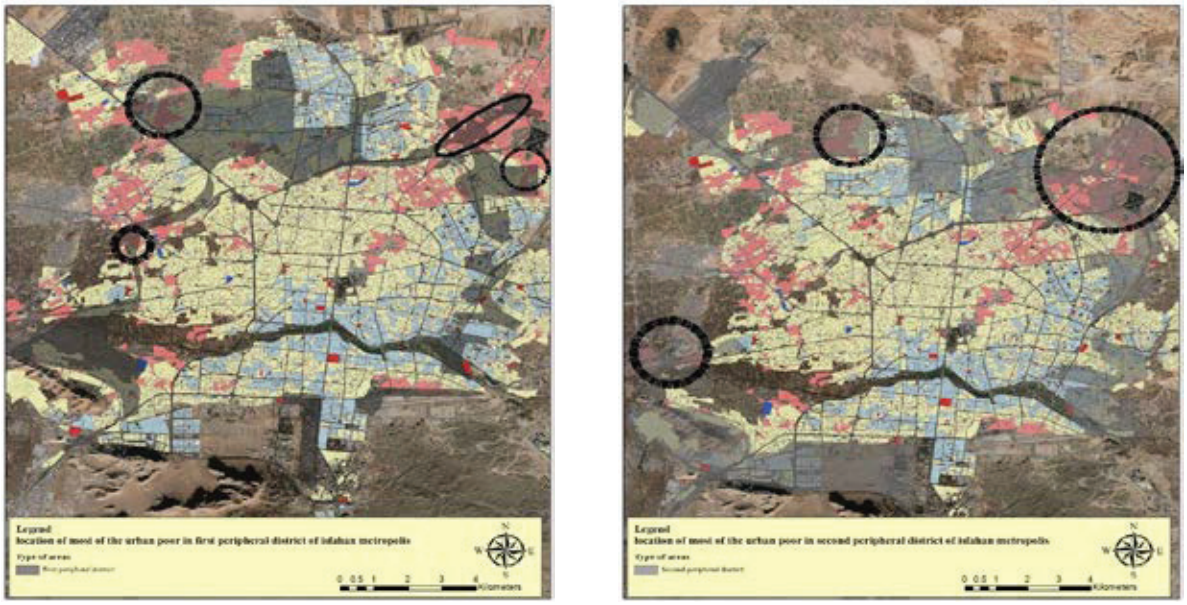


Fig. 12: The spatial concentrations of urban poor (UPRDS) in first peripheral district (a) and second peripheral district (b)

pressure of the economic gravity has push them to the nearest buffer of inner-city (Anderson, 2007)

There are two peripheral districts, which include 42.65% of HH urban blocks. These two main concentrations of urban poor are located at the northeast of first and second peripheral districts called "Zeinabieyeh" and "Haftoun" neighborhoods which include a high number of urban poor. In the northwest of first peripheral district, there is a neighborhood called "Marchin" where urban poor are concentrated in (Fig. 12a). "Nasser Khosro" neighborhood located in the northwest of the second peripheral district is another neighborhood faced with concentration of urban poverty. In the west part of the first peripheral district there is a neighborhood called "Sudan" where urban poor are located in. In the southwest part of second peripheral district there is a neighborhood called "Jerukan" where the poor located in (Fig. 12b). What can be concluded is that the concerns about urban poverty in Isfahan metropolitan area most be focused on the poverty concentration in peripheral districts. As Kinfu *et al.* (2018) affirms, poverty concentration in these kinds of districts mostly are the result of inefficient urban governance to provide land and shelter, and also the limitation to deliver services and infrastructure especially for migrants in city evolutions. Emergence of peripheral district mostly are accompanied with concentration of urban poverty and the deterioration of central city and, results social and economic inequalities and challenge the environmental sustainability (Joassart-Marcelli *et al.,* 2005). While urban management and planning system can see the urban poverty concentration in historical, inner city, and middle districts, contemporary urban policies fail to address the concentration of urban poverty in peripheral districts which confront with less quality of life in comparison with others (Anderson, 2007).

In 2003, some adjacent cities, towns and villages were annexed to Isfahan Metropolis. The result of this annexation is that Isfahan has surrounded by 512 HH urban blocks (28.25%). The two cities of Khorasgan and Sepahanshar are among those that were annexed to Isfahan Metropolis. "Khorasgan", located in the southeast, is faced with a huge number of urban poor in its east part; while there is not any concentration of urban poor in "Sepahanshahr" which is located in the southern part of the Isfahan Metropolis (Fig. 13a). Among the towns attached to Isfahan Metropolis, there is just one old town called "Hasan Abad Gari" located at the north part of Isfahan Metropolis which is faced with concentration of urban poverty (Fig. 13b). There are three main urban poor concentrations located in the annexed

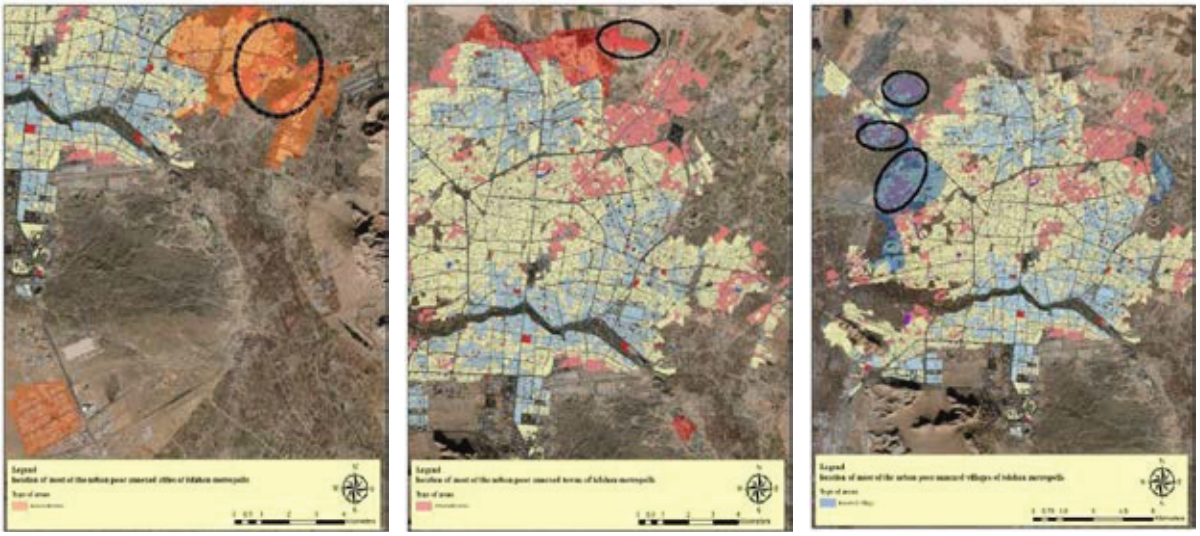


Fig. 13: The spatial concentrations of urban poor (UPRDS) in annexed cities (a), towns (b) and villages (c)

villages in northwest part of the Isfahan Metropolis: "Asheq Abad", "Babukan" and "Rahnan" (Fig. 13c).

In line with Berube and Kneebone (2006) and Cooke (2010), it is found that of the urban poverty concentration (near 70% in Isfahan metropolis) are located in suburb (annexed villages and cities) and peripheral district. Thus, public policy, urban management and planning system must focus on peripheral and annexed districts in Isfahan metropolitan area according to the high-concentration of urban poverty in them.

CONCLUSION

The growing trend of urban population, especially in the large cities and metropolises of the developing countries, has made the need for more complex and comprehensive policymaking undeniable. Urban policies must be able to address the problem of urban poverty, which is inherent in the present tense urbanization process. This requires equipping urban policymakers with a multifaceted and inclusive methodology that can explain the complexities surrounding urban poverty in metropolises. The aim of this paper was to suggest a methodology for identifying the spatial representation of urban poverty in Isfahan Metropolis. In this regard, first the indicators related to the substantive dimension of urban poverty were extracted from the related literature (27 indicators). Then, using the F'ANP model, 7 domains of urban poverty in Isfahan Metropolis were identified including "general poverty", "crowdedness in housing unit", "economic poverty", "intrinsic poverty", "infrastructure poverty", "migrant's poverty" and "unhealthy living condition". In the next step, the weight of each of the indicators affecting urban poverty in this metropolis was calculated. The findings show that "Household Size", "Unemployment rate", "Kind of households settled in housing unit (female-headed)", "Persons per housing unit" and "Unemployment rate of men" are the first five most important indicators in defining urban poor in Isfahan metropolis. The composite index of spatial distribution of urban poverty in Isfahan Metropolis (UPI) was calculated. Classifying urban blocks based on the UPI has shown that 9.8% of population and 15.7% of urban blocks had the highest urban poverty rate. Additionally, the traps of urban poverty that face the extreme concentration of urban poverty and can reproduce urban poverty were identified. Autocorrelation test has indicated that urban poverty is clustered in Isfahan metropolis. Finally, layers of development and evolution of Isfahan Metropolis were used to investigate the spatial distribution of urban poverty traps. Using Cluster and outlier analysis, it was determined that 70% of urban poverty concentrations were located in suburbs and peripheral districts.

In this paper, a methodology has been suggested

to:

- Investigate different aspects of the substantive dimension (spatial representation) of urban poverty in metropolitan areas and provide the conditions needed to identify the procedural dimension (the set of non-spatial processes that cause urban poverty). Determine variety types of urban poverty based on the metropolitan areas contexts (Exploratory Factor Analysis of F'ANP model): Unlike previous research, which mainly focused on the study of urban poverty with a predetermined theoretical framework, the methodology suggested in this paper extracts the urban poverty analysis framework based on the context of the case study.
- Prioritize the impact of indicators on urban poverty; (using Analytical Network Process of F'ANP model): Unlike previous studies that rely on expert opinions to determine the weight of urban poverty indicators or consider equal weights for all indicators, in the methodology suggested by this paper, the weights of indicators are calculated based on the relationships among the indicators through the F'ANP model. That is to say, the key determinant of the weight of the indicators in this methodology is the context (the data is driven from the context).
- Show the spatial distribution of urban poverty in metropolitan areas (Based on UPI made by F'ANP model),
- Identify urban poverty traps (UPRDS) that are actually reproducers of urban poverty (with Using the clustering and Outlier model)
- Determine that each UPRDS was formed in which part of the metropolis (in comparison with areas developed through the evolution of Isfahan Metropolis)

Urban policymakers can adopt relevant policies in relation with variety types of urban poverty identified in metropolises and determine policy priorities based on the weights calculated for each indicator. They can also suggest policies at the macro and micro levels using the urban poverty distribution map in metropolises. Those districts that face the trap of urban poverty or the overwhelming concentration of urban poverty require special policymaking. Investigating the areas facing urban poverty concentration in comparison with the areas developed in the metropolis evolution will help to elucidate the procedural dimensions of urban poverty that have shaped this spatial representation.

AUTHOR CONTRIBUTIONS

M.J. Nouri performed the literature review, experimental design, analyzed and interpreted the data, prepared the manuscript text, and manuscript edition. E. Zebardast supervised the experiments, literature review, data compiling and manuscript preparation.

ACKNOWLEDGEMENT

The authors would like to extend their appreciation for the support of the Deputy of the Planning and Research Department of the Municipality of Isfahan.

CONFLICT OF INTEREST

The authors declare no potential conflict of interest regarding the publication of this work. In addition, the ethical issues including plagiarism, informed consent, misconduct, data fabrication and, or falsification, double publication and, or submission, and redundancy have been completely witnessed by the authors.

ABBREVIATION

ANP	Analytical Network Process
CHDER	Child mortality rate
DER	Actual dependency ratio
EFA	Exploratory Factor Analysis
F'ANP	A hybrid model of exploratory factor analysis and analytical network process
HHS	Household Size
ILR	Percentage of illiterate population
KHSHNFH	Kind of households settled in housing unit(female-headed)
KMO	Kaiser-Meyer-Olkin
PDIS	Percentage of persons with disabilities
PHU	Persons per housing unit
PHWAU	Percentage of housing units with an area of 50 m2 or less
PHWB	Percentage of housing units with access to kitchen, bathroom and toilet
PHWCAR	Percentage of households without a own car
PHWCOM	Percentage of households with access to computer

PHWF	Percentage of housing units with access to piped water, electricity, telephone and gas plumbing
PHWMO	Percentage of households without motorcycles
PHWOR	Percentage of housing units with a room
PHWSW	Percentage of housing units with public or private sewer network
PHWWS	Percentage of housing units with unstable structure
PIMH	Migration rate
PO5	Percentage of the population under 5 years of age
PO65	Percentage of the population over 65 years old
POH	Percentage of old housing units
POPDEN	Population density
PQH	Percentage of housing units in form of sheds, huts and slums ...
PRH	Percentage of rented residential units
PSW	Percentage of simple workers
RIC	Relational Importance Coefficient
UEMR	Unemployment rate of men
UER	Unemployment rate
UEWF	Unemployment rate of women
UPI	Urban poverty index
UPRDS	Urban Poverty Reproduced Districts

REFERENCES

Alkire, S.; Conconi, A.; Seth, S., (2014). Multidimensional poverty index 2014: brief methodological note and results. University of oxford, department of international development, oxford poverty and human development initiative, oxford, UK.

Alkire, S.; Santos, M.E., (2010). Acute multidimensional poverty: a new index for developing countries. United Nations development program human development report office background paper (2010/11).

Armaş, I., (2012). Multi-criteria vulnerability analysis to earthquake hazard of Bucharest, Romania. Nat. Hazard, 63(2): 1129-1156 **(28 pages)**.

Anderson, M.W., (2007). Cities inside out: Race, poverty, and exclusion at the urban fringe. UCLAL. Rev., 55: 1095.

Atlas of Isfahan Metropolis (2017). Municipality of Isfahan Metropolis.

Azpitarte, F., (2012). Social exclusion monitor bulletin April 2012.

Berube, A.; Kneebone, E., (2006). Two steps back: city and suburban poverty trends 1999I2005. Washington, DC: The Brookings Institution.

Bjarnadottir, S.; Li, Y.; Stewart, M.G., (2011). Social vulnerability index for coastal communities at risk to hurricane hazard and a changing climate. Nat. hazards. 59(2): 1055-1075 **(21 pages)**.

Borden, K.A.; Schmidtlein, M.C.; Emrich, C.T.; Piegorsch, W.W.; Cutter, S.L., (2007). Vulnerability of US cities to environmental hazards. J. Homeland Secur. Emerg., 4(2): 1-21 **(21 pages)**.

Chakraborty, J.; Tobin, G.A.; Montz, B.E., (2005). Population evacuation: assessing spatial variability in geophysical risk and social vulnerability to natural hazards. Nat. Hazards. Rev., 6(1): 23-33 **(11 pages)**.

Cooke, T. J., (2010). Residential mobility of the poor and the growth of poverty in inner-ring suburbs. Urban. Geogr., 31(2): 179-193 **(15 pages)**.

Crowder, P.A., (2014). (Sub) Urban poverty and regional interest convergence. Marq. L. Rev., 98(2): 763-830 **(68 pages)**.

Cutter, S.L.; Boruff, B.J.; Shirley, W.L., (2003). Social vulnerability to environmental hazards. Soc. Sci. Q., 84(2): 242-261 **(20 pages)**.

De Oliveira Mendes, J.M., (2009). Social vulnerability indexes as planning tools: beyond the preparedness paradigm. J. Risk. RES., 12(1): 43-58 **(16 pages)**.

Esnard, A.M.; Sapat, A.; Mitsova, D., (2011). An index of relative displacement risk to hurricanes. Nat. Hazards., 59(2): 833-859 **(27 pages)**.

Finch, C.; Emrich, C.T.; Cutter, S.L., (2010). Disaster disparities and differential recovery in New Orleans. Popul. Environ., 31(4): 179-202 **(24 pages)**.

Flanagan, B.E.; Gregory, E.W.; Hallisey, E.J.; Heitgerd, J.L.; Lewis, B., (2011). A social vulnerability index for disaster management. J. Homland Secur. Emerg., 8(1): 1-22 **(22 pages).**

Guimarães, T., (2013). An integrated analytical tool for exploring the links between job accessibility and social exclusion. Paper presented at the XIII World Conference on Transport Research, XIII World Conference on Transport Research (Río de Janeiro).

Joassart-Marcelli, P.M.; Musso, J.A.; Wolch, J.R., (2005). Fiscal consequences of concentrated poverty in a metropolitan region. Ann. Assoc. Am. Geogr., 95(2): 336-356 **(21 pages)**.

Kaiser, HF., (1960). The application of electronic computers to factor analysis. Educ. Psychol. Measur., 20(1):141–151 **(11 pages)**.

Khan, S., (2012). Vulnerability assessments and their planning implications: a case study of the Hutt Valley, New Zealand. Nat. Hazards, 64(2): 1587-1607 **(21 pages)**.

Kinfu, E.; Bombeck, H.; Nigussie, A., (2018). Africa's Urbanization and Emerging Settlement Forms: Implications to Urban Planning.

Kis, A.; Gábos, A., (2016). Consistent poverty across the EU. Corvinus J. Sociol. Soc. Policy , 7 (2): 3-27 **(25 pages)**.

Labonté, R.N.; Hadi, A.; Kauffmann, X.E., (2011). Indicators of social exclusion and Inclusion: A critical and comparative analysis of the literature. Population health improvement research network.

Lee, Y.J., (2014). Social vulnerability indicators as a sustainable planning tool. Environ. Impact Assess. Rev., 44: 31-42 **(12 pages)**.

Lemanski, C., (2016). Poverty: multiple perspectives and strategies. Geography, 101(1): 4-10 **(7 pages)**.

Lok-Dessallien, R., (1999). Review of poverty concepts and indicators. UNDP.

Martínez, J., (2009). The use of GIS and indicators to monitor intra-urban inequalities. A case study in Rosario, Argentina. Habitat Int., 33(4): 387-396 **(10 pages)**.

Menoni, S.; Molinari, D.; Parker, D.; Ballio, F.; Tapsell, S., (2012).

Assessing multifaceted vulnerability and resilience in order to design risk-mitigation strategies. Nat. Hazards., 64(3): 2057-2082 **(26 pages)**.

Myck, M.; Oczkowska, M.; Duda, D., (2015). Innovations for better understanding deprivation and social exclusion. In: F. Malter, and A. Börsch-Supan (Eds.), SHARE Wave 5: Innovations and Methodology. Munich: Munich Center for the Economics of Aging (MEA): 29-36 **(8 pages)**.

Myers, C.A.; Slack, T.; Singelmann, J., (2008). Social vulnerability and migration in the wake of disaster: the case of Hurricanes Katrina and Rita. Popul. Environ., 29(6): 271-291 **(21 pages)**.

Nelson, J.; Grubesic, T.; Sim, L.; Rose, K.; Graham, J., (2015). Approach for assessing coastal vulnerability to oil spills for prevention and readiness using GIS and the Blowout and Spill Occurrence Model. Ocean. Coast. Manage., 112: 1-11 **(11 pages)**.

Niemietz, K.P., (2011). A new understanding of poverty. Institute of Economic Affairs Monographs (65).

Popay, J.; Escorel, S.; Hernandez, M.; Johnston, H.; Mathieson J, Rispel L., (2010). On behalf of the WHO social exclusion knowledge network .2008. Understanding and tackling social exclusion: Final report of the social exclusion knowledge network of the commission on social determinants of health. Geneva: World Health Organization.

Ravallion, M.; Chen, S.; Sangraula, P., (2007). New evidence on the urbanization of global poverty. Popul. Dev. Rev., 33(4): 667-701 **(35 pages)**.

Schmidtlein, M.C.; Deutsch, R.C.; Piegorsch, W.W.; Cutter, S.L., (2008). A sensitivity analysis of the social vulnerability index. Risk. Anal., 28(4): 1099-1114 **(16 pages)**.

SCI: Statistic Center of Iran, (2016). Population and Housing census.

Tate, E., (2013). Uncertainty analysis for a social vulnerability index. Ann. Assoc. Am. GEOGR., 103(3): 526-543 **(18 pages)**.

Teitz, M.B.; Chapple, K., (2013). Planning and poverty: An uneasy relationship. Policy, Planning, and People: Promoting justice in urban development, 205-223 (**19 pages**).

United Nations Department of Economic and Social Affairs, (2007). Indicators of sustainable development: guidelines and methodologies: United Nations Publications.

United Nations, Department of Economic and Social Affairs, Population Division, (2015). World urbanization prospects: The 2014 revision (ST/ESA/SER.A/420). New York: United Nations.

Van Zandt, S.; Peacock, W.G.; Henry, D. W.; Grover, H.; Highfield, W. E.; Brody, S. D., (2012). Mapping social vulnerability to enhance housing and neighborhood resilience. Hous. Policy Debate, 22(1): 29-55 **(27 pages)**.

Watson, V., (2009). 'The planned city sweeps the poor away…': Urban planning and 21st century urbanization. Prog. Plann., 72(3): 151-193 **(43 pages)**.

Wilson, W.J., (1987). The truly disadvantaged. Chicago: University of Chicago Press.

Wood, N. J.; Burton, C. G.; Cutter, S. L., (2010). Community variations in social vulnerability to Cascadia-related tsunamis in the US Pacific Northwest. Nat. Hazards., 52(2): 369-389 **(21 pages)**.

Wratten, E., (1995). Conceptualizing urban poverty. Environ. Urban., 7(1): 11-38 **(28 pages)**.

Zebardast, E., (2013). Constructing a social vulnerability index to earthquake hazards using a hybrid factor analysis and analytic network process (F'ANP) model. Nat. Hazards., 65(3): 1331-1359 **(29 pages)**.

HOW TO CITE THIS ARTICLE

Nouri, M.J.; Zebardast, E., (2021). Where are the urban poor? The spatial distribution pattern of urban poverty. Int. J. Hum. Capital Urban Manage., 6(3): 305-322.

DOI: 10.22034/IJHCUM.2021.03.08

url: http://www.ijhcum.net/article_241835.html

Int. J. Hum. Capital Urban Manage., 6(3): 323-336, Summer 2021

International Journal of Human Capital in Urban Management
(IJHCUM)

Homepage: http://www.ijhcum.net/

ORIGINAL RESEARCH PAPER

Identification and prioritization of factors affecting the adoption of electric vehicles using analytic network process

Kh. Eshtiaghi, M. Aliyannezhadi, A.H. Najafian*

Department of Business Management and Engineering, Iran University of Science and Technology, Tehran, Iran

ARTICLE INFO

Article History:
Received 01 October 2020
Revised 14 January 2021
Accepted 31 January 2021

Keywords:
Analytical network process
Adoption
Electric vehicles
Transportation management

ABSTRACT

BACKGROUND AND OBJECTIVES: Given the spread of environmental pollution, the development of strategies and changes in lifestyle to reduce urban environmental pollution is of great importance. One of the existing solutions is to develop and promote the use of electric vehicles. An electric vehicle is a car that uses a battery pack to store the electrical energy that powers the motor. EV batteries are charged by plugging the vehicle in to an electric power source. These days, electric vehicles are considered as one of the most modern innovations in the car business. However, the use of these vehicles has not been particularly widespread in third world countries, and this may be due to several reasons. Despite the high level of air pollution in Iran, People and the government still do not accept electric vehicles as an important way to reduce air pollution, and electric vehicles are rarely seen on the streets. The main factors that can affect the reception of electric vehicles by the Iranian people are economic, technical, access, laws, marketing, and personal.

METHODS: The factors extracted from literature and identified factors were prioritized using the analytic network process technique. After data gathering with help of questionnaire which its relaiablity and validity was confirmed through inconsistency index and content validity ratio consecutively, the data analysis was performed using SuperDecision software.

FINDINGS: The results showed that Economic with 23%, Technical with 17.8%, Accessibility with 16.4%, laws with 15.3%, marketing with 15.1% and personal with 12.2% had the most significant effect in acceptance of the Iranian people of electric vehicles.

CONCLUSION: The results showed that economic factors had the most significant effect in comparison with other criteria. depreciation time, producer company, fuel subsidy, availability of repair shop, car and importance to the environment were the most significant factor in each criteria.

DOI: 10.22034/IJHCUM.2021.03.09

NUMBER OF REFERENCES	NUMBER OF FIGURES	NUMBER OF TABLES
48	2	12

*Corresponding Author:
Email: *amirhossein.najafian@gmail.com*
Phone: +989356292212

Note: Discussion period for this manuscript open until October 1, 2021 on IJHCUM website at the "Show Article.

INTRODUCTION

In recent decades, environmental issues have been addressed in various ways. The environmental issues began in the 1960s and their main focus was on industrial pollution, due to the growth of industrial economies (Khalil and Inam, 2006). In the late 1970s, the link between trade development and the environment peaked, and environmentalists organized widespread opposition and rallies around the world to protest the state of the environment as trade grew. They believed that as a result of trade liberalization and increased exports, economic activity, including pollutant activity, will expand exponentially and resource and energy use will increase improperly (Khalil and Inam, 2006). Emission from motor vehicles are one of the most important sources of human exposure to air pollution (johansson *et al*., 2017). The World Health Organization (WHO) estimates 2.4 million fatalities due to air pollution every year. Since the breathing of polluted air can have severe health effects such as asthma, increased cardiovascular risks, most countries have strengthened laws to control the air quality and mainly focus on emissions from automobiles. (Müller *et al*., 2017). Developing Electric Vehicles (EVs) has a significant meaning in protecting the environment (Adnan *et al*., 2017). Plug-in electric vehicles can potentially emit substantially lower CO2 emissions than internal combustion engine vehicles, and so have the potential to reduce transport emissions without curtailing personal car use (Graham-Rowe *et al.,* 2012). These days the use of EVs in the world is increasing. In 2012, approximately 110,000 batteies in the electric vehicles were used worldwide, and this number was mounted to nearly 3.3 million in 2019. (Huda *et al.,* 2019). Environmental and energy security issues have prompted governments to pursue a number of incentive policies to upgrade electric vehicles and benefit from policy dividends, beyond the global threshold of 1 million electric cars on the road in 2015, and went and closed at 1.26 million (Wang *et al.,* 2019). Electric vehicles (EV) are introduced as a medium-term technology suitable for reducing dependence on fossil fuels and eliminating or reducing GreenHouse Gases (GHGs) emissions associated with conventional vehicles (CVs). Despite the benefits of electric cars, several barriers need to be overcome before the widespread adoption of electric vehicles. (Egbue and Long 2012). The environmental and economic impact of electric vehicles will depend on the users that can accept EVs of a given capability, and then in turn on how those EVs are actually used. *(*Tamor *et al.,* 2013). However, the low public acceptance of EVs hinders the promotion of EVs in Iran. To address this problem, this study examines the factors that can affect the acceptance of electric vehicles by the Iranian people. The result of this research can define the barriers of Iranian EVs acceptance and also categorize the most important factors of EVs acceptance. Also, by identifying barriers to EV acceptance, not only can barriers be overcome, but also the electric vehicle industry and electric vehicle acceptance can be improved.

litereture review

The transport sector plays an important role in air pollution and consequently climate change due to Greenhouse gas emissions in urban areas (Chapman, 2007) Thus replacing internal combustion vehicles with new energy vehicles such as electric vehicles (EVs) is a promising step in predicting urban sustainability. Technologies related to electric mobility have changed exponentially (Song and Aaldering, 2019) Therefore, the literature covering these changes has increased significantly furthermore EVs adoption by society plays important role in this situation and some factors affect this adoption. But what is the most important factors that affecting EVs adoption? China's electric vehicle market has expanded rapidly, making China the world's largest electric vehicle market. Therefore, research on China and how to expand the acceptance of electric vehicles in this country is so important (Du and Ouyang, 2017). Based on a research in China, Tu and Yang (2019) stated that when consumers believe that electric vehicles are more profitable on individual, environmental or at the national level, or that they find it easier and more convenient to use electric vehicles, they will show a more positive attitude towards buying electric vehicles. Consumers' access to buy electric cars and their accessories will have the greatest impact on their behavioral attitudes. However, the opinions of buyers' friends regarding the use of electric vehicles also significantly affect their behavioral intention to buy electric vehicles. Thus, individual and accessibility factors plays an important role in EVs adoption. Wang *et al.,* (2017) stated that government rules is one of the effective factors in EVs adoption and China by

Stimulating encouraging policies, promoted sales of EVs exceeded 500,000 in 2016. In a research in Toyota company about purchasing Toyota Pirus, Ozaki and Sevastyanova (2011) stated that the financial benefits related to transport policy are an important factor in consumer hybrid purchase motivations and therefore economic and marketing factors play an important role in accepting EVs. In another study Jensen *et al*., (2013) mentioned that one the important factors in EVs adoption is technical factors and stated that there are major changes in the preference for driving range, top speed, fuel cost, battery life and charging in city centres and train stations. In Table 1 some of the important previous studies about EVs acceptance and their result are mentioned. These studies are classified to 6 criterias that affecting EVs adoption in

Table 1: important previous studies about EVs acceptance

Result	Refrence
Mentioned driving a plug-in hybrid electric vehicle can save hundreds of dollars annually on gas and diesel costs and contribute to environmental sustainability	Khooban *et al.,* (2016)
Classified the effecting factors as environmental-related, cost-related, comfort-related, trust-related, and technology-related argumentations.	Ziefle *et al.,* (2014)
Indicated that the higher a consumer's perception of the price of electric vehicles and the long charging times are, the less a consumer's willingness to buy a new electric car is .	Junquera *et al.,* (2016)
Showed that frequent car use, climate awareness, fuel economy, range, reservation price are EVs use effective factors.	Bigerna and Micheli (2018)
Showed the effect of fuel type and operation method, availability of charging facilities, fuel cost and vehicle price on EVs choice	Choi *et al.,* (2018)
Stated EVs' effective factors can be classified as command and control, economic (direct investments in r&d or infrastructure, preferential pricing policies, subsidies for EV purchase or EV infrastructure construction and tax incentives for EVs), procurement, collaborative, communication, and diffusion	Leurent and Windisch (2011)
Showed that personal norms have a positive impact on the intention to adopt the EV, and such influence is moderated by external costs, including perceived price and perceived complexity. The former moderates it, while the latter has the effect of the nonlinear adjustment. Also, awareness of the consequences, the description of responsibility and perceived consumer effectiveness are positive predictors of personal norms	He and Zhan (2018)
Indicated that some prople are unfamiliar with the concept of net cost and the long-term benefit of EVs.	Gillingham *et al*., (2009); Allcott and Greenstone, (2012); Gillingham and Palmer, (2013)
Stated that some believe that car consumers prefer novel technology to traditional technology so they use EVs	Arning *et al*., (2013); Joffe, (2003)
Showed the geographical characteristics such as age, education, and gender are proved the affect EVs acceptance	Wilkowska and Ziefle, (2013); Carley *et al.,* (2013)
The effect of vehicle confidence or environmental attitudes on electric car purchases was proven	Graham-Rowe *et al.,* (2012), Daziano and Bolduc (2011) and Turcksin *et al*.,(2013)
In a research determined that middle-aged women are far more likely to use electric vehicles than men and young people. Also, being aware of the benefits and how to use this type of vehicle can affect their tendency to use this type of vehicle.	Kumar and Kumar (2020)
Showed the complexity/ease of, trialability. observability and social norm effect on EVs acceptance	Dütschke *et al.,* (2013)
Believed that when consumers believe that electric vehicles are more beneficial at the individual, environment or national level, or they believe that the usage of electric vehicles is simpler and more convenient, they will show a more positive attitude towards the purchase of EVs.	Tu and Yang (2019)

Continued Table 1: important previous studies about EVs acceptance

Found that ecological significance and individual preference affect EVs acceptance.	Adnan *et al.,* (2017)
Showd the effect of consumers'attitude, subjective norms, perceived behavioral control and personal moral norm on plugin hybrid electric vehicles adoption	Adnan *et al.,* (2018)
Showed the special skills needed for using the electric vehicle as novel technology are another factor that affects using EVs	Gaul and Ziefle, (2009); Melenhorst, *et al.,* (2006)
Stated social influence, perceived enjoyment, anxiety and facilitation condition affect EVs' intention to use.	Khazaei (2016)
Showed that the effect of perceived ease of use, perceived usefulness, perceived enjoyment, satisfaction, public attitude, perceived cost on EVs intention to use	Park *et al.,* (2018)
Indicated the effect of environmental concern, psychological benefit, infrastructure readiness, consumer knowledge, demographic on EVs intention to use	Sang and Bekhet (2015)
Stated that a major potential barrier to the widespread adoption of EVs is the uncertainty regarding EV battery technology and fuel source sustainability	Egbue and Long (2012)
Showed the limited charging time of EVs is another factor that affects people's negative attitudes toward Evs	Jensen *et al*.; (2013); Krupa *et al.,* (2014)
Believed that the technical performance of EVs is an effective factor in consumers' acceptance of EVs	Ozaki and Sevastyanova (2011)
Showed that another factor that can affect EVs acceptance is perceived usefulness	Wilkowska *et al.,* 2014; Beul-Leusmann, *et al.*, 2014). Ziefle *et al.,* (2014)
Concluded that cruise range, purchase price, road tolls exemption, purchase tax exemption, tax exemption, parking fee exemption, insurance fee exemption, public charging fee exemption, purchase restriction rescission, driving restriction rescission, and access to bus lanes affect electric vehicle acceptance.	Wang *et al.,* (2017)
Investigate the role of 7 different incentives including exemption from purchase tax, exemption from VAT, vehicle license fee reduction, exemption from road tolling, free parking, bus lane access and free ferry tickets on battery electric vehicles.	Bjerkan *et al.,* (2016)
Stated that a regulatory framework can affect EVs using.	Haddadian *et al.,* (2015)
Showed the government role in EVs purchasing	Lane and Potter (2007)
Showd the environmental protection awareness effect on EVs acceptance	Hidrue *et al*., (2011); Tian (2012) and Plötz *et al.* (2014)
Studied the technical level, marketing, perceived risks, and environmental awareness are the most effective factors in public acceptance of EVs.	Wang *et al.,*(2019)
Stated that besides supportive national policies, skillful marketing is needed to get it accepted and diffused throughout society.	Gärling and Thøgersen (2001)
Stated that without the advantage of increased gasoline prices, the growth of the hybrid vehicles market is insignificant, and that the Internet has a significant influence on the word of mouth effect in the purchasing process.	Choi *et al.,(2013)*

the world (technological, economic, marketing, rules, individual, accessibility).

Despite the high level of air pollution in Iran, the popularity of electric vehicles as an important way to reduce air pollution is very low and electric vehicles are rarely seen on the streets. This paper is structured as follows. It opens with a general discussion of EVs and the factors which can affect their acceptance and then followed by the conceptual model, the methodology and the analysis of empirical findings. Finally, the paper outlines the conclusions. The current study has been carried out in Tehran in 2020.

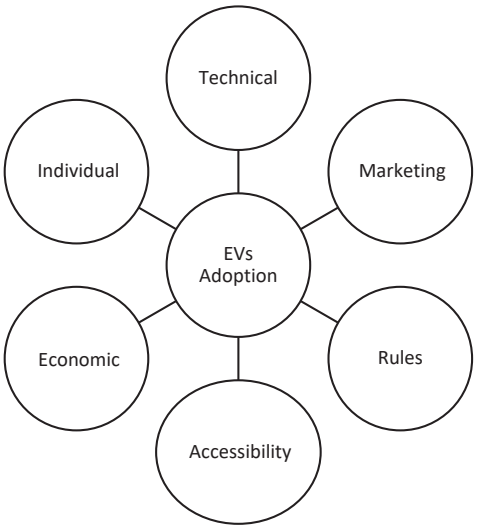


Fig. 1: Conceptual model

MATERIALS AND METHODS

Although many studies about the prioritization of factors affecting a particular issue and its evaluation have been applied in the AHP, studying the factors influencing the acceptance of electric vehicles needs to have a way beyond the hierarchical relations. The hierarchy network can show top-down linear connections and is weak in showing dependency or subordination and complex direct or indirect relationships. Since the use of AHP to prioritize the factors of electric vehicle selection is limited, we intend to use the ANP method in prioritizing the factors influencing the acceptance of electric vehicles, because it considers the factors and the relationship between them. The ANP method can identify intangible interdependencies and the relationship between factors, subfactors, and alternatives. It is possible that some elements of a cluster may affect one or all of the other cluster elements. The reasons for using the ANP method are as follows:

1- Prioritizing the factors affecting the acceptance of electric vehicles is a multi-criteria decision problem.
2- Dependence on network elements, in which each element affects another
3- It is difficult to achieve the relative importance of some criteria using the simple weighting method (Agarwal *et al.*, 2006)

The advantage of using the ANP in factor prioritization is to show the effect of factors on each other in which each factor can interact with other clusters (i.e., factors) and their sub-factors. In addition, sub-factors of each factor can influence other factors. The ANP method requires the use of a pairwise comparison matrix (Hosseini *et al.*, 2013). This complex and sensitive pairwise comparison is performed by a skilled team of experts. The opinion of some experts about the pairwise comparison is presented in this article and the mean of this collation is calculated according to their opinions. The ANP can be used to find the best strategy. AHP / ANP reduces a multidimensional problem to a one-dimensional problem (Saaty and Sodenkamp, 2008). Like AHP, in ANP the main logic is based on pairwise comparisons. However, this pairwise comparison matrix in ANP is more complex than that in the AHP. In ANP, to complete the super matrix, we need to consider the relationship between factors / sub-factors and the relationship between sub-factors in one cluster to sub-factors in another cluster. Then a pairwise comparison must be made between the network elements, which is different from the AHP network comparison (Hosseini *et al.*, 2013). To find the matrix priority and calculate the consistency ratio (CR), SuperDecision is used software. Based on the literature about the factors affecting EVs adoption, EVs adoption factors are classified as technical, marketing, rules, access, economic, individual factors. Fig. 1 shows the research model and Table 2 shows the criteria and sub-criteria with their codes.

Table 2: EVs adoption effective factors coding

Code	Criteria	Code	Sub-Criteria
C1	Technical	S1	Charging time
		S2	Parts availability
		S3	Vehicle appearance
		S4	Depreciation time
		S5	Technology development
		S6	Competitiveness
		S7	Production run
		S8	After-sales service
		S9	Accessory supply
		S10	Product variety
		S11	Safety assurance
C2	Marketing	S12	Advertising
		S13	Producer country reputation
		S14	Branding
C3	Rules	S15	Tax deficit
		S16	Purchase facility
		S17	Fuel subsidy
		S18	Import license
C4	Accessibility	S19	Information on how to use it
		S20	Access to fuel station
		S21	Ability to charge at home
		S22	Availability of repair shop
C5	Economic	S23	Car price
		S24	Fuel price
		S25	Repair cost
		S26	Accessory cost
		S27	Insurance cost
		S28	Amortization cost
C6	Individual	S29	Importance to the environment
		S30	Gender
		S31	Education
		S32	Age
		S33	Community acceptance

The statistical sample includes automotive industry experts with a minimum bachelor's degree, more than 5 years of work experience and organizational position of management and academic experts in industrial engineering with an associate degree. Based on the purposive sampling the total numbers of 40 experts were selected as sample. An analytic network process questionnaire was designed according to purposes, criteria, sub-criteria, and intervention effect of each criterion. The ANP is a broad form of AHP that considers the relationship of factors to each other, the effect of each element on other criteria, and independency between and within levels. The steps for using the ANP method are as follows (Yuksel and gdeviren, 2007; Lee, 2012):

Step 1: determining the importance value of factors, based on **6** elements (technical, marketing, rules, accessibility, economic, individual). This step is the common part between AHP and ANP for pairwise comparison and priority vectors.

Step 2: determining the magnitude of subfactors (e.g., Charging time, Parts availability, Vehicle appearance, and Depreciation time) should be done as the second stage. For comparing the elements in each cluster, scales in discrete interval {1-9} are chosen (Saaty and Sodenkamp, 2008). Scale 9 shows the extremely preference of an element in comparison with others and scale 1 shows the same preference of the elements, in which aij indicates the importance of the ith element with respect to the jthe element (Lee, 2012). After designing the questionnaire, it was completed by the selected population sample based on the numerical values in Table 3.

Step 3: Calculating the super matrix partitioned based on the cluster (factors) and Its elements are

Table 3: Numeral values for items comparison

Numeral value	Degree of importance in pairwise comparison
1	Same preference
2	Same to fairly preferred
3	Fairly preferred
4	Fairly to strongly preferred
5	Strongly preferred
6	Strongly preferred to very strong preferred
7	Very strong preferred
8	Very strong to extremely preferred
9	Extremely preferred

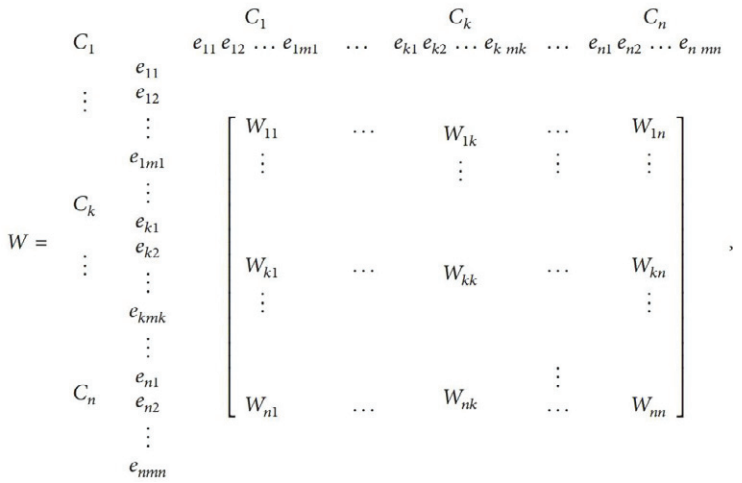


Fig. 2: super matrix partitioned based on the cluster (factors)

taken from a pairwise comparison.The super matrix which consists of N clusters is displayed as follows. where Ck is the kth cluster (k = 1, 2, . . . , n) and each cluster K consists of mK items showd by $ek1$, $ek2$,...,$ekmk$. Each column of Wij is the priority vector acquired from the identical pairwise comparison, indicating the preference of the elements in the ith cluster with respect to an element in the jth cluster (Lee, 2012).

Step 4. The calculation of the weight of the super matrix by multiplying this matrix by the priority of the factors should be done as the final step. Then, the limited super matrix is obtained by increasing a weighted super matrix to power. As a result, we have some fixed numbers to find an alternative as a solution.

Application of the ANP methodology in prioritization of EVs adoption factors

The general information about the characteristics of respondents, including their age, gender, work experience are shown in Table 4. the majority of respondents were male (34), between 40-50 years old (17), and have greater than 15 years of work experience (19).

Interdependency between EVs adoption factors is shown by analyzing the impact of each factor on the other factors based on literature review. Using the analysis of internal and external conditions of the organization, the dependency between EVs adoption factors which the questionnaire was designed based on them, are shown in Fig. 3. The reliability of the questionnaire was assessed using the inconsistency index and if this index is below 0.1, the questionnaire is reliable. The validity of the questionnaire was assessed using the CVR index and because this index is higher than 0.29 (the valid number in the sample population of 40 people), it can be said the questionnaire is valid. After designing the questionnaire, it was completed by the selected

Table 4: Sample demographic characteristics

Demographic profile	Category	Frequency	Frequency Percent
Gender	Male	34	85%
	Female	6	15%
Age	<30	3	8%
	30-40	5	13%
	40-50	17	43%
	>50	15	38%
Experience	5-10	6	15%
	10--15	15	38%
	>15	19	48%

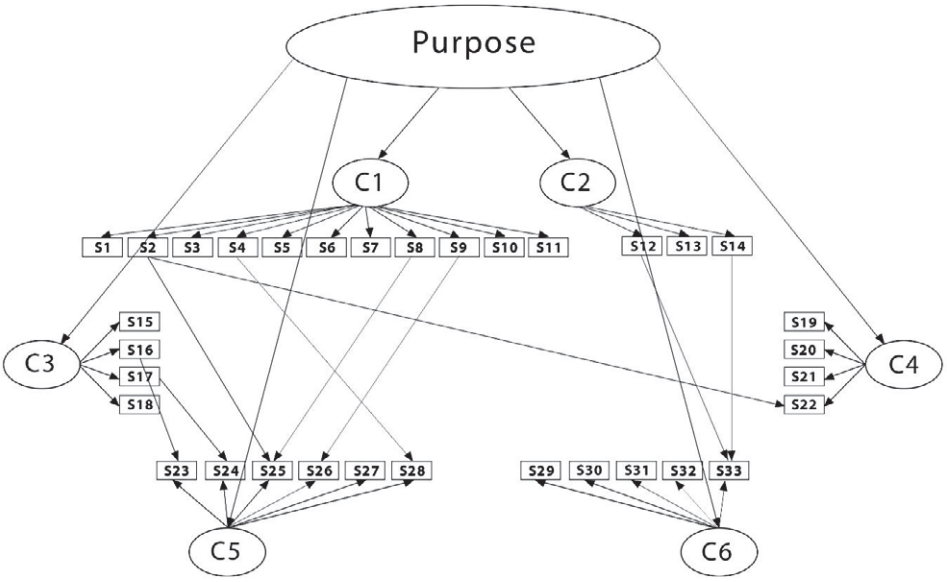


Fig. 3: The relationships between criteria and sub-criteria (ANP structure)

population sample based on the numerical values in Table 3. After data gathering, the data analysis was done using SuperDecision software. To implement the ANP analysis, the main criteria, the sub-criteria of each criterion, the sub-criteria that are intrinsically linked to each other, and the main criteria by controlling the effect of each criterion must be compared together. The result of each comparison and the weight of each criterion and sub-criteria are shown below. Results of calculation of compatibility of criteria and sub-criteria indicated that incompatibility was less than 0.1 in all cases, and thus the prioritization of pairwise comparison of matrices was acceptable, and consistency of responses was confirmed; hence, the assigned coefficients were reliable and paired comparisons could be obtained.

RESULTS AND DISSCUSION

Based on the results shown in Table 5, the economic factors are the most important criteria in comparison with the purpose

Based on the results shown in Table 6 the depreciation time is the most important technical factor which can affect EVs adoption.

Table 5: Pairwise comparison matrix of main criteria in comparison with the purpose.

	C1	C2	C3	C4	C5	C6	Normalized	Idealized
C1	1.000	1.600	1.190	1.200	0.614	1.230	0.178	0.775
C2	0.625	1.000	1.450	0.610	0.671	1.530	0.151	0.658
C3	0.840	0.690	1.000	1.210	0.658	1.470	0.153	0.666
C4	0.833	1.640	0.826	1.000	0.658	1.360	0.164	0.714
C5	1.628	1.490	1.520	1.520	1.000	1.470	0.230	1.000
C6	0.813	0.654	0.680	0.735	0.680	1.000	0.122	0.531
Inconsistency				0.019				

Table 6: Pairwise comparison matrix of technical sub-criteria

	S1	S2	S3	S4	S5	S6	S7	S8	S9	S10	S11	Inconsistency
S1	1.000	0.725	0.787	0.840	0.794	1.620	0.847	0.820	0.870	0.926	1.786	
S2	1.380	1.000	0.694	0.855	0.847	1.230	0.847	0.794	0.752	0.709	0.877	
S3	1.270	1.440	1.000	0.840	1.610	0.775	0.621	0.752	1.695	0.613	1.176	
S4	1.190	1.170	1.190	1.000	0.685	0.637	0.752	0.877	0.79	0.794	0.813	
S5	1.260	1.180	0.621	1.460	1.000	0.877	0.763	0.752	0.952	0.901	0.877	
S6	0.617	0.813	1.290	1.570	1.140	1.000	0.877	0.79	0.794	0.741	0.752	
S7	1.180	1.180	1.610	1.330	1.310	1.140	1.000	0.694	0.658	1.176	0.794	0.021
S8	1.220	1.260	1.330	1.140	1.330	1.410	1.440	1.000	0.901	0.794	0.877	
S9	1.150	1.330	0.590	1.410	1.050	1.260	1.520	1.110	1.000	0.709	1.351	
S10	1.080	1.410	1.630	1.260	1.110	1.350	0.850	1.260	1.410	1.000	0.813	
S11	0.560	1.140	0.850	1.230	1.140	1.330	1.260	1.140	0.740	1.230	1.000	
Normalized	0.1	0.1	0.09	0.1	0.1	0.1	0.09	0.08	0.08	0.08	0.09	
Idealized	0.92	0.97	0.89	1	0.92	0.97	0.82	0.76	0.81	0.74	0.86	

Based on the results shown in Table 7 the producer company reputation is the most important marketing factor which can affect EVs adoption.

Based on the results shown in Table 8 the fuel subsidy is the most important rules factor which can affect EVs adoption.

Based on the results shown in Table 9 the availability of a repair shop is the most important

Table 7: Pairwise comparison matrix of marketing sub-criteria

	S12	S13	S14	Normalized	Idealized
S12	1.000	0.901	1.150	0.334	0.846
S13	1.110	1.000	1.540	0.394	1.000
S14	0.870	0.649	1.000	0.272	0.691
Inconsistency			0.004		

Table 8: Pairwise comparison matrix of rules sub-criteria

	S15	S16	S17	S18	Normalized	Idealized
S15	1.000	1.180	1.360	0.690	0.258	0.870
S16	0.847	1.000	0.552	1.160	0.209	0.703
S17	0.735	1.810	1.000	1.550	0.297	1.000
S18	1.450	0.862	0.645	1.000	0.237	0.798
Inconsistency			0.056			

Table 9: Pairwise comparison matrix of accessibility sub-criteria

	S19	S20	S21	S22	Normalized	Idealized
S19	1.000	1.270	1.350	1.180	0.292	0.927
S20	0.787	1.000	1.290	0.543	0.210	0.668
S21	0.741	0.775	1.000	0.571	0.184	0.585
S22	0.847	1.840	1.750	1.000	0.314	1.000
Inconsistency			0.014			

Table 10: Pairwise comparison matrix of economic sub-criteria

	S23	S24	S25	S26	S27	S28	Normalized	Idealized
S23	1.000	1.160	1.650	1.810	1.280	1.230	0.219	1.000
S24	0.862	1.000	0.826	1.280	1.360	1.350	0.178	0.810
S25	0.606	1.210	1.000	0.570	1.210	1.220	0.152	0.691
S26	0.552	0.781	1.754	1.000	1.590	1.580	0.185	0.843
S27	0.781	0.735	0.826	0.629	1.000	1.250	0.137	0.626
S28	0.813	0.741	0.820	0.633	0.800	1.000	0.129	0.588
Inconsistency				0.021				

accessibility factor which can affect EVs adoption.

Based on the results shown in Table 10 the car price is the most important economic factor which can affect EVs adoption.

Based on the results shown in Table 11 the importance of the environment is the most important individual factor which can affect EVs adoption. So it can be concluded that the contributed factors which

Table 11: Pairwise comparison matrix of individual sub-criteria

	S29	S30	S31	S32	S33	Normalized	Idealized
S29	1.000	1.410	1.360	1.220	1.290	0.246	1.000
S30	0.709	1.000	1.110	1.170	1.200	0.201	0.819
S31	0.735	0.901	1.000	1.190	0.685	0.176	0.717
S32	0.820	0.855	0.840	1.000	1.260	0.188	0.763
S33	0.775	0.833	1.460	0.794	1.000	0.189	0.768
Inconsistency				0.012			

affect EVs adoption in order of priority are:
1. Economic: 23.0%
2. Technical: 17.8%
3. Accessibility: 16.4%
4. Rules: 15.3%
5. Marketing: 15.1%
6. Individual: 12.2%

In this research the results of previous researches were collected together and were generally placed in 6 categories. For example, Bjerkan *et al.,* (2016), named purchase tax as one of these factors and in another study, Huang and Qian (2018), cited operational cost as an influential factor. The results in this research showed that economic factors had the most significant effect in comparison with other criteria. depreciation time, producer company, fuel subsidy, availability of repair shop, car and importance to the environment were the most significant factor in each criteria. According to Egbue and Long (2012), the major potential barrier to the widespread adoption of EVs is the uncertainty regarding EV battery technology and fuel source sustainability (technical and individual factors). Although based on this research, economic factors are the major barriers to acceptance of EVs for Iraninan people. Lane and Potter (2007), stated that government rules has the major effect on people's electric cars acceptance. It seems that government policies in EVs has also the major effect in Iran. Because government rules can effect on other factors, such as accessibility and economic and make a better circumstances for EVs acceptance. Arning *et al.,* (2013) in their studies on customer acceptance and behavior towards new products, and Joffe (2003) in examining the risks associated with new products, concluded that the general public is more interested in new and up-to-date technologies than traditional products. In these studies, researchers showed the tendency of people to use electric cars and indicated people tendency in the direction of modern technologies; In the continuation of these researches, it is showed what factors determine the degree of this tendency and what is the role of each of these factors in this choice. In one of the researches in the field of electric vehicles, Tu and Yang (2019) had studied the benefits of using electric vehicles and has explored them in individual, environmental or national level. In general, the benefits of using electric vehicles in that research are examined and the benefits of using electric vehicles have been investigated in the study. These factors motivate people to buy electric cars. However, what factors and how much affect the purchase of these cars is something that was addressed in this study regarding Iran, so that by recognizing these factors and working on them, it can be provided the basis for more use of these cars for sustainable development.

CONCLUSION

The world is going through important issues such as energy shortages, air pollution, and Greenhouse Gases (GHGs) emissions. Electric vehicles, which use internal and electric combustion engines for propulsion purposes, appear to be a very promising prospect. Despite the importance of EVs in pollution reduction, in Iran, people are not interested in buying these types of vehicles. Therefore, in the current study the factors affecting the acceptance of electric vehicles by consumers of vehicles have been identified and priorized. To this end, factors influencing the acceptance of electric vehicles were identified by reviewing the literature. Then, the identified factors were prioritized using the ANP

technique. In general, six criteria and thirty-three sub-criteria were compared. those 6 criteria, based on priority in percentage, are: Economic (23.0%), Technical (17.8%), Accessibility (16.4%), Rules (15.3%), Marketing (15.1%), Individual (12.2%). According to the results, the policies implemented by the government in the acceptance of electric vehicles are in the fourth place influencing this issue. But the important point is that in Iran, government policies affect 5 other factors (especially economic factors) and it can be said that government policies play a key role in the adoption of electric vehicles. However, due to the fundamental role of domestic automakers in the country's economy, the government has not been able or unwilling to adjust policies for the use of electric vehicles in the Iranian economy (This also applies to the import of foreign cars into Iran). For example, because domestic automakers, auto parts makers, and auto-related industries have taken over a large chain of the country's economy, implementing any changes that hurt domestic automakers could provide an introduction to the emergence of other economic problems. Also because the government has not provided the necessary infrastructure in this area, carmakers do not have the necessary technology and knowledge, and therefore the cost is high and consequently car prices have risen, and because in Iran, the economy is the most important factor in acceptance of Electric cars, it is beyond the economic power of the people to buy such cars. Therefore, it seems that, at present, the best way to adjust the government's policies in the field of accepting electric vehicles is to strengthen domestic automakers in order to launch an electric vehicle production line to minimize any side effects of accepting electric vehicles and consequently reducing the use of traditional vehicles, or to neutralize each other at best. Also, the technology implemented by car manufacturers, in addition to maintaining the quality compared to traditional cars, must also have a reasonable price, so that people can buy these cars, or in other words, prefer to buy electric cars to traditional cars. This is also true in terms of accessibility, because the more appropriate the government's policies on access to electric vehicle services, the more motivated people would be. In addition, attracting foreign capital and the entry of the private sector into the industry can be one of the solutions to this problem, because with the launch of the domestic industry and the beginning of competition between industries at the national level, not only production standards increase but also its impact on the country's economy will be considered.

AUTHOR CONTRIBUTIONS

Kh. Eshtiaghi performed the literature review, experimental design, analyzed and interpreted the data, prepared the manuscript text, and manuscript edition. M. Aliyanezhadi performed the literature review and manuscript preparation. A. Najafian performed the literature review and manuscript preparation.

ACKNOWLEDGMENT

This study was completely self-funded. The authos would like to extent their appreciation to thoes who had assisted in the data collection process as well as the anonymous reviewers whose judgements helped to advance and promot the scienntific level of this research.

CONFLICT OF INTEREST

The authors declare that there is no conflict of interest regarding the publication of this manuscript. In addition, the ethical issues, including plagiarism, informed consent, misconduct, data fabrication and/or falsification, double publication and/or submission, and redundancy has been completely observed by the authors

ABBREVIATIONS

ANP	Analytic Network Process
CO2	Carbon dioxide
CVR	Content validity ratio
Evs	Electric vehicles
GHG	Greenhouse gas
VAT	Value-added tax

REFERENCE

Adnan, N.; Nordin, S.M.; Amini, M. H.; Langove, N., (2018). What make consumer sign up to PHEVs? Predicting Malaysian consumer behavior in adoption of PHEVs. Transp. Res. Part A: Policy Pract., 113: 259-278 (**20 pages**).

Adnan, N.; Nordin, S.M.; Rahman, I.; Vasant, P.M.; Noor, A., (2017). A comprehensive review on theoretical framework-based electric vehicle consumer adoption research. Int. J. Res., 41(3): 317-335 (**19 pages**).

Agarwal, A.; Shankar, R.; Tiwari, M.K., (2006). Modeling the metrics

of lean, agile and leagile supply chain: An ANP-based approach. Eur. J. Oper. Res. 173(1): 211-225 (**15 Pages**).

Allcott, H.; Greenstone, M., (2012). Is there an energy efficiency gap?. JEP., 26(1): 3-28 (**26 pages**).

Arning, K.; Kowalewski, S.; Ziefle, M., (2014). Health concerns versus mobile data needs: Conjoint measurement of preferences for mobile communication network scenarios. Hum. Ecol. Risk. Assess., 20(5): 1359-1384 (**26 pages**).

Beul-Leusmann, S.; Samsel, C.; Wiederhold, M.; Krempels, K.H.; Jakobs, E.M.; Ziefle, M., (2014, June). usability evaluation of mobile passenger information systems. In international conference of DUXU. 217-228 (**12 pages**).

Bigerna, S.; Micheli, S., (2018). Attitudes toward electric vehicles: The case of perugia using a fuzzy set analysis. Sustainability, 10(11): 3999.

Bjerkan, K.Y.; Nørbech, T.E.; Nordtømme, M.E., (2016). Incentives for promoting battery electric vehicle (BEV) adoption in Norway. Transp. Res. D. Transp. Environ., 43: 169-180 (**12 pages**).

Carley, S.; Krause, R.M.; Lane, B.W.; Graham, J.D., (2013). Intent to purchase a plug-in electric vehicle: A survey of early impressions in large US cites. Transp. Res. D. Transp. Environ., 18: 39-45 (**7 pages**).

Choi, H.; Shin, J.; Woo, J., (2018). Effect of electricity generation mix on battery electric vehicle adoption and its environmental impact. Energy Policy, 121: 13-24 (**12 pages**).

Chapman, L., (2007). Transport and climate change: a review. J. Transport Geog., 15(5): 354-367 (**14 pages**).

Du, J.; Ouyang, D., (2017). Progress of Chinese electric vehicles industrialization in 2015: Rev. Appl. Energy, 188: 529-546 (**18 pages**).

Dütschke, E.; Schneider, U.; Peters, A., (2013). Who will use electric vehicles? (No. S6/2013). Working Paper Sustainability and Innovation.

Egbue, O.; Long, S., (2012). Barriers to widespread adoption of electric vehicles: An analysis of consumer attitudes and perceptions. Energy policy, 48: 717-729 (**13 pages**).

Franke, T.; Krems, J.F., (2013). Interacting with limited mobility resources: Psychological range levels in electric vehicle use. Transp. Res. Part A: Policy Pract., 48: 109-122 (**14 pages**).

Gärling, A.; Thøgersen, J., (2001). Marketing of electric vehicles. Bus. Strategy. Environ., 10(1): 53-65 (**13 pages**).

Gaul, S.; Ziefle, M., (2009), November. Smart home technologies: Insights into generation-specific acceptance motives. In Symposium of the Austrian HCI and usability engineering group. Springer, Berlin, Heidelberg. 312-332 (**21 pages**).

Gillingham, K.; Palmer, K., (2013). Bridging the energy efficiency gap: insights for policy from theory and empirical analysis. In RFF Discussion Paper 13-02.

Gillingham, K.; Newell, R.G.; Palmer, K., (2009). Energy efficiency economics and policy. Annu. Rev. Resour. Econ., 1(1): 597-620 (**24 pages**).

Graham-Rowe, E.; Gardner, B.; Abraham, C.; Skippon, S.; Dittmar, H.; Hutchins, R.; Stannard, J., (2012). Mainstream consumers driving plug-in battery-electric and plug-in hybrid electric cars: A qualitative analysis of responses and evaluations. Transp. Res. Part A: Policy Pract., 46(1): 140-153 (**14 pages**).

Haddadian, G.; Khodayar, M.; Shahidehpour, M., (2015). Accelerating the global adoption of electric ehicles: barriers and drivers. Electr. J., 28(10): 53-68 (**16 pages**).

He, X.; Zhan, W., (2018). How to activate moral norm to adopt electric vehicles in China? An empirical study based on extended norm activation theory. J. Clean. Prod., 172: 3546-3556 (**11 pages**).

Hidrue, M.K.; Parsons, G.R.; Kempton, W.; Gardner, M.P., (2011). Willingness to pay for electric vehicles and their attributes. Resour. Energy Econ., 33(3): 686-705 (**20 pages**).

Hosseini, L.; Tavakkoli-Moghaddam, R.; Vahdani, B.; Mousavi, S.M.; Kia, R., (2013). Using the Analytical Network Process to Select the Best Strategy for Reducing Risks in a Supply Chain. J. Eng., 2013(4)

Hsu, C.; Li, H.; Lu, S., (2013). A dynamic marketing model for hybrid electric vehicles: A case study of Taiwan. Transp. Res. D. Transp. Environ., 20: 21-29 (**9 pages**).

Huda, M.; Aziz, M.; Tokimatsu, K. (2019). The future of electric vehicles to grid integration in Indonesia. Energy Procedia, 158: 4592-4597 (**6 pages**).

Jensen, A.F.; Cherchi, E.; Mabit, S.L., (2013). On the stability of preferences and attitudes before and after experiencing an electric vehicle. Transp. Res. D. Transp. Environ., 25: 24-32 (**9 pages**).

Joffe, H., (2003). Risk: From perception to social representation. Br. J. Soc. Psychol., 42(1): 55-73 (**19 pages**).

Johansson, C.; Lövenheim, B.; Schantz, P.; Wahlgren, L.; Almström, P.; Markstedt, A.; Strömgren, M.; Forsberg, B.; Sommar, J.N., (2017). Impacts on air pollution and health by changing commuting from car to bicycle. Sci. Total Environ., 584: 55-63 (**9 pages**).

Junquera, B.; Moreno, B.; Álvarez, R., (2016). Analyzing consumer attitudes towards electric vehicle purchasing intentions in Spain: Technological limitations and vehicle confidence. Technol. Forcast. Soc. Cange., 109: 6-14 (**9 pages**).

Khalil, S.; Inam, Z., (2006). Is trade good for environment? A unit root cointegration analysis. Pak. Dev. Rev., 1187-1196 (**10 pages**).

Khazaei, H., (2016). Predictors of acceptance of electric cars in Malaysia: Moderating effects of driving experience and voluntariness of use. Eur. J. Innov. Manage., 1893 (**1 page**).

Khooban, M.H.; Niknam, T.; Sha-Sadeghi, M., (2016). Speed control of electrical vehicles: a time-varying proportional–integral controller-based type-2 fuzzy logic. IET Sci. Meas. Technol., 10(3): 185-192 (**8 pages**).

Krupa, J.S.; Rizzo, D.M.; Eppstein, M.J.; Lanute, D.B.; Gaalema, D.E.; Lakkaraju, K.; Warrender, C.E., (2014). Analysis of a consumer survey on plug-in hybrid electric vehicles. Transp. Res. Part A: Policy Pract., 64: 14-31 (**18 pages**).

Kumar, R.R.; Kumar, A., (2019). Adoption of electric vehicle: a literature review and prospects for sustainability. J. Clean. Prod., 119911 (**1 page**).

Lane, B.; Potter, S., (2007). The adoption of cleaner vehicles in the UK: exploring the consumer attitude–action gap. J. Clean. Prod., 15(11-12): 1085-1092 (**8 pages**).

Lee, H.; Kim, M., Park, Y., (2012). An analytic network process approach to operationalization of five force model. Appl. Math. Model., 36(4): (11-12): 1783-1795 (**13 pages**).

Leurent, F.; Windisch, E., (2011). Triggering the development of electric mobility: a review of public policies Eur. Transp. Res. Rev., 3(4): 221-235 (**15 pages**).

https://link.springer.com/article/10.1007/s12544-011-0064-3

Melenhorst, A.S.; Rogers, W.A.; Bouwhuis, D.G., (2006). Older adults' motivated choice for technological innovation: Evidence

for benefit-driven selectivity. Psychol Aging., 21(1): 190 (**1 page**).
Müller, D., Klingelhöfer, D., Uibel, S.; Groneberg, D.A., (2011). Car indoor air pollution- analysis of potential sourses. J. Occup. Med. Toxicol., 6: 33 (**1 page**).
Ozaki, R.; Sevastyanova, K., (2011). Going hybrid: An analysis of consumer purchase motivations. Energy policy, 39(5): 2217-2227 (**11 pages**).
Park, E.; Lim, J.; Cho, Y., (2018). Understanding the emergence and social acceptance of electric vehicles as next-generation models for the automobile industry. Sustainability, 10(3): 662 (**1 page**).
Plötz, P.; Schneider, U.; Globisch, J.; Dütschke, E., (2014). Who will buy electric vehicles? Identifying early adopters in Germany. Transp. Res. Part A: Policy Pract., 67: 96-109 (**14 pages**).
Saaty, T.L., (2004). Decision making-the Analytic Hierarchy and Network Processes (AHP/ANP). J. Syst. Sci. Syst. Eng., 13: 1-35 (**35 pages**).
Sang, Y.N.; Bekhet, H.A., (2015). Modelling electric vehicle usage intentions: an empirical study in Malaysia. J. Clean. Prod., 92: 75-83 (**9 pages**).
Song, C.H.; Aaldering, L.J., (2019). Strategic intentions to the diffusion of electric mobility paradigm: The case of internal combustion engine vehicle. J. Clean. Prod., 230: 898-909 (**12 p**ages).
Tamor, A.M.; Gearhart, H.; Soto, C., (2013). A statistical approach to estimating acceptance of electric vehicles and electrification of personal transportation. Transp. Res. Part C Emerg. Technol., 26: 125-134 (**10 pages**).
Tian, W.; He, J.; Jiang, J.; Niu, L.; Wang, X., (2012). Multi-objective optimization of charging dispatching for electric vehicle battery swapping station based on adaptive mutation particle swarm optimization. Power Syst. Technol., 36(11): 25-29 (**5 pages**).
Tu, J.C.; Yang, C., (2019). Key factors influencing consumers' purchase of electric vehicles. Sustainability, 11(14): 3863 (**1 page**).
Turcksin, L.; Mairesse, O.; Macharis, C.; Mierlo, J.V., (2013). Encouraging environmentally friendlier cars via fiscal measures: General methodology and application to Belgium. Energies, 6(1): 471-491 (**21 pages**).
Wang, N.; Tang, L.; Pan, H., (2017). Effectiveness of policy incentives on electric vehicle acceptance in China: A discrete choice analysis. Transp. Res. Part A: Policy Pract., 105: 210-218 (**9 pages**).
Wang, N.; Tang, L.; Pan, H., (2019). A global comparison and assessment of incentive policy on electric vehicle promotion. Sustain. Cities Soc., 44: 597-603 (**7 pages**).
Wilkowska, W.; Ziefle, M., (2013). User diversity as a challenge for the integration of medical technology into future smart home environments. In user-driven healthcare: Concepts, methodologies, tools, and applications. IGI Global, 553-582 (**29 pages**).
Wilkowska, W.; Farrokhikhiavi, R.; Ziefle, M.; Vallée, D., (2014). Mobility requirements for the use of carpooling among different user groups. In proceedings of the 5th AHFE conference 19(23): 129-140 (**12 pages**).
Yuksel, I.; Dag, M., (2007). Using the analytic network process (ANP) in a SWOT analysis-A case study for a textile firm. Inf. Sci., 16: 3364-3382 (**19 pages**).
Ziefle, M.; Beul-Leusmann, S.; Kasugai, K.; Schwalm, M., (2014). Public perception and acceptance of electric vehicles: exploring users' perceived benefits and drawbacks. In international conference of design, user experience, and usability Springer, Cham, 628-639 (**12 pages**).

HOW TO CITE THIS ARTICLE

Eshtiaghi, Kh.; Aliyannezhadi, M.; Najafian, A.H., (2021). Identification and prioritization of factors affecting the adoption of electric vehicles using analytic network process. Int. J. Hum. Capital Urban Manage., 6(3): 323-336.

DOI: 10.22034/IJHCUM.2021.03.09

url: http://www.ijhcum.net/article_241935.html

Int. J. Hum. Capital Urban Manage., 6(3): 337-350, Summer 2021

International Journal of Human Capital in Urban Management
(IJHCUM)

Homepage: http://www.ijhcum.net/

CASE STUDY

The Impact of Legal Frameworks on Bidding Mechanisms

H. Raghfar[1], A. Taklif[2], S. Shahhosseini[3,*], A. Ghasemi[4], A. Faridzad[4]

[1] *Department of Economics, Alzahra University, Tehran, Iran*

[2] *Department of Energy, Agricultural and Environmental Economics, Allameh Tabataba'i University, Tehran, Iran*

[3] *Department of Economics, Allameh Tabataba'i University, Tehran, Iran*

[4] *Department of Energy, Agricultural and Environmental Economics, Allameh Tabataba'i University, Tehran, Iran*

ARTICLE INFO

Article History:
Received 28 October 2020
Revised 17 January 2021
Accepted 09 February 2021

Keywords:
Auctions
Competitive Bidding
First Price Sealed Bid Auction (FPSBA)
Mechanism Design
Optimal Auction Design

ABSTRACT

BACKGROUND AND OBJECTIVES: The long-term nature and capitalization of projects as well as the risks of the country's economic environment have made the provision of proper infrastructure as a permanent problem for national and local governments. Governments prefer to outsource the development and exploitation of capital assets to the private sector due to several reasons. In this matter, government institutions, due to their weaknesses in both technology and financing, are willing to create some optimal policy frameworks to utilize financial instruments to encourage private sector participation, as well as increase the share of revenues from the urban projects.The aim of this paper is to use the auction theory to improve the current mechanisms of public asset allocation.

METHODS: This paper investigated the legal framework to design an allocation mechanism for the public assets using a qualitative approach. This qualitative method is based on the case study. This paper works on a series of library studies in order to analyze and familiarize with the problems, shortcomings, and inadequacies in the allocation of public assets exploitation plans in the Municipality of Tehran.

FINDINGS: The obtained results indicate that the current rule can be improved in terms of choosing the process holding model, bidding criteria, and focusing on sharing future revenues in order to strengthen both the optimality and efficiency of outputs.

CONCLUSION: This paper proposed the bidding mechanisms that can be employed based on the current rules. After determining the qualifications of the contractors, a two-step model can be utilized to provide the set of assets. The mechanism of holding bidding was provided based on the results of previous researches as well as the features of the current rule in the form of two stages of price detection and the First Price Sealed Bid Auction mechanism.

DOI: 10.22034/IJHCUM.2021.03.10

NUMBER OF REFERENCES	NUMBER OF FIGURES	NUMBER OF TABLES
56	4	2

*Corresponding Author:
Email: *shahhosseini.rpc@gmail.com*
Phone: +989123270181
Fax: +982122392090

Note: Discussion period for this manuscript open until October 1, 2021 on IJHCUM website at the "Show Article.

INTRODUCTION

Governments prefer to outsource the development and exploitation of capital assets to the private sector due to several reasons including insufficient financial resources, the lack of access to appropriate technologies, future uncertainties about infrastructure projects, and the exploitation of public resources. The utilization of administrative processes to allocate the resource exploitation rights is economically inefficient due to the restrictions of governments' financial and technical capacity to assess the work plans, leading to a loss of potential resource rents (Sunnevåg, 2000). In this way, recently, auctioning as a competitive allocation tool has become one of the most widely used models to allocate public assets to the private sector (Bulow *et al.,* 2009). An auction is used to sell a resource that is then developed by the winning buyer to generate a profit (Abhishek *et al.,* 2013). Utilizing the auctions to allocate the exploitation rights of public assets as a solution to the current situation, the use of negotiation is proposed in terms of domestic and international contractors. Auction and negotiation are known as both market mechanisms in the transaction of goods and services. The formal comparison between mechanisms in the economic literature is conducted based on the principles of rationality as well as the individual interests of the players, which is limited to real situations and takes an empirical form. Indeed, it is impossible to investigate and choose a preferred mechanism outside the framework without regard to three dimensions of the product, participants, and market (Bajari *et al.*, 2008). Traditionally, from the auctioneer's point of view, the auction excludes the negotiator from the selection range because of the economic return, although the inability to optimally define the product or process can lead to the opposite result. As such, the content of the application of mechanisms is the main determinant in the investigation and comparison environment of the performance of mechanisms (Wu and Kersten, 2014). In this regard, the allocation of exploitation rights of the capital asset through competitive mechanisms, in addition to increasing revenue for the government, it decreases to some extent the inefficiencies of the auctioneer (government) due to information asymmetry because of information disclosure. Overall, utilizing the auction theory to allocate the exploitation of the public asset to increase competition and encouraging private sector participation can strengthen the allocation outputs in both dimensions of both efficiency and optimality. To allocate the exploitation rights of the asset, entering the Contingent Payment (CP) of auctioned assets, the issue of the related Moral Hazard (MH), the characteristics of large contracts, the complexities of the economic environment, and how assets are assigned in the allocation of asset exploitation rights, creates an analytical gap compared to other economic goods and classical literature. Obviously, risk coverage and project uncertainty can restrict the optimal policies and affect the strategic behaviors of players. Organizations should try to produce and offer more of their customers' desired product or service with all the features they want, and to continuously provide new competitive advantages with a new combination of available resources (Hosseini *et al.,* 2020). In this paper, the problem of designing an appropriate mechanism to allocate the asset exploitation, with the approach of game theory and strategic behaviors of players, is conducted using a qualitative research method. The complexity of applying auction theory in the country's market, in addition to legal challenges, may also encounter some challenges in two ways. There are few research studies conducted on the use of theory in Non-Concessionary Allocation Systems (NCAS). Moreover, the analysis gap is intensified due to the difficulties of inferring and predicting the outputs of the designed and alternative models. So far, the issue of using auction theory tools in the allocation of public assets has focused on the first Price Sealed Bid Auction. The present paper focuses on the study of legal capacities in the use of combined auction mechanisms and the extraction of a new model of price discovery with the approach of improving efficiency and optimization. Combined patterns in auction theory can cover the shortcomings of classical patterns and offer greater efficiency and optimization than conventional negotiation methods. This paper presents a composite model based on the existing challenges of allocating public assets with respect to the limitations of the current law in municipalities.

Research background

The generation and exploitation of public assets encompass a level of risk and uncertainty due to the inflationary environment of the country, long-

term characteristics of contracts and investment. Traditionally, the execution of government projects on a linear sequence with an emphasis on the bidding processes is usually focused to ensure transparency and responsiveness (Lam and Yang, 2020). As a result, designing a legal framework that can encourage players with appropriate technical and financial capabilities to manage and invest in participation, is known as the objective of policymakers. Nevertheless, holding auctions to choose the appropriate allocation model for assets as well as to predict their outputs is a complex and controversial mission (Brasil and Postali, 2014). The first step to designing an appropriate allocation process is to identify the nature of the markets. Creating a complete differentiation between markets may not be complete. Overall, four types of Dynamic Pricing (DP) are conceivable for each type of allocation: transaction, auction, bargaining and negotiation, and administrative allocation processes (Wyld, 2001). Recently, the auction theory to arrange the transactions and allocations in the real world has also been paid attention to. For instance, one can mention employing the theory in the allocation of Radio Spectrum Auctions (Rothkopf *et al.,* 1998), transportation auctions (Ledyard *et al.,* 2002), resource exploitation rights auctions (Cramton, 2010), and public asset allocation (Janssen, 2004). Conceptually, auction refers to any transaction or allocation, in which the final price in the allocation and equipment of goods, services, and asset utilization, is determined based on the competitive bidding by market players. Auction theory, in addition to being able to state current sales methods in the real market of the economy, can also describe the normative frameworks regarding the performance of the market institution (Samuelson, 2014). Theory as a tool for market price detection as well as an application of Arrow–Debreu value theory (Geanakoplos, 1989) in the general equilibrium theory is assumed to not explicitly address how prices are discovered, based on which it provides an alternative tool in the dynamic formation of prices by the market conditions. In this regard, several studies such as Klemperer (1999) and Milgrom (2004) surveyed the evolution and main features of the theory in previous research findings. In terms of functional design, it designs rules (i.e. mechanisms) in order to determine how to disclose information between players as well as to specify the conditions for information exchanging based on the disclosed information (Talluri and Van Ryzin, 2006). Classification of holding models can take the form of an auction-based on some possible and different aspects of the auction. Based on the economic literature to call such holding models, a complete verbal sharing is not recognizable. Undoubtedly, recognizing the divisions on these auction models can be separated, can be more practical than terminology (Maasland, 2012). In terms of design, the auctioneer of the auction may encounter with dual choices to shape the auction process, which are summarized in Fig. 1.

In the simplest form possible, the auctioneer should decide on the following dualities:

- Choosing between conducting an auction process for one or more assets simultaneously,
- Choosing between the bidding single-criteria or multi-criteria model,
- Choosing between the bidding one-way or two-way (both the auctioneer or auctioneers announce the offers, and also the bidder such as simultaneous buying and selling)
- Choosing between an open bidding model, in which all players can see and then modify their bids, or a sealed package that reveals only the market signs of some information.
- Ascending or descending pricing method
- Choosing the winner agent payment based on the submitted bid or the bid of the *n*th player in the bid ranking.

According to these choices, the classic four-mode bidding of English, Dutch, sealed package based on the best did, and sealed package based on the *n*th bid of player are identified, based on which under some certain assumptions, they can generate the Revenue Equivalence for the auctioneer. Although this assumption has little application in the real world, one of the main applications of the revenue equivalence theorem as a criterion model is to analyze those cases that the assumptions of the theorem are not assumed to be fixed (Milgrom, 2004).

Here, it should be noted that the characteristics to allocate the exploitation rights of assets can restrict the use of classical models. Some of the characteristics affecting the allocation of these rights are as follows:

1. Uncertainty arising from business and non-business risks, in addition to strategic behaviors, affects the allocation models due to bidding time

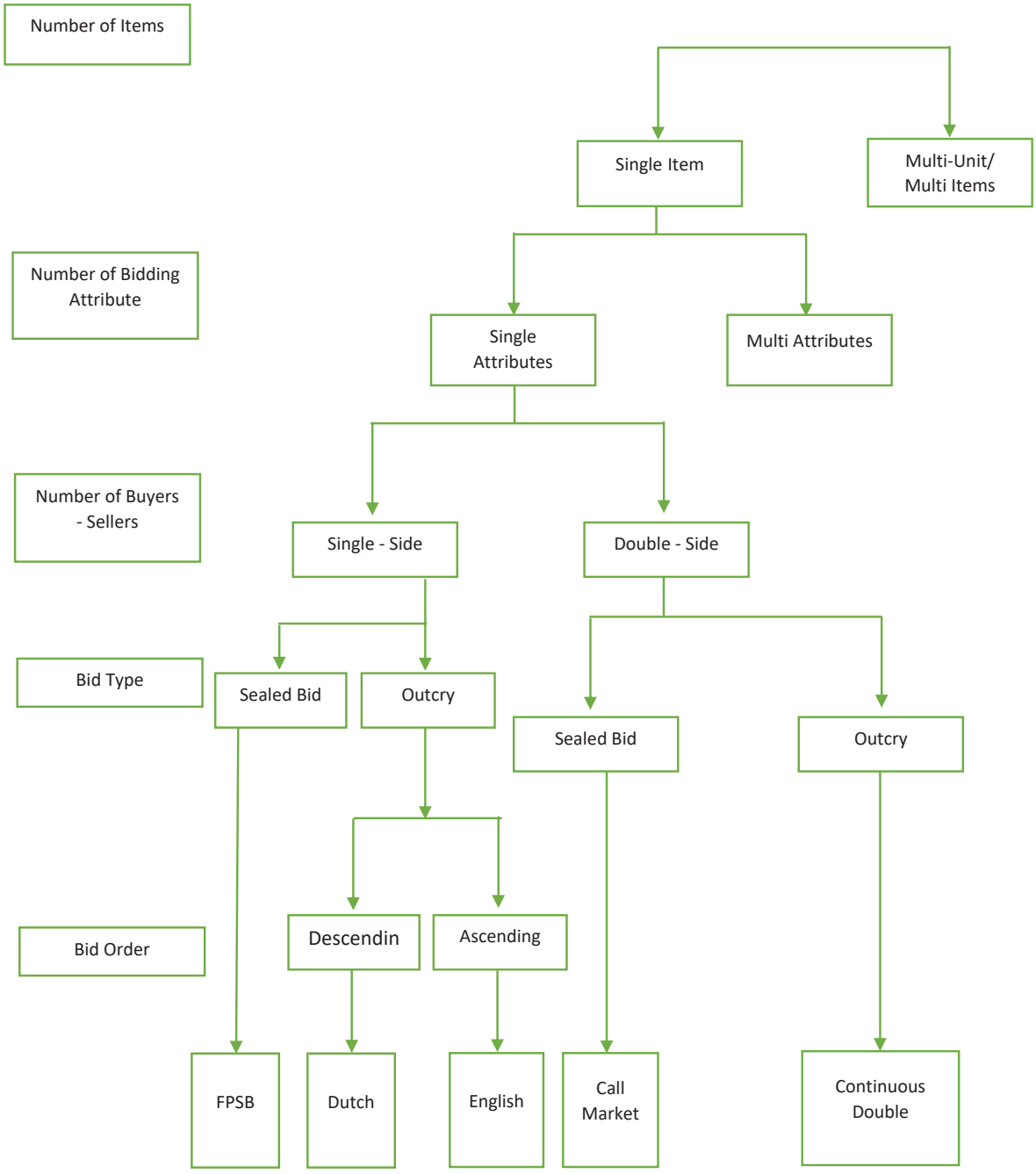


Fig. 1: Auction environment classification (Emiris and Marentakis, 2010)

decisions in terms of asset value and related investment costs. Based on the effects of the winner agent's subsequent decisions on asset outputs, the issue of moral hazard is added to the problem of adverse selection in the classical auction models. The moral hazard can give policymakers the tools to focus on extracting unpredictable product rents, contingent cash flow sharing; so it excludes some of the classical

models to design in this field (Cong, 2018).

2. Entering the contingent revenues of the asset to the related moral hazard as well as the characteristics of large contracts, the complexities of allocating infrastructure projects, and how assets are allocated over other economic goods. The proposed models should provide the dimensions of efficiency, optimality, Reducing Transaction Costs (RTC), and transparency (Griffin, 2013)

3. Long-term definition of contracts is created due to the risk and operating costs of the activity that challenges transparency, profit sharing, rent extraction for the auctioneer (The economic literature distinguishes between an auctioneer and an asset owner. As municipalities manage the process, in this paper, the auctioneer is used instead of the asset owner), and the loss of the opportunity to exploit the information obtained to change the conditions of the allocation (Brown *et al.*, 2016).

4. Concerning the mentioned differences, more diverse variables are available as the bidding parameters separately and in combination with other auctions.

To design a holding model by the status of the various assets, the following process should be determined by the auctioneer and then clarified and announced before the start of the bidding time.

•A clear and precise definition of the objectives of the auction, and assuming the optimality (maximization of revenue from the asset) as the classical purpose of the auction. Having a clear and understandable process methodology to translate winners' bids and auction rules (Cramton, 2010) is a key point in this section. Here, some policymakers assume that the bidders' decisions are taken based on the contractual terms bid by the auctioneer, such as the shared revenue such as taxes, design process (Milgrom and Weber, 1982), decision theory, and game theory (Rothkopf, 2007).

• Regarding the susceptibility of players from other market players, the auctioneer must consider the strategic behavior of all players (Dixit and Skeath, 2015). In the real case, in a designed competitive model, the payments of the winner are auctioned under the influence of individual preferences, the preferences of other players, and the intrinsic characteristics of the asset (Milgrom and Weber, 1982).

•The exact definition of the dimensions of the auctioned asset, although the auctioned product or asset are predefined in the standard theories, in many cases in the design of actual processes, the design, and definition of the asset form part of the design of the auction.

• The transparency, definition of prediction, and announcement of the bidding process are required before the start of the auction. The issues related to how to choose the winner and payment rules are described in this section.

• Determining the qualified players to participate in the process in the very key design for the use in this section, refers to the process being open to all participants and non-discrimination in participation or restriction of participation according to open conditions (Sunnevåg, 2000). Two approaches can be identified to determining the qualifications of players in the auction as follows: determining the qualifications of bidders by imposing the required minimums on bidders - generating a shortlist of the qualified bidders to participate; and the second case, the prediction of qualitative dimensions to define the product (specific asset) that is considered as a prediction before the bidding process, or as part of the participation and bidding process that can also be visualized as the translation form into the financial bids (Asker and Cantillon, 2008). Overall, to design a holding model by the status of the various assets, the following process, Fig 2, should be determined, so that the auctioneer should announce the bidding time before beginning.

Among four design steps, the main focus of this paper is on the rules of bidding as well as the problem solving of how to choose the winning broker. In the empirical models of choosing the appropriate model in target markets will often involve a complex process, particularly in the areas of efficiency, optimality, application, proportion to different levels, the asymmetry with the target market, approaches to player risk, and collusion (Cramton, 2010). On the other hand, Janssen (2004) classified the decision-making indices into five indicators:

1. Optimality, maximizing the expected revenue is the first decision criterion in this area. Optimal auctions to maximize the expected revenues of the seller with a set of tools such as the minimum price, setting the entering cost, etc., lead the surplus welfare expected from other players to the auctioneer. The classic paper for this issue goes back to the study of

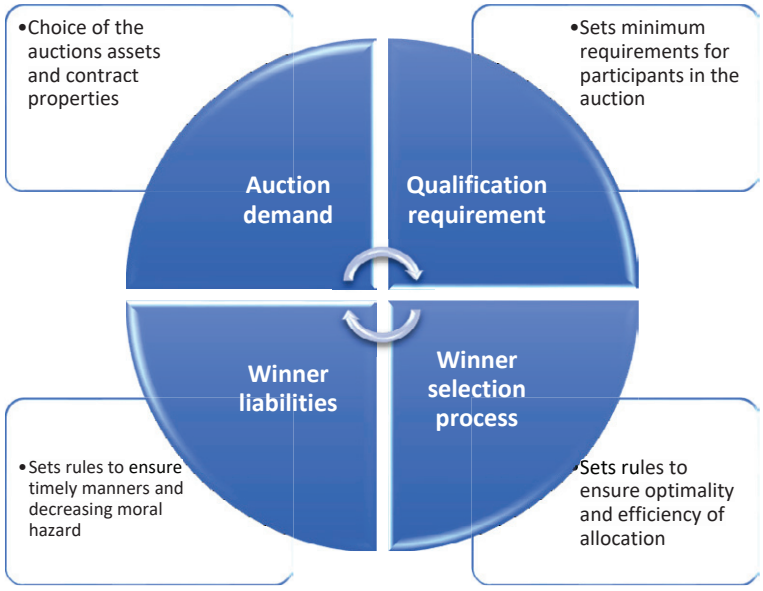


Fig. 2: The influential components on auction design (Grenadier and Wang, 2005; IRENA, 2017)

Myerson (1981).

2. The efficiency of the process: in the auction literature is called as efficient, provided that the allocation to the highest bidder for the subject of the auction is made as prior. This concept, in turn, is equivalent to the best use of the allocated license. This feature is especially important when it comes to the transfer of a public asset by governments and when it provides services or revenue flow in the future. Some limitations are significant to achieve efficiency; for example, if players have different limitations relative to each other, ensuring the efficiency may encounter some problems. For instance, if a player allocates the highest value to the asset that faces financial limitations, the efficiency may not necessarily be accomplished (Krishna, 2009). The issue of efficiency should be employed with caution if the government acts as the auctioneer. The concept of allocating assets to the highest value is not always equivalent to the concept of "economic efficiency". The reason for this should be founded on the foreign license allocation. The benevolent government sells the license for the welfare of the consumer, but the consumer does not participate directly in the auction; as a result, the output of the licensing process is the most valuable company, not necessarily coordinated with the consumer preferences (Borgers and Van Damme, 2004). Overall, in the condition that the desired result is not achieved by conventional models, it may be necessary to change the rules to allow the desired result to be achieved. When there are net common values, the investigation of efficiency is not debatable, as all bidders allocate relatively equal values to their assets (Kagel and Levin, 2009). In the case that the desired result is not obtained from the conventional models, changing the rules may be achieved to make it possible to achieve the desired result. This can easily be accomplished due to the inherent flexibility in the process design.

3. Time and other holding costs, the designed processes by the characteristics of the subject of the auction, volume, and the number of assets to be auctioned. Structural optimization in terms of time, the effort required, etc. can be an effective criterion to choose a mechanism.

4. Simplicity, if it is assumed that attracting more participants in the process is one of the main objectives of auctions, simplicity of auction rules can help increase participation.

5. Collusion, the issue of how the use of collusion in any of the conventional models will affect the outputs and revenue of the auction, is the issue of many discussions in the economic literature. For instance, McAfee and McMillan (1987) investigated

the SPSB and then concluded that the results of creating a loop in this model could not necessarily be better than the random allocation. Previous studies have considered various aspects.

In order to achieve a comprehensive theoretical framework based on the mentioned issues, the models listed in Table 1 can be utilized to allocate the infrastructure projects as well as the asset exploitation, which allows the measurement of different methods.

In this paper, the results of previous conducted studies are surveyed to investigate the impact of various auction features on process performance as well as possible policy recommendations. This qualitative study is based on individuals at the Municipality of Tehran, in 2020. The root of the analysis is in the framework of the principal-agent analysis environment, in which the knowledge and private information of the players can affect the strategic behaviors in bidding and output of the process in terms of revenue by increasing public welfare. In order to achieve the answer, along with studying the dimensions and frameworks of the theory and the differences between the target market and the classical theory, the investigation of allocation models in other areas of public asset transfer is the basis of research inferences in the next section. The second section deals with the research

Table 1: Characteristics of chosen models to allocate the exploitation rights of assets

Design criteria/patterns	FPSB based on the best or k rating offered - in one round	Iterative	Hybrid	More than one asset at a time
Simplicity	Maximum	Relative - Require gathering all bidder	Minimum - More difficult to implement and communicate	Relative minimum - More difficult to package bidding and Set the rules and ex-ante choices
Transparency and fairness (Cramton, 2010; Gretschko and Wambach, 2016)	Relative - Possibly opaque mechanism once offer is opened	Maximum – open real-time information	Relative Maximum - Ensured by the iterative phase	Relative - According to the information available on various assets
Efficiency (Cramton, 2010; Klemperer, 2002; (Klemperer, 2000; Milgrom and Weber, 1982)	Relative – bidding subject to winner curse	Relative – bidding subject to collusion Vulnerability	Relative – bidding subject to collusion Vulnerability	Relative maximum – decrease collusion Vulnerability and complement and substitute assets
Bidder ability to react	Minimum – information must be disclosed beforehand	Maximum – gradual disclosure of information, allowing agents to respond	Relative – only during the iterative phase	Relative - Not including all information in the combinatorial auction
Prevent of collusion (Salant, 2014)	Relative maximum – undisclosed in formation bid collusion	Relative minimum – bidder may force the auction to terminate early	Relative – second phase makes collusion more difficult	Relative – because of different preferences of bidders
Matching	Maximum – market curves fully known	Relative minimum – requires some assumption for optimal results	Relative maximum – market curves fully know in the second phase	Relative minimum - requires some assumption for optimal results

method. The general study of the rules and the conditions of the case study based on the outputs of the second section is the focus of the third section of the research. The final section provides conclusions and summaries. The current study has been carried out in Tehran in 2020.

MATERIALS AND METHODS

According to the content of the issue, this paper is conducted as a qualitative method based on the case study. The selection of the case study is carried out according to the questions of what and how it is performed. Qualitative research is research that aims to explore and examine the problems of research so that it reflects the views of participants in those problems based on the collection of textual and visual data (Clark and Creswell, 2014). Regarding the focus of the paper on the presentation of lessons learned, "Case study research" is chosen because it is a study of a system of individuals at the Municipality of Tehran in order to understand, interpret, and improve what is being performed. Collecting and analyzing different forms of data in order to describe the issues and lessons learned is a key procedure of this method. The case study is chosen based on theoretical reasons rather than statistics, where the aim is to select items that are likely to replicate or develop the theory (Eisenhardt, 1989). This paper aims to investigate the results of utilizing the auction in the process as well as its impact on legal frameworks. Accordingly, the type of case study is "instrumental case study", in which the researcher focuses on a controversial issue or problem, and then selects a limit and individual case to illustrate that issue (Clark and Creswell, 2014). This paper is the result of a series of library studies in order to analyze and familiarize with the problems, shortcomings, and inadequacies in the allocation of public assets exploitation plans in the Municipality of Tehran, Iran.

RESULTS AND DISCUSSION

Utilizing the theory in allocating asset exploitation rights in municipalities

The criteria for the processes of tenders and auctions in the Municipality of Tehran are the Rule on Tenders approved in 2004 (Majlis Research Center, 2004), and the Transactions Regulations of the Municipality of Tehran approved in 1976 (Majlis Research Center, 1976), in which the main focus is on buying and selling of assets and procurement rules. Moreover, there are several rules for holding this at the national level. The law on Holding Tenders Approved in 2004 (Majlis Research Center, 2004), Approval of the Cabinet of Ministers dated 2008 the written guarantee for Contracts, Amendment of the Executive Regulations of the Tender Documentation and Information System Approved in 2007 (Majlis Research Center, 2007), Quorum of Transactions Subject to Article 3 of the Law on Tenders Adopted in 2015 (Majlis Research Center, 2015), Executive Regulations Cabinet Resolution 2006 (Majlis Research Center, 2006c), Executive Regulations issue (a) Article 26 of the Law on Tenders Subject to Cabinet Resolution dated 2006, Executive Regulations Paragraph (e) Article 29 of the Law on Tenders Subject to Cabinet Resolution dated 2006 (Majlis Research Center, 2006a), List of Proposed Subjects Paragraph 2 of the 2009 Working Group Support for production The subject of the Commission's approval of Article 138 of the constitution (Majlis Research Center, 2009), the law regulating part of the government's financial regulations adopted in 2001, is considered one of the most important procurement laws in Iran. In addition to the rule on tenders approved in 2004 (Majlis Research Center, 2004), the rules governing sales and auctions in the Municipality of Tehran are subject to the Municipality of Tehran Transactions Regulations approved in 1976 (regulations governing development projects subject to Note 3 of Article 15), and in the case of lack of bylaw, the Municipal Financial Regulations approved by the Parliament in 1976 by the Senate (Senate, 1976). According to the definition of the rule of holding tenders approved in 2004 is a competitive process to provide the desired quality (according to the tender documents) (Majlis Research Center, 2004), in which the obligations of the subject of the transaction are allocated to the bidder who has bid the lowest appropriate price. The most important bases of this rule are transparency, competitiveness, attention to quality, consistency of procedure in spending credits, and resources belonging to the public sector. Despite satisfying the features in the definition in terms of the rules in two areas of utilizing the model of holding tenders and auctions, it seems that the current condition can be improved to the capacities of auction theory. Based on the results of previous theoretical and experimental research, two shortcomings can be detected in the legal framework. First, how to solve the Winner Determination Problem (WDP): the selection of the winner agent in the

rules is limited to the first-price sealed-bid auction. Holding a first-price sealed-bid auction in the space of independent privately-known values of those players in the simplest conventional auction arrangement, which has been accepted as a selected model in the rules of the Municipality of Tehran. The player's valuation is not affected by the designed model of information as well as the choices of other players, which is determined independently based on data analysis of each player. The model faces some challenges in terms of assumptions including bidding beyond predicting Nash Equilibrium(The Nash equilibrium: The idea of the Nash equilibrium is that a set of strategies, one for each player, would be stable if nobody has a unilateral incentive to deviate from their own strategy: A self-countering n-tuple is called an equilibrium point (Nash, 1950)) for the risk-neutral bidders (Engelbrecht-Wiggans and Katok, 2007), failure to optimize bid prices due to the truthful report (Vickrey, 1961). Thus, bidders offer lower prices because of the reduced risk of the winner's curse, and therefore earn less revenue for the auctioneer (The winner agent loses due to incorrect information and the optimistic overestimating of the auctioned asset. As such, one of the cases of renegotiation is to leave the project and pay the penalty or non-optimal options in the prior decisions at the time of investment in proportion to the estimated loss. This issue is different from the issue of changing market conditions and understanding the market) (Mochón and Sáez, 2015). Second, possible models to allocate the exploitation rights of the capital assets: choices in the allocation mechanism directly affect output. In addition to the dual efficiency-optimality in objective setting, there are other choices in holding that the choice of them can have a direct impact on the expected outputs of the designed process, especially in terms of revenue (McAfee *et al.*, 1989). Employing the allocation mechanism of different financial instruments to solve the problem of choosing the winner agent prepares the flexibility in determining how to bid prices to market players. Considering the problems of the chosen model, some alternative methods can be utilized, which obtain from the combination of classic auction models or specific designs by the asset, in which its path has remained silent in the rule. The defined models can be defined to allocate the capital assets including the exploitation of urban land, the construction of parking, the construction and management of cultural and sports facilities, and the activities that require investment by contractors. Dual choices of urban policymakers, which are the selected state of the Rule on Tenders adopted in 2004 and the Municipal Transactions Regulations adopted in 1976, compared to the choices of results on the allocation of rights exploitation of public resources and assets, are compared in Table 2.

Policy Implications - Designing a Bidding Model for Municipalities

Based on classical models, proposed innovations in the literature of public asset allocation, and lessons learned from employing auctions in the allocation of asset exploitation rights in empirical works, and the features extracted in Tables 1 and 2, as well as the silence of the rules of practice on how the allocation process, a composite model to allocate the exploitation rights of the asset in municipalities is proposed in this section. The main aim of the proposed changes is to decrease the process-related risks, which include multiple criteria to solve the winner problem, holding several rounds of bidding, and contractor participation. Selection from Table 1 aims to increase transparency and efficiency by reducing simplicity. The designed environment increases the possibility of players learning, which also improves and reduces the risks in the process. Although the same view of holding all asset allocation processes cannot be complete in the current economic situation despite the various commercial and non-commercial risks (For instance, the existing laws have the same view of process documents and information. Whereas deciding on the amount of information disseminated in each auction can affect the level of competition. Here, the key questions are: What is the optimal level of information provided by the auctioneer for each asset? Regarding that comprehensive information is not available, the evaluation gap of creation and design is incomplete and accompanied by uncertainty, and on the other hand, complete information leading to provide identical bids), at what cost should the information be provided to the bidders? At the same time, problems and challenges are not visible in the short time bidding, because there is not enough time to gather relevant information), the proposed bidding model contains the capabilities to fit the current situation and the endogenously of the valuation problem in proportion to the number of players. The bidding model utilizes the features of hybrid models with an emphasis on the clock auction model in price

Table 2: Comparison of the status of rules of practice and the findings of previous research

Feature	Variable	Description	Current Situation	Selected Status Of Previous Research Findings	Some Articles Confirm
Biddable Items	One item	homogenous assets	*	-	It is usually not recommended for real option auctions
	More than one items	Package bidding	-	The attractiveness of the bidding package of assets for the bidders	(Bichler and Goeree, 2017; Cramton, 2010; Griffin, 2013)
Proposed criteria	One item	Price is the only bidding factor	Other factors meet at pre-qualification	Pre-qualification in empirical researches	(Asker and Cantillon, 2008; Branco *et al.*, 2017; Che, 1993)
	More than one items	Quantitative and qualitative factors	-	Biddable Factors	
Market sides	One-sided auctions	-	*	*	(Board, 2007; Brown *et al.*, 2016)
	Double-sided auctions		-	This is not a literature selection due to the auctioneer legal status	
Bid type	Open	Each bidder has information of others	-	In some hybrid cases, open auctions use for the exploitation of public assets	(Griffin, 2013)
	Sealed Bid	The only auctioneer has information of all bidders	*	Reduce collision risk in bidding	
The basis for payment of the price by the winning broker	Selected bid	The winner pays his bid	*	*	(DeMarzo *et al.*, 2005; Sunnevåg, 2000)
	Nth bid among others	The winner pays the price bid by the nth-highest bidder	-	* Increase the probability of truthfulness report	(Abhishek *et al.*, 2013; Cong, 2018; Skrzypacz, 2013)

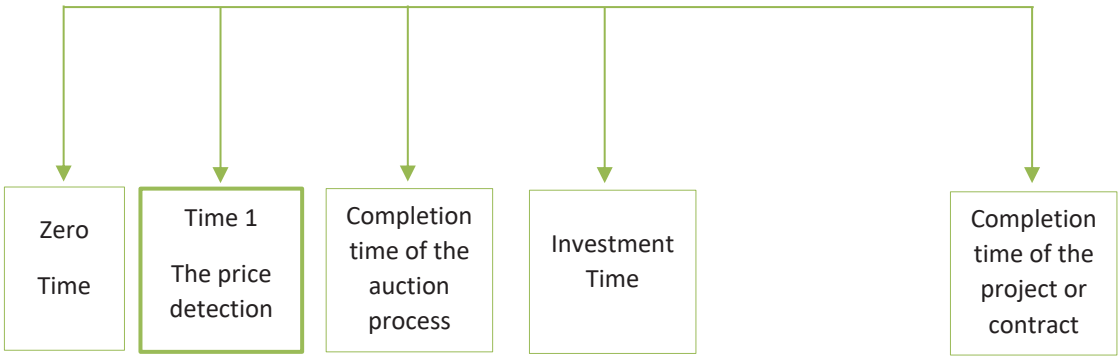


Fig. 3: Scheduling based on the proposed mechanism

detection. The clock auction model is a repeating auction that the auctioneer announces the prices, and then based on prices, players announce demand for each asset. After that, in the case of assets with excess demand, increasing-price is predicted, and then demand is recorded again. This process continues until no assets are left. All bids are recoded by the players themselves. In the following, a brief overview of the basic rules and procedures is described. The process is expected to be able to be registered on the Internet and run on an electronic auction software platform. The following points should be considered regarding the choices and conditions set for the bidders in the designed model:

- ✓ Model of holding simultaneously and in different periods,
- ✓ Relationship between contingent revenue and incentive adjustment (the use of various financial instruments including bonus and royalty rate).
- ✓ The non-financial bidding criteria before the auction to determine the qualifications of bidding;
- ✓ Cons bids provided in different periods,

In terms of scheduling, the scheme of the bidding process in terms of the allocation of exploitation rights of the asset can be illustrated as follows in Fig 3.

Zero-time

The auctioneer strategically begins the process, and then sets the rules and chooses how to solve the winner problem. In the proposed mechanism, a two-step auction is set. After repeated periods of the price detection step, the remaining players provide their bids in a sealed package so that they can have the strengths of both mechanisms. The decision-making process of the players can be simplified as follows. There is no requirement to bid on all provided assets. Players can leave during various steps due to strategic reasons, viewing preliminary data, predicting the participating of other players, and technical and engineering analysis.

Time 1

The price detection step: based on the definition, the bids are provided by the players based on the chosen model of the auctioneer in the specified format, and then the winner agent is selected in this step. Due to the importance of the price detection problem in the first step at the zero-time step, the clock auction mechanism step is defined as a few increments, with the possibility of withdrawal and the possibility of presenting the bid package. In each round, two choices are available for the bidders: providing their bids in cash at current round prices, or exit the process at the same price as before or above. It should be mentioned that this price increase process continues as long as there are at least three maximum price bids in the process. In this step, the players can direct the calculations regarding the package auction. Mainly, determining preferences in package auction is costly and this model would lead to cost reduction. In each round, the number of received bids qualified to provide the bids in the next rounds is announced. The new price contains a percentage increase compared to the minimum acceptable price announced in the previous round, which will be announced as the new price by the auctioneer to provide the bids. In each step, those players who have offered the highest price are faced with three choices. Failure to provide a bid

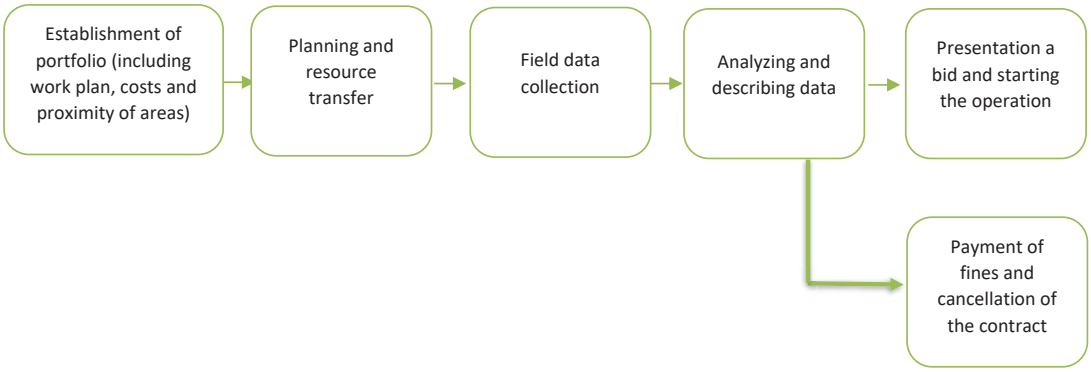


Fig. 4: The process after the auction until the end of the auction

means maintaining the previous bid. Moreover, it is possible to bid an exit between the previous bid, the minimum acceptable price of the second round, and the disqualification to participate in the next rounds, as well as to provide a new and higher bid and attend the next rounds if necessary. Furthermore, other players can bid an exit price or a higher bid.

Supplementary stage

This section aims to ensure the efficiency and optimality of the allocation. There is no incentive to reduce demand, which eliminates the chance of collusion. Besides, the activity rules can be eliminated in this section, meaning that if there is a possibility of expanding demand, there is no incentive to reduce demand and therefore it eliminates the chance of collusion. In this way, there are two ways to exploit this step as follows:

✓ Providing the bids in the form of a first-price sealed-bid auction

✓ Providing the bids on proxy models, especially when the competition is restricted and the complementary assets are different among players, leading to a rapid end to the price detection step. In the proxy model, the maximum bid and how to increase the announced prices, and the bidding, are simulated by expert systems.

Time 2

The movement of the players in the two-time step, which covers the subject of investment and exploitation of assets, is summarized as follows. One step after the auction, the agent can decide whether to continue the process. Accordingly, it can be assumed that a final bidding step can be considered after the initial round of commitments based on the attractiveness of the first step as well as the evaluation of operational capacities and commitment strategies. Note that this step can be considered as renegotiation or completion of the selection process.

CONCLUSION

Regarding the long-term duration of contracts, the capital-intensive nature, and the integral role of urban areas, preparing adequate infrastructure is a constant problem for national and local governments. One of the ways of financial supporting the infrastructure and decreasing the running costs of the outsourcing route is to utilize the power of the private sector in the creation and operation of urban projects. Urban policymakers must seek to formulate policies to attract more companies via higher financial and technical capacity. The use of auction theory can largely cover the shortcomings of the current status. As result of this paper, it focuses on understanding the impact of legal frameworks on auctions involving private sector participation to allocate the exploitation rights of public assets. In addition to surveying the characteristics and challenges of the current rule by applying the results of previous researches, it has focused on policy bids to improve the investment attractiveness using the participatory methods, and also to decrease the uncertainties in the current status. As such, this paper proposes the bidding mechanisms that can be employed based on the current rules. After determining the qualifications of the contractors, a two-step model can be utilized to provide the set of assets. The first step is carried out by the auctioneer

to identify the most desirable combinations as well as to detect the base price. Afterward, the players who have remained in the process by following the rules can compete with each other based on the first-price sealed-bid auction mechanism. This model can take advantage of both open and closed models to some extent.

Research limitations

This research, like other researches, has some limitations, which are mentioned below:

• Impossibility of evaluating an alternative model based on field data in the allocation of municipal assets

• Lack of access to past auction results

While the rules used focus on the use of the classical patterns, the advantages of alternative and hybrid patterns have been overlooked. Accordingly this study faced empirical challenges in evaluating the results. It is hoped that future researches will face fewer limitations and provide more accurate results.

AUTHOR CONTRIBUTIONS

A. Faridzad has reviewed the research literature. A. Ghasemi has collect the data and has performed the data corrections. S. Shahhosseini has analyzed the data and has prepared the manuscript. A. Taklif has aided in performing the methodology. Proofreading and final corrections have been done by A. Raghfar.

ACKNOWLEDGEMENT

This research is extracted from S. Shahhosseini's PhD thesis. The authors would like to extent their special gratitude to the anonymous reviewers whom their suggestions made great modifications to the current research and also to the Editorial Office of IJHCUM for their prompt and accurate processing.

CONFLICT OF INTEREST

The authors declare no potential conflict of interest regarding the publication of this work. In addition, ethical issues including plagiarism, informed consent, misconduct, data fabrication and, or falsification, double publication and, or submission, and redundancy have been completely witnessed by the authors.

ABBREVIATIONS

CP	Contingent Payment
DP	Dynamic Pricing
FPSBA	First Price Sealed Bid Auction
MH	Moral Hazard
NCAS	Non-Concessionary Allocation Systems
RTC	Reducing Transaction Costs
WDP	Winner Determination Problem

REFERENCES

Abhishek, V.; Hajek, B.; Williams, S.R., (2013). Auctions with a profit sharing contract. Game. Econ. Behav., 77(1): 247-270 (**24 pages**).

Asker, J.; Cantillon, E., (2008). Properties of scoring auctions. RAND J. Econ., 39(1): 69-85 **(17 pages).**

Bajari, P.; McMillan, R.; Tadelis, S., (2008). Auctions versus negotiations in procurement: an empirical analysis. J. Law Econ. Organ, 25(2): 372-399 **(28 pages).**

Bichler, M.; Goeree, J K., (2017). Handbook of spectrum auction design. Cambridge University Press.

Borgers, T.; Van Damme, E., (2004). Auction theory for auction design. Auctioning Public Assets: Analysis and Alternatives: 19-63 **(45 pages).**

Brasil, E.U.R.; Postali, F. A. S., (2014). Informational rents in oil and gas concession auctions in Brazil. Energy Econ, 46: 93-101 **(9 pages).**

Board, S., (2007). Selling options. J. Econ. Theory, 136(1): 324–340 **(17 pages).**

Brown, J.P.; Fitzgerald, T.; Weber, J.G., (2016). Capturing rents from natural resource abundance: Private royalties from US onshore oil and gas production. Resour. Energy Econ., 46: 23-38 **(16 pages).**

Bulow, J.; Levin, J.; Milgrom, P., (2009). Winning play in spectrum auctions. NBER. (No. w14765).

Clark, V.L.P.; Creswell, J.W., (2014). Understanding research: A consumer's guide. Pearson Higher Ed.

Cong, L.W., (2018). Auctions of real options. Available at SSRN 2136359, November.

Cramton, P., (2010). 10 How best to auction natural resources. The Taxation of Petroleum and Minerals: 289.

DeMarzo, P.M.; Kremer, I.; Skrzypacz, A., (2005). Bidding with securities: Auctions and security design. Am. Econ. Rev, 95(4): 936-959 **(23 pages).**

Dixit, A.K.; Skeath, S., (2015). Games of Strategy: Fourth International Student Edition. WW Norton and Company.

Eisenhardt, K.M., (1989). Building theories from case study research. Acad. Manage. Rev., 14(4): 532-550 **(19 pages).**

Emiris, D.M.; Marentakis, C.A., (2010). A unified classification ecosystem for auctions.

Engelbrecht-Wiggans, R.; Katok, E., (2007). Regret in auctions: Theory and evidence. Econ. Theory, 33(1): 81-101 **(21 pages).**

Geanakoplos, J., (1989). Arrow-Debreu model of general equilibrium. In General Equilibrium Palgrave Macmillan, London., 43-61 **(19 pages).**

Grenadier, S.R.; Wang, N., (2005). Investment timing, agency, and information. J. Financ. Econ., 75(3): 493-533 **(41 pages).**

Griffin, R., (2013). Auction designs for allocating wind energy leases on the US outer continentalshelf. Energy Policy, 56: 603-611 **(9 pages).**

Hosseini, E.; Tajpour, M.; Lashkarbooluki, M., (2020). The impact of entrepreneurial skills on manager's job performance. Int. J. Hum.

Capital Urban Manage. 5(4), 361-372 **(12 pages).**
IRENA, A.D., (2017). Renewable energy auctions: Analysing 2016. Author Abu Dhabi.
Janssen, M. (2004). Auctioning public assets: Analysis and alternatives. In Auctioning Public Assets: Analysis and Alternatives. Cambridge University Press.
Kagel, J.H.; Levin, D., (2009). Common value auctions and the winner's curse. Princeton University Press.
Klemperer, P., (1999). Auction theory: A guide to the literature. J. Econ. Surv., 13(3): 227-286 **(60 pages).**
Klemperer, P. (2000). Why every economist should learn some auction theory. Available at SSRN 241350.
Klemperer, P., (2002). What really matters in auction design. J. Econ. Perspect., 16(1): 169-189. **(21 pages).**
Krishna, V., (2009). Auction theory. Academic Press.
Lam, P.T.I.; Yang, W., (2020). Factors influencing the consideration of Public-Private Partnerships (PPP) for smart city projects: Evidence from Hong Kong. Cities, 99: 102606 **(1 page).**
Ledyard, J.O.; Olson, M., Porter, D.; Swanson, J.A.; Torma, D.P., (2002). The first use of a combined-value auction for transportation services. IJAA, 32(5): 4-12 **(9 pages).**
Maasland, E., (2012). Essays in auction theory. CentER, Tilburg University.
Majlis Research Center.; Islamic Parliament Research Center Of The Islamic Republic Of IRAN., (1976). Capital Municipality Trading Regulations. (In Persian)
Majlis Research Center.; Islamic Parliament Research Center Of The Islamic Republic Of IRAN., (2004). Law on Tenders. (In Persian)
Majlis Research Center.; Islamic Parliament Research Center Of The Islamic Republic Of IRAN., (2007). Amend the executive regulations of the tender documentation and information system. (In Persian)
Majlis Research Center.; Islamic Parliament Research Center Of The Islamic Republic Of IRAN., (2015). Approval letter regarding the determination of the quorum of transactions subject to Article (3) of the Law on Tenders. (In Persian)
Majlis Research Center.; Islamic Parliament Research Center Of The Islamic Republic Of IRAN., (2006). Executive regulations of paragraph "c" of Article (12) of the Law on Tenders. (In Persian)
Majlis Research Center.; Islamic Parliament Research Center Of The Islamic Republic Of IRAN., (2006). Executive regulations of paragraph "a" of Article (26) of the Law on Tenders. (In Persian)
Majlis Research Center.; Islamic Parliament Research Center Of The Islamic Republic Of IRAN., (2009). Approval letter regarding the ban on the purchase of foreign goods by the executive bodies. (In Persian)
McAfee, R.P.; McMillan, J., (1987). Auctions and bidding. J. Econ. Lit., 25(2): 699-738 **(40 pages).**
McAfee, R.P.; McMillan, J.; Reny, P.J., (1989). Extracting the surplus in the common-value auction. Econometrica: J. Econ. Soc., 1451-1459 **(9 pages).**
Milgrom, P.R., (2004). Putting auction theory to work. Cambridge University Press.
Milgrom, P. R.; Weber, R. J., (1982). A theory of auctions and competitive bidding. Econ.: J. Econ. Soc., 1089-1122 **(34 pages).**
Mochón, A.; Sáez, Y., (2015). Understanding auctions. Springer.
Myerson, R.B., (1981). Optimal auction design. Math. Oper. Res., 6(1): 58-73 **(16 pages).**
Nash, J.F., (1950). Equilibrium points in n-person games. PNAS., 36(1): 48-49 **(1 page).**
Rothkopf, M.H., (2007). Decision analysis: The right tool for auctions. Decis. Anal., 4(3): 167-172. **(5 pages).**
Rothkopf, M.H.; Pekeč, A.; Harstad, R.M., (1998). Computationally manageable combinational auctions. Manage. Sci., 44(8): 1131-1147 **(17 pages).**
Salant, D.J. (2014). A Primer on Auction Design, Management, and Strategy: 184 **(1 page).**
Samuelson, W., (2014). Auctions: Advances in Theory and Practice. In Game Theory and Business Applications, Springer: 323-366 **(44 pages).**
Senate.; US Government publishing office., (1976).
Skrzypacz, A., (2013). Auctions with contingent payments—an overview. Int. J. Ind. Organ, 31(5): 666-675 **(10 pages).**
Sunnevåg, K.J., (2000). Designing auctions for offshore petroleum lease allocation. Resour. Policy, 26(1): 3-16 **(14 pages).**
Talluri, K.T.; Van Ryzin, G.J., (2006). The theory and practice of revenue management 68: Springer Sci. Bus. Media.
Vickrey, W., (1961). Counterspeculation, auctions, and competitive sealed tenders. J. Finance, 16(1): 8-37 **(30 pages).**
Wu, S.; Kersten, G.E., (2014). Multi-attribute Procurement Auctions and Negotiations: An Experimental Comparison. Proceedings of the Sixteenth International Conference on Electronic Commerce, 72-79 **(8 pages).**
Wyld, D.C., (2001). The auction model: how the public sector can leverage the power of e-commerce through dynamic pricing. E-Government, 44: 84 **(1 page).**

HOW TO CITE THIS ARTICLE

Raghfar, F.; Taklif, A.; Shahhosseini, S.; Ghasemi, A.; Faridzad, A., (2021). The Impact of Legal Frameworks on Bidding Mechanisms. Int. J. Hum. Capital Urban Manage., 6(3): 337-350.

DOI: 10.22034/IJHCUM.2021.03.10

url: http://www.ijhcum.net/article_242131.html

PUBLICATION ETHICS

The ethical policy of IJHCUM is based on the Committee on Publication Ethics (COPE) guidelines and complies with International Committee of IJHCUM Editorial Board codes of conduct. Readers, authors, reviewers and editors should follow these ethical policies once working with IJHCUM. The ethical policy of IJHCUM is liable to determine which of the typical research papers or articles submitted to the journal should be published in the concerned issue. For information on this matter in publishing and ethical guidelines please visit http://publicationethics.org

Duties and Responsibilities of Publishers

1. IJHCUM is committing to ensure that editorial decisions on manuscript submissions are the final.
2. IJHCUM is promising to ensure that the decision on manuscript submissions is only made based on professional judgment and will not be affected by any commercial interests.
3. IJHCUM is committing to maintain the integrity of academic and research records.
4. IJHCUM is monitoring the ethics by Editor-in-Chief, Associate Editors, Editorial Board Members, Reviewers, Authors, and Readers.
5. IJHCUM is always checking the plagiarism and fraudulent data issues involving in the submitted manuscript.
6. IJHCUM is always willing to publish corrections, clarifications and retractions involving its publications as and when needed.

Duties and Responsibilities of Editors

1. The Editors of the journal should have the full authority to reject/accept a manuscript.
2. The Editors of the journal should maintain the confidentiality of submitted manuscripts under review or until they are published.
3. The Editor-in-Chief should take a decision on submitted manuscripts, whether to be published or not with other editors and reviewers
4. The Editors of the journal should preserve the anonymity of reviewers.
5. The Editors of the journal should disclose and try to avoid any conflict of interest.
6. The Editors of the journal should maintain academic integrity and strive to meet the needs of readers and authors.
7. The Editors of the journal should be willing to investigate plagiarism and fraudulent data issues and willing to publish corrections, clarifications, retractions, and apologies when needed.
8. The Editors of the journal should have the limit themselves only to the intellectual content.
9. The Editors of the journal must not disclose any information about submitted manuscripts to anyone other than the corresponding author, reviewers, potential reviewers, other editorial advisers, and the publisher, as appropriate.
10. Unpublished materials disclosed in a submitted paper will not be used by the editor or the members of the editorial board for their own research purposes without the author's explicit written consent.

Duties and Responsibilities of Reviewers

1. The Reviewers of the journal should assist the Editors in taking the decision for publishing the submitted manuscripts.
2. The Reviewers should maintain the confidentiality of manuscripts, which they are invited to review.
3. The Reviewers should provide comments in time that will help editors to make decision on the submitted manuscript to be published or not.
4. The Reviewers are bound to treat the manuscript received for peer reviewing as confidential, and must not use the information obtained through peer review for personal advantage.
5. The Reviewers comments against each invited manuscript should be technical, professional and objective.
6. The Reviewers should not review the manuscripts in which they have found conflicts of interest with any of the authors, companies, or institutions.
7. The Reviewers should disclose and try to avoid any conflict of interest.

Duties and Responsibilities of Authors

1. Manuscripts must be submitted only in English and should be written according to sound grammar and proper terminology.
2. Manuscripts must be submitted with the understanding that they have not been published elsewhere (except in the form of an abstract or as part of a published lecture, review, or thesis) and are not currently under consideration by another journal published by or any other publisher.
3. The submitting (corresponding) author is responsible for ensuring that the manuscript article's publication has been approved by all the other coauthors.
4. In order to sustain the peer review system, authors have an obligation to participate in peer review process to evaluate manuscripts from others.
5. It is also the authors' responsibility to ensure that the manuscripts emanating from a particular institution are submitted with the approval of the necessary institution.
6. It is a condition for submission of a manuscript that the authors permit editing of the paper for readability.
7. Authors are requested to clearly identify who provided financial support for the conduct of research and/or preparation of the manuscript and briefly describe the role of the funder/sponsor in any part of the work.
8. A copy right release and conflict of interest disclosure form must be signed by the corresponding author in case of multiple authorships, prior to the acceptation of the

manuscript, by all authors, for publication to be legally responsible towards the Journal ethics and privacy policy.

9. Under open access license, authors retain ownership of the copyright for their content, but allow anyone to download, reuse, reprint, modify, distribute, and/ or copy the content as long as the original authors and source are cited properly.
10. All authors have agreed to allow the corresponding author to serve as the primary correspondent with the editorial office, to review the edited manuscript and proof.
11. When author(s) discovers a significant error or inaccuracy in his/her own published work, it is the author's obligation to promptly notify the journal editor or publisher to retract or correct the manuscript.
12. All authors must know that that the submitted manuscripts under review or published with IJHCUM are subject to screening using Plagiarism Prevention Software. Plagiarism is a serious violation of publication ethics.

Violation of Publication Ethics

1. **Plagiarism:** Plagiarism is intentionally using someone else's ideas or other original material as if they are one's own. Copying even one sentence from someone else's manuscript, or even one of your own that has previously been published, without proper citation is considered by IJHCUMJournal as plagiarism. All manuscripts under review or published with IJHCUM are subject to screening using plagiarism prevention software. Thus, plagiarism is a serious violation of publication ethics. The development of CrossCheck is a service that helps editors to verify the originality of papers. CrossCheck is powered by the Ithenticate software from iParadigms, known in the academic community as providers of Turnitin. For a searchable list of all journals in the CrossCheck database, please visit: www.ithenticate.com/search
2. **Data Fabrication and Falsification:** Data fabrication and falsification means the researcher did not really carry out the study, but made up data or results and had recorded or reported the fabricated information. Data falsification means the researcher did the experiment, but manipulated, changed, or omitted data or results from the research findings.
3. **Simultaneous Submission:** Simultaneous submission occurs when a manuscript (or substantial sections from a manuscript) is submitted to a journal when it is already under consideration by another journal.
4. **Duplicate Publication:** Duplicate publication occurs when two or more papers, without full cross referencing, share essentially the same hypotheses, data, discussion points, and conclusions.
5. **Redundant Publications:** Redundant publications involve the inappropriate division of study outcomes into several articles, most often consequent to the desire to plump academic vitae.
6. **Improper Author Contribution or Attribution:** All listed authors must have made a significant scientific contribution to the research in the manuscript and approved all its claims. Don't forget to list everyone who made a significant scientific contribution, including students and laboratory technicians.
7. **Citation Manipulation:** Citation Manipulation is including excessive citations, in the submitted manuscript, that do not contribute to the scholarly content of the article and have been included solely for the purpose of increasing citations to a given author's work, or to articles published in a particular journal. This leads to misrepresenting the importance of the specific work and journal in which it appears and is thus a form of scientific misconduct.

Handling Cases of Misconduct

Once IJHCUM confirms a violation against IJHCUM's publication ethics, IJHCUM addresses ethical concerns diligently following an issue-specific standard practice as summarized below.

1. The first action of the journal Editor is to inform the Editorial Office of IJHCUM by supplying copies of the relevant material and a draft letter to the corresponding author asking for an explanation in a nonjudgmental manner.
2. If the author's explanation is unacceptable and it seems that serious unethical conduct has taken place, the matter is referred to the Publication Committee via Editorial Office. After deliberation, the Committee will decide whether the case is sufficiently serious to warrant a ban on future submissions.
3. If the infraction is less severe, the Editor, upon the advice of the Publication Committee, sends the author a letter of reprimand and reminds the author of IJHCUM publication policies; if the manuscript has been published, the Editor may request the author to publish an apology in the journal to correct the record.
4. Notification will be sent to corresponding author and any work by the author responsible for the violation or any work these persons coauthored that is under review by IJHCUM journal will be rejected immediately.
5. The authors are prohibited from serving on IJHCUM editorial board and serving as a reviewer for IJHCUMJournal. IJHCUM reserves the right to take more actions.
6. In extreme cases, notifications will be sent to the affiliations of the authors and the authors are prohibited from submitting their work to IJHCUM for 5 years.
7. In serious cases of fraud that result in retraction of the article, a retraction notice will be published in the journal and will be linked to the article in the online version. The online version will also be marked "retracted" with the retraction date.

GUIDE FOR AUTHORS

International Journal of Human Capital in Urban Management (IJHCUM) is a double blind peer reviewed electronic and print quarterly publication concerned with allaspects of environmental science and management. IJHCUM publishes original research papers, review papers, case reports and short communications, letters to editor and authors' response about letters to editor across the broad field of human capital in urban management and the related fields of urban management. The publication appears at regular intervals time quarterly. The Journal database is fully openaccess and full text of published articles are available for everyone who can get access to the Journal website free of cost. The authors never pay any charges for submission, article processing and publication.

Guide for Authors: More details on guide for authors refer: http://ijhcum.net/journal/authors.note

GENERAL

1. Authors should submit their contributions electronically through the IJHCUM website submission system to the Editorial Office.

2. Manuscripts must be submitted only in English and should be written according to sound grammar and proper terminology. Manuscripts should be typed in Times New Roman of 11 pt. font and in MS-Word format in one column with 2.5 cm margin at each side. Manuscript submission must be applied once in order to obtain only one submission ID number. More than one submission for a single manuscript can lose the chance of the manuscript consideration. Manuscript must be accompanied by a covering letter including title and author(s) name.

3. There are no strict formatting requirements but all manuscripts must contain the essential elements needed to convey your manuscript, for example Abstract, Keywords, Introduction, Materials and Methods, Results, Conclusions, Artwork and Tables with Captions. Please ensure the figures and the tables included in the single file are placed next to the relevant text in the manuscript, rather than at the bottom or the top of the file. There are no strict requirements on reference formatting at submission. References can be in any style or format as long as the style is consistent.

BEFORE YOU BEGIN

1. Peer-Review Process: In order to sustain the peer review system, authors have an obligation to participate in peer review process to evaluate manuscripts from others. When appropriate, authors are obliged to provide retractions and/or corrections of errors to the editors and the Publisher. All papers submitted to IJHCUM journal will be peer reviewed for at least one round. IJHCUM journal adopts a double-blinded review policy: authors are blind to reviewers, but reviewers are not blind to authors. After receiving reviewers' comments, the editorial team member makes a decision. Because reviewers sometimes do not agree with each other, the final decision sent to the author may not exactly reflect recommendations by any of the reviewers. The decision after each round of peer review may include (a) Accept without any further changes, (b) Accept with minor revision, (c) Major changes are necessary for resubmission and (d) Decline without encouraging resubmission.

2. Post-Publication Evaluation: In addition to rapid Peer Review Process, the IJHCUM Journal has Post-Publication Evaluation by the scientific community. Post-Publication Evaluation is concentrated to ensure that the quality of published research, review and case report meets certain standards and the conclusions that are presented are justified. The post-publication evaluation includes online comments and citations on published papers. Authors may respond to the comments of the scientific community and may revise their manuscript. The Post-Publication Evaluation is described in such a way; it is allowing authors to publish quickly about Environmental science, management, engineering and technology concepts.

3. Publication Ethics: The ethical policy of IJHCUM is based on the Committee on Publication Ethics (COPE) guidelines and complies with International Committee of IJHCUM Editorial Board codes of conduct. Readers, authors, reviewers and editors should follow these ethical policies once working with IJHCUM. The ethical policy of IJHCUM is liable to determine which of the typical research papers or articles submitted to the journal should be published in the concerned issue. The ethical policy insisted the Editor-in-Chief, may confer with other editors or reviewers in making the decision. Visit at: http://publicationethics.org

4. Conflict of Interest: Authors are requested to evident whether impending conflicts do or do not exist. A copyright transfer agreement is signed by the corresponding author, upon the acceptance of the manuscript, on behalf of all authors, for publication to be legally responsible towards the journal ethics and privacy policy. Authors will be notified as soon as possible of decisions concerning the suitability of their manuscripts for publication in the journal. The submitted materials may be considered for inclusion but cannot be returned and Editors of the journal reserve the right to accept or reject any article in any stage, if necessary. Conflict of Interest Disclosure form can be found at: http://ijhcum.net/data/ijhcum/news/Conflict of Interest.doc

5. Submission Declaration and Verification: While submitting a manuscript to IJHCUM, all contributing author(s) must verify that the manuscript represents authentic and valid work and that neither this manuscript nor one with significantly similar content under their authorship has been published or is being considered for publication elsewhere including electronically in the same form, in English or in other language, without the written consent the copy right holder.

6. Authorship: All contributing authors should qualify for authorship and corresponding author should sign the authorship form while submitting the manuscript. It can be found at:
http://ijhcum.net/data/ijhcum/news/Authroship form.docx

7. Changes to Authorship: After the manuscript is submitted or accepted for publication, the corresponding author is required to send a request to add or remove an author or to rearrange the author names of the submitted/accepted manuscript by sending the change of authorship form to editorial office. No authorship change is allowed after publication of manuscript. More details may be found at:
http://ijhcum.net/data/ijhcum/news/change of authorship form.docx

8. Retained Author Rights: As an author, author or authors' employer or institution retains certain rights. For more information on author rights, found at:
http://ijhcum.net/data/ijhcum/news/retained_authors_right.docx

9. Copy Right: Journals should make clear the type of copyright under which authors' work will be published. For open access articles the publisher uses an exclusive licensing agreement in which authors retain copyright in their manuscript. More details may be found at: http://ijhcum.net/data/ijhcum/news/copyright form.doc

10. User license Agreement: IJHCUM provides access to archived material through IJHCUM archives. Manuscripts are the parts of an open archive are made freely available from IJHCUM website after certain period, which begins from the final publication date of the manuscript. All articles published open access will be immediately and permanently free for everyone to read and download. Permitted reuse is defined by Creative Commons user license called ***Creative Commons Attribution***. Visit at: **(**Creative Commons Attribution 4.0 International (CC BY 4.0)**)**

11. Plagiarism Prevention and Violation of Publication Ethics: All manuscripts under review or published with IJHCUM are subject to screening using Plagiarism Prevention Software. Plagiarism is a serious violation of publication ethics. Other violations include duplicate publication, data fabrication and falsification, and improper credit of author contribution. Thus, the Plagiarism or Fraudulent or knowingly inaccurate statements constitute unethical behavior are unacceptable and submitting the same manuscript to more than one journal concurrently constitutes unethical publishing behavior and is unacceptable. The development of CrossCheck is a service that helps editors to verify the originality of papers. CrossCheck is powered by the Ithenticate software from iParadigms, known in the academic community as providers of Turnitin. For more details visit at: www.ithenticate.com/search

12. Handling Cases of Misconduct: Once IJHCUM confirms a violation against IJHCUM's publication ethics, the following actions will be taken.

a. The work is rejected / retracted immediately. Notification will be sent to corresponding authors. In extreme cases, notifications will be sent to the affiliations of the authors.
b. The authors are prohibited from submitting their work to IJHCUM for 5 years.
c. Any work by the authors responsible for the violation or any work these persons coauthored that is under review by any IJHCUM journal will be rejected immediately.
d. The authors are prohibited from serving on IJHCUM editorial board. IJHCUM reserves the right to take more actions.

MANUSCRIPT PREPARATION

1. Title Page: The title page should include: the name(s) of the author(s), a concise and informative title, the affiliation(s) and address (es) of the author(s), and e-mail address, telephone and fax numbers of the corresponding author.

2. Manuscript Title: Title of up to 17 words should not contain the name of locations, countries or cities of the research as well as abbreviations. The title should be oriented to Environmental issues while not being obscure or meaningless.

3. Abstract: An abstract of 150 to 250 words that sketches the purpose of the study; basic procedures; main findings its novelty; discussions and the principal conclusions, should not contain any undefined abbreviations or references.

4. Keywords: Provide 5 to 7 keywords which can be used for indexing purposes. Keywords should not repeat the words of the manuscript title or contain abbreviations and shall be written in alphabetical order as separated by semicolon.

5. Introduction: The Introduction should state the purpose of the investigation and identify clearly the gap of knowledge that will be filled in the Literature review study. Date and location of the research carried out throughout the study must be mentioned at the end of this section.

6. Materials and methods: The Materials and Methods section should provide enough information to permit repetition of the experimental work. It should include clear descriptions and explanations of sampling procedures, experimental design, and essential sample characteristics and descriptive statistics, hypothesis tested, exact references to literature describing the tests used in the manuscript, number of data involved in statistical tests, etc.

7. Results and Discussion: The Results section should describe the outcome of the study. Data should be presented as concisely as possible - if appropriate in the form of tables or figures, although very large tables should be avoided. The Discussion should be an interpretation of the results and their significance with reference to work by other authors. Please note that the policy of the Journal with respect to units and symbols is that of SI symbols.

8. Tables: Do not submit tables and graphs as photograph. Place explanatory matters in footnotes, not in the heading. Do not use internal horizontal and vertical rules. Tables should be called out in the text and should have a clear and rational structure and consecutive numerical order. All tables should be numbered 1, 2, 3, etc. Give enough information in subtitles so that each table is understandable without reference to the text. Footnotes to tables should be indicated by superscript lower-case letters (or asterisks for significance values and other statistical data) and included beneath the table body.

9. Figures: Figures/ illustrations should be in high quality art work, within 200-300 dpi and separately provided in Excel format. Ensure that figures are clear, labeled, and of a size that can be reproduced legibly in the journal. Each figure should have a concise caption describing accurately what the figure depicts. Figure captions begin with the term Fig. Figures should be with the captions placed below in limited numbers. No punctuation is to be placed at the end of the caption.

10. Conclusion: This section should highlight the major, firm discoveries, and state what the added value of the main finding is, without literature references.

11. Acknowledgements: Acknowledgments of people, grants, funds, etc. should be placed in a separate section before the reference list. The names of funding organizations should be written in full. Financial support affiliation of the study, if exists, must be mentioned in this section. Thereby, the Grant number of financial support must be included.

12. References: All the references should be cited throughout the manuscript text as well as in the Reference section organized in accordance with Harvard system. Groups of references should be listed first alphabetically, then chronologically. The number of references extracted from each journal should not exceed 3 to 5 citations, which is the average acceptable amount. The number of references should not be less than 30 for original paper, less than 100 for review paper. It is substantially recommended to the authors to refer to more recent references rather than old and out of date ones. Volume, issue and pages of the whole references must be specified according to the IJHCUM format.

Citing and listing of Web references: As a minimum, the full URL should be given. Any further information, if known (Author names, dates, reference to a source publication, etc.), should also be given.

Text: All citations in the text should refer to: 1. Single author: the author's name (without initials, unless there is ambiguity) and the year of publication; 2. Two authors: both authors' names and the year of publication; and 3. Three or more authors: first author's name followed by "et al." and the year of publication. Citations may be made directly (or parenthetically). Groups of references should be listed first alphabetically, then chronologically. Examples: "as demonstrated (Allan, 1996a, 1996b, 1999; Allan and Jones, 1995). Kramer *et al.,* (2000) have recently shown …".

List: References should be arranged first alphabetically and then further sorted chronologically if necessary. More than one reference from the same Author(s) in the same year must be identified by the letters "a", "b", "c", etc., placed after the year of publication.

Journal article: Nouri J.; Lorestani B.; Yousefi N.; Khorasani N.; Hassani A. H.; Seif, F.; Cheraghi M., (2011). Phytoremediation potential of native plants grown in the vicinity of Ahangaran lead-zinc mine. Environ. Earth Sci., 62(3): 639-644.

Book: Davis, M. L., (2005). Introduction to Environmental Engineering, 3rd. Ed. McGraw Hill Inc.

Book chapter: Mettam, G. R.; Adams, L. B., (1999). How to prepare an electronic version of your article, in: Jones, B. S., Smith, R. Z. (Eds.), Introduction to the electronic age. E-Publishing Inc., New York.

Conference paper: Brown, J., (2005). Evaluating surveys of transparent governance. In UNDESA, 6th. Global forum on reinventing government: towards participatory and transparent governance. Seoul, Republic of Korea 24-27 May. United Nations: New York.

Dissertation: Trent, J. W., (1975). Experimental acute renal failure. Ph.D. Dissertation, University of California. USA.

Online document: Cartwright, J., (2007). Big stars have weather too. IOP Publishing Physics Web.
http://physicsworld.com/cws/article/news/2007/jun/26/big-stars-have-weather-too

AFTER ACCEPTANCE

1. Online Proof Correction: Corresponding authors will receive an e-mail with a link to our online proofing system, allowing annotation and correction of proofs online. Use this proof only for checking the typesetting, editing, completeness and correctness of the text, tables and figures. Significant changes to the article as accepted for publication will only be considered at this stage with permission from the Editor-in-Chief. It is important to ensure that all corrections are sent back to us in one communication. Please check carefully before replying, as inclusion of any subsequent corrections cannot be guaranteed. Proofreading is solely the corresponding author responsibility.

2. Offprints: The offprints can be downloading from the IJHCUM website once the final corrected manuscripts are disseminated.

AUTHORS INQUIRIES

Authors can track their submitted article through IJHCUM website on author's login section at: http://ijhcum.net/contacts?_action=login

International Journal of Human Capital in Urban Management (IJHCUM)

Copyright Transfer Agreement

1. Parties of the agreement

Author (s):

Manuscript Title:

Manuscript ID:

(Herewith referred to as the "materials"),

Journal Title: International Journal of Human Capital in Urban Management (IJHCUM)

2. Subject of the agreement

A) Copyright
1- The Author and each co-authors shall transfer and sell to the Publisher for the length of the copyright starting from the moment the present agreement comes into force the exclusive rights to the materials, including the rights to translate, reproduce, transfer, distribute or otherwise use the materials or parts (fragments) contained therein, for publication in scientific, academic, technical or professional journals or other periodicals and in derivative works thereof, worldwide, in English, in print or in electronic editions of such journals, periodicals and derivative works in all media or formats now existing or that may exist in future, as well as the right to license (or give permission to) third parties to use the materials for publication in such journals, periodicals and derivative works worldwide. The transfer under this agreement includes the right to adapt the presentation of the materials for use in conjunction with computer systems and programs, reproduction or publication in machine-readable format and incorporation into retrieval systems.
2- Reproduction, placement, transfer or any other distribution or use of the materials, or any parts of the materials contained therein, in any way permitted under this Agreement, shall be accompanied by reference to the Journal and mentioning of the Publisher, namely: the title of the article, the name of the Author (Co-authors), the name of the Journal, volume/number, copyright of the publisher.

B) Reserved Rights
The Author (Co-authors) or the employer of the Author (Co-authors) of the materials shall retain all proprietary rights (with the exception of the rights transferred to the Publisher under the present Agreement).

C) Author Guarantee
The Author (Co-authors) guarantees that the materials are an original work, submitted only to IJHCUM, and have not been published previously.
In case the materials were written jointly with co-authors, the Author guarantees that he/she has informed them of the terms of this Agreement and obtained their signatures or written permission to singe on their behalf.
The Author guarantees as well that:
The materials do not contain libelous statements.
The materials do not infringe on other persons' rights (including without limitation copyrights, patent rights and the trademark right).
The materials do not contain facts or instructions that can cause damage or injury to third parties and their publication does not cause the disclosure of any secret or confidential information

Author (Corresponding Author):

Correspondence Address:

Phone:

Fax:

Email:

Corresponding Author Name: Signature Date

On Behalf of the Publisher:

Human Resource Development,
Navab High Way, Tehran 1346914117
Iran

Phone: (+9821) 6403 8606

Fax: (+9821) 6403 8226

Email: *editor@ijhcum.net*
ijhcum@gmail.com

Website: www.ijhcum.net

Accepted for publication ☑ Signature Date

PLEASE NOTE: The accepted manuscript cannot be processed for publication until the publisher has received this signed form. The form MUST be signed by the Corresponding Author and then scanned and sent through the system or email. If the manuscript is not published in the Journal, this release will not take effect.

The sole responsibility for the whole content (s) of the article remains only with the corresponding author. However, Editor would reserve the right to adjust the style to certain standards of uniformity before publication.

CONFLICT OF INTEREST DISCLOSURE FORM

Conflict of Interest is defined as a set of conditions in which professional judgment concerning a primary interest, such as the validity of research, may be influenced by a secondary interest, such as financial gain. A Conflict of Interest Disclosure is an agreement or notification from the authors that they have not been paid for the work, or if they have, stating the source of their payment. The purpose of Conflict of Interest Disclosure form is to provide readers of authors' manuscript with information about authors' interests that could influence how the authors receive the work. The corresponding author (on behalf of all co-authors) should submit a conflict of interest disclosure form and is responsible for the accuracy and completeness of the submitted manuscript. Conflict of Interest Disclosure form can be signed by the corresponding author on behalf of all co-authors and stating that the submitted manuscript is the authors' original work, has not received prior publication and is not under consideration for publication elsewhere, permission has been received to use any material in the manuscript much as tables, figures etc. or no permissions have necessary to publish the authors' work.

1. Name of the corresponding author

2. Affiliation including e-mail and phone number

3. Manuscript Title

4. Do the authors or authors' institution at any time receive payment or services from a third party (government, commercial, private foundation, etc.) for any aspect of the submitted manuscript (including but not limited to grants, data monitoring board, study design, manuscript preparation, statistical analysis, etc.)?

   Are there any relevant conflicts of interest? Yes / No

5. Do the authors have any patents, whether planned, pending or issued, broadly relevant to the work?

   Are there any relevant conflicts of interest? Yes / No

6. Are there other relationships or activities that readers could perceive to have influenced, or that give the appearance of potentially influencing, what the authors' information in the submitted manuscript?

   Are there any relevant conflicts of interest? Yes / No

7. Are there any aspect of the work covered in this manuscript that has involved either experimental animals or human patients has been conducted with the ethical approval of all relevant bodies or not.

   Are there any relevant conflicts of interest? Yes / No

Corresponding Author Signature | Print Name | Date

AUTHORSHIP FORM

By completing and signing the following statements, the corresponding author acknowledges and accepts the responsibility on behalf of all contributing authors, if any, concerning Authorship Responsibility.

Manuscript title:

Corresponding author:

Affiliation:

Email:

Phone No:

By signing and filling this form, the corresponding author certifies that each author has met all criteria below (A, B, C, and D) and indicates each author general and specific contributions by listing his or her name next to the relevant section.

A. I certify that

- The manuscript is authentic and valid and that neither this manuscript nor one with considerably similar content under my authorship has been published or is being considered for publication elsewhere, except as described in an attachment, nor copies of closely related manuscripts are provided.
- I will provide the data or will contribute fully in providing and obtaining the data on which the manuscript is based for examination by the editors or their assignees, if requested.
- Every author has agreed to allow the corresponding author to serve as the primary correspondent with the editorial office, to review the edited manuscript and proof.

B. Each author has given final approval of the submitted manuscript.

C. Each author has participated sufficiently in the work to take public responsibility for the whole content.

D. Each author qualifies for authorship by listing his or her name on the appropriate line of the categories of contributions listed below. List appropriate author next to each section – each author must be listed in at least 1 field. More than 1 author can be listed in each field.

- conception and design
- acquisition of data
- analysis and interpretation of data
- drafting of the manuscript
- critical revision of the manuscript for important intellectual content
- statistical analysis
- obtaining funding
- administrative, technical, or material support
- supervision
- no additional contributions
- other (specify)

Corresponding Author Signature **Print Name** **Date**

FINAL CHECKLIST

International Journal of Human Capital in Urban Management (IJHCUM)

Prior to acceptance of the manuscript, the corresponding author is responsible to adjust the whole manuscript according to the following items and then the marked final checklist should be attached along with the covering letter:

- ☐ A covering letter herewith, **not previously published and submitted elsewhere, fully or partially,** must be signed and accompanied by the corresponding author in the time of manuscript submission.
- ☐ All authors have read the **Ethics in publishing, Plagiarism prevention and violation of Publication Ethics and Handling cases of misconduct**.
- ☐ The Manuscript has been **read and approved by all listed authors**.
- ☐ The title page contains the **Title, Author (s) Name, Degree (s), Addresses, Tel., Fax and Email** of author (s) separated from the manuscript body.
- ☐ Not only the corresponding author, but also the whole contributors of the manuscript are advised to be registered at the journal website in order to keep their names in the manuscript biosketches.
- ☐ The abstract words content is not less than **150** and more than **250 words**, which brings upper scores for both; the publication as well as author (s).
- ☐ Key words count should be 5 to 7 words.
- ☐ It is suggested to the authors to define some proper main subjects related to their manuscript topic.
- ☐ Figures / illustrations are **in high quality art work**, with at least 200 dpi to 300 dpi. All graphs preferred to be provided in excel format.
- ☐ All Figures and Tables are cited throughout the text.
- ☐ The references are cited based on the authors surname and year of publication (Harvard System) throughout the text body. Moreover, the list of the references is carefully arranged alphabetically at the end of manuscript.
- ☐ The number of references in the review paper preferred to be not contain less than 100; for original research paper or case report not less than 30 and for short communication 20 references are required.
- ☐ The majority of manuscript references must not be extracted from a single journal. The acceptable average can be indicated at most 4 to 6 references from each journal.
- ☐ A **copy right release and conflict of interest disclosure form** must be signed by the corresponding author in case of multiple authorships, prior to the acceptation of the manuscript, by all authors, for publication to be legally responsible towards the Journal ethics and privacy policy.
- ☐ The manuscript is in structured format with; **Abstract; Key words; Introduction; Materials and Methods; Results and Discussion; Acknowledgements and References.**
- ☐ The author(s) are appealed to provide the source(s) of financial support along with the grand number for the study in the acknowledgements section.
- ☐ Hereby, I accept liability for the scientific integrity of the manuscript contents.

Name:

Corresponding Author Signature:

Date:

SUBSCRIPTION FORM

Subscription form

International Journal of Human Capital in Urban Management

Please enter my annual subscription to the International Journal of Human Capital in Urban Management (IJHCUM), including 4 quarterly issues for the year ..... Vol. ..... Nos. .....

	Domestic	Foreign
☐ Institutional	IRR. 1,000,000	US$ 100
☐ Individual	IRR. 800,000	US$ 80
☐ Student	IRR. 600,000	US$ 60
☐ Single copy	IRR. 300,000	US$ 30

Name: **Tel.:** **Email:**

Mailing Address:

** Please allow 3 to 5 weeks for delivery*

Please send this filled in order form along with the Bank receipt payment to:

International Journal of Human Capital in Urban Management,
Human Resources Office, Municipality of Tehran, Navab High Way,
Postal Code 1346914117,
Tehran, Iran

INTERNATIONAL

Journal of HUMAN CAPITAL IN URBAN MANAGEMENT

CONTENTS

Volume 6, Number 3, Summer 2021

(Serial # 23)