International Transaction Journal of Engineering, Management, & Applied Sciences & Technologies

Volume 10 Issue 3 (2019)

ISSN 2228-9860
eISSN 1906-9642

http://TuEngr.com

Cover photo is tested concrete slab composites at their points of failure, in this issue paper entitled Analysis of Horizontal Shear Strength of Precast Prestressed Concrete Slab and Concrete Topping Composites, by Wilaiwong and Vivitkeyoonvong.

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:: International Transaction Journal of Engineering, Management, & Applied Sciences & Technologies

Volume 10 Issue 3 (2019)
http://TuEngr.com

ISSN 2228-9860
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FEATURE PEER-REVIEWED ARTICLES

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MATHEMATICAL MODELS FOR EVALUATING PROGRAM AND COURSE LEARNING OUTCOMES IN HIGHER EDUCATION

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ARTICLEINFO

Article history:
Received 12 November 2018
Received in revised form 12 February 2019
Accepted 18 February 2019
Available online
25 February 2019

Keywords:
Program learning outcomes (PLO); CLO; KPI; Key Performance Indicators; Learning Assessment Model.

ABSTRACT

At present, most of the Universities concentrates on assessing the programming learning outcome. These programs learning outcomes (PLO) are defined/fixed by the accreditation agencies and are mapped with the course learning outcome (CLO). In a micro level, key performance indicators (KPIs) are defined for each program learning outcomes. The role of a faculty member is very important in this stage in evaluation and assessment. The faculty member sets the assessment tools based on the course learning outcomes and the associated key performance indicators. Evaluation is carried out by the faculty member based on the rubrics associated with the performance indicator. The evaluation process should be more transparent and to provide a clear picture of the student position in the class. The need for developing a suitable mathematical model to record the marks at micro level and assess the outcomes must be considered by the Universities in order to strengthen the assessment process. This research paper deals with developing mathematical models to evaluate the average scores of the programming learning outcomes and course learning outcomes.

1. INTRODUCTION

The assessment and evaluation process is very vital in any education system. The courses in the higher educational level are evaluated against the learning outcome. This learning outcome are referred as course learning outcome (CLO). This course learning outcomes are then mapped with the program learning outcomes. The higher educational institutions in the Kingdom of Saudi Arabia also uses the Key Performance Indicators (KPI). These KPIs are at the micro level and are mapped with the course learning outcomes. The teacher sets the question paper for a chosen course based on the KPIs and CLOs. After the

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evaluation, the marks are entered against the KPIs to calculate the average score for each outcome. At present, there is no uniform / standard model available with the Universities to calculate the average score. Most of the Universities uses custom build software or an Excel sheet to enter the marks and calculate the average score. The proposed research deals about development mathematical models for calculating the score for evaluating KPIs, CLOS and program learning outcome. This model is tested with two courses with the College of Computer and Information Sciences of Majmaah University of Kingdom of Saudi Arabia. The developed mathematical model with the test cases for two courses are presented to demonstrate the application of the proposed approach. The Developed mathematical models improve the quality of assessment and evaluation. The results are presented at the end of the paper by comparing with the existing approaches presently used to calculate the average scores.

The main objectives of the paper are provided below

- Study of existing evaluation methods and criteria
- Study the role of mathematical model in assessment and evaluation
- Developing a suitable mathematical model to assess the programming learning outcomes and course learning outcome
- Testing the developed model
- Implementation of the tested model in colleges / Universities

2. REVIEW OF THE LITERATURE

The literature review had been carried out in various aspects by considering the scope of the project.

Love et al. [1] presents a new model that concentrates more on the problem-solving approach rather that the traditional approach such as using the classrooms etc., The author proposes a STEM model which can be used in science, technology, engineering, and mathematics fields. This is data-driven model presented by the author. The author has carried out only little research in assessing the potential effects of student learning outcomes using the STEM approach.

Phillips [2] analyses the work of previous images of mathematical modelling are reviewed and compared. These previous images are used to develop a set of definitions for the different components of modelling. To develop an improved image of modelling for teaching and learning, new systems are developed in the mathematical modelling process. Furthermore, new processes between all the systems are examined. The new systems and processes are included in a new image to acknowledge and recognize important processes in the classroom. The new theory and image are then used to represent and reconcile past images of modelling.

Mason and Dragovich [3] presents a coursework-based assessment methodology. The author implements and analyses this methodology using a database system, and a least square analysis. The methodology is then presented by analysing the data in an engineering program over a four-year period. The results of this assessment are clearly discussed in this paper.

Harmanani [4] presents a bottom-up outcome-based assessment approach. This approach facilitates the faculty members participation and simplifies the assessment and reporting processes in the evaluation. The author has implemented the proposed approach for the successful accreditation of a computer science program. This approach can be easily applied to any higher education program.

Springer et al. [5] demonstrates that various forms of small-group learning are effective in promoting greater academic achievement. The author presents the important attitudes toward learning. The author presents a SMET approach, which can be used to, to group of students learning science, mathematics, engineering, and technology courses of the department.

Hajj-Hassan et al. [6] highlights the Biomedical Engineering program students learning outcomes assessment approach. The results in this paper discusses the data collection in line with the best practices, usage of key performance indicators. The overall objective of this paper is to help the academic departments to improve the quality in assessment and evaluation.

Imam and Tasadduq presents a simple formula that can be used to convert CLO-based assessment scores to SO-based scored through the CLO-SO mapping. The author presents a software package namely "CLOSO" which is used to implement the formula. This software automates the evaluation of CLO scores and SO scores which is used to improve the quality of assessment data. This software also helps the faculty members to save the time [7].

Bareduan et al. [8] presents an application of continuous quality improvement process. The author uses this process for an engineering course. The author considers the performance measures such as course learning outcomes (CLO), CLO attainment levels and overall course grades. The author also presents a pareto diagram which is used to analyse the CLO attainment levels data resulting from tests, assignments and final exam marks.

Freeman et al. proposes and tests a hypothesis, this is used to maximize learning and course performance. The authors analysed 225 studies that reported data on examination scores, the author has tested the model with the students learning science, mathematics, engineering, and technology courses of the department [9].

Huang and Fang compares four types of mathematical models. The developed mathematical models are used to predict student academic performance in a course (engineering dynamics). This course is considered by the author due to a high-enrolment and it is a core course that many engineering undergraduates are required to take. The author uses multiple linear regression model, the multilayer perception network model, the radial basis function network model, and the support vector machine model in the proposed mathematical model. The author integrates the proposed model with a learning management system. The learning management system enhances the learning outcomes to meet the expectations [10].

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The learning management system also enhance the learning outcomes to meet the expectations [11]. Marks et al (study the uses of technology in higher education for the course evaluation for the several parameters e.g. quality of questions, grouping of the course and course learning outcomes at the college and university level [12]. George et al. develop a software tool to calculate the KPI for the course evaluation and ABET criterion [13].

It is clear from the above-reviewed literature that there is no standard mathematical available to evaluate the average scores as proposed in this research work. Also, the few existing mathematical models are not suited to be used with the educational institutions.

3. METHODOLOGY

In order to meet the defined first objective, a detailed study was carried out on existing evaluation. The study focused on six colleges in the Majmaah University. It is noted that all the colleges have their custom build software or a sheet to calculate the score. There is no uniformity in the calculation of the average evaluation score. This provides strong justification to the authors to proceed with defined problem. At present, the scope is limited inside the college. Efforts will be taken to extend the scope after successful validation. The whole assessment process is presented in Figure 1.

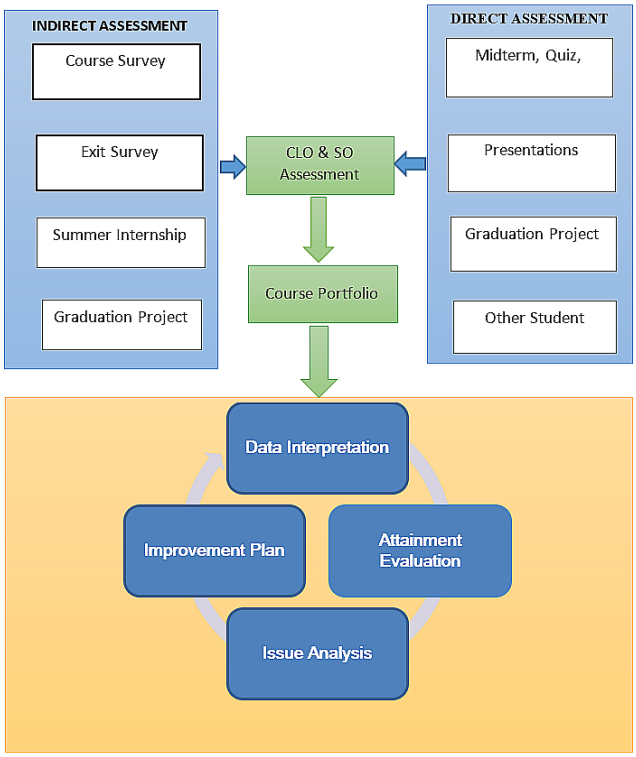

Figure 1: Assessment and Evaluation Processes

Also, as stated in second objective, the proposal of using standard Mathematical model leads to a creation of a new standard. Once the standard validation is successful in all aspects, this helps the Universities to follow and establish common acceptance criteria among all the colleges.

For the objective three, this research aims to develop a suitable mathematical model for the following parameters used in assessment and evaluation

- Key Performance Indicators (KPIs)
- Course Learning Outcomes (CLOs)
- Program Learning Outcomes (PLOs)

3.1 Assessment Process

The assessment and evaluation of SOs of an individual course during the semester based on data collection is explained in detail. Table 1, the various attainment level based on the marks scored by the students has been given.

Table 1: Assessment Attainment Level

Exceeds Expectations (EE)	Meets Expectations (ME)	Progressing Towards Expectations (PE)	Does Not Meet Expectations (DNME)
>=80% or more of students are achieving the satisfactory level or above	>=70% and <80% of students are achieving the satisfactory level or above	>=60% & <70% of students are achieving the satisfactory level or above	< 60% of students are not achieving the satisfactory level

4. DATA COLLECTION

The direct assessment is evidence of student outcome. It is tangible, visible, measurable and tends to be more compelling evidence of exactly what students have and does not learned. The evidence of students' performance to determine what they've learned is available in the course portfolio.

Indirect assessment evidences tend to be composed of proxy signs that students are probably learning. An example of indirect evidence is a survey through which asking students their self-report that what they have learned. This is evidence that students probably are learning what they report to have learned, but it is not as compelling as a faculty member looking at students' work. It is not uncommon in students' self-reports to either inflate or undervalue what they have learned.

Course assessment report is a consolidated evidence by the instructor of each and individual section. It contains the data collected from direct and indirect assessments, which were practiced during semester. The information is gathered using several instruments at regular intervals. For example, an exit survey is a data collection instrument that is used to gather information about the graduating students' opinion to measure the SOs achievement. These instruments are described in detail at later sections.

Data Preparation: The data preparation involves validation and transformation to make it ready for use in evaluation of SOs. For example, the paper-based survey data is converted to electronic format. The illegible, incomplete, erroneous or duplicate submissions are discarded whenever necessary.

4.1 EVALUATION PROCESSES

Data Interpretation: Metrics are used to summarize data and its interpretation based on the points of interest. For example, the survey responses are used to calculate weighted averages scored of SOs.

Attainment Evaluation: The attainment of evaluation for all the SOs are measured in

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this step. For example, the verification of the SO achievement from various data sources with reference to the threshold values (EE-Exceeding Expectation, ME-Meeting Expectation, PE-Progressing towards Expectation & DNME-Does Not Meet Expectation) are carried out.

Issue Analysis: Wherever the evaluation of targeted SOs are not achieved, an issue based deeper analysis is conducted. For example, reviewing faculty course assessment reports, discussing with faculty and students to determine underlying issues for poor achievement.

Improvement plan: An action plan is developed to remedy the identified issues and recommended implementation over the issue.

4.2 MATHEMATICAL MODEL FOR KPIs

A Key Performance Indicator is a quantitative value that demonstrates how effectively a course is achieving the objectives. The Universities used the KPIs at multiple levels to evaluate their performance. The KPIs provides how well the course is progressing across the semesters/years. The KPIs vary for each course and program across a University. The following are the important properties of the KPIs

- Well defined
- Measurable
- Important in achieving the objective
- Aligned with the objective of the department

In the Course level, the KPIs are defined for each PLOs. Few example KPIs for the PLO *"An ability to apply knowledge of computing and mathematics appropriate to the discipline"* is listed below

a) Ability to apply knowledge of mathematics (e.g., statistics, probability, discrete mathematics)
b) Ability to solve and implement a programming problem from a given computation model using procedural and/or object-oriented programming approach
c) Ability to use algorithmic knowledge to present a feasible algorithmic solution to a problem
d) Ability to apply knowledge of computing

By keeping these justifications, this research paper proposes mathematical model to calculate the score of a KPI which is presented as detailed below.

Let us consider as follows. The total size of the class

$$\boldsymbol{N} = \boldsymbol{n_1} + \boldsymbol{n_2} + \boldsymbol{n_3} \quad (1),$$

where $\boldsymbol{n_1}$ is the number of students who scored above 80% marks in the question pertaining to assigned KPI., $\boldsymbol{n_2}$ is the number of students who scored above 60% and less than 80% marks in the question pertaining to assigned KPI, $\boldsymbol{n_3}$ is the number of students who scored less than 60% marks in the question pertaining to assigned KPI.

KPI Results in Percentage for m^{th} KPI is denoted by K_m. KPI has been calculated based on the marks score in the assessments. The techniques based on the weightage of

student's category e. g meet expectation, below expectation or above the expectation. One can choose the category as per the requirement of the criteria of assessments.

$$K_m = \frac{\sum_{i=1}^{l} w_i n_i}{w_{imax} N} \quad (2),$$

where w_i is the weight assign for category of the students who score in ith type of category types based on the performance and $w_{imax} = \max(w_1, w_2, w_3, \ldots w_i \ldots, w_l)$. The weightage can be obtained after validation with the average percentage obtained by the whole course.

4.3 MATHEMATICAL MODEL FOR THE PLOs

The program learning outcomes are the statements that specify what the students will know or will be able to do after completing a program. These outcomes are indicated using knowledge, cognitive skills, communication skills, information technology skills etc. The important characteristics of the PLOs are

- Measurable
- To be demonstrated
- Observable

All the programs (BS, MS etc.,) in the Universities are provided with the PLOs. Mostly, these PLOs are defined by the accreditation agencies such as ABET, NCAAA etc., Few example PLOs are listed below

1) An ability to apply knowledge of computing and mathematics appropriate to the discipline.
2) An ability to analyze a problem and identify and define the computing requirements appropriate to its solution.
3) An ability to use current techniques, skills, and tools necessary for computing practices

By calculating the average score of the PLOs, the Universities/departments knows the present performance and take remedial actions to further strengthen the assessment and evaluation process. This paper proposes the following mathematical model to be used to calculate the average score for each PLOs.

Let us consider as follows. The students learning outcome for a to k (the ABET LO) assessed by the

$$S_j = \frac{1}{p}\sum_{i=1}^{p} K_i = \frac{\text{Sum of results of corresponding KPI's in percentage}}{\text{Number of KPI Under Consideration}} \quad (3),$$

where, p is the number of KPI associated with the j^{th} students' outcome, j = a to k are the ABET learning outcomes for BS Computer Science program, and a to n for ABET learning outcomes for BS Information technology program (as applicable). For example: the jth SO is associated with the KPI number p, q, r then the calculated learning outcome. $S_j = (k_p + k_q + k_r)/3$.

4.4 MATHEMATICAL MODEL FOR THE CLOs

The course learning outcomes are clear and concise statements that provide the students

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expected and achievable skills by the end of the semester. The CLOs should be related to the topics in the course. Also, the CLOs are more detailed and specific than the program learning outcomes as it uniquely identifies the expected skills to be learned by a student. The important characteristics of the CLOs are

- Clear
- Measurable
- Using Verbs

This course learning outcomes are related the programming learning outcomes. Both CLOs and POs are mapped to each other to calculate the average score. Few example CLOs for the course *"Coding and Information Theory"* is provided below.

- Understand the definitions and basic properties of uniquely decodable, instantaneous, prefix and optimal codes, the entropy function, and error-correcting codes;
- Implement Huffman's algorithm for the construction of optimal codes;
- State and prove basic theorems, such as the McMillan and Kraft inequalities and Hamming's sphere-packing bound.
- State and apply deeper results, such as the Sardinas-Patterson Theorem and Shannon's Fundamental Theorem (for the binary symmetric channel);
- Construct some simple error-correcting codes, such as the binary Hamming codes, and understand their basic properties

This paper proposes the following mathematical model to be used to calculate the average score for each CLOs. Let us consider as follows,

C_i= Average of results of corresponding SLO's belonging to that ith CLO, where C_i denotes the ith course learning outcome. Let C_i course learning outcome is associated with the SLO, *s*, *a*, *b* and

$$C_i = \frac{S_a+S_b+S_i}{3} \tag{4}$$

The class have total *N* number of students. Class size may be divided into several categories based on the marks obtained question or group of questions corresponding to the KPI. In this paper, the class performance is divided into three categories progressive towards expectation [PE], meet expectation [ME] and exceed expectation [EE] based on the performance in the direct assessments midterm, class test, quizzes, and final examination. The following base table is used as guideline to calculate the average score of the outcome / KPIs.

5. RESULTS

Two courses are taken as samples to implement the developed mathematical models. The calculation of CLO's, KPI'S and SO's have been done based on the methodology described. In this approach, first, calculate the KPI's then calculate the CLO's with have a correspondence with the respective KPI's and finally the SO's will be calculated by taking the average of the corresponding CLO's.

Table 2: Marks scored by the students in each KPIs

Assessment Tools→	Mid Exam		Final Exam	Assignment 1		Assignment 2	Exercises	Final Exam
PLOs→	PLO(b)			PLO(d)			PLO(i)	
KPIs→	KPI-b2	KPI-b3	KPI-b4	KPI-d1	KPI-d2	KPI-d3	KPI-i1	KPI-i2
Max Marks→	11	5	23	2.5	2.5	5	10	12
Marks Scored→	11	5	23	2.5	2.5	5	10	12
	11	5	23	2.5	2.5	5	10	12
	11	5	17	2.5	2.5	5	8	9
	11	5	18	2.5	2.5	5	9	4
	11	5	19	2	2	4	8	7
	11	5	20	2.5	2.5	5	8	5
	11	5	13	2	2	4	7	10
	11	5	11	2.5	2.5	4	7	9
	10	4	17	2.5	2.5	5	8	5
	5	4	12	2.5	2.5	5	8	6
	3	4	3	2.5	2.5	5	7	2
	11	4	18	2.5	2.5	5	8	9
	1	4	8	2.5	2.5	5	8	6
	10	5	20	2	2	3	6	10
	11	5	23	2.5	2.5	5	9	6
	6	5	11	2	2	3	4	9

5.1 CASE 1

Course Name: Coding and Information Theory

Table 2 presents the marks scored by 15 students in each KPIs for the course *"Coding and Information Theory"*. The PLOs *b, d, i* of the ABET student outcomes are mapped to this course. The PLOs and KPIs associated with detailed in Table 3.

Table 3: PLOs and KPIs

PLOs	KPIs Considered
An ability to analyse a problem and identify and define the computing requirements appropriate to its solution. (b)	Ability to analyze and solve the problem
	Ability to develop prototype, test cases, evaluation and validation tools
	Ability to specify the software tools needed for a given problem/software development
An ability to function effectively on teams to accomplish a common goal. (d)	Ability to participate effectively as part of a team
	Ability to fulfill team roles assigned
	Ability to accomplish the team goals.
An ability to use current techniques, skills, and tools necessary for computing practices. (i)	Ability to apply knowledge of simulation tools, analysis and software's used
	Ability to choose modern tools, latest software, emulation, simulation tools necessary for computing practice

Table 4: Number of Students Attainment Levels in KPIs

Attainment Levels \ KPIs	KPI-b2	KPI-b3	KPI-d1	KPI-d2	KPI-d3	KPI-i1	KPI-b4	KPI-i2
EE	11	15	15	15	13	8	5	3
ME	0	0	0	0	0	5	4	4
PE	4	0	0	0	2	1	1	0
DNME	0	0	0	0	0	1	5	8
Average Score	81	100	100	100	91	78	67	61

Table 4 and Figure 2 presents the KPI values for each of the attainment levels. The mathematical model presented in section 4.1 is used to calculate the cell values (number of students). Table 5 presents the average values of the PLOs. The PLOs are provided in Table 3. The mathematical model presented in section 4.2 is used to calculate the average value for each of the outcome.

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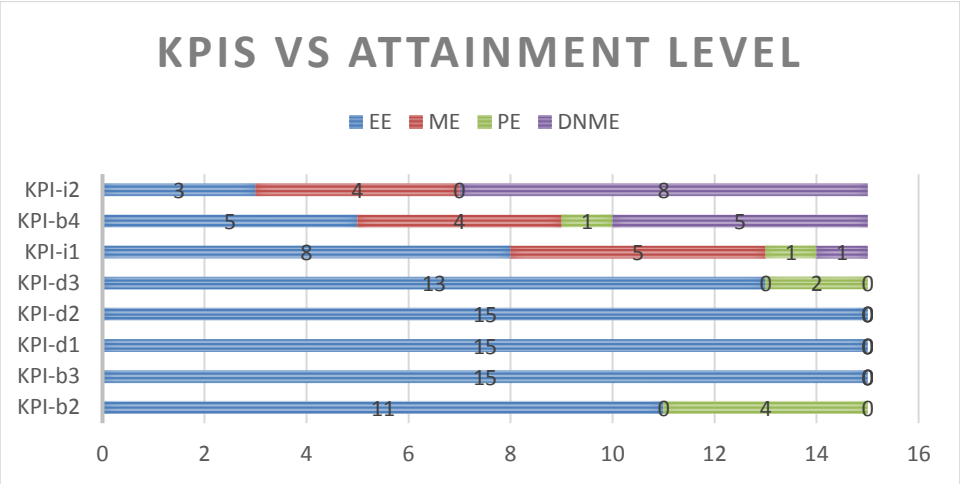

Figure 2: KPIs Vs Attainment Level

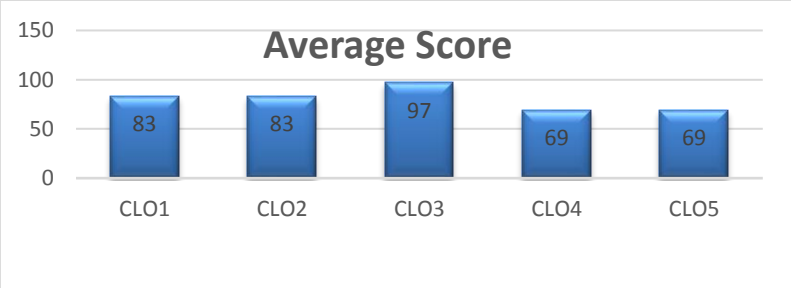

Figure 3: Average Score in CLOs

Table 7: Marks scored by the students in each KPIs

Assessment Tools→	Mid Exam	Exercise / Final Exam	Mid Exam/ Exercise	
PLOs→	PLO(a)		PLO(b)	
KPIs→	KPI-a1	KPI-a3	KPI-b1	KPI-b2
Max Marks→	22	30	19	29
Marks Scored by Students→	17	27	15	16
	15	19	16	10
	20	27	17	12
	15	24	15	17
	21	30	19	25
	17	20	16	7
	15	17	17	12
	13	27	14	15
	16	23	16	16
	19	21	14	18
	18	21	17	10
	17	25	14	24
	17	22	15	12
	20	27	18	21
	15	22	15	15
	20	24	14	16
	15	10	13	6
	17	24	17	18
	18	18	15	20
	16	23	15	17
	21	29	17	24
	15	23	14	13
	14	21	16	19
	15	20	15	10
	18	17	15	17
	15	25	16	14
	15	24	17	20
	15	24	15	20
	16	22	17	16
	17	24	18	17

Table 5: Average Score in PLOs

PLO	Average Score
b	83
d	97
i	69

Table 6: Average Score in CLOs

CLO	Average Score
CLO1	83
CLO2	83
CLO3	97
CLO4	69
CLO5	69

Table 6 and Figure 3 presents the average values of the CLOs. The mathematical model presented in section 4.3 is used to calculate the average value for each of the outcome.

5.2 CASE 2

Course Name: Calculus 2

Table 7 presents the marks scored by 30 students in each KPIs for the course *"Linear Algebra"*. The PLOs a,*b* of the ABET student outcomes are mapped to this course. The PLOs and KPIs associated with detailed in Table 8.

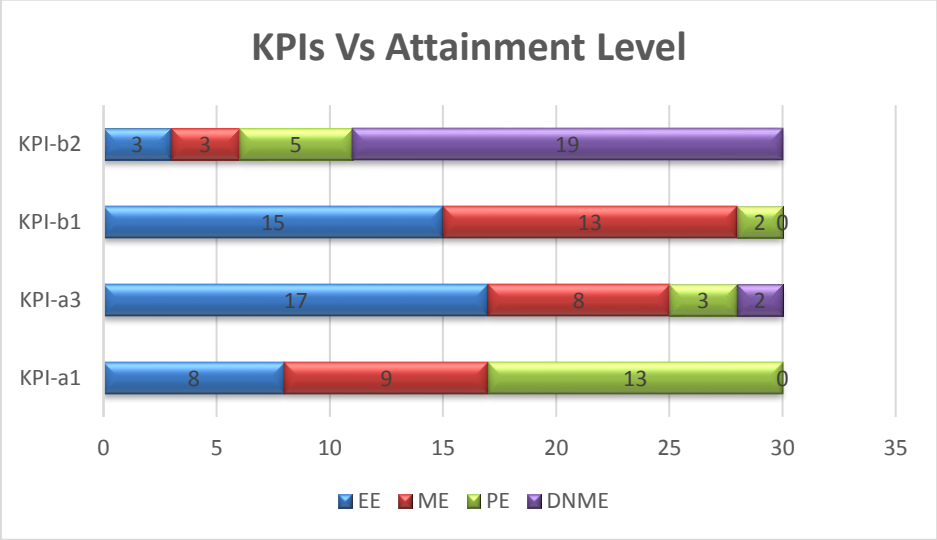

Figure 4: KPIs Vs Attainment Level

Table 8: PLOs and KPIs

PLOs	KPIs Considered
An ability to apply knowledge of computing and mathematics appropriate to the discipline. (a)	Ability to apply knowledge of mathematics (e.g., statistics, probability, discrete mathematics)
	Ability to use algorithmic knowledge to present a feasible algorithmic solution to a problem
An ability to analyse a problem, and identify and define the computing requirements appropriate to its solution. (b)	Ability to identify key points of the project. Ability to formulate an approach to solve.
	Ability to analyze and solve the problem

Table 9 and Figure 4 present the KPI values for each of the attainment levels. The mathematical model presented in section 4.1 is used to calculate the cell values (number of students). Table 10 presents the average values of the PLOs. The PLOs are provided in table 3. The mathematical model presented in section 4.2 is used to calculate the average value for each of the outcome.

Table 9: Number of Students Attainment Levels in KPIs

Attainment Levels \ KPIs	KPI-a1	KPI-a3	KPI-b1	KPI-b2
EE	8	17	15	3
ME	9	8	13	3
PE	13	3	2	5
DNME	0	2	0	19
Average Score	77	75	82	55

Table 10: Average Score in PLOs

PLO	Average Score
a	76
b	68

Table 11: Average Score in CLOs

CLO	Average Score
CLO1	72
CLO2	72
CLO3	68
CLO4	68

Table 12: PLO Scores for proposed and existing model for Calculus 2

PLO	Existing Approach	Proposed Approach
a	76	75
b	68	67

Table 13: PLO Scores for proposed and existing models for Coding and Information Theory

PLO	Existing Approach	Proposed Approach
b	83	75
d	97	93
i	69	68

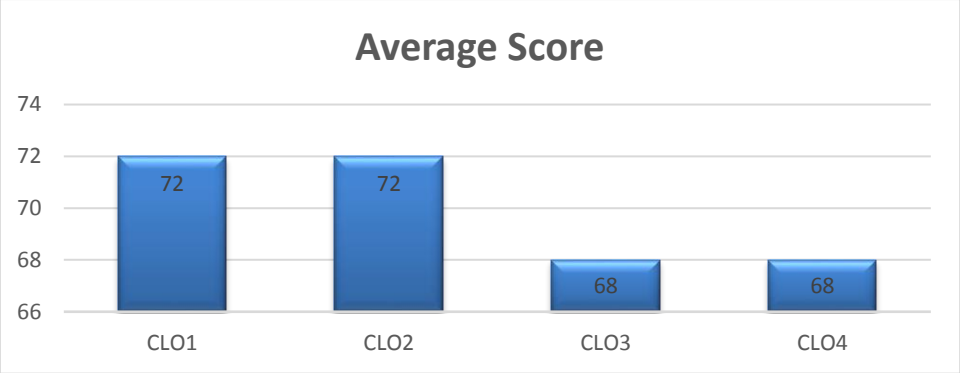

Figure 5: Average Score in CLOs

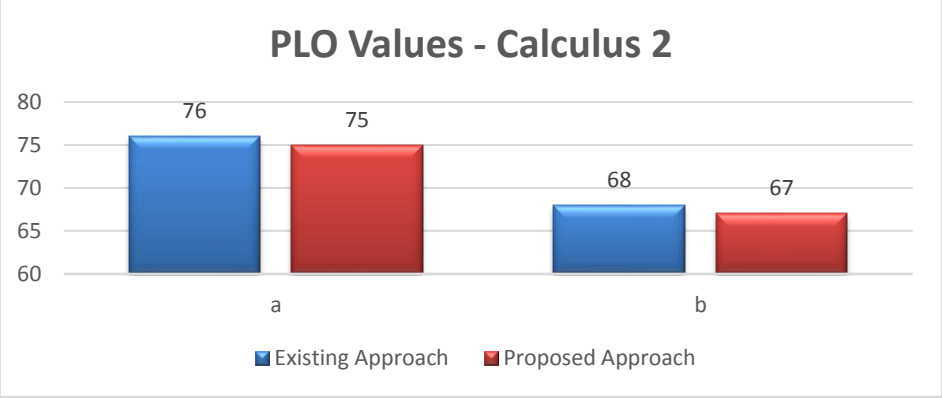

Figure 6: Average Score in PLOs - Calculus 2

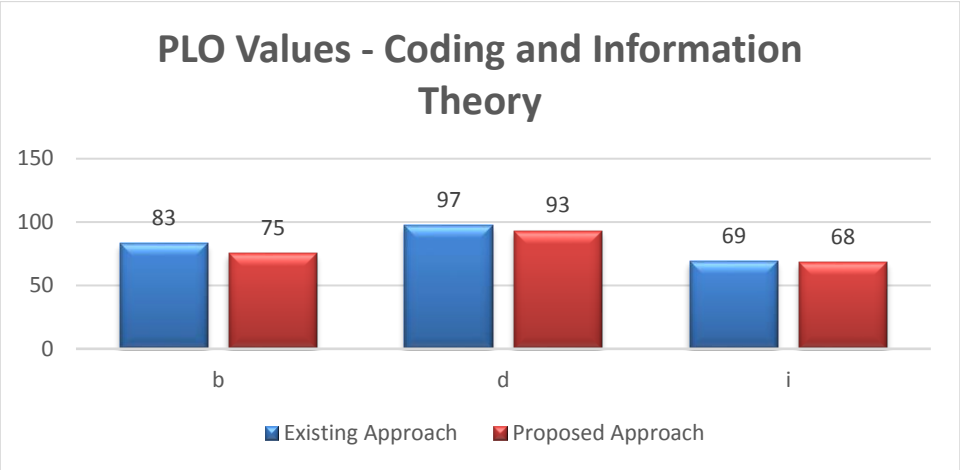

Figure 7: Average Score in PLOs – Coding and Information Theory

Table 11 and Figure 5 presents the average values of the CLOs. The mathematical model presented in section 4.3 is used to calculate the average value for each of the outcome.

It is noted from Figures 6 & 7, the proposed approach gives the values close to the existing approach. This clearly indicates that there is a high degree association between the proposed approach and the existing approach. The advantage of the proposed approach is the exit analysis of the courses in a micro level (KPIs and CLOs). Overall, the developed mathematical model is a standard approach, which can be used to calculate the average scores for KPIs, CLOs, and PLOs.

6. CONCLUSION

This paper presented mathematical models to evaluate the average scores of the program learning outcomes and course learning outcomes. The developed models are tested for two courses in the college of computer and information sciences of Majmaah University, Kingdom of Saudi Arabia. Using the developed mathematical models, the scores shows the attainment levels in each outcomes/KPIs. Based on the acceptance level in the Departments, efforts will be taken in the near future to develop a software system using this developed mathematical models. It is also concluding that the evaluation of course learning outcomes based on the KPI may help in the teaching-learning process, decision makers and at the end for the industry. The key performance indicator also helps for in prediction of results in the course so that the concern teacher can plan the teaching strategies as the students' performance in the KPI. This approach is useful to identify the skills of the students and achievement in the specific skill. The KPI has been measured based on the performance category of the students. The different performance categories have their different weights, the high weightage has been assigned for the students who have the good performance this is better measurement than by considering only the average of the performance of the students. Eventually, it will help in the accurate measurements of the students' outcome.

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However, in future by applying the optimization techniques for choosing the weight may help in the selection of the weights of the different categories of the students.

7. ACKNOWLEDGMENT

The authors thank Deanship of Scientific Research at Majmaah University for supporting this work under Project Number No. 1440- 57.

8. REFERENCES

[1] B. Love, A. Hodge, N. Grandgenett and A. W. Swift, Student learning and perceptions in a flipped linear algebra course. International Journal of Mathematical Education in Science and Technology, 45(3), 2014. pp.317-324. https://doi.org/10.1080/0020739X.2013.822582

[2] C. G. Phillips, An Improved Representation of Mathematical Modelling for Teaching, Learning and Research. *International Journal of Innovation in Science and Mathematics Education* (formerly CAL-laborate International, 23(4). 2016. https://openjournals.library.sydney.edu.au/index.php/CAL/article/view/7815/10019

[3] G. Mason J. and Dragovich, Program assessment and evaluation using student grades obtained on outcome-related course learning objectives. *Journal of professional Issues in Engineering education and Practice*, 136(4), 2010. pp.206-214. https://doi.org/10.1061/(ASCE)EI.1943-5541.0000029

[4] H. M. Harmanani, A bottom-up outcome-based learning assessment process for accrediting computing programs. *In Proceedings of the International Conference on Frontiers in Education: Computer Science and Computer Engineering (FECS)* (p. 1). The Steering Committee of The World Congress in Computer Science, Computer Engineering and Applied Computing (WorldComp).

[5] L. Springer, M. E. Stanne and S. S. Donovan, Effects of small-group learning on undergraduates in science, mathematics, engineering, and technology: A meta-analysis. *Review of educational research*, 69(1), 1999, 21-51. Available from http://www.jstor.org/stable/1170643

[6] M. Hajj-Hassan, B. Hussein, K. Chahine and A. Haj-Ali, A sustainable approach for program students outcomes assessment: the case of the Department of Biomedical Engineering at the Lebanese international university. *J Mod Educ Rev*, 7(4), 2014. pp.555-63.

[7] M. H. Imam and I. A. Tasadduq, Evaluating the satisfaction of ABET student outcomes from course learning outcomes through a software implementation. *International Journal of Quality Assurance in Engineering and Technology Education*, 2(3), 2012. 21-33. https://doi.org/10.4018/ijqaete.2012070102

[8] S.A. Bareduan, I. Baba, Z. M. Ali and A. Ponniran, Continuous Quality Improvement Process Using on strictive alignment, *Journal of Technical Education and Training* Vol. 4. (1) 2012. http://eprints.uthm.edu.my/2858/1/continuous_quality_improvement_process_using.pdf

[9] S. Freeman, S. L. Eddy, M. McDonough, M. K. Smith, N. Okoroafor, H. Jordt and M. P. Wenderoth, Active learning increases student performance in science, engineering, and mathematics. *Proceedings of the National Academy of Sciences*, 111 (23), 2014. pp.8410-8415. https://doi.org/10.1073/pnas.1319030111

[10] S. Huang and N. Fang, Predicting student academic performance in an engineering dynamics course: A comparison of four types of predictive mathematical models. Computers & Education, 61, 2013, 133-145. https://doi.org/10.1016/j.compedu.2012.08.015

[11] Y. Park and I. H. Jo, Using log variables in a learning management system to evaluate learning activity using the lens of activity theory. Assessment & Evaluation in Higher Education, 42(4), 2017. pp.531-547. https://doi.org/10.1080/02602938.2016.1158236

[12] Marks, A. A. Maytha, M. Majdalawieh and A. Bani-Hani, Improving Academic Decision-Making through Course Evaluation Technology. International Journal of Emerging Technologies in Learning 12(11), 2017. pp.4-14. https://doi.org/10.3991/ijet.v12.i11.6987

[13] George, T. Lethbridge and L. Peyton, Graduate attribute assessment in software engineering program at university of ottawa–continual improvement process. Proceedings of the Canadian Engineering Education Association. 2017. https://doi.org/10.24908/pceea.v0i0.6484

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ASSESSMENT OF WATER BALANCE IN FOOD TRADE IN THE WATER-SCARCE REGIONS OF NIGERIA

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ARTICLEINFO

Article history:
Received 04 January 2019
Received in revised form 07 February 2019
Accepted 21 February 2019
Available online
25 February 2019

Keywords:
Food trade; crop productions; water footprint; water balance; virtual water; CROPWAT; imports and exports.

ABSTRACT

Rapid growth in the world population leads to increase demand for water and hence water scarcity rises. Water is said to be virtually transported when the produced food are transferred from the point of its production to the point of consumption. Hence, this research was aimed at determining the volume of virtual water required to produce 25 different crops in the most water-scarce region of Nigeria for the year 2013. In the meantime, the virtual water imports and exports, the volume of virtual water produced, water balance, and water footprint, contributions of green, blue, and grey water for crop productions, imports costs, exports income and productions value of the selected crops were distinguished. CROPWAT 8.0 software was used in conducting this research. The result showed that in the selected six states of the water-scarce region, the sum of the volumes of virtual water produced of the crops selected was approximately 34.7 Gm^3/yr., virtual water imports volume was 8.3 Gm^3/yr, virtual water exports volume was 26.5 Mm^3/yr., water balance was 8.3 Gm^3/yr. and water footprint was 43 Gm^3/yr. Total production value was $2.5 billion, import cost $763.5 million and export income $1.1 million. The most suitable state to grow crops in the water-scarce region of Nigeria is Zamfara as it has more percentage of green water used than others, which can, therefore, reduce cost of production and scarcity of water.

1. INTRODUCTION

With persistent increase in world population, water resources are tremendously regarded as an economic good due to its scarcity in numerous countries and areas of the globe (Yang et al., 2006, Hoekstra and Hung, 2005). So many countries due to their scarcity of water resources depend on food importation in order to acquire the desired domestic demand of food. However, for those water-scarce countries, the food imported was virtually equal to the importation of water which can be used under other circumstances to produce food within the nation domestically. According to Allan (1993), water which is conveyed within imported food is regarded as 'Virtual Water'. Moreover, Hoekstra (2003)

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expanded the idea of virtual water as water needed to produce agricultural goods and also goods by industries. Deliberations on issues of virtual water are until now based mainly on food items because of their major ratio in aggregate water use (Yang et al., 2006). Yang et al (2003) meanwhile, explained that, with a prolonged increase in scarcity of water in numerous countries of the globe, the function of virtual water trade (VWT) in equating domestic water budget is anticipated to rise.

This research was aimed at determining the volume of virtual water required to produce 25 different crops in the water-scarce region of Nigeria in 2013, virtual water imports and exports, volume of virtual water produced, water balance, and water footprint, contributions of green, blue, and grey water for crop productions, imports costs, exports income and productions value of the selected crops. The result showed that in the selected 6 states of the water-scarce region, the sum of the volumes of virtual water produced of the crops selected was approximately 34.7 Gm^3/yr, virtual water imports volume was 8.3 Gm^3/yr, virtual water exports volume was 26.5 Mm^3/yr, water balance was 8.3 Gm^3/y and water footprint was 43 Gm^3/yr. Total production value was $2.5 billion, import cost $763.5 million and export income $1.1 million. The most suitable region to grow crops in the water-scarce region of Nigeria is Zamfara as it has more percentage of green water used than others, which can, therefore, reduce cost of production and scarcity of water.

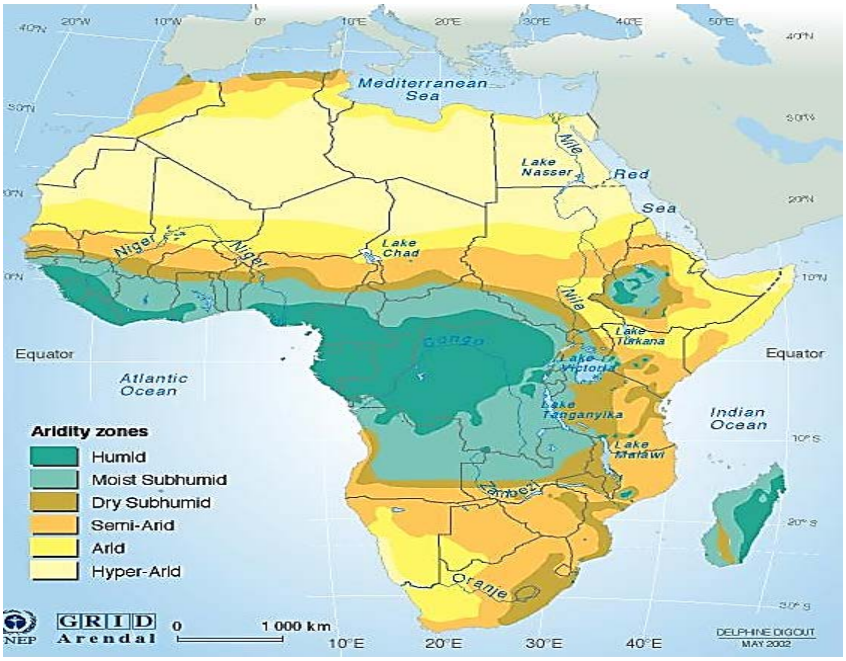

Figure 1: Aridity zones in Africa
[Source: World Meteorological Organization (WMO), United Nations Environment Programme (UNEP), climate change 2001. Accessed February 2016]

2. MATERIALS AND METHOD

2.1 STUDY COUNTRY

Nigeria is situated in West African region of the tropical zone, it has latitude between 40N to 140N and longitudes of 202'E to 14030'E with an area of 923,770 km^2. The distance from North to South of Nigeria is 1,050 km while the optimum distance from east to west is 1,150 km. Nigeria is surrounded by Benin to the west, to the North and Northwest by Niger, to the Northeast by Chad, and to the east by Cameroon, while bordered by the Atlantic Ocean in Southern Nigeria. Nigeria's Land

constitutes of dense rain forests and thick mangrove forests at south, and the close-to-desert situation at the northeastern part of the country (FAO AQUASTAT, 2005). The Nigeria's federal capital territory (F.C.T) is Abuja and is surrounded by 36 states that form up the country. Six states representing the water-scarce region were selected for this study including Zamfara, Kano, Katsina, Borno, Yobe and Sokoto.

The aridity zones in Nigeria are categorized into four (as in Figure 1) they are;

- Humid
- Moist sub-humid
- Dry sub-humid and
- Semi-arid

Among the four zones, the semi-arid zone has the highest rate of water scarcity. Therefore, this research was conducted in the most scarce water region of the northern part of Nigeria.

2.2 STUDY REGION

The water-scarce (semi-arid) region covered a huge part of Northern Nigeria and it includes Sahel savanna and Sudan bioclimatic regions. Rain-bearing dominated the climate, the dry, tropical continental North-easterly, and tropical maritime South Westerly air masses (Tarhule and Woo, 1998). Humidity discontinuity called Inter-tropical Discontinuity of a quasi-frontal zone formed by the air masses meeting which traveled over West Africa in reaction to the relative intenseness of the St. Helena and the Azores-Libyan system for tropical pressure (Anyadike, 1993). The rainy season begins at any moment, whenever the Inter-tropical Discontinuity migrates beyond Northward bound while retreating at the end Southward. Within June to September, the Inter-tropical discontinuity invade the North and the Northern Nigeria subsequently influenced by tropical maritime. Figure 2 shows the study region.

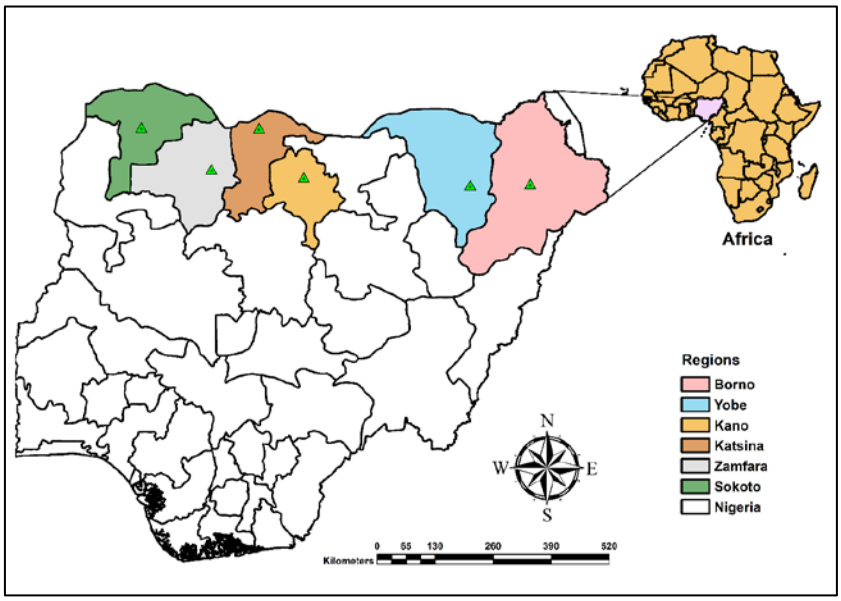

Figure 2: Map of Nigeria showing the study region
[Source: FAO AQUASTAT, 2005/Nigeria. Accessed February 2016]

In each of the states, 25 crops were selected. The crops are: Banana 1, Banana 2, Barley, Beans dry, Beans green, Cabbage, Citrus, Date palm, Groundnut, Maize, Mango, Millet, Pepper, Potato,

Pulses, Rice, Sorghum, Soybean, Sugarcane, Sugarbeet, Tobacco, Tomato, Vegetables fresh nes, Wheat (spring) and Winter wheat. They were grouped into Cereals, Vegetables, Fruit and Nuts, Oilseed crops and other crops.

2.3 VIRTUAL WATER TRADE

The virtual water flows for the water-scarce region of Nigeria were calculated using the equations in Table 1:

Table 1: Virtual water trade calculations procedure.

Equation Name	Equation	
Virtual Water Content (VWC)	$ETc = Kc\ x\ ETo$	(1)
Reference evapotranspiration (ET_0)	$ET_0 = \frac{0.408\,\Delta(R_n - G) + \gamma\frac{900}{T+273}U_2\,(e_s - e_a)}{\Delta + \gamma\,(1+0.34U_2)}$	(2)
Virtual Water Content (VWC)	$VWC[n,c] = \frac{CWR[n,c]}{CY[n,c]}$	(3)
Virtual Water Import (VWI)	$VWI\ [ni, c, t] = CT\ [ni, c, t]\ x\ VWC\ [n, c, t]$	(4)
Virtual Water Export (VWE)	$VWE\ [ne, c, t] = CT\ [ne, c, t]\ x\ VWC\ [n, c, t]$	(5)
Net Virtual Water Import (NVWI)	$NVWI = GVWI - GVWE$	(6)
Gross Virtual Water Import (GVWI)	$GVWI\ [ni, c, t] = \sum VWT\ [ni, c, t],$	(7)
Gross Virtual Water Export (NVWI)	$GVWE\ [ne, c, t] = \sum VWT\ [ne, c, t]$	(8)
Virtual Water Demand (VWD)	$VWD\ [c, t] = QP\ [c, t]\ x\ VWC\ [c, t]$	(9)
Water Footprint (WP)	$WP = VWD + NVWI$	(10)

where Kc is crop coefficient Rn = net radiation at the crop surface (MJ/m^2/day), G = soil heat flux density (MJ/m^2/day), T = mean daily air temperature at 2 m height (°C), U_2 = wind speed at 2 m height (m/s), e_s= saturation vapour pressure (kPa), e_a = actual vapour pressure (kPa), $(e_s - e_a)$ = saturation vapour pressure deficit (kPa), γ = slope vapour pressure curve (kPa/°C), Δ = psychrometric constant (kPa/°C), CWR represents crop water requirements in (m^3/ha), CY represent crop yield in (ton/ha), CT implies crop trade (ton/y), ne, ni, t implies, Nigeria export, Nigeria import, at time t, QP = Quantity produced (ton/yr), VWC = Virtual water content (m^3/ton).

2.4 CLIMATE DATA

CLIMWAT 2.0 for CROPWAT is a database software developed by FAO to provide a climate data that can be used as an input to CROPWAT (FAO, 2015). It provided data on temperatures, relative humidity, solar radiation, sunshine hours and wind speed. The software is available and can be downloaded from FAO's website. There are data for over 100 countries in the CLIMWAT database, and the data for Nigeria (as a case study) is inclusive.

2.5 CROP PARAMETERS

The crop parameters for which includes crop coefficient in the initial stage, middle stage, and late stage, and also root depth were adopted from CROPWAT/CLIMWAT database, planting date from FAO crop calendar. Crop yield data was taken from FAOSTAT database and is accessible via FAO's website (FAOSTAT, 2015).

The regional cultivated lands owing to the lack of the data is obtained by generating an equation considering the population distributions in the country.

2.6 PROPOSED METHODOLOGY

The step by step procedure applied for the virtual water trade in the water-scarce region of Nigeria were summarized in Figure 3.

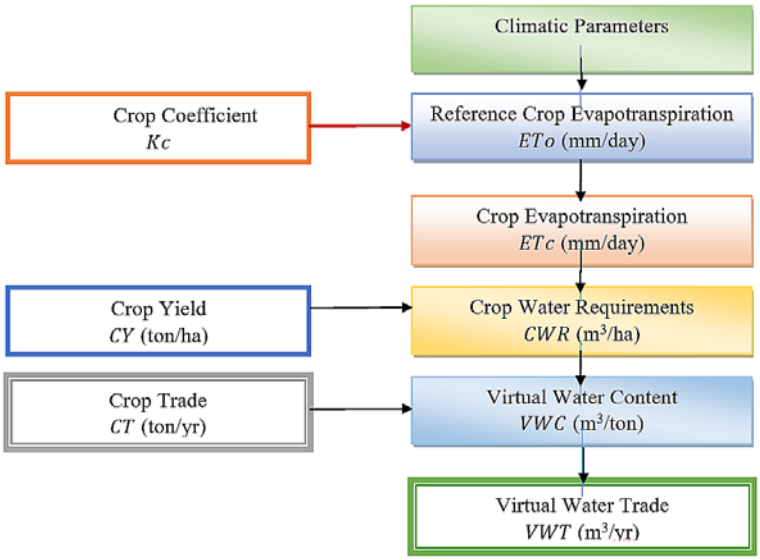

Figure 3: Flow chart showing the overall procedure for virtual water trade calculations

3. RESULTS AND DISCUSSION

Owing to the methodology and procedure explained, the results were obtained and presented. According to the results obtained in Table 2, crops grew in Kano have the highest virtual water content, consequently, consumed/required more water than any production area of the region. The next in terms of water consumption by crops is Borno then followed by Sokoto, Yobe, Zamfara, and lastly Katsina. The volume of Virtual water import in the water-scarce region of Nigeria in 2013 was far larger than that of virtual water export with 363 million m^3/yr import and 1 million m^3/yr export, from Yobe which was the least region in terms of virtual water. Being the highest crop virtual water content region, Kano also had the largest volume of virtual water for both imports and exports with 3.1 billion m^3/yr and 9.3 million m^3/yr, respectively (Table 2).

Even though Borno was the second highest virtual water content region, but it was the third with regards to crops' virtual water volume for both imports with 1.4 billion m^3/yr and exports with 4.4 million (Table 2). The average volume of gross virtual water imports between the 6 states in the region can be calculated from Table 2 as approximately 1.4 Gm^3/yr for 2013 while for export as 4.4 Mm^3/yr.

Table 2: Gross virtual water content, import, and export for water-scarce region of Nigeria.

State Name	GVWC (m^3/ton)	GVWI (m^3/yr)	GVWE (m^3/yr)
Zamfara	104,668	674,802,864	2,724,064
Kano	127,859	3,078,763,708	9,345,039
Katsina	102,012	1,601,627,723	5,473,175
Borno	127,205	1,443,513,905	4,400,463
Yobe	105,082	363,234,270	1,078,763
Sokoto	118,895	1,159,193,397	3,513,415
Total	685,721	8,321,135,867	26,534,919

Based on the result obtained and shown in Figure 4, the volume of virtual water produced was incomparably larger than both volumes of imports and exports in each region by providing more than two-thirds of the total virtual water volume of productions, imports, and exports.

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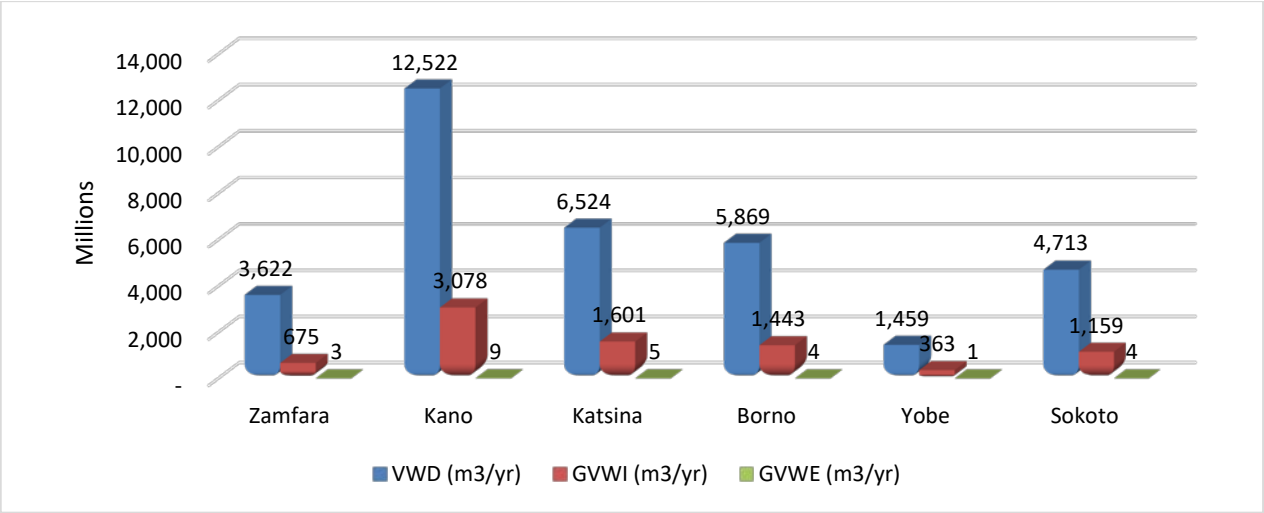

Figure 4: Variations in production, imports, and exports of virtual water.

Kano was by far the largest Green water region between the 6 states of the water-scarce region with 3.6 Gm^3/yr (Table 3). Zamafara came second with regards to Green water availability with a difference of over 2 billion cubic meters of water when compared to Kano. The third was Katsina, then Borno, Sokoto, and the highest Green water scarce region was Potiskum, with 459 Mm^3/yr (As seen in Table 3 and Figure5).

The region which consumed the largest Bluewater was Kano which happens to be the biggest consumer of crops virtual water with approximately 9 Gm^3/yr. The next in Bluewater consumption was Katsina, followed by Borno, Sokoto, Zamfara, and Yobe the lowest Green water region had the lowest Bluewater demand with 999 Mm^3/yr (As seen in Table 3 and Figure 5).

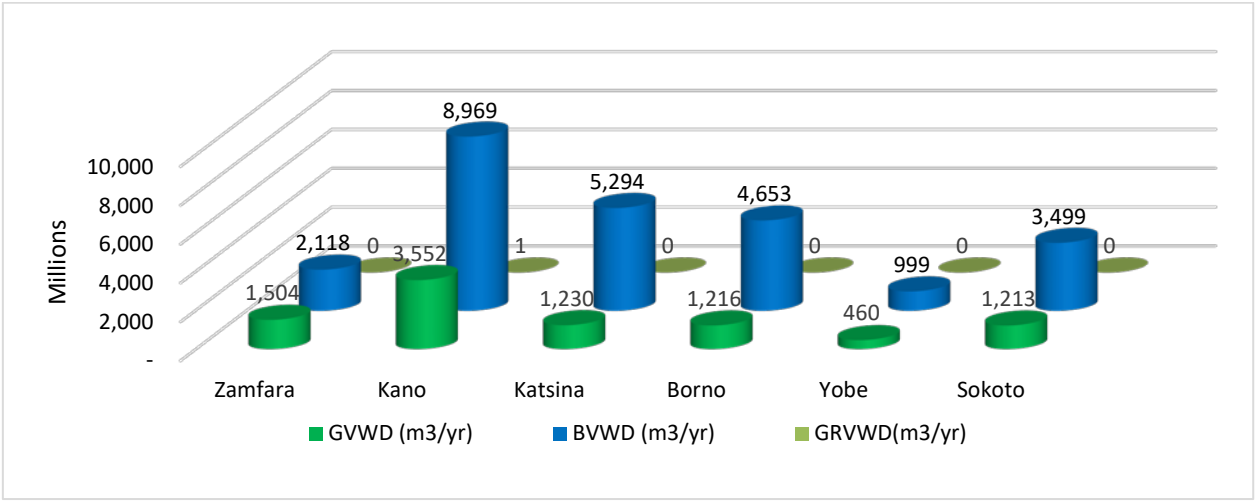

Figure 5: chart showing the contributions of Green, Blue and Greywater of water-scarce region of Nigeria in the year 2013.

Table 3: Summary of Green, Blue, and Greywater of each state of water-scarce region

State Name	GVWD (m^3/yr)	BVWD (m^3/yr)	GRVWD(m^3/yr)
Zamfara	1,504,465,401	2,117,760,631	159,620
Kano	3,551,547,344	8,969,386,987	609,755
Katsina	1,229,568,020	5,294,143,902	42,085
Borno	1,216,349,109	4,652,553,446	110,831
Yobe	459,737,955	999,386,669	9,856
Sokoto	1,213,002,117	3,499,408,156	218,988
Total	9,174,669,946	25,532,639,791	1,151,136

Grey water was less significant in crop productions. As a result, less than 0.01% of Greywater was used for the entire produced selected crops. Kano region has the highest virtual water volume of Greywater with 609.8 thousand m^3/yr, followed by Zamfara, Sokoto, Borno, Katsina, and the fewest Potiskum with 9.7 thousand m^3/yr (as shown in Table 3).

Considering the result obtained, Bluewater had the highest virtual water contributions to crops production in the region of Nigeria in 2013 (Figure 6). The overall Blue, Green and Greywater contributions are given in Figure 6. The Bluewater contributions for each region were Zamfara 58%, Kano 72%, Katsina 81%, Borno 79%, Yobe 68% and Sokoto 74%. However, Green water contributions were 42%, 28%, 19%, 21%, 32% and 26%, respectively. Greywater remained 0% throughout the region (as seen in Figure 6).

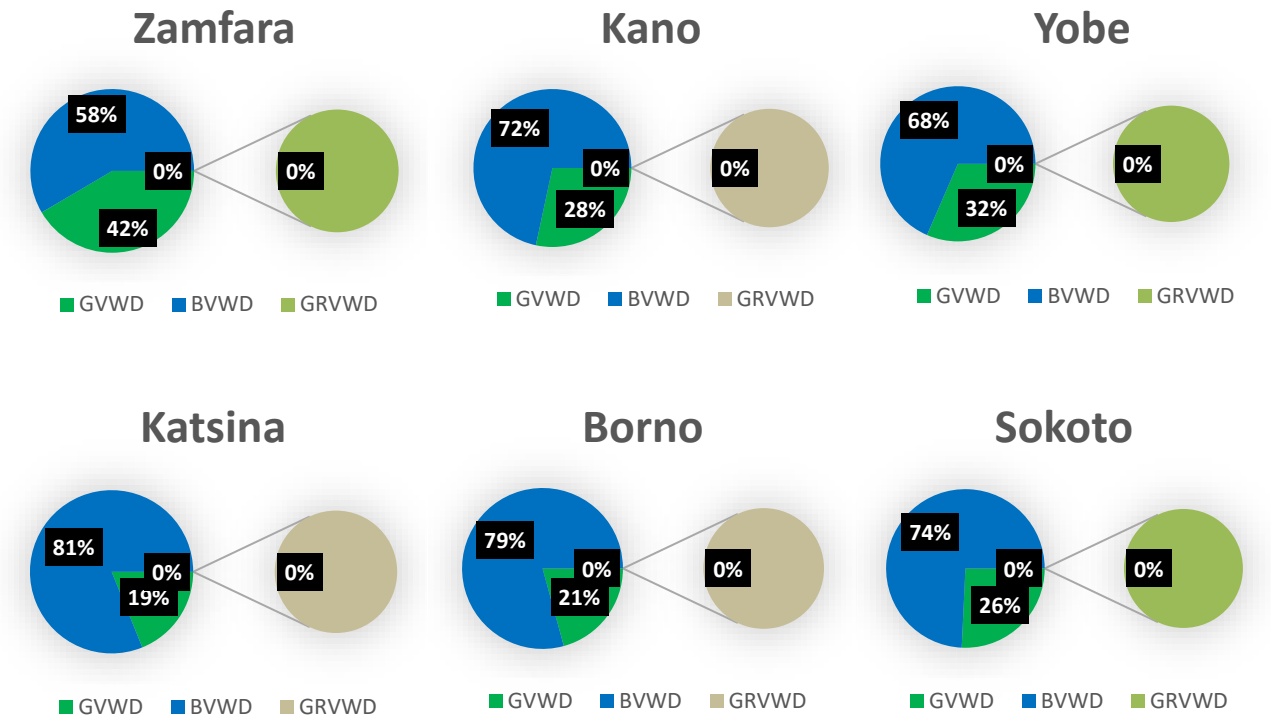

Figure 6: Regional percentage contributions of Green, Blue, and Greywater.

The water balance for all the region were positives (NVWI), implying that there were more imports than exports (Table 4). It can be calculated from Table 4 that the total volume of virtual water demand (virtual water produced) in the region is 81% of total water used (water footprint) while the water balance to be 19%. The region with a maximum volume of virtual water used was Kano with 15.6 Gm^3/yr and the minimum was Yobe with 1.8 Gm^3/yr (Table 4).

By vividly looking at table 4, it can be distinguished that production value is higher than import cost which in turn greater than export income. As may be predicted owing to its superiority production quantity, Kano region had the highest production value which stood at $842 million. Katsina reclaimed the next position with $511.9 million, Borno $375.5 million, Sokoto $326.7 million, Zamfara $292.2 million, and Yobe $109.9 million. Furthermore, Kano led in import cost with $261.5 million, joined behind by Katsina, Borno, Sokoto, Zamfara, and Yobe $34 million. The export income goes in a similar manner with $364.33 thousand, $221.4 thousand, $162.4 thousand, $141.3 thousand,

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$126.4 thousand, and $47.5 thousand, respectively. The total production value was $2.5 billion, import cost $763.5 million, and export income $1.1 million (Table 4).

Table 4: Virtual water demand, water balance, water footprint, production value, import cost and export income of the water-scarce region of Nigeria for the year 2013

State Name	VWD (m^3/yr)	NVWI (m^3/yr)	WP (m^3/yr)	Production Value ($)	Import Cost ($)	Export Income ($)
Zamfara	3,622,385,651	672,078,800	4,294,464,451	292,209,166	90,761,786	126,448
Kano	12,521,544,086	3,069,418,670	15,590,962,756	842,028,048	261,539,746	364,333
Katsina	6,523,754,007	1,596,154,548	8,119,908,555	511,886,141	158,995,364	221,399
Borno	5,869,013,385	1,439,113,442	7,308,126,827	375,456,645	116,619,529	162,381
Yobe	1,459,134,481	362,155,507	1,821,289,989	109,901,608	34,135,493	47,483
Sokoto	4,712,629,262	1,155,679,982	5,868,309,244	326,694,329	101,473,382	141,259
Total	34,708,460,872	8,294,600,949	43,003,061,822	2,458,175,937	763,525,300	1,063,303

4. CONCLUSION

The virtual water content of crops varied in each of six water-scarce region of Nigeria due to the difference in climatological parameters. It was observed that some crops have high water requirements but due to their large crop yield, they possessed less virtual water content.

Based on the results obtained, it was deduced that the circumstances surrounding the virtual water trade volume could be classified into regulated and unregulated circumstances. The regulated circumstances include the types of crops and the quantities of their imports and exports. While, the unregulated circumstances are Temperatures (Max. and Min.), humidity, wind speed, sunshine hours and solar radiation.

With the advancement in technology and improved awareness in the agricultural production techniques, Nigeria may soon be self-sufficient in food production, as of 2013, production was averagely 81% of virtual water consumed with only 19% imported through virtual water trade. By immense contributions in food productions, the country within the semi-arid zone was able to domestically produced food crops which was consumed that amount to approximately $2.5 billion and also received internal income of $1.1 million but spent $763.5 million for food importation. As production capacity increases, there will be a rise in income generation and drought in food expenditure through import, and consequently, result in developmental growth.

As the world population continues to increase, and the global warming continues to be experienced, the scarcity of water tends to be ascending due to increasing water demand and drying of surface water. Hence, a care should be given to the regions necessitating the minimum blue water for cultivation of the crops in order not to depleting the water resources. Consequently, among the seven (6) states of the water-scarce region of Nigeria, Zamfara is the preferable state to grow crops due to it higher percentage of green water and minimum blue water used and therefore, reduced cost of blue water provision.

4.1 RECOMMENDATIONS

Upon completion of this research and the results obtained, the recommendations were drawn:

This research was limited to most water-scarce region of Nigeria, similar researches should be conducted in other regions to determine how the degree of aridity influence productions, imports, and exports of virtual water in Nigeria.

The research was specifically conducted for 2013, more researches should be done earlier and later than 2013, to figure out how a change in population (and possibly weather) affects the virtual water trade in Nigeria.

The study was based on 25 most populous crop products in Nigeria, more crops should be added for future researches.

The research was focused on crop products, same research should be conducted on livestock products to know the virtual water trade of livestock products in Nigeria.

In consideration of the obtained result in this research, where it is revealed that the majority of water used was blue water and continues crop productions will eventually exhaust the available blue water in the region, and thereby exposing people living in the areas to unnecessary hardship due to scarce water supply for daily use. Crop productions in the region should be stopped or reduce to the barest minimum. For the vulnerable people that cannot afford it or whose, their survival is dependent on farming, government should devise a means of supporting and empowering by enrolling them into skills acquisition programs, give them loans to start trade, and a lot of other initiatives that can provide for their daily needs. By so doing, the region will continue to be comfortable area for its dwellers by utilizing the little available water in the regions for consumptions and other day-to-day activities.

As the nation continue to experience a tremendous growth in population, the demand for food is also on the rise. Therefore, modern sophisticated means through advanced farming machines and equipments should be employed to enhance the current production capacity, so that the country could be self-reliable in crop productions and the money that could have been used for food imports will then be channeled into other infrastructural works for the benefits of the citizens.

5. REFERENCES

Allan, J. A. (1993). Fortunately there are substitutes for water otherwise our hydro-political futures would be impossible. *Priorities for water resources allocation and management, 13, 26.*

Anyadike, R. N. C. (1993). Seasonal and annual rainfall variations over Nigeria. *International journal of climatology*, *13*(5), 567-580.

FAO (Food and Agricultural Organization of the United Nations) AQUASTAT (2005). Geography, Climate, and Population. FAO's Information System on Water and Agriculture [online]. Available at http://www.fao.org/nr/water/aquastat/countries_regions/nga/index.stm [accessed February 2016].

FAO (Food and Agricultural Organization of the United Nations) 2015. CLIMWAT 2.0 for CROPWAT: A Climatic database for Irrigation Planning and Management [online]. Available at http://www.fao.org/nr/water/infores_databases_climwat.html [accessed September 2015].

FAOSTAT (Food and Agricultural Organization of United Nations Statistical Division) 2015. Crop Yield Data [online]. Available at http://faostat3.fao.org/browse/Q/QC/E [accessed November 2015]

Hoekstra, A. Y. (2003). Virtual water: An introduction. *Virtual water trade*. Proceedings of the International Expert Meeting on Virtual Water Trade. Value of Water Research Report Series N0.12, 13. IHE Delft, The Netherlands.

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Hoekstra, A. Y., & Hung, P. Q. (2005). Globalization of water resources: international virtual water flows in relation to crop trade. *Global environmental change*, *15*(1), 45-56.

Tarhule, A., & Woo, M. K. (1998). Changes in rainfall characteristics in northern Nigeria. *International Journal of Climatology*, *18*(11), 1261-1271.

World Meteorological Organization (WMO), United Nations Environmental Programme (UNEP), Climate Change 2001: Impacts, Adaptation, and Vulnerability, Contribution of Working Group II to the Third Assessment Report of the Intergovernmental Panel on Climate Change (IPCC). http://www.grida.no/graphicslib/detail/aridity-zones_a6d3

Yang, H., Reichert, P., Abbaspour, K. C., & Zehnder, A. J. (2003). A water resources threshold and its implications for food security. *Environmental science & technology*, *37*(14), 3048-3054.

Yang, H., Wang, L., Abbaspour, K. C., & Zehnder, A. J. (2006). Virtual water trade: an assessment of water use efficiency in the international food trade. *Hydrology and Earth System Sciences Discussions*, *10*(3), 443-454.

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International Transaction Journal of Engineering, Management, & Applied Sciences & Technologies

http://TuEngr.com

SOIL AND ECOLOGICAL EVALUATION OF AGRO-CHERNOZEMS OF SIBERIA

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ARTICLEINFO

Article history:
Received 12 November 2018
Received in revised form 18 February 2019
Accepted 21 February 2019
Available online
25 February 2019

Keywords:
Soil science; soil assessment; chernozem map; chernozem soil index, agrochemical index, climate index; soil-ecological index.

ABSTRACT

The comparative assessment of natural potential of agro-chernozems of Siberia in order to plan rational land use, protection of soils and soil cover is carried out. The score was determined by soil-ecological index (SEI). SEI calculation was carried out on climatic, agrochemical and soil parameters. At calculating the climate index, the sum of temperatures above 100°C and precipitation was taken into account; the agrochemical index was calculated by the content of humus, mobile forms of phosphorus and potassium, the reaction of the medium and the soil index – by alkalinity, salinity, erosion, granulometric composition of soils. According to the data of the Landsat satellite and the QGIS software, a map of the distribution of chernozems in the Siberian region was created. Interactive map is comparable to the relief map of the study area, cadastral, geological and other maps. The most valuable soils for agricultural use are formed in the Krasnoyarsk and Altai Krai, where up to 50% of the total chernozem area of the Siberian Federal district (SFD) is concentrated. SEI of agro-chernozems of Siberia decreases in a number: Krasnoyarsk Krai – Altai Krai – Irkutsk region – Omsk region – the Republic of Tuva. The development of erosion and deflation to an average degree reduces the SEI value by 14-36%. The calculated SEI values of agro-chernozems can be used to determine their resource potential, cadastral and market assessment, development of recommendations for land transformation. In modern conditions, the unused chernozems are considered as unrecorded reserve for expansion of arable land, most balanced, anthropogenic, environmental resource.

1. INTRODUCTION

The first fundamental work on the chernozems of Siberia is the report of V.V. Dokuchaev "On

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the Siberian chernozem" (Dokuchaev, 1950). In the report, it was noted that "Siberian chernozem does not represent such continuous areas as European chernozem ...", as well as that "under chernozem in Siberia they often understand soils that have nothing to do with the present chernozem; it is clear, thus, the area of Siberian chernozems can grow to infinity". The Dokuchaev's position of the properties of chernozems looks like as follows: "The composition and structure of the Siberian chernozems as diverse as the chernozems of European Russia; and both lie indifferently on clay, sand, limestone and massive rocks (what are granites). Obviously, the quality of Siberian chernozems should not be the same".

A number of generalizing works are devoted to chernozems of different regions of Siberia (Khmelev and Tanasienko, 1983; Burlakova, 1984; Mishchenko and Prudnikova, 1984; Krupkin, 2002), but they were studied more in the regional aspect, often with the use of "local" soil classifications and groupings, with different approaches to their assessment.

In accordance with the integrated assessment of soil quality for agricultural use, all subjects of the SFD, with the exception of the Altai Krai, are classified as "the most unfavorable regions" or "regions with poor soil quality" (Ivanov et al., 2013). Long-term agricultural use of chernozems led to the progressive development of a number of degradation processes (alkalinization, salinization, dehumidification, increased hydromorphism, erosion), contributing to a decrease in their fertility and a change in agrochemical indicators in the unfavorable direction (Wen and Liang, 2001; Vlček et. al., 2011; Chendev et. al., 2015; Hristov et. al., 2017; Stepanova and Korenkova, 2018). The percentage of soils unsuitable for agricultural production is 82 in the Republic of Tuva, 81 in the Krasnoyarsk Krai, 63 and 62 in the Omsk and Irkutsk regions, respectively, and 42 in the Altai Krai.

This work is based on the calculation of soil-ecological indices (SEI), which are used in the comprehensive monitoring of soil fertility of agricultural land. The purpose of the study is by means of SEI to assess agro-chernozems of a number of subjects of the Siberian region for the planning of their rational land use and protection.

2. OBJECTS AND METHODS

The main sources of data on the distribution of chernozems in the SFD are the soil map of the RSFSR of 1988 and the monograph "Soil cover and land resources of the Russian Federation" (Shishov et al., 2001). For each subject of the SFD types of agro-chernozems were allocated (Shishov, 2004) and their area was calculated using standard GIS tools. According to the Landsat series of satellites, the interactive map of the spread of chernozems on the territory of subjects of the Siberian Federal district was created. The map is compared with the relief map of the territory and, if necessary, can be combined with cadastral, geological and other maps.

Various methods are used to assess soil fertility and suitability for use in agriculture (Shishov et al., 1991; Molchanov et al., 2015; Rousseva et al., 2016; Amara and al., 2017; Sirotkin and al., 2017; Musakwa, 2018; Mehra and Singh, 2018). In this work, the assessment of chernozems is carried out by the technique developed by I. I. Karmanov (Shishov et al., 1991), which is based on the calculation of SEI. This is a quantitative value that reflects the natural potential of arable land in points (from 1 to 100) of productivity of leading crops.

The source data for the calculation of the SEI of agro-chernozems in Omsk region was taken from the materials of agrochemical examinations conducted in the service areas of CAS "Omsk" and AAS "Tarskaya". Agro-chernozems clay-illuvial typical (Luvic Chernozems) provided with humus have an increased amount of mobile phosphorus and potassium. Agro-chernozems texture-calcareous (Calcic Chernozems) and dispersed-carbonate (Veronica Chernozems Pachic), and their alkaline counterparts have less humus. Soils are characterized by average phosphorus and very high – potassium, neutral and close to neutral reaction of the soil medium.

Agro-chernozems of Altai Krai are characterized according to the CAS "Altai" (The fertility monitoring, 2016). Agro-chernozems clay-illuvial typical and dispersed-carbonate provided with humus have a neutral reaction of the soil solution, medium-loamy granulometric composition. Agro-chernozems textural and carbonate have less humus and differ by slightly alkaline reaction and lighter granulometric composition, very high and high movable potassium provision. Soils are less provided with mobile phosphorus.

For the Krasnoyarsk Krai data for chernozems was generalized by I.P. Krupkin (Krupkin, 2002) for largest agricultural Kansk natural district. The high content of humus is typical of agro-chernozems clay-illuvial podzol. Agro-chernozems clay-illuvial typical and dispersed-carbonate differ from it by a lower content of humus, by 1 and 2%, respectively.

All soils have a neutral medium reaction and a very high provision of mobile phosphorus and potassium.

Data for the chernozems of Tuva are taken from the materials of agrochemical inspection of SAAS "Tuvan" (Savich et al., 2012). The amount of humus in agro-chernozems dispersed-carbonate and texture-carbonate is low. Tuva agro-chernozems are characterized by light granulometric composition, slightly alkaline and neutral reaction of soil solution, average provision of mobile phosphorus and potassium.

Data on agro-chernozems of the Irkutsk region are obtained from the materials of agrochemical survey carried out by CAS "Irkutsk" (Soils of the Irkutsk region, 1983; Annual production report..., 2015). Agro-chernozems clay-illuvial typical and dispersed-carbonate are sufficiently provided with humus, have a neutral medium reaction and an average provision of mobile phosphorus and potassium.

3. RESULTS AND DISCUSSION

Siberian chernozems are widespread in the south Asian part of Russia and are formed in all subjects of SFD. The area of chernozems distributed across the regions is extremely uneven, from 20 thousand hectares in the Tomsk region to 10 million hectares in the Altai Krai (table 1). The total area of chernozems of SFD is more than 27 million hectares, among them, the types of dispersed carbonate (42.4%) and clay-illuvial typical (33.1%) are dominated. The areas of chernozems clay-illuvial podzolic (7.9%) and texture-carbonate typical (14.7%) are significant. This is the most valuable soil, "gold" fund of arable land, allowing conducting profitable agricultural production. Chernozems

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alkaline are boundedly distributed, in the structure of the soil cover they occupy about 1%.

In the Altai Krai, there are more than one-third of all chernozems of the SFD, which are dominated by clayey-illuvial typical (35.6%) and dispersion-carbonate (32.0%) types.

Table 1: Chernozems distribution on the territory of the Siberian Federal district, thousand hectares

Subject	Chernozem						Area
	Clay-illuvial		Migration micellar	Dispersed-carbonate	Texture-carbonate typical	Alkaline	
	podzol	typical					
Altai Krai	690,10	3355,92	203,84	3014,68	1953,00	202,40	9419,94
Krasnoyarsk Krai	191,36	2301,06	-	1563,49	56,50	-	4112,41
Omsk region	27,30	288,86	-	2352,53	429,44	51,30	3149,43
Novosibirsk region	522,53	1350,62	-	405,97	540,21	22,09	2841,42
Zabaikalsky Krai	-	-	-	1968,45	-	32,43	2000,88
Kemerovo region	649,31	1262,13	-	-	-	-	1911,44
The Republic of Khakassia	32,81	116,55	-	876,45	750,37	-	1776,18
The Republic of Buryatia	-	-	-	672,11	-	-	672,11
Irkutsk region	-	212,40	-	292,16	-	28,28	532,84
The Republic of Tuva	-	-	-	100,53	241,17	-	341,69
Altai republic	38,33	47,14	-	85,64	144,40	-	315,52
Tomsk region	-	22,30	-	-	-	-	22,30
Total	2151,74	8956,98	203,84	11472,65	3974,45	336,50	27096,16

Here migration micellar chernozems (Chernozems Voronic) are formed, which other subjects of the Siberian Federal district do not have. The zonal feature of the chernozems of the plain part of the Altai Krai is their meridional location associated with hydrothermal conditions. Chernozems clay-illuvial, formed in the east of the Altai Krai, in conditions of sufficient moisture supply, in the west are replaced by chernozems dispersed-carbonate, which causes greater complexity of the soil cover in the transition zones. Over 60% of the chernozems area is plowed and is eroded and deformed.

In the Krasnoyarsk Krai, more than 4.1 million hectares of chernozems are formed, which are mainly clay-illuvial typical (55.5%) and dispersed-carbonate (38.0%) types. The region occupies the second place in the SFD for the spread of chernozems. Sharply contrasting, harsh temperature regime defines a number of provincial peculiarities of Krasnoyarsk chernozems: short humus horizon and its high humus content; low biological activity; lower boundary stoniness of the humus layer; the signs of permafrost gley; layered texture. Chernozems are characterized by the complexity of the soil cover and lithological heterogeneity of soil-forming rocks. In connection with the active development of erosion processes in the open areas eroded and deflated chernozems are widespread. Tens of thousands of hectares of fertile clay-illuvial and dispersed-carbonate chernozems are subject to chemical degradation (Tandelov, 2012) and more than 129 thousand hectares of agricultural lands are polluted to varying degrees.

The territory of chernozems distribution in Omsk region is characterized by high complexity, weak drainage and lack of water, salinity of soil-forming and underlying rocks, high occurrence and mineralization of groundwater (Mishchenko and Prudnikova, 1984). The region is on the third place among subjects of the Siberian Federal district according to the chernozems distribution. Chernozems are dispersed-carbonate, often alkaline, occupy here up to 75% of the total area of chernozems.

Formed in the conditions of sharply continental climate, severe winter, and deep freezing, chernozems of the region are characterized by relatively low potential fertility (Krasnitsky and Schmidt, 2016; Fedorova et al., 2016) and are represented mainly by low-power and low-humus species.

Significant areas of chernozems, from 1.8 to 2.8 million hectares, are concentrated in the Novosibirsk and Kemerovo regions, the Zabaikalsky Krai and the Republic of Khakassia. The unfavorable situation is with the clay-illuvial chernozems of the Kemerovo region, where the territory is uncontrollably withdrawn for open (quarry) coal mining, the main reserves of which are concentrated within the Kuznetsk basin, in the structure of the soil cover of which chernozems are dominated.

In the Irkutsk region, chernozems occupy about 0.53 million hectares and are distributed on the terraces of the Angara, Kuda rivers, their tributaries and do not form large massifs. These soils have a shallow humus layer, high content of humus, intense freezing and long persistence of seasonal permafrost(Kuzmin, 1988).

On the territory of Tuva, the area of chernozems is 0.34 million hectares and is formed locally on the sloping ridges and foothills in the Turano-Uyuk basin, in the northern foothills of the Eastern and Western Tannu-Ola. For soils lithological heterogeneity of soil-forming rocks, stoniness, light (often sand) granulometric composition is typical.

The chernozems clay-illuvial typical, common in the north of the Omsk region, have the highest SEI (Table 2). For chernozems dispersed carbonate and texture-carbonate typical that are formed in conditions of low moisture, the input of organic substances, accelerated process of mineralization and development of deflation, SEI is reduced by 14-19 points. Alkaline subtypes of these soils are estimated in 24.5 points.

The development of erosion and deflation reduces the SEI value to an average degree. On average eroded soils, against the degraded standards, are assessed higher by 6 points. The weighted average value of SEI of agro-chernozems of the region is lower by 8-10 points than for soils of the Altai and Krasnoyarsk Krai.

The highest SEI are calculated for agro-chernozems clay-illuvialin Altai Krai, which are the most fertile and productive soils of the SFD. They are characterized by a high climate index, which makes them the most valuable. Agro-chernozems dispersed-carbonate and texture-carbonate are estimated lower by 14-22 points. Erosion processes decrease their SEI on average by 10and a manifestation of average degree alkalinity by 9 points.

SEI of different types of agro-chernozems of Krasnoyarsk Krai is quite high and is within 47-48 points. Erosion and deflation reduce their value by 12 points. In general, agro-chernozems of the region are characterized by high soil and agrochemical indices but are inferior to Altai agro-chernozems in the climatic index, for this reason, the value of the final SEI of agro-chernozems of these regions differs slightly.

On the territory of Tuva SEI of agro-chernozems dispersed and texture-carbonate is the lowest one, the development of deflation and stoniness of soils reduces it on average by three points.

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Table 2: Soil-ecological index of agro-chernozems of the Siberian Federal district, point

Name of soil	Index			
	Soil	Agro-chemical	Climate	Soil-ecological
Omsk region				
Agro-chernozem clay-illuvial typical	9.41	1.05	4.93	48.7
also moderately eroded	6.49	1.05	4.93	33.6
Agro-chernozem dispersed-carbonate	8.11	1.05	4.05	34.5
also moderately deflated	7.14	1.05	4.05	30.4
Agro-chernozem texture-carbonate typical	7.77	1.05	3.61	29.5
also moderately deflated	6.84	1.05	3.61	25.9
Average for non-eroded soils	*8.43*	*1.05*	*4.20*	*37.2*
Weighted average for non-eroded soils	-	-	-	*34.5*
Average for eroded and deflated soils	*6.39*	*1.05*	*4.20*	*28.2*
Agro-chernozem dispersed-carbonate moderately alkaline	5.77	1.05	4.05	24.5
also moderately deflated	5.08	1.05	4.05	21.6
Altai Krai				
Agro-chernozem clay-illuvialpodzol	9.26	1.11	5.25	54.0
also moderately eroded	6.39	1.11	5.25	37.2
Agro-chernozem clay-illuvial typical	9.31	1.16	5.18	55.9
also moderately eroded	6.43	1.16	5.18	38.6
Agro-chernozem dispersed-carbonate	8.82	1.05	4.31	39.9
also moderately deflated	7.76	1.05	4.31	35.1
Agro-chernozem texture-carbonate typical	7.94	1.04	4.11	33.9
also moderately deflated	6.98	1.04	4.11	29.8
Average for non-eroded soils	*8.83*	*1.09*	*4.71*	*45.3*
Weighted average for non-eroded soils	-	-	-	*45.0*
Average for eroded and deflated soils	*6.89*	*1.09*	*4.71*	*35.4*
Agro-chernozem texture-carbonate moderately alkaline	5.95	1.04	4.11	25.4
also moderately deflated	5.24	1.04	4.11	22.4
Krasnoyarsk Krai				
Agro-chernozem clay-illuvial podzol	10.08	1.23	3.85	47.7
also moderately eroded	6.96	1.23	3.85	33.0
Agro-chernozem clay-illuvial typical	9.98	1.23	3.88	47.6
also moderately eroded	6.88	1.23	3.88	32.8
Agro-chernozem dispersed-carbonate	10.26	1.23	3.77	47.6
also moderately deflated	9.02	1.23	3.77	41.8
Average for non-eroded soils	10.11	1.23	3.83	47.6
Weighted average for non-eroded soils	-	-	-	47.6
Average for eroded and deflated soils	7.62	1.23	3.83	35.9
The Republic of Tuva				
Agro-chernozem dispersed-carbonate	8.28	1.00	2.55	21.1
also moderately deflated	7.29	1.00	2.55	18.6
Agro-chernozem texture-carbonate typical	7.94	1.00	2.55	20.3
also moderately deflated	6.98	1.00	2.55	17.8
also moderately stony	6.74	1.00	2.55	17.2
Average for non-eroded soils	8.11	1.00	2.55	20.7
Weighted average for non-eroded soils	-	-	-	20.6
Average for deflated soils	7.14	1.00	2.55	18.2
Irkutsk region				
Agro-chernozem clay-illuvial typical	9.12	1.03	3.68	34.6
also moderately eroded	6.29	1.03	3.68	23.8
Agro-chernozem dispersed-carbonate	10.35	1.03	3.48	37.1
also moderately deflated	9.11	1.03	3.48	32.7
Average for non-eroded soils	9.74	1.03	3.58	35.9
Weighted average for non-eroded soils	-	-	-	35.8
Average for eroded and deflated soils	7.70	1.03	3.58	28.4

In Irkutsk region, the greatest value has agro-chernozems dispersed-carbonate, clay-illuvial slightly inferior to it. As a result of the development of erosion and deflation SEI of these soils is reduced by more than 7 points.

Analysis of all available data suggests that the most fertile agro-chernozems are formed in the Altai and Krasnoyarsk Krai. For comparison, all the soil in Krasnodar region has SEI equal to 100 points. According to the study, Siberian agro-chernozems are inferior in fertility to Krasnodar ones more than by 2-5, and taking into account the development of erosion and deflation – by 3-6 times.

The soil index makes a great contribution to the resulting SEI. Depending on the type of soil, the presence or absence of erosion and deflation, stoniness the soil index varies in 1.2-1.9 times. The values of the agrochemical index are comparable, as the soils of the same genesis were estimated, similar in properties and characteristics of fertility. In most cases, the soil had a favorable medium response, the average and above the average provision of mobile forms of phosphorus and potassium.

Agro-chernozems of Krasnoyarsk Krai have maximum agrochemical index, characterized by a very high supply of nutrients. Climate index naturally decreases in the direction from west to east – from Omsk agro-chernozems to Irkutsk ones. This series does not include agro-chernozems of Tuva because of their orographic isolation and formation in the most severe, even for Siberia, climatic conditions.

Comparing the agro-chernozems of Omsk and Irkutsk regions, we can note their close final values of SEI. The final SEI of Omsk agro-chernozems is influenced by higher values of climate index, and SEI of the Irkutsk agro-chernozems is formed to a greater extent by soil index.

Thus, the SFD has a huge soil potential in the form of different types of chernozems. The most valuable agro-chernozems are formed in the Altai and Krasnoyarsk Krai. In these subjects, up to 50% of the area of all chernozems of the macro region is also concentrated. Siberian chernozems are inferior to European analogs infertility, have a number of provincial, often negative features. For the most rational use of these soils, it is necessary to study fully their properties and regimes, to develop for them at the species level the agrotechnical, agrochemical and soil protection measures aimed at obtaining economically optimal yields, at ensuring the implementation of the soil cover its global environmental functions.

4. CONCLUSION

The total area of SFD chernozems is more than 27 million hectares, among them, the types of dispersed-carbonate (42.4%) and clay-illuvial typical (33.1%) prevail. Chernozems clay-illuvialpodzol (7.9%) and texture-carbonate typical (14.7 %) are less spread.

A favorable hydrothermal regime is formed on the territory of the Altai Krai, where the sum of t > 10ºC is higher in relation to other subjects of the SFD (except for Omsk region) by an average of 230-467ºC, and moisture supply – by 30-50 mm. Chernozems of Irkutsk region, Krasnoyarsk Krai and the Republic of Tuva are formed in areas of insufficient moisture and lower average annual temperatures, so the value of the climate index decreases at moving from the Altai Krai and Omsk

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region to the Krasnoyarsk Krai, then Irkutsk region and the Republic of Tuva.

The mobile forms of phosphorus and potassium are only in the chernozems of the Krasnoyarsk Krai. The potassium content is sufficient in the chernozems of the Altai Krai and Omsk region. By the amount of phosphorus the chernozems of other subjects of the Siberian Federal district have average provision, which is below the optimum level recommended for grain and vegetable crops. The chernozems of the Krasnoyarsk Krai and Irkutsk region contain more humus. The reaction of the environment is favorable for most crops cultivated in the Siberian region, a small alkalinization is characteristic of the chernozems of the Republic of Tuva. In general, chernozems need to be improvedin the nutritional regime by applying phosphorus-potassium fertilizers. The value of the agrochemical index decreases in a number of Krasnoyarsk Krai–Altai Krai – Omsk region –Irkutsk region – the Republic of Tuva.

The value of the soil index decreases from the chernozems of the Krasnoyarsk Krai to the soils of Irkutsk region, Altai Krai, Omsk region and the Republic of Tuva. The score of the soil index is lower in the presence of salts, alkalinization in the soils, which is typical for the chernozems of Omsk region. Chernozems of the Republic of Tuva are more prone to erosion processes due to the predominant light particle size distribution, which significantly reduces their soil index score. The development of degradation processes in the form of salinization of soils, their alkalinization and carbonation is not typical for the Krasnoyarsk and Altai Krai, Irkutsk region, so they have a higher soil index score.

The weighted average of the SEI of agro-chernozems of the SFD change from 47.6 to 20.6 points and decreases in the row: Krasnoyarsk Krai – Altai Krai – Irkutsk region – Omsk region – the Republic of Tuva. Development of erosion and deflation in agro-chernozems lower the value of their SEI from 3 to 17 points in the average degree, and the presence of alkalinity – by 9-10 points.

The value of the final soil-ecological index is largely determined by the values of soil and climate indices. The values of the agrochemical index change insignificantly, due to the fact that the soils of the same genesis, similar in properties and characteristics of fertility were estimated.

5. REFERENCES

Amara, D., P. Patil, A. Kamara, and D. Saidu, 2017. Assessment of soil fertility status using nutrient index approach. Academia Journal of Agricultural Research, 5(2): 725–735.

Annual production report on research work for 2015, 2015. Irkutsk: CAS “Irkutsk”, p.: 128.

Burlakova, L. N., 1984. The fertility of chernozems of the Altai in the system of agro-ecosystem. Novosibirsk: Science, p.: 199.

Chendev, Y., T. Sauer, G. Ramirez and C. Burras, 2015. History of East European Chernozem Soil Degradation; Protection and Restoration by Tree Windbreaks in the Russian Steppe. Sustainability, 7: 705–724.

Dokuchaev, V.V., 1950. On the issue of Siberian chernozem. Vol.2. M.-L.: Publishing house of USSR Academy of Sciences, p.: 357–381.

Fedorova, E.A., E.P. Avgul and O.V. Ilyushkina, 2016. The state of soil fertility, the dynamics of the use of mineral and organic fertilizers, the balance of nutrients and humus in the Northern zone of Omsk region. Achievements of science and technology of agriculture, 7(30): 38–40.

Hristov, B., I. Nikova and N. Andreeva, 2017. Fertility of Soils over Loess in the Danubian Plain. Bulgarian Journal of Soil Science, 2(2): 123–132.

Ivanov, A. L., I.Yu. Savin and V.S. Stolbovoy, 2013.Russian soil quality for agricultural use. Reports of the Russian Academy of Agricultural Sciences, 6: 41–45.

Khmelev, V.A. and A.A. Tanasienko, 1983. The chernozems of the Kuznetsk basin. Novosibirsk: Science. Siberian branch, p.: 256.

Krasnitsky, V.M. and A.G. Schmidt, 2016. The dynamics of fertility of arable soils of Omsk region and the efficiency of its improvement in modern conditions. Achievements of science and technology of agribusiness, 7(30): 34-38.

Krupkin, P.I., 2002. The chernozems of the Krasnoyarsk Krai. Krasnoyarsk: Krasnoyarsk State University, p.: 332.

Kuzmin, V.A., 1988. The soils of the Pre-Baikal region and Northern Transbaikalia. Novosibirsk: Science, p.: 174.

Mehra, M. and C. K. Singh, 2018. Spatial analysis of soil resources in the Mewat district in the semiarid regions of Haryana, India. Environment, Development and Sustainability, 2(20): 661–680.Mishchenko, L.N. and V. M. Prudnikova, 1984. Features of soil cover of Omsk region. Soils of Western Siberia and increasing their fertility, OAI, p.: 3–12.

Molchanov, E.N., I. Yu. Savin, A.S. Yakovlev, D.S. Bulgakov and O.A. Makarov, 2015.Domestic approaches to assessing the degree of soil and land degradation. Soil science, 11: 1394–1406.

Monitoring of soil fertility of agricultural lands of the Altai Krai (1965-2010), 2016. Barnaul: CAS “Altai”,p.: 28.

Musakwa, W., 2018. Identifying land suitable for agricultural land reform using GIS-MCDA in South Africa. Environment, Development and Sustainability, 5(20): 2281–2299.

Rousseva, S., I. Malinov and V. Stefanova, 2016. Soil erosion risk assessments using GIS technologies – Bulgarian experience. Bulgarian Journal of Agricultural Science, 2 (22): 205–208.

Savich, V.I., V.N. Zhulanova, V.S. Kashchenko and S.N. Yakimov, 2012. Agroecological assessment of Tuva soils (1970-2010). M: Russian State Agrarian University named after K. A. Timiryazev, p.: 440.

Shishov, L.L., N.V. Komov, A.Z. Rodin and V.M. Friedland, 2001. Soil cover and land resources of the Russian Federation. M: Soil Institute named after V.V. Dokuchaev of RAAS, p.: 400.

Sirotkin, V., S. Vasyukov and B. Usmanov, 2017. The possibility of using spectrographic data to assess soils fertility. International Multidisciplinary Scientific GeoConference Surveying Geology and Mining Ecology Management, 32(17): 639–646.

Soils of Irkutsk region, 1983. Report of the Irkutsk branch of the Institute of EastSibSDILM. Irkutsk, p.: 223.

Stepanova, L. and E. Korenkova, 2018. Agroecological significance of chernozem soil pasports for evaluation of soil degradation. International agricultural journal, 3: 1–5.

Shishov, L.L., D.N. Durmanov, I.I. Karmanov and V.V. Efremov, 1991. Theoretical bases and ways of soil fertility regulation. M: Agropromizdat, p.: 304.

Shishov L.L., V.D. Tonkonogov, I.I. Lebedeva and M.I. Gerasimova, 2004.Classification and diagnosis of soils in Russia. Smolensk: Oykumena,p.: 342.

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Vlček, V., M. Brtnický and J. Foukalová, 2011. Soil organic matter of chernozem in the part of Central Europe.Actauniversitatisagriculturaeetsilviculturaemendelianaebrunensis, 6: 381–386.

Wen, D. and W. Liang, 2001. Soil fertility quality and agricultural sustainable development in the chernozem region of northeast China. Environment, Development and Sustainability, 1(3): 31–43.

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International Transaction Journal of Engineering, Management, & Applied Sciences & Technologies

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A LEARNING AUTOMATA-BASED APPROACH FOR DYNAMIC LOAD BALANCING IN MANET

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ARTICLEINFO

Article history:
Received 30 October 2018
Received in revised form 14 February 2018
Accepted 25 February 2019
Available online
27 February 2019

Keywords:
Load balancing; MANET; Optimal route; Node energy; Energy saving; MANET simulation.

ABSTRACT

In mobile ad hoc networks (MANET) due to the high mobility of nodes, routing and load balancing are of major problems. In the proposed framework first, routes leading to destination is found and the value of compound route with the average of total probability of nodes for each route is calculated. Final value is considered to select a route among all routes leading to the destination. We considered the parameters in order to balance the load on the network and use of learning automata technique to select the optimal route. Simulation result shows that the proposed approach offers better performance in terms of energy consumption and the number of packets received by the sink.

1. INTRODUCTION

Many of the activities that are taking place in today's world are dependent on services offered by computer networks, and MANET networks are one of the networks that have many applications. Load balancing and network congestion are major problems in MANET network routing, therefore load balancing technique in this kind of network so that all data is transmitted intact are important[1]. For this purpose, it is necessary to perform routing in the network so that the load is balanced in all directions as well as it is essential that all the deficiencies that may unbalance the network be identified. Characteristics such as high mobility of the nodes, dynamic topology of the network, low bandwidth, limited power, and energy lead to the complexity of routing algorithms in ad hoc networks. These characteristics make most of routing algorithms on other networks not be applicable for ad hoc networks. Algorithms that perform routing as a single route or those are on demands have not generally solved the problem of load in MANETs.

Some of ad hoc routing algorithms perform routing as a multi-path operation to increase fault tolerance effectively [2, 3]. Most multi-route routing algorithms after route discovery process where they found multiple routes from source to destination choose one of them as the main route and begin

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sending data on it. They keep the other routes as alternative routes and in case of failure of the main route, they use one of the alternative routes for sending data. Using a permanent route leads to decrease of nodes energy level. Ending of the node energy in a route leads to failure of nodes. It creates gaps in the network and decreases the performance of the network.

Given the need for load balancing in MANETs and its importance, in this paper, we consider upgrading parameters that directly affect the type of balance to improve load balancing in this type of networks. To this end, a framework based on learning automata are proposed by considering nodes energy, signal strength and hop count of each route in MANETs.

2. LITERATURE REVIEW

Many studies have been done on load balancing of MANET, the most important of them are reviewed. In [4], different load balancing techniques in wireless mesh networks have been investigated to avoid congestion in gateways, as well as the effective parameters that are used in these techniques has been surveyed, In [5], they considered a Cluster-Based Wireless Mesh Architecture which the Wireless Mesh Network is divided into clusters that could minimize the load on a cluster or updating overhead during topology change due to mobility of mesh nodes. In [6], a method has been proposed to balance load by considering three metrics: 1) Route Energy, 2) queue traffic, and 3) hop count with the corresponding weight. In [7], priority-scheduling technique based on fuzzy is used to determine effects of this method on routing protocols AODV and DSR. In this method, a priority index is added to each packet in the queue nodes and this priority index is based on queue length, data rate, and packet expiration time.

In [8], stable routing algorithms based on fuzzy are provided for MANET to strengthen quality of services (QOS). One of the major problems in QOS routing in MANET is ensuring that one route is established in the network until the end of data transmission. To reduce the number of broken routes, a reliable routing algorithm that uses fuzzy logic is presented. This algorithm chooses a sustainable route based on the position of nodes and data rate. Moreover, a new protocol has been presented for maintenance of routes so that when a route breaks, a new route is established. In [9], Energy Efficiency in MANET routing protocols load balancing is studied. The presented works in this paper are: 1) New energy efficient AODV-based node caching routing protocol with adaptive workload balancing(AODV-NC-WLB); 2) New application of energy efficiency metrics to MANET routing protocols; 3) implementation and simulation of the study in. In [10], multiple adaptive routing has been offered for load balancing. In this method, an algorithm is used which detects multiple routes to the destination called Fail-Safe routing. There is one main route, which composed of nodes with minimal load, delay, and highest bandwidth. In routing when the average load of a node has an increase beyond the threshold, to reduce the traffic load on that congested route, traffic is distributed over multiple other routes. In [11], an energy efficient routing in MANETs based on learning automata are suggested. The proposed protocol is able to apply effectively with regard to limited energy. This method is applied in a version of AODV routing algorithm (i.e., routing AODV with learning automata) (AAODV). A representative of learning automata runs on each node, and this representative dynamically trains the best route to the destination. In [12], the efficiency of routing protocols of traffic-oriented load balancing in MANET has been compared.

In [13], Load Balancing Parallel Routing Protocol (LBPRP) has been provided that solves the problems of previous multiple routing protocols and distributes data in parallel in all directions at the same time. In this paper, a simple test scenario has been presented to ensure that the model is effective and credible. LBPRP prepares load balancing, reduces delay, increases packet delivery ratio and throughput. In [14], the performance analysis of load balancing in MANET routing protocols is done. In [15], the load balancing protocols in MANET are investigated. In addition to the above-mentioned methods that are more important, other methods are provided in the literature for load balancing in MANET.

3. THE PROPOSED METHOD

A research group called Tsetlin in the Soviet Union introduced the concept of random automata for the first time in the early 1960s. After that in later research, several application of learning methods in engineering systems such as routing in phone, pattern recognition, Object Partitioning, and Adaptive Control were developed.

Each Stochastic Learning Automata (SLA) include of two main components: 1) A stochastic automata with a limited number of operative that interact with a stochastic environment. 2) A learning algorithm which the automata learns the optimal action by it.

Each automaton can be considered as a Finite State Machine (FSM) that can be presented by the following pentamerous:

$$SA = \{\alpha, \beta, F, G, \phi\} \tag{1}$$

The parameters in this pentamerous are:

- Set of automata operations: $\alpha \equiv \{\alpha_1, \alpha_2, ..., \alpha_r\}$
- Set of the automata input: $\beta \equiv \{\beta_1, \beta_2, ..., \beta_r\}$
- Function that maps input and the current states to the next state: $F \equiv \phi \times \beta \to \phi$
- Output function that maps the current state to the next output: $G \equiv \phi \to \alpha$
- The set of the internal states of the automata at the n_{th} moment: $\phi(n) \equiv \{\phi_1, \phi_2, ..., \phi_r\}$

Setα includes applying the automata where the automata in each iteration, choose one of them. Inputsβ define automata input; the details of it will be discussed in the next section. F and G convert the current state and input to the next output (action) selected by the automata. If F and G areDeterministic, the automaton is called Deterministic Automata. In such a case, by having primary and input modes, output and the next state are uniquely obtained. If mappings F and G are random, automata are called stochastic automata. In that case, only the probabilities related to the next state and corresponding outputs could be determined. Stochastic Automata is divided into two categories: 1) Automata with a fixed structure 2) Automata with Variable Structure.

We use learning automata with variable structure L_{R-P} where the probability selecting p for each action of α is updated according to the following equations. In case of receiving a favorable response from the environment β(k)=0, possibility of that action is rewarded by the following equation:

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$$p_j(k+1) = \begin{cases} p_j(k) + a[1 - p_j(k)] & j = i \\ (1-a)p_j(k) & \forall j \neq i \end{cases} \quad (2)$$

In case of receiving an unfavorable response from the environment β(k)=1, possibility of that action is fined by the following equation:

$$p_j(k+1) = \begin{cases} (1-b)\,p_j(k) & j = i \\ (\frac{1}{r-2}) + (1-b)\,p_j(k) & \forall j \neq i \end{cases} \quad (3)$$

In both of the above equations: p_j (k + 1) is probability of automata at the time k + 1, p_j (k) is the probability of automata at time k, *a* is reward, *b* is penalty, and *r* is number of measures.

After creating the existing nodes in the network, two nodes are selected randomly which one of them is a source and the other plays the role of the destination. If two nodes are directly connected to each other, routing does not make sense and packet transmission is performed. Otherwise, the routes between two nodes are determined. An example of this is shown in Figure 1.

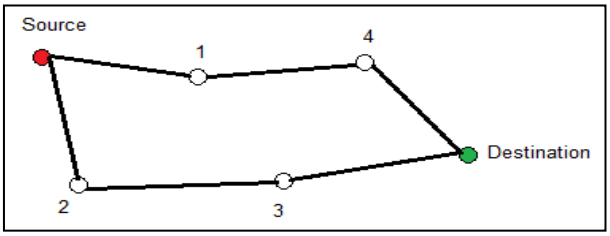

Figure 1: The path between the source and sink

As shown in Figure 1, there are two routes as [source, 1, 4, destination] and [source, 2, 3, destination]. In this protocol, we want to choose the route that is more efficient than other routes. Considered parameters of any route are route energy, signal strength, number of steps, and the average speed of nodes movement in the route. Value given to each route in the first step is based on fuzzy rules. Here for each parameter, two levels are defined. Let us assume that [source, 1, 4, destination] has a value of 0.56 and route [source, 2, 3, destination] has a value of 0.45. Another important point here is the effect parameter of the probability of each node based on learning automata. In this proposed network, there are six nodes, therefore, the initial probability of each node is 1/6=0.17. The average probability of each route is calculated based on the probability of each node:

P ([source, 1, 4, sink]) = 0.17&P ([source, 2, 3, sink]) = 0.17

Thus, according to the previous value of each route and average probability of the route, the new value of each route is calculated as follows:

[Source, 1, 4, sink] = 0.17 + 0.56 = 0.73 (Route A)

[Source, 2, 3, sink] = 0.17 + 0.45 = 0.62 (Route B)

After calculating the value of each route, we calculate the route:

Route A = 0.54

Route B = 0.46

Choosing route is based on the roulette wheel, so a random number is selected, for example, if the generated random number be 0.4 so route A is selected and the packets transmit via this route. Thus, route A is selected as an appropriate route and nodes in this route are selected as appropriate nodes. Therefore, nodes in route A are rewarded and other nodes are penalized, it is given as:

$$P(N: Source, Sink, 1, 4)= P(N: Source, Sink, 1, 4)+a[1- P(N: Source, Sink, 1, 4)] \quad (4)$$

$$P(N:2,3)=(1-a)[P(N:2,3)]$$

The flowchart of the proposed method is shown in Figure 2.

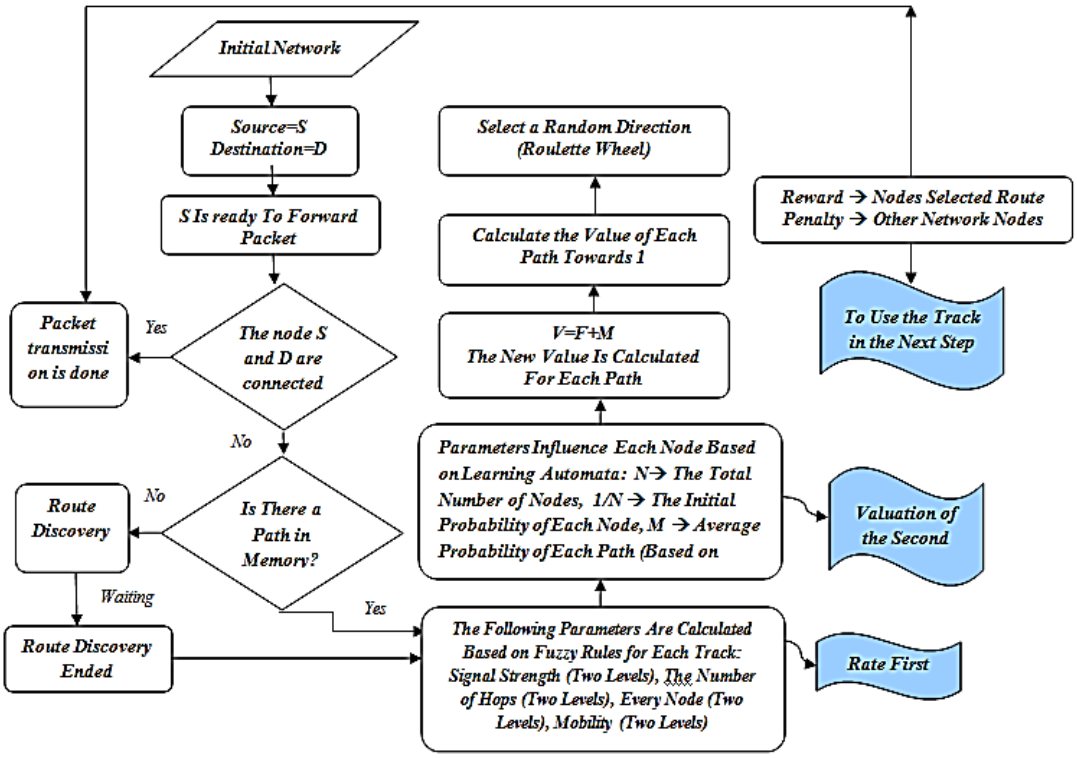

Figure 2: Proposed method

4. EVALUATION AND RESULTS

The absence of infrastructure, freedom of movement in all directions, the ability to communicate with anyone and at any time, independence of any control and other features are the keys to popularity of MANET, even if it is an emerging technology. Despite of this success, MANETs still have several drawbacks such as the dynamic topology, variable within flow, limited connections and bandwidth, limited power supply and lower security. In addition, the displacement of nodes that is an important advantage in MANET is the main source of many problems. For example, when nodes come out of the other nodes, the connection is interrupted. Speed sets used in the simulation are: Speeds= [2 3 4 5]

This matrix shows that the speeds are 2 meters per second to 3 meters per second, 4 meters per second, and 5 meters per second. The space examined is 600 × 600 square meters and the number of nodes is variable.

Network Space investigated when the number of nodes changes is as 280, 396, 485, 560, and

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627 meters and the number of nodes in the network are 50 nodes, 100 nodes, 150 nodes, 200 nodes, and 250 nodes, respectively, and constant speed of 2 meters per second.

This simulation defined with the dimensions above is carried out in an outdoor environment. There is no height difference between the nodes. Simulation time is evenly 5000 milliseconds in each scenario. It should be noted that the simulation was conducted in a manner that can provide different statistics. The number of nodes is variable and there is no problem in terms of increasing or decreasing nodes, and their number can be expanded.

4.1 CHANGE IN THE NUMBER OF NODES IN FIXED SPACE

The results vary with increasing number of nodes in the network and average number of steps. Nevertheless, it is noteworthy that the number of steps has a reduced rate showing better performance of the proposed protocol in environments with large scale.

Another parameter studied here is the rate of successful packet transmission. With increasing the number of nodes in the network, packet successful transmission rate increases. It should be noted that the rate of increasing, in this case, decreases with increasing the number of nodes in the network. Therefore, we can say that in the proposed protocol, network performance is improved with increase in its scale.

Figure 3 shows changes in energy consumption in MANET based on the proposed protocol compared to changes in the number of nodes. As expected with the increase in the number of nodes in the environment, energy consumption increases. It should be noted that slight increase in the number of nodes has no effect on energy consumption and after increase in the number of nodes from certain values, energy consumption increases and then remains fixed.

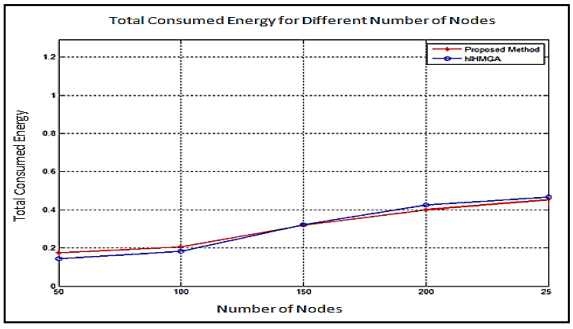

Figure 3: Energy consumption in MANET based on the proposed protocol compared to changes in the number of nodes

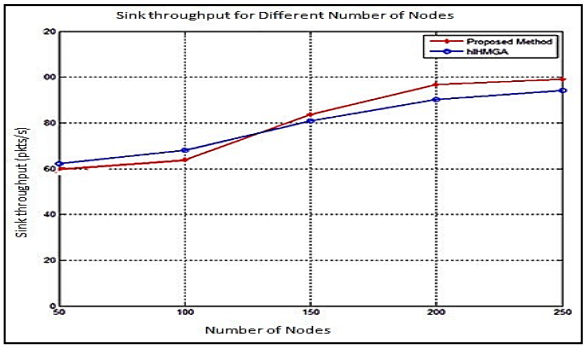

Figure 4: The number of packets received by the sink

According to the results, it is expected that the number of packets received by the sink increase with increasing the number of nodes. This increase is shown in Figure 4. As learning automata are used here, it can be stated that increasing the number of nodes has a positive effect on the learning process.

4.2 CHANGE IN THE SPEED OF THE NODE

The parameter that has been studied here is successful transmission rate of packets compared to different speeds. Figure 5 shows the rate of successful packet transmission relative to speed. With increasing the speed, transmission rate of the nodes in the network did not change significantly. It should be noted that the number of nodes used in this simulation is 200 nodes network, and network space in 500 × 500 square meters.

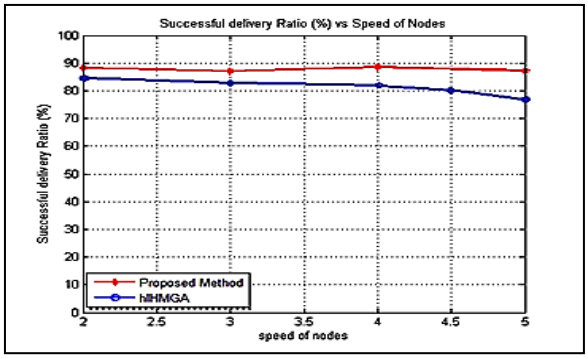

Figure 5: The rate of successful packet transmission in ratio to the speed of the node

4.3 NETWORK WITH FIXED DENSITY

Here, the influence of the number of nodes in MANET with fixed density or increase of environmental aspects on parameters such as energy consumption, change in the number of steps, successful transmission percentage, and the number of successful submissions received by the sinks were evaluated. To this end, node's movement speed was considered constant and equal to 2 m/s. The number of nodes was variable and respectively 50, 100, 150, 200 and 250 nodes in the area. Packet transmission speed was considered constant and equal to 100 packets per second. Length and width of the environment where nodes are is considered equal to 280, 396, 485, 560 and 627 meters.

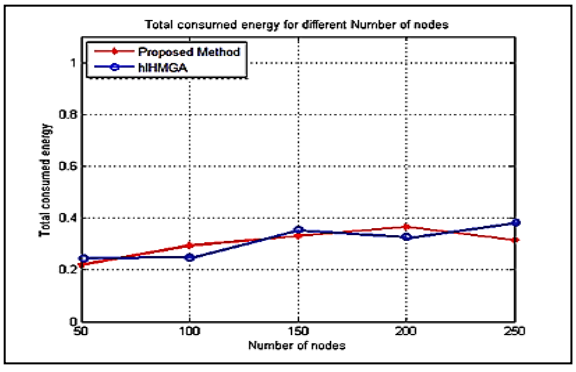

Figure 6: Change in total energy consumption in ratio to change in the number of nodes in the network with constant density

Figure 6 shows the change in total energy consumption in ratio to change in the number of nodes in the network with constant density. As shown, by increase in number of nodes in the network, energy consumption also increases. This increase could be due to increased connectivity between nodes, increased congestion, increase in the number of transactions and communications. The

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quantity and quality of increase of energy consumption in this mode are different from when the density is variable. Here the rate of increase is decreasing.

Figure 7 shows the change in the number of packets received by the sink in ratio to increase the number of nodes in the network with fixed density. As shown in Fig., with increase in the number of nodes in the network, number of incoming packets to the sinks reduces. Since energy consumption and the number of steps increase in the route, and the ratio of successful submission of package reduces, so according to previous figures, it is expected that the packet received by the sink reduce as well.

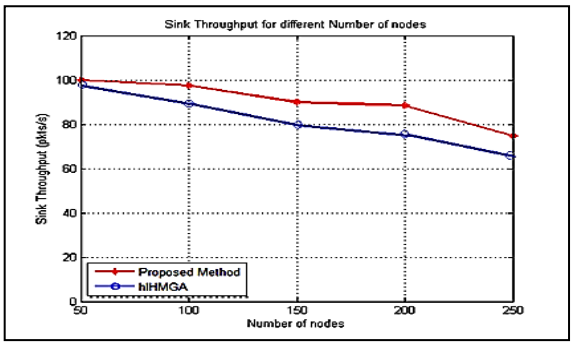

Figure7: The number of packets received by the sink in ratio to increase the number of nodes in the network with fixed density

Figure 8 shows the simulated time on each node in the whole time. As shown, except for a few nodes, most nodes have equal amount of load. In the proposed method, it has been tried to use all nodes to transmit packets. That is why energy consumption is improved, the number of lost packets has reduced, and successful transition has increased, all of which has happened due to more uniform distribution of the load on the network as shown in Figure 8, happened.

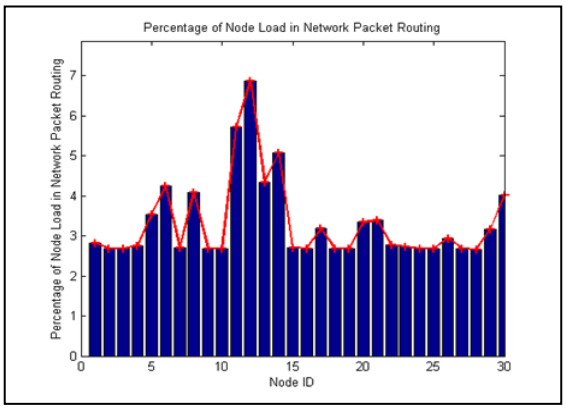

Figure 8: Simulated time on each node in the whole time

5. CONCLUSION

MANETs are self-organizing networks without centralized control or fixed structure and contain dynamic, mobile, and wireless nodes. Hence, they are called ad-hoc that do not have definite and fixed network structure, and each node transmits the data itself. The use of this network is in military systems, small personal and administrative networks, and ad hoc networks of vehicles. After creating random nodes in the network, two nodes are selected, one of which is as a resource and the other one plays the role of destination. In this protocol, we want to choose the route that is more efficient than other routes.

The parameters considered here of any route are energy route, signal strength, number of steps, and the average speed of movement of nodes in the route. The value given to each route in the first step is based on fuzzy rules. Choosing route is based on the roulette wheel, so a random number is selected, based on which the desired route is selected. Therefore, the nodes in the route are rewarded and other nodes are fined. The results show that the proposed method has better performance in terms of energy consumption and the number of packets received by the sink.

6. REFERENCES

[1] Zehni, A., Zolfaghari , S., Fathy, M., Shahverdy, M., Asgari, M., (2017), WIRELESS MESH NETWORK ROUTING: A COMPARATIVE SURVEY, QUID, Special Issue No. 1, pp. 412-421.

[2] Anchari, A.A., Amin, A., Ashraf, S., (2017), Routing Problems in Mobile Ad hoc Networks (MANET), JCSMC, Volume (6), Issue(7), pp .9–15.

[3] Desai, R., Patil, B.P., Sharma, D.P, (2017), Routing Protocols for Mobile Ad Hoc Network:A Survey and Analysis, ndonesian Journal of Electrical Engineering and Computer Science, Volume(7), No. 3, pp.795-801

[4] Asgari, M., Shahverdy, M., Fathy, M., Movahedi, Z., (2015), Load Balancing in Wireless Mesh Network: a Survey, ACSIJ Advances in Computer Science: an International Journal, Volume (4), Issue 4, No. 16. Pp. 60-64.

[5] Shahverdy, M., Behnami, M., Fathy, M.,(2011). A New Paradigm for Load Balancing in WMNs, International Journal of Computer Networks (IJCN), Volume (3), Issue (4).pp. 239-246.

[6] Ran, A., Dave M., (2009). Load Balanced Routing Mechanisms for Mobile Ad Hoc Networks, International Journal of Communications, Network and System Sciences, 7, Volume (2), pp.627-635.

[7] Setti,S.P.,et. al, (2010), Implementation of Fuzzy Priority Scheduler for MANET and Performance Analysis with Reactive Protocols, International Journal of Engineering Science and Technology, 8, Volume (2), pp.3635-3640.

[8] Dana, A., Babaei, M.H.,(2011), A fuzzy based stable routing algorithm for MANET, International Journal of Computer Science Issues, 1, Volume (8), pp.367-371.

[9] Jung, S., Hundewale, N., Zelikovsky, A., (2005), Energy efficiency of load balancing in MANET routing protocols. InSoftware Engineering, Artificial Intelligence, Networking and Parallel/Distributed Computing, First ACIS International Workshop on Self-Assembling Wireless Networks, SNPD/SAWN, Sixth International Conference on 2005 May 23, pp.476-483.

[10] Soundararajan, S., Bhuvaneswaran, R.S.,(2012), Adaptive Multi-Path Routing for Load Balancing in Mobile Ad Hoc Networks, Journal of Computer Science, 5, Volume (8), pp.648-655.

[11] Hosseini, V., Taghipoor, M.,(2012), A Novel Method of Routing for MANETs with Considering the Energy by Learning Automata. World Applied Sciences Journal, 1(17), pp.113-118.

[12] Ali, H.A., Hamza, T.T., Sarhan, S.,(2012), MANET Load Balancing Parallel Routing Protocol, International Journal of Computer Science, 9(4), pp.187-193.

[13] Torkestani, J., Meybodi, M.R., (2010), Mobility-based multicast routing algorithm for wireless mobile Ad-hoc networks: A learning automata approach, Computer Communications, 33(6), pp.721-735.

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[14] Malik, M., et al., (2014), Performance Analysis of Load Balancing in MANET using On-demand Multipath Routing Protocol, International Journal of Advanced Research in Computer Engineering & Technology, 3(6), pp.2106-2110.

[15] Patlib, A.B., (2012), Survey of load balancing routing in MANET, International Journal of Emerging Trends of Technology in Computer Science, 3(1), pp.133-41

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DESIGN FOR PEOPLE WITH DISABLED HEALTH OPPORTUNITIES (ON THE EXAMPLE OF BLIND AND WEAK PEOPLE)

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ARTICLEINFO

Article history:
Received 30 October 2018
Received in revised form 14 February 2018
Accepted 25 February 2019
Available online
27 February 2019

Keywords:
Accessible environment; Universal design; Ergodizain; Design of relief.

ABSTRACT

Disability is an emerging field within public health; people with significant disabilities account for more than 15% of the world population. People with disabilities who receive a high-quality education and enter the workforce prepared are not only a benefit to themselves, but to their families, employers, and communities. Disparity status for this group would allow federal and state governments to actively work to reduce inequities. In this article, the application of the basic principles of universal design on the example of creating relief-graphic aids for blind and visually impaired people is considered. We developed a methodology for this purposed which results demonstrates its accuracy and efficiency.

1. INTRODUCTION

The concept of "universal design" is based on the idea of convenience and comfort for everyone. According to experts, universal design is important for people with disabilities (10% of the total population), necessary for people with limited mobility (40%) and convenient for everyone (100%) [1, 2]. Universal design is the design of objects, space, programs, and services that help maximize the use of space and the objects in it to various categories of people. But in this case, the moment of using specialized devices for various limited mobility groups is not excluded. The creation and maintenance of a barrier-free living environment includes:

- unhindered access to objects of social infrastructure;
- use of transport and transport communications;
- access to media;
- obtaining social services;
- the creation of a "barrier-free" psychological environment in society[1, 3].

The implementation of the state program "Accessible Environment" is currently extended until

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2020 (order No. 2736-p, dated October 27, 2014). Currently, designers and architects create objects that match to needs of different groups of people. Design solutions help to increase the overall level of comfort for all people. The creation of an accessible environment is the basic principle of universal design. Consider the basic principles of universal design for the design of elements of an accessible environment for the visually impaired [4].

It is known that the visually impaired are divided into two categories with differing needs: people who do not see at all (blind) and with residual vision (visually impaired). Visually disabled people make up approximately 4% of the total number of people with disabilities, including completely blind people - less than 1% [5]. Race/ethnicity, age, language, sex or gender, poverty, and low education can compound the impact of disability, leading to even poorer health and quality of life [6, 7].

For blind and visually impaired citizens, a "barrier-free" environment is not only special means of social and environmental adaptation but well-known adaptations necessary for all categories of the population (curbs, sidewalks, stairs, handrails). Tactile informational resources are all surfaces that inform a blind person about the location, purpose of a certain object, warn about the dangers and direct the blind in the right direction, as well as means involved in the spiritual, aesthetic and educational activities of a blind person.

2. METHODOLOGY

Relief is a form that by plastic modeling on the surface visually depicts a three-dimensional object. There are apply three types of relief drawings for the visually impaired.

- -contour drawings;
- -application (silhouette) drawings (this type of drawing is usually carried out in the form of a silhouette cut out of thick paper and glued onto a paper sheet or tablet);
- -bath-relief drawings convey the shape of the object. They are made of gypsum, metal, followed by printing under press on punched card paper or plastic [8].

The spreading of the relief is largely dependent on the ratio of height and surface size of the relief. With the help of tactile sensations, the texture of objects is known, it means the properties of their surface. These properties can cause aesthetic sensations, perceived by the tips of the fingers. Tactile informing surfaces should be safe [7].

Note that blind and visually impaired people perceive a graphic pattern differently. First along the contour, and then the remaining elements, and only then a complete picture of the whole image is formed. This should be taken into account when creating graphic images intended for blind people. Simplified a lot of number of small parts. The image should be clear and concise. In the conditions of the "Lipetsk Regional Special Library for the Blind", relief-graphic aids for the blind and visually impaired people were designed and created. This process was carried out using modern technologies and included the following steps:

- analysis of the model;
- creating a sketch of the object;
- scanning and processing a sketch;

- print on the heater "Tiger" (France) on special paper "ZY-TEX SwellPaper", intended for tactile perception.

The device allows you to create relief images. With the help of heat, the graphic pattern on special paper becomes voluminous, which makes information accessible to the visually impaired. Creating a relief-graphic images begins with the study, analysis, selection of the angle mode, and then converting the objects of the original image. It is necessary to simplify a large number of lines and elements. Therefore, when converting objects, it is necessary to graphically transfer the characteristic features of the form. Correctly determine the size and proportionality of the object and its parts. The image should be clear.

3. RESULTS

Taking into account all the scientifically-based principles of ergonomics and aesthetics, we have developed and manufactured unique didactic aids for the blind and visually impaired. The process of design and manufacturing of the product was carried out taking into account the optimality of its functional, operational qualities. The publication "In the memory of the people for centuries ...", fig. 1 (monuments of the Great Patriotic War in Lipetsk), created thanks to the implementation of the municipal social grant in the framework of the city program "Lipetsk - our common home".

Figure 1: Cover of the publication for the visually impaired "In the memory of the people for centuries" [3].

Training can be improved at several levels: (1) basic disability awareness for all public health workers and clinical care providers, (2) discipline-specific training on select aspects of disability, and (3) a needed infrastructure for core leadership training of health professionals in disabilities that addresses the full life span. Table 1 presents the Population Differences between People with and

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Without Disabilities on Health Indicators of Health Care Access, Health Behaviors, Health Status, and Social Determinants of Health.

Table 1: Population differences between people with and without disabilities on health indicators of health care access, health behaviors, health status, and social determinants of health: United States

Health Indicator	People With Disabilities (%)	People Without Disabilities (%)	Data Source
Health care access			
In past year, needed to see doctor but did not because of cost[a]	27.0	12.1	BRFSS 2010
Women current with mammogram[a]	70.7	76.6	BRFSS 2010
Women current with Pap test[a]	78.3	82.3	BRFSS 2010
Health Behaviors			
Adults who engage in no leisure-time physical activity[a]	54.2	32.2	NHIS 2008
Children and adolescents considered obese (aged 2–17 y)[b]	21.1	15.2	NHANES 1999–2010
Adults who are obese[a,b]	44.6	34.2	NHANES 2009–2010
Adults who smoke (100 cigarettes in lifetime and currently smoke)[a]	28.8	18.0	NHIS 2010
Annual no. of new cases of diagnosed diabetes (per 1000 persons)[a]	19.1	6.8	NHIS 2008–2010
Adults with cardiovascular disease			NHIS 2009–2011
18–44 y	12.4	3.4	
45–64 y	27.7	9.7	
Victim of violent crime (per 1000 persons)[a]	32.4	21.3	NCVS 2007
Adults reporting sufficient social and emotional support[a]	70.0	83.1	BRFSS 2010
Social determinants of health			
Adult (> 16 y) unemployment	15.0	8.7	CPS 2011
Adult (> 16 y) employment	17.8	63.6	CPS 2011
Adults with < high school education	13	9.5	BRFSS 2010
Internet access	54	85	NOD 2010
Household income < $15 000	34	15	NOD 2010
Inadequate transportation	34	16	NOD 2010

In addition, the design of relief-graphic images of the following manuals for the blind and visually impaired has been developed: “The streets of the city named their names”, “The estates of the Lipetsk region”; "Temples and monasteries of the Lipetsk and Yelets eparchy." In order to familiarize themselves with the art crafts of the Lipetsk region, “The Magic Power of the Romanov Toy” illustrations of the relief-graphic manual were developed.

4. CONCLUSION

Relief-graphic illustrations for the blind and visually impaired. This manual is very popular among the visually impaired, as it allows you to explore the features of the traditional folk crafts of the Lipetsk region. On the basis of the received artistic images, the visually impaired can make a traditional Ramon's toy. In accordance with the modern requirements of education, relief publications

for the blind and visually impaired acquire the status of a necessary condition for the organization of training for disabled people. An important role here is ergodizayn.

5. REFERENCES

[1] Kulaykin, Grashin A.A. Design a developing object-spatial environment for children. The material was prepared with the support of the RGNF on project No. 12-04-00352 [Electronic resource]. Access mode: www.advtech.ru/vniite/stat17.doc

[2] Design in the educational system / Designer Library. A series of design education. - M.: VNIITE, 1994.

[3] Reshetova M. V., Kukushkina V.A. Tactile Land - Design Rehabilitation for people with disabilities // Collection of scientific papers of the International Scientific and Practical Conference dedicated to the 60th anniversary of Lipetsk State University and the 20th anniversary of the professorial chair "Design and artistic processing of materials" of the Institute of mechanical engineering. 05-07December 2016 - Lipetsk: Publishing house of Lipetsk State Technical University, 2017, 195p.

[4] Kukushkina V.A. Design tactile images for the blind and visually impaired. International polythematic magazine of scientific publications "Project culture and quality of life." - Moscow, 2015, 669p.

[5] Kazachkova, O.A. Zyabneva, O.A. Mamedova, I.Y. Kulishova, E.A. 3D technologies in the production of jewelry with elements of complicated design. International Journal of Engineering and Technology(UAE), 7(3), 2018, pp. 155-157.

[6] Abdullah L.S., Kukushkina V.A., Kantaryuk E.A.the perspective of using 3d-modeling in the designing of technological solutions for chassis design. International Journal of Engineering and Technology (UAE). 2018, 7(2), 13-15.

[7] Gamov E.S., Tonkovid S.B., Kukushkina V.A., Nikulcheva N.A.A. 3D design based on jewelry production technology with special features International Journal of Engineering and Technology(UAE). 2018, 7(3), 10-12.

[8] Kukushkina V.A., Kantaryuk E.A., Hechiashvili I.T., Kantaryuk M.V. hermeneutics of a barrier-free environment for people with disabilities (experience of visual comment).International Journal of Engineering and Technology(UAE). 2018, 7(3), 65-67.

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DEVELOPMENT OF RURAL AREAS IN RUSSIA IN TERMS OF PROGRAM-TARGET MANAGEMENT

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ARTICLEINFO

Article history:
Received 22 January 2019
Received in revised form 25 February 2019
Accepted 27 February 2019
Available online 28 February 2019

Keywords:
Rural monitoring;
Rural population;
Rural employment;
Rural quality of life;
Rural settlement;
Rural analysis; Rural social infrastructure.

ABSTRACT

This study identifies factors that make difficulties for sustainable development of Russia rural areas; to develop a concept of forming an effective social infrastructure. There was a decrease in rural population to the level of 1991 by 982 thousand people, or 2.5%. The total rural population is considered from four positions: natural increase (or decrease); migration increase; changes in a settlement status (from urban to rural); expansion of the rural area due to the annexation of the Crimea. So, there was a decrease in the first factor (natural increase) by 3.7 million people during the market reforms 1992-2016. The second factor, half a million people were increased. The third factor (changes in a settlement status) had an increase of over 2 million people. The fourth factor, the rural population of the Russian Federation grew almost 800 thousand people due to the rural territory of the Crimea. If to deal with a structure of the employed rural population in the Russian Federation by types of economic activity, it should be emphasized that the proportion of those directly engaged in agriculture is 21% of the economically active rural population or about 8 million people. This underlines the multifunctionality of rural areas. It is recommended to ensure financial priority for strategic projects that increase the profitability of the agricultural sector for its modernization and increasing competitiveness, improving the infrastructure of rural areas and a local self-government, developing agricultural and green tourism; to develop agricultural and green tourism; to carry out certification of rural settlements; to implement minimum standards of social and communal infrastructures; to legislate a status of a young specialist who goes to rural areas, concerning his rights and obligations, as well as benefits and preferences of various kinds. This decision, in the authors' opinion, will significantly increase the attractiveness of rural areas for young people.

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1. INTRODUCTION

Russia, like any other state, has many different socio-economic problems. But the problem of rural development is among the priority ones, as the agrarian and agri-food sectors of the economy are a basis of food security and food supply of the population in the Russian Federation. An effective food security system is a basis for keeping the sovereignty and national security of the country.

Unfortunately, the rural areas as the main location for agricultural production are in crisis. The crisis can be proved not only with the disappearance of 23 thousand settlements in Russia (over the last twenty-five years) but also with worsening the conditions for agribusiness and decreasing the living standards at rural areas.

But at the same time, it is worth mentioning that the first modern agro reforms (in the early 90s of the last century), during the transition to a new paradigm of development of the Russian economy, attempted to develop the agricultural sector of the rural economy and social infrastructure. Economic and legal regulation of development of non-urban areas was marked by the adoption of the RSFSR Law "On social development of the rural areas" (December 21, 1990). Then, there was a whole series of decrees of the Government of the Russian Federation on the development of electrification, gasification, water supply at rural settlements, as well as on housing, cultural and social construction, etc.

However, the inefficient arrangement only deepened that difficult situation in rural areas [8; 9].

2. METHODOLOGY

To identify factors that make difficulties for sustainable development of rural areas, the following research methods were used: monographic (to clarify the essential characteristics of non-urban areas, features of their development not only in Russia but also abroad), economic and statistical (to analyze demography, improvement of housing stock at rural areas, a compensation rate for agricultural labour and other characteristics of a social and labour sphere at rural areas), sociological (to make questioning of young professionals), economic and mathematical modeling (to assess the potential of a rural territory and predict its sustainable development).

3. RESULTS

To improve the current situation in rural areas, the Government of the Russian Federation and the governing bodies of the agro-industrial complex use a program-targeted method of planning and management to develop and introduce certain strategic documents. There are such programs as the federal target program on stabilization and development of the agro-industrial complex in the Russian Federation for 1996-2000; the federal target program "Social development of rural areas up to 2010"; the federal target program "Sustainable development of rural areas" for 2014-2017 and for the period up to 2020 and other strategic regulatory and legal documents.

Monitoring of a social and labor sphere at rural areas and the population censuses

indicate that the rural population in the Russian Federation is about 38 million people, or 25.7% of the total population in Russia (tab. 1).

In comparison to the level of 1991, the decline in the rural population is 982 thousand people or 2.5%.

We consider the total rural population from four positions:

- natural increase (or decrease);
- migration increase;
- changes in a settlement status (from urban to rural);
- expansion of the rural territory due to the annexation of the Crimea.

Table 1: Components of changes in the number of rural population * (thousand people)

Year	The population by January,1	Changes during the year				Total increase during the year, %
		Total increase	Natural increase	Migration increase	Changes in a settlement status	
1991	38868.6	288.4	43.0	62.0	183.4	0.74
1992	39157.0	736.3	-32.8	308.5	460.6	1.88
1993	39893.3	157.8	-178.5	265.9	70.4	0.40
1994	40051.1	87.1	-224.2	291.1	20.2	0.22
1995	40138.2	-157.2	-206.5	47.6	1.7	-0.39
1996	39981.0	-140.2	-221.4	23.7	57.5	-0.35
1997	39840.8	-149.5	-226.0	32.8	43.7	-0.38
1998	39691.3	-205.1	-203.7	31.0	-32.4	-0.52
1999	39486.2	-15.6	-265.1	49.9	199.6	-0.04
2000	39470.6	-238.7	-274.2	-2.6	38.1	-0.60
2001	39231.9	-307.9	-271.7	-51.9	15.7	-0.78
2002	38924.0	-281.6	-281.9	-26.7	27.0	-0.72
2003	38642.4	-348.3	-281.5	-90.5	23.7	-0.90
2004	38294.1	324.8	-260.3	-108.8	693.9	0.85
2005	38618.9	-200.9	-287.6	-117.4	204.1	-0.52
2006	38418.0	-287.0	-230.4	-109.0	52.4	-0.75
2007	38131.0	-248.6	-145.7	-50.9	-52.0	-0.65
2008	37882.4	-60.7	-113.3	-60.6	113.2	-0.16
2009	37821.7	-49.6	-88.9	-47.8	87.1	-0.13
2010	37772.1	-327.9	-81.7	-228.8	-17.4	-0.87
2011	37444.2	-129.8	-42.5	-149.9	62.6	-0.35
2012	37314.4	-85.6	-6.3	-166.6	87.3	-0.23
2013	37228.8	-110.6	-0.8	-176.8	67.0	-0.30
2014	37118.2	866.9	-19.7	886.6	…	2.33
2015	37985.1	-97.8	-61.4	-46.8	10.4	-0.26
2016	37887.3	N/I	N/I	N/I	N/I	
Total in 1992-2015		-1254.1	-3741	452.1	2034.8	-3.20
Total in 1992-2015 (without the Crimea)		-2014.1	-3740	-308.9	2034.8	-5.14
Total in 1992-2015 (without the Crimea and changes in a settlement status)		-4048.9	-3740	-308.9	-	-10.34

*Note: Increase in the rural population due to the Crimea is calculated in the column "Migration increase". Since the beginning of market reforms in Russia in the period of 1992-2016, the rural population decreased from 39157 thousand to 37887,3 thousand people or by 3,2%. Source: Federal state statistics service. Demography. URL: http://www.gks.ru N/I: No information

So, there was a decrease in the first factor (natural increase) by 3.7 million people in the period of market reforms of 1992-2016. Concerning the second factor, there was an increase of about half a million people. The third factor (changes in a settlement status) had an

increase of over 2 million people. As to the fourth factor, the rural population of the Russian Federation grew by almost 800 thousand people due to the rural territory of the Crimea.

If to deal with a structure of the employed rural population in the Russian Federation by types of economic activity, it should be emphasized that the proportion of those directly engaged in agriculture is only a little more than 21% of the economically active rural population or about 8 million people. Once again this underlines a well-known thesis about the multifunctionality of rural areas.

Currently, more than 12% of the economically active population at these territories are employed in commerce, in an education sphere and health care - 18%, at industrial and construction enterprises - 24.5%, state and municipal administration - 7.5%, transport, and communication - 7.7%.

A well-known state program on the development of agriculture (2013-2020) and regional programs on the development of rural areas have special sections related to the development of the above-mentioned branches of the real sector of the economy.

The living standards in rural areas are still significantly lower than in urban areas. A compensation rate for agricultural labour is about 60% of the average wage in the Russian economy. An unemployment rate among rural inhabitants (7.3%) exceeds an unemployment rate among the urban population (4.6%). Improvement of the housing stock in rural areas significantly falls behind the urban housing stock (Table 2).

Table 2: Improvement of the housing stock in rural and urban areas (%)
(Available from Russia Federal State Statistics Service. Improvement of the housing stock. http://www.gks.ru)

Period	Total area equipped with						
	Water supply system	Water discharge	Heating system	Baths (shower)	Gas	Hot water supply system	All kinds included
Rural settlement							
2010	47,6	38,5	60,0	28,7	74,5	25,3	23,9
2011	48,5	39,2	60,8	29,1	74,0	26,2	24,5
2012	49,1	39,9	61,3	29,4	73,8	26,5	24,8
2013	52,0	41,1	63,6	30,7	73,3	27,9	26,0
2015	54,7	43,4	66,3	32,5	74,1	30,2	28,4
2016	58,0	47,0	68,0	35,0	74,0	34,0	N/I
2017	59,0	48,0	68,0	36,0	73,0	35,0	N/I
City							
2010	89,3	87,3	92,0	81,3	66,9	80,1	77,3
2011	89,5	87,5	92,1	81,5	66,6	80,3	77,5
2012	89,6	87,5	92,2	81,4	66,2	80,4	77,4
2013	89,8	87,6	92,1	81,6	65,4	80,5	77,6
2015	91,0	89,0	92,0	82,0	64,0	81,0	78,0
2016	91,0	89,0	92,0	82,0	64,0	82,0	N/I
2017	91,0	89,0	93,0	82,0	64,0	82,0	N/I

N/I: No Information

Thus, availability of a water supply system at rural areas is 54.7%, while in the city it is 91%; a heating system is 66.3%, and 92%; a hot water supply system is 30.2% and 81%, respectively.

Low living standards result in depopulation at rural settlements (Table 3). In Russia, more than 8% of the total number of rural settlements (SNP) is depopulated. If to apply a term of pre-revolutionary Russia, 12.5 thousand of the rural settlements in our country are "wastelands".

Table 3: Grouping of rural settlements by population size in the Sverdlovsk region and the Russian Federation (Available from the website of Administration of Federal Service in the Sverdlovsk and Kurgan regions. sverdl.gks.ru).

Habitancy, people	The Sverdlovsk region				The Russian Federation, % of the total # of settlements
	# of settlements, pcs.	% of the total # of settlements	# of residents in settlements, people	% of the total number of residents	
0	134	7.2*	0	0	8.4*
≤ 10	198	11.6	870	0.1	23.9
11-50	306	17.9	8349	1.1	26.8
51-100	224	13.1	16503	2.2	10.5
101-500	606	35.5	145446	19.4	25.5
501-1000	203	11.9	146889	19.6	7.6
1001-3000	130	7.6	211547	28.3	4.5
3001 and more	42	2.4	218850	29.3	1.2
Total with population	1709	100	748454	100	100

*From the total number of populated settlements including the ones without inhabitants (for reference: in the Sverdlovsk region – 1843, in Russia – 155289 of populated rural settlements).

The Sverdlovsk region, an industrially-developed region, concerned about such a situation in rural areas. Early before the current market reforms, in 1983, Sverdlovsk people held a Republican meeting and seminar on comprehensive development and improvement of rural settlements in the RSFSR. This is how experimental rural settlements "Baltym" and "Patrushi" started. The idea was that the transformation of rural settlements is impossible without the support of large cities in construction of housing stock, social and cultural facilities, reconstruction of agricultural facilities, development of new living standards, work and recreation.

«Uralelectromed» was the first who implemented this idea in practice; it financed construction of a whole district in one architectural style at "Patrushi". Then, "Baltym" started transformations (with the support of house-building plants), where we could find a cultural and sports complex, which was considered as "unique in the construction practice".

The Sverdlovsk region became the first Russian region to develop and start the practical implementation of a unique program on the redevelopment of rural areas the "Ural village", which was developed with consideration of the previously acquired experience of development of unique rural settlements with a modern social infrastructure [1; 2; 3].

The program "Ural Village" was introduced to the President of the Russian Federation V.V. Putin at a meeting on October 9, 2007, by the Governor of the Sverdlovsk Region. The head of the state approved the program. The Minister of Agriculture of the Russian Federation proposed to make it a federal program.

*Corresponding author (A.S.Lylov) E-mail: las@ursmu.ru Volume 10 No.3 ISSN 2228-9860 eISSN 1906-9642 http://TUENGR.COM/V10/335.pdf DOI: 10.14456/ITJEMAST.2019.33

Like any other strategic program on socio-economic development, it has its own unique features. In this particular case, the "Ural village" was developed on the existing standards of social and communal infrastructures, as well as the certification of rural settlements in the Middle Urals [7].

Its general goal is sustainable socio-economic development of rural areas, social security of the territory due to the implementation of minimum social standards that ensure the living standard of the rural population.

According to the developers, at least four interrelated tasks should be solved to achieve a general goal of this program and implement the necessary criteria and indicators.

Firstly, a mechanism on implementing the program should ensure the transition to the formation of diversified agricultural production, which ensures environmentally friendly agricultural products and raw materials with the use of advanced technologies, robotics, and other scientific and technical achievements. Secondly, a mechanism should be susceptible not only to innovations; it should stimulate the development of small agribusiness and consumer cooperations in rural areas. Thirdly, it should contribute to providing the rural population with proper socio-cultural and housing services. Fourthly, the program and measures on its implementation should be developed to enhance the prestige of the rural area for young rural people.

The main directions of the comprehensive program "Ural Village" include 32 positions covering a social and economic sphere of rural areas.

The certification of rural settlements became a very objective material of a socio-economic nature for development of basic sections of this regional program "The Ural Village" [7].

The sections in the passport of a rural settlement provide almost complete information about its social, financial, economic, ecological status.

This allows development of scientifically-proved measures and fixing sources of financing and performance periods.

Also, the Passport has minimum standards of social and communal infrastructures developed for rural areas with consideration of the norms of a planned economy and the results of modern research on a market economy.

The standards are developed for a normative model of rural development, but at the same time, they can be used for clusters and ecovillages [6].

The program pays special attention to an issue of attracting young specialists to work at rural organizations and enterprises. The conducted research in 29 municipalities in the forest-steppe and forest-meadow natural-climatic zones of the Sverdlovsk region showed that adaptation of young specialists occurs differently at business entities of various organizational and legal forms (Table 4).

Graduates of agricultural colleges adapt to production much faster than graduates of agrarian higher schools. This is due to the fact that specialists with a higher education lack more practical experience, this fact is proved with questionnaires conducted at enterprises of the agro-industrial

complex of the Sverdlovsk region. Moreover, there is no mentoring support in the majority of business entities, some collective agreements do not have issues on young specialists, and many business managers consider it unnecessary to develop a regulation paper on young specialists.

In surveys, young specialists still indicate three main reasons for unwillingness to work in rural areas: housing, low wages, lack of a developed social infrastructure [4, 5].

Table 4: Adaptation of young specialists in accordance with the organizational and legal form of an organization and the educational institution.

Agricultural organization	Adaptation period of young specialists									
	agricultural college					agricultural higher school				
	agronomist	veterinary assistant	economist	mechanic	zootechnician	agricultural scientist	veterinary doctor	economist	mechanic engineer	livestock engineer
PAO	♦	♦	●	■	♦	♦	▼	●	■	♦
OOO	♦	▼	♦	■	♦	♦	▼	■	▼	▼
Production cooperative	▼	▼	●	■	▼	♦	♦	■	♦	▼
Farm	▼	▼	●	●	■	●	▼	●	▼	♦
Private subsidiary farm	●	●	●	●	▼	●	●	●	■	▼
Consumers' cooperative	▼	♦	■	●	♦	▼	▼	■	▼	♦

Note: ● – adaptation during a year; ■ – adaptation during 1.5 years;
▼ – adaptation during 2 years; ♦ – adaptation during 2.5-3 years.

We have developed an economic mechanism for attracting young specialists to rural areas and it is used by the governing bodies of the agro-industrial complex and agrarian educational institutions.

A multi-unit and multi-component mechanism involves a whole system of measures to increase the attractiveness of the rural area, to ensure comfortable living and proper labour compensation, more successful adaptation and opportunities for further career growth.

The program allows improving a demographic situation in rural areas. Compare, in 1985 the rural population was 634 thousand people, then as of January 1, 2018, it was 665 thousand people; a share of the rural population in the region increased from 13.6% to 15.2% of the total population. It is worth mentioning the increase in the birth rate in rural areas of the region. In 2017, a birth rate at rural areas was 11.2 people per 1000 people, while generally in the region this indicator is less than 10 people. Implementation of the program allowed keeping a birth rate at rural areas at the level of 1985. The natural increase in the rural population is about 2 people per 1000 inhabitants. It is interesting to note that a natural population increase is much higher in some individual rural municipalities. Thus, it is 9.6 people in the Aramil municipal formation, 4.2 people in the Kamyshlovsky municipal formation, 3,0 people in the Achitsky municipal formation, and 2.4 people in the Irbitsky municipal formation per 1000 inhabitants.

However, a migration decrease in the rural population is about 75 people per 10,000 residents, and across the whole region, there is a migration increase.

The average labour compensation paid to agrarians in the Sverdlovsk region is gradually increasing. If in 2010 it was 64.1% of the average compensation across the region, in 2016 it was

70.9%. Last year the average wage paid to agricultural producers was 23192 rubles.

The "Ural village" program is being updated every year, and its measures are detailed, but, unfortunately, budget financing does not allow solution the problems of rural areas in accordance with the general goal, objectives and existing minimum social standards.

As a result of the inefficient functioning of a financial mechanism, a progress rate of achievement of stated indicators remains very low. So, if to speak about the improvement of housing, it should be noted that the development of the water supply system over the past 15 years is only 9.5 p.p., the heating system is 14.3 p.p., hot water supply system is 12.9 p.p., gas - no increase.

If to speak about agricultural production, there has been a decrease in the acreage of agricultural crops. In 2017, the total planting area in the Sverdlovsk region was 835.9 thousand hectares, which was 2.5% less than in 2013. In agricultural organizations for the analyzed period it decreased by 44.1 thousand hectares; in household farms - by 1.3 thousand hectares. In 2017, in all categories of economic entities, potatoes were produced by 126.3 thousand tons less than in 2013, and vegetables - by 8.1 thousand tons. In comparison to 2016, the volume of potato production was reduced by 95.6 thousand tons in 2017.

At the same time, in 2017 there was an increase in production (in organizations of all forms) of milk and eggs, by 6.2 and 3.7% respectively. This tendency was continued in 2018.

4. DISCUSSION

The analysis of the development of rural areas, as well as personal observations and scientific research, made it possible to make particular conclusions and strategic recommendations.

It is necessary to make a financial priority for strategic projects that increase the profitability of the agricultural sector (aimed at modernizing and improving the competitiveness of the rural sector of the economy, improving the infrastructure of rural areas and local governments, developing agricultural and green tourism, etc.).

Development of target comprehensive programs on the development of rural areas involves multifunctionality. Certification of rural settlements should take place before the development of the Program.

The minimum standards of social and communal infrastructures developed for the "Ural Village" Program can also be recommended for use in other regions of the Russian Federation.

Draft legislation should be developed on the status of a young specialist who goes to rural areas; it should concern his rights and obligations, as well as benefits and preferences. This solution, in our opinion, will significantly increase the attractiveness of rural areas for young people [10].

Sectoral unions should be more actively involved in the development of rural cooperation in order to weaken the monopoly position of the processing enterprises and retail chains.

Agricultural producers of various forms of ownership, educational and scientific institutions

together with municipalities should apply more effective mechanisms of organizational and economic interaction to make agro-clusters, agro-towns, agro-techparks, agro-technopolises and other structures whose activities would be aimed at sustainable development of rural areas.

5. CONCLUSION

With the program-target approach, the issue of ensuring financial priority for strategic projects that increase the profitability of the agricultural sector and the efficiency of the rural social infrastructure has not been solved.

Despite the high importance of need in the development of rural areas in Russia, today there is no well designed, scientifically based, developed state policy concerning this issue. Degradation processes are increasing in rural areas. Thus, with a share of rural inhabitants in the total population of the country of 26%, 36% of the Russian unemployed and 39% of the poor people live in rural settlements.

Draft legislation should be developed on the status of a young specialist who goes to rural areas; it should concern his rights and obligations, as well as benefits and preferences. This solution, in our opinion, will significantly increase the attractiveness of rural areas for young people.

6. CONFLICT OF INTEREST

The authors confirm that the revealed information does not contain a conflict of interest.

7. ACKNOWLEDGMENT

The work was carried out with the support the Ural Federal University.

8. REFERENCES

[1] Semin A.N., Tretyakov A.P. Trends of new industrialization in agriculture of modern Russia // Agrofood policy of Russia. 2017. №2 (62). P.25-33.

[2] Semin A.N., Tretyakov A.P., Lylov A.S. Rural infrastructure development // News of the International Academy of Agrarian Education. 2016. №29. S.94-98.

[3] Semin A.N., Miloenko E.V. The quality of life of the population and social engineering infrastructure in the rural areas of the Tyumen region // Agrofood policy of Russia. 2015. №5. P.35-38.

[4] Semin A.N., Lutfullin Yu.R., Kislitsky M.M., Lylov A.S. Organization of "Agropolis" in rural areas // News of the International Academy of Agrarian Education. 2015. № S25. P.415-429.

[5] Semin A.N., Sharapova V.M. Socio-economic design of a rural area of an innovative type: some provisions // Agrofood policy of Russia. 2014. № 4 (28). Pp. 20-25.

[6] Semin A.N., Kucherov A.S., Lylov A.S. Farm cooperation in the field of beef cattle: problems of innovative development in rural areas // Agrofood policy of Russia. 2013. №7 (19). Pp. 52-56.

[7] Treskova E.A., Semin A.N. The concept of rural development: two basic approaches // Agrarian Bulletin of the Urals. 2012. № 12 (104). Pp. 69-73.

*Corresponding author (A.S.Lylov) E-mail: las@ursmu.ru

[8] Semin A., Kibirov A., Rassukhanov U., European Research Studies Journal. Volume XXI, Issue 2, 2018. pp. 378-400.

[9] Altukhov A., Semin A. Increase of the EAEU Countries // European Research Studies Journal. Volume XXI, Issue 2, 2018. pp. 753-771.

[10] Semin A.N., Miloenko E.V. Formation and development of social infrastructure outside the territory / A.N. Semin, E.V. Miloenko. - Ekaterinburg: SvRO MAAO, 2017. - 212 p.

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CREATIVITY-BASED INTEGRATION PEOPLE WITH LIMITED OPPORTUNITY ON THE EXAMPLE OF CREATING ARTISTIC PRODUCTS OF METAL CLAY

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ARTICLEINFO

Article history:
Received 16 January 2019
Received in revised form 22 February 2019
Accepted 27 February 2019
Available online 01 March 2019

Keywords:
Universal design; barrier-free environment; PMC (Precious Metal Clay); art therapy.

ABSTRACT

This study applies low cost material to build creative specimens. Several areas of possible testing include compression, and bending. The organization of events with the joint participation of healthy people and people with disabilities in creative activities contributes to the formation of a barrier-free environment. This is the creation of medical and labor workshops, creative festivals, exhibitions and fairs. When there is an opportunity not only to submit their own products to the competition, but also to sell them, having received monetary rewards for their creative works. All this also contributes to the erasure of the psychological framework in communication of people with disabilities with people without disabilities. With creations under a barrier-free environment, creativity is one of the effective ways to integrate people with disabilities into society.

1. INTRODUCTION

The right of access to cultural property, participation in cultural life and in creative processes, refers to the fundamental rights of an individual, guaranteed by the state. The surrounding space should be accessible to all people, which is not fully realized in relation to people with disabilities. Very often people with disabilities face the problem of socio-cultural isolation. Universal design is a design that is convenient for everyone without exception; society should not divide people into categories, into “people with disabilities” and “healthy”. A society cannot be complete without the involvement of people with disabilities in it. Adaptation through creativity is aimed at creating a full-fledged environment and conditions under which the creative activity of the disabled person, his creative achievements become an integral part of the general culture of society. The method of creating art products proposed in the article allows integrating people with such disabilities into the

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society: the deaf, hard of hearing, with disorders of the musculoskeletal system and people with limited mobility [1].

2. MATERIALS AND METHODS

For any art work an important factor is the choice of material. It must have functional and aesthetic properties, be environmentally friendly, durable and easy to process [2-6]. New material of recent years, meeting the requirements is steel metal plastic masses.

The idea of creating a metal with the properties of ceramic clay belonged to the Japanese scientist Dr. Masaki Morikawa, an employee Mitsubishi Materials Corporation. July 12, 1994 Mitsubishi Materials Corporation of Japan received a patent number 5328775 for a product that received PMC name (Precious Metal Clay) [7, 9]. In its composition, the material contained powders of precious metals and a plasticizer - a water-soluble binder. Plastic metal masses based on pure precious metals consisting of pure silver or gold were created first. In the last two years (2016-2017), powders of alloys of non-ferrous and ferrous metals, such as bronze, brass, steel, were obtained [6].

The relationship between the stress and the strain is given by a stress-strain curve as shown in Figure 1. To determine mechanical properties for each material such as the modulus of elasticity, an algorithm involving the linear regression was created. The algorithm begins by storing all the data points between the initial start point and the maximum peak point (ultimate strength). It is then that the stored data set is split into approximately six equal sets with zero overlap. Within each region, a linear regression is performed in order to determine the slope of the line, for each portion.

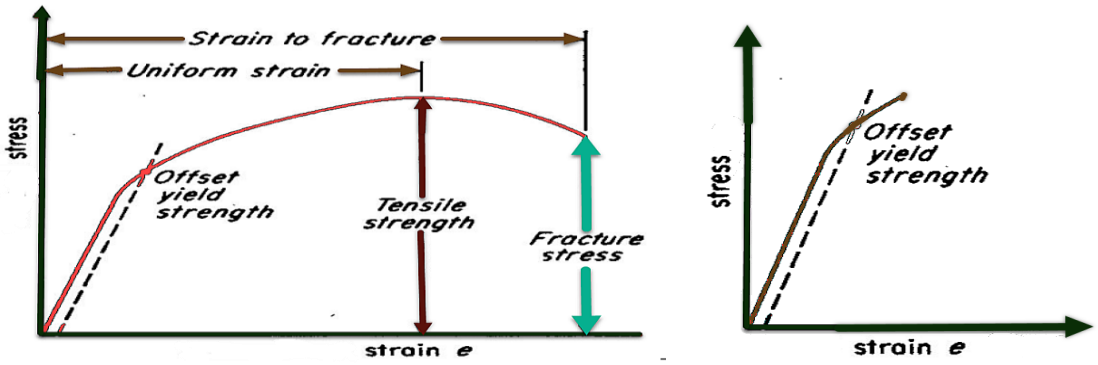

Figure 1: Stress-strain curves for ductile and brittle materials.

3. RESULTS

The material combines the properties of metal and ceramics, so the shaping operations are similar to the processing of clays, after firing in a muffle furnace, the product acquires all the properties of metals, the subsequent finishing operations are similar to the processing of metals (Figure 2) [13-15]. Plastic metals provide new potential opportunities needed to implement the ideas of the artist. The

material is easy to process and does not require complex equipment (Figure 3).

Figure 2: Creating a pendant based on natural materials using plastic metal paste in the form of a paste [13]

Figure 3: Tools for work [5]

These materials and technologies may interest people with disabilities. Such an effective way of rehabilitation of people with disabilities, such as clay therapy [11], which is basically based on work with plastic material, has long been known and used. Working with plastic metals can help people with disabilities believe in themselves and their capabilities, rehabilitate and integrate into society, uncover and realize their creative potential. Unusual jewelry (Figure 4) and souvenirs (Figure 5) can be created from plastic metals, which can become not only a hobby, but also an opportunity to earn [3-4].

Engineering materials can utilize several mechanical tests to measure strength. Specimens are destroyed in the test process. Perhaps the most common experiment is the tensile force. Hardness is usually defined in terms of resistance of the material to penetration by a hard ball or point. Specimens are affectionately called dog bones. This is because of the shape is a bar with larger sized ends. We used the ASTM standards [5] for metal testing using our specimen design.

A person is a social being with a need for communication and interaction with other people, hence the importance of the integration of people with disabilities into society [12]. Creativity is the

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highest form of activity inherent in man alone, one of the foundations of human life, culture, its result is the manifestation of the essential qualities of a person. The role of creativity is so important in a person's life that it is used as a restorative art therapy. Therefore, people with disabilities often find an outlet to their potential in the works. A person isolated from the world due to illness can create works of art [17].

Figure 4: Examples of products from plastic metal masses
Mitsubishi Materials Corporation MJC[8]

Figure 5: Bronze figure "Usarobo001" made of metal plastic mass

4. CONCLUSION

The material used is low cost, and many more specimens can be produced. Several areas of possible testing include compression, and 3 bar bending. The organization of events with the joint participation of healthy people and people with disabilities in creative activities contributes to the formation of a barrier-free environment. This is the creation of medical and labor workshops, creative festivals, exhibitions and fairs. Where there is an opportunity not only to submit their own products to the competition, but also to sell them, having received a monetary reward for their work. All this also contributes to the erasure of the psychological framework in communication of people with disabilities with people without disabilities [14-16]. So, it can be concluded that to create a barrier-free environment, creativity [10] is one of the effective ways to integrate people with disabilities into society.

5. REFERENCES

[1] “Man and Science” Petrosyan Vladimir Arshakovich Minister of the Government of Moscow, Head of the Department of Labor and Social Protection of the Population of the City of Moscow: http://cheloveknauka.com/integratsiya-invalidov-v-rossiyskoe-obschestvo https://www.mos.ru/dszn/structure/person/20740093/ [Electronic resource] (access date: 16.04.2018).

[2] Livshits, V.B. Kumanin V.I., Sokolova M.L. Art materials: jewelry: a textbook for academic undergraduate - 2nd ed., Revised and add. - M .: Publishing house Yurayt, 2018, 208 p. - (Series: Universities of Russia).

[3] Kumanin V.I., Livshits V.B. Materials for jewelry. M .: Astrel, 2012, 240p.

[4] Boyko Yu. A., Dryukova A. E`., Kazachkova O. A., Komissarova L. A., Livshicz V. B., Navroczkij A.G. material processing technology. Moscow, OntoPrint Publ., 2016. (In Russian).

[5] Moldable mixture of metal articles: USA patent 5328775; claim 11/18/1992; issued 07/07/1994. [Electronic resource] Access mode: http://www.google.com.ua/patents/US5328775?hl=en (access date 04/16/2018).

[6] Sokolova M.L. Modern problems of the direction "Technology of artistic processing of materials." // Russian technological journal. – 2017, 5(1), 50-56.

[7] Metalclay Studio [Electronic resource] Access mode: http: //www.metalclaystudio.ru (access date 04/04/2018).

[8] PMC (Precious Metal Clay) [Electronic resource] Access mode: http://www.mmtc.co.jp/pmc/how_to_make.html (access date 16.04.2018).

[9] Mitsubishi Materials Corporation [Electronic resource] Access mode: http://www.mmtc.co.jp/en/products/pmc.html (access date 16.04.2018).

[10] ART CLAY RUSSIA [Electronic resource] Access mode: http: //www.artclayrussia.ru (access date 04.04.2018) [Electronic resource] Access mode: http: //www.bijou.marydoll.ru/metal_clay/art_clay_and_pmc.html.

[11] Tim McCreight. PMC Decade: The First Ten Years of Precious Metal Clay. BrynmorgenPress, 2006, 256 pages.

[12] Vichulen E.V. Content and methods of sociocultural rehabilitation of persons with disabilities https://yadi.sk/i/dSsQAr6z3VPgcf [Electronic resource] (access date 16.04.2018).

[13] Shulga E.M. Creativity as a way to integrate people with disabilities into society https://www.scienceforum.ru/2016/1559/17145 VIII International Student Electronic Scientific Conference "Students' Scientific Forum - 2016" [Electronic resource] (access date 16.04.2018).

[14] Kazachkova O.A., Kulishova E.A. The creation of jewelry, the design of which is based on the exact reproduction of the form and texture of natural objects. Collection of scientific papers. Edited by Bulatov MF. 2017 Publisher: Moscow Technological University (MIREA) (Moscow) p.: 542-545 https://elibrary.ru/item.asp?id=29247670 (access date 04/16/2018).

[15] Kazachkova, O.A. Zyabneva, O.A. Mamedova, I.Y. Kulishova, E.A. 3D technologies in the production of jewelry with elements of complicated design. International Journal of Engineering and Technology(UAE), 7(3), 2018, 155-157.

[16] Kazachkova O.A., Kulishova E.A. Design and manufacturing technology features art products of small forms from metal plastic masses. Russian scientific and technical conference with international participation. Informatics and technology. Innovative technologies in industry and Informatics (RNTK FTI - 2018) [Electronic resource]: Collection of reports conference “Informatics and

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technology. Innovative technologies in Industry and Computer Science" Moscow Institute of Physics and Technology. technological university. - M .: MIREA, 2018, 944 p.

[17] Abdullah L.S., Kukushkina V.A., Kantaryuk E.A.The Perspective Of Using 3d-Modeling In The Designing Of Technological Solutions For Chassis Design. International Journal of Engineering and Technology (UAE), 2018, 7(2), 13-15.

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IMPROVING AWARENESS OF TOURISM EDUCATION AMONG STUDENTS' IN INTERMEDIATE AND SECONDARY SCHOOLS IN THE KINGDOM OF SAUDI ARABIA: EXPERTS' SOCIAL STUDIES CURRICULA POINT OF VIEW

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ARTICLEINFO

Article history:
Received 14 December 2018
Received in revised form 15 February 2019
Accepted 25 February 2019
Available online
01 March 2019

Keywords:
2030 KSA vision; studying tourism; curricula development; tourism and hospitality; travel industry; visitor destination.

ABSTRACT

Improving the awareness toward the tourism and tourism education among young generations and schools' student is one of the strategic directions considered by the government of the Kingdom of Saudi Arabia (KSA) as one-step to the 2030 vision of the country. This paper unfolds the inherent to know tourism education dimensions that are important from social studies curricula experts' point of view in the intermediate and secondary schools in the KSA to develop a process of the curricula and improve the tourism awareness among the students. The findings highlight the lack of the tourism education dimensions of social studies curricula from the experts' point of view and weak communication between curricula developers in the KSA Ministry of Education and the teachers who work for schools.

1. INTRODUCTION

"Many countries have made more attention for tourism, where we find that some countries have established special ministries concerned with tourism, some of which allocated independent bodies and institutions for the same purpose" (Ashley et al., 2007). Others have established political forces aimed at maintaining the tourism potential, while some developing countries continue to suffer from lack of adequate attention to tourism, which are seen as being the luxury of civilization (McLaren, 2003). This makes some individuals of those communities play with the estimators of the tourism do not care about legacies of civilization (Alomerre, 2013; Busby, 2003). According to Wang et al. (2010), there is real gap between tourism education institutions' provisions and what the tourism industry requires in terms of knowledge and skills sets. AL Dosary (2014) found in study a low rates of tourism values in primary education curriculum in Kingdom of Saudi Arabia. From here comes the research problem of this paper**,** hence**,** the study **w**ill explore and examine the comparative study of tourism education dimensions in educational social studies to intermediate and secondary schools

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in the relevant society of KSA.

Based on the cultural, religious, social and psychological point of curricula appropriate, how these dimensions will affect teacher's point of view will improve the quality and standard of tourism education in KSA. Finally, this study discloses the relationship between school activities, tourism dimensions and its' introduction into the social studies curricula. It also reveals what would be the suitability for the current and future generation. This study seeks to address the problem by achieving the following objective to determine the degree of importance of the dimensions of tourism education that should be included in the social studies textbooks for intermediate and secondary levels in the Kingdom of Saudi Arabia, from the social studies teachers' point of view. For the availability of the dimensions of tourism education in social studies curricula for intermediate and secondary, schools in the Kingdom of Saudi Arabia.

1.1 TOURISM EDUCATION

The importance of teaching and learning together because the building of tourism awareness is the responsibility of the family first and foremost role. In the other hand schools and universities must play their part, through the introduction of tourism education in the curricula of their also establishment of colleges and disciplines to graduate specialists in tourism and hospitality. As considered, the teacher in basic and higher education plays a key role in the education of tourism, heritage education, museum education and the reinforcement of positive attitudes toward it (Abu-Romman, 2013). Baraidh (2011) explains that knowledge of concepts tourism development (geographical or historical) and importance, economic, social and psychological effects, using different methods and techniques of teaching and activities of the teaching and learning of variety and requires the teaching aids and multiple methods of assessment. According to the tourism education vocabulary, values, and skills acquired by students through the curriculum in the general education using a variety of innovative methods of teaching and educational activities.

1.2 DIMENSIONS OF TOURISM EDUCATION

Cooper and Shepherd (1997) assent “but not a strong sentence: That on establishing the skills and knowledge through education stages and their relevance for curriculum design is discussed more generally". Which in the future hospitality managers in which today's education will must be require, therefore, be providing. Identified the Tourism Education Futures Initiative (TEFI) by defining a set of foundational values for tourism education programs worldwide (stewardship, ethics, knowledge, mutuality, professionalism). TEFI is now addressing other important shifts needed to provide an education of quality and relevance to future of tourism industry (Sheldon et al., 2011**).** Regarding the schools’ role of enhancing employability, Connolly & McGing (2006) argue, that it more than just providing students with basic skills it is about educating them for “appropriate attitudes and aspirations to guide their career trajectories and industry vision”. Similarly, Illich (1973) states that an insistence on skill drill alone could be a disaster; equal emphasis must be placed on other kinds of learning. This does not mean that tourism education should focus on academic subjects at the expense of internships or field experience. It is certainly more than a simple matter of vocational vs. academic education discourse.

2. LITERATURE REVIEW

Tourism researchers and educators should discover what Apple (2004) calls "taken for granted perspectives", and they must investigate what constitutes common sense in the development of tourism curricula and the tourism industry. In North American and European countries, "students with basic education processed to be happy only in the schools of fellow consumers of the product of the education machine" (Illich, 1973). This narrows their perspective; hence, students see university education as an investment for a future career and desire its monetary return. Diplomas and certificates offer economic value to the graduates, giving them the power to define and respond to the expectations of society (Illich, 1973). Tourism educators need to ask if employability is the only important product of tourism education. Constructing meaning is learning, and learning is a social phenomenon. Inui et al. (2006) states that meaning resides in one's mind but reflects the cultural context in which one is living. Giving eventual meaning to employability is merely a reproduction of the contemporary society's dominant ideology. Illich (1973) calls such reproduction of social norms as "addiction" and states "institutions should support personal growth rather than addiction.

Educational institutions should serve a society that does not yet exist. That is, we should educate students who can create and manage the future. There is a growing acknowledgment that economies of the 21st century need to be knowledge-based rather than commodity-based and be driven by knowledge development, innovation, and commercialization. Knowledge will become the fundamental factor underpinning successful tourism and hospitality organizations (Markovic, 2006). Kelly (2006) conducted a study entitled tourism education, peace and awareness is working to the tourism industry, to explore the possibility of teaching tourism and recognising its ability to contribute to building a more harmonious and peaceful world. This reference is made to the United Nations Global Code of Ethics for Tourism as a source available to the teacher. So the tourism is providing education, awareness opportunities and working for the tourism industry, Hence there are suggestions on how to do by incorporating relevant considerations into curricula, courses and educational status (Awhen et al., 2014).

2.1 TOURISM EDUCATION IN THE CURRICULA OF SOCIAL STUDIES

The study of Mofleh (2011) emphasized the existence of a close relationship between the curricula of social studies and tourism education. This is due to the fact these curricula have an effective impact over the development of tourism awareness among learners. The close links between the sections of social studies from history, geography, national, economy, and society, with what provide tourism education to the learner, agrees with what educational organizations seek to achieve. The study shows that the social studies curricula are one of the most appropriate curricula in the possibility of achieving the goals of tourism education. By its human nature, it is a study of the natural and historical environment and the contemporary cultural features on the homeland, through which the learner can acquire the concept of tourism and its importance. To identify problems of tourism movement, and then recognize the role the citizen towards the places, the tourist landmarks, and the coming tourist must play that role also. Considered the social studies and national of the highlights of the educational system that take it upon themselves to contribute to the tourism education, so considered the main source of education and in directing students at this stage (13-15 age) critical

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which is characterized vibrant and change (Awhen et al., 2014). According to Mahmoud (2002) the study role of social studies curricula in developing tourism awareness among the first-grade students. The study emphasized the prominent role of social studies in achieving tourism awareness.

3. METHODOLOGY

The qualitative research approach adopted for this paper as it is connected with cause and provides greater objectively, data reliability, validity and representation of reality (Outhwaite & Turner, 2007). Another reason for applying the qualitative approach to the study was to better reveal the number of differences (Hunter & Brewer, 2002). The study was conducted based on interviewing experts in social studies in two levels intermediate school and secondary school). The total number of interviewees are six from different levels (Table 1).

Table 1: Participants Interviewed across Jazan Region.

Participant	Total
Supervisors for Intermediate Schools	2
Supervisors for Secondary Schools	2
Supervisors for the two stage	2
Total	6

4. FINDINGS AND DISCUSSION

As prior talked about in the past section, three topics rose as the last subjects from the information. A sum of 98 codes were at first created from the six reports, one from every interviewee. From the 98 codes, they were sifted to 45 codes and arranged (classes) in light of event and recurrence and inferred twenty classifications. From the twenty classes, developed eight topics and regrouped into five principle subjects as mentioned. The topics are as per the following:

4.1 TOURISM EDUCATION

Researchers in the 21st century have been pulled into tourism education and its segments due to the noteworthiness to the economy, yet the required consideration have not been given to this "monetary blowhard" at the middle of the road and optional dimensions, so the young could be connected with at the beginning period of their life. This topic tourism education gives the interviewees the chance to share a portion of their encounters. Interviewees (1 and 5) say that tourism education is a science that means to spread the way of life of diversion and amusement and furthermore a noteworthy component in the economy of numerous nations. While Interviewee 4 says, tourism education is to teach the young or understudy about the travel industry and visitor destinations and decide the spots and conceivable outcomes accessible in the nation. "In the conclusion of Interviewee 5, he said the tourism education is a cutting edge wonder with various measurements either by the vacationer or the expert in charge of the travel industry and its significance in the economy of the nation and mirror a phenomenal picture of the archeological, authentic and traveler locales".

4.2 SIGNIFICANCE OF THE TOURISM EDUCATION

Subject two gives the interviewees to features the significance of tourism education to society and economy of the KSA. Interviewee 1 says the importance of the tourism education cannot be over-underscored yet express dread that enough have not been done regarding learning exchange.

While Interviewee 2 trusts, that tourism education gives more noteworthy open doors than oil to the new age if very much mixed. He says, “by uprightness of the situation of the KSA as an Islamic and Muslim Express, the tourism education field must be opened in an efficient way to characterize its traditions, customs, Islamic and social legacy, and its atmosphere and landscape." Interviewee 3 trusts that social investigations courses where the tourism education has a place in extremely applicable in light of the fact that it is firmly identified with the general public and along these lines nearer to clarifying the social and monetary status of the general public. There is requirement for more exercises and measurements to build the learning, ideas, aptitudes, and patterns related with measurements of the tourism education (Interviewees 1, 2, 3, 4, 5, and 6). This is one reason for this examination, to proffer conceivable approaches to build the instructing of the tourism education in both middle and secondary levels of the road and auxiliary and upgrade the measurements for better comprehension by the understudies.

4.3 CONCEPT OF THE TOURISM EDUCATION

This subject "tourism education" gives the stage to interviewees to talk about what idea and learning of the tourism education is about from their point of view and experience. Interviewee 2 says the idea of the tourism education from my perspective is an arrangement of qualities, propensities, and learning that must be bestowed to understudies. In this way, this idea is not very many in social examinations courses and isn't obvious to teachers or understudies" This is one of the commitments of this investigation to the assemblage of information, to have the capacity to grow more possible and clearer ideas for the advantages of the social examinations educators and understudies, and by expansion to humankind. Interviewee 3 says "information of the tourism education concept, regardless of whether geological or recorded and monetary significance, social and mental and distinctive showing strategies, including different learning and techniques for evaluation and instructive techniques, one of the cutting edge patterns to think about the tourism education." For Interviewee 4, the idea of tourism education can't be over-underscored; "it is vital, so it is important to increment and consolidate some learning and data about this idea in the courses of social examinations, for example, (definitions – pictures of common and archeological destinations)" While Interviewee 6 says that the idea of the tourism education is the person's learning of the ideas of the travel industry, whether land, authentic or social capacity to manage guests to the nation with all graciousness and affability and conservation of the advantages of his nation and submit in great shape.

4.4 EMERGED NEW ITEMS (TOURISM EDUCATION DIMENSIONS)

This topic "Developed New items" is one of the oddities of this examination. This stage gives the interviewees the chance to distinguish new things related with the builds utilized in the tourism education dimensions. Twenty-one new items rose up out of the oral meeting study. Seven new items added to information items, six added to ideas items, four added to aptitudes items and four added to patterns items. For information as the primary build, the interviewees concur crosswise over board that religious constituent of the religious significance of the tourism education, the connections and correspondence and wellbeing of interviewees as imperative things related with learning. While Interviewees (2 and 5) distinguish security and steadiness of the tourism education, Interviewees (1, 3, and 5) recognize advancement and media of the tourism education, and more fixation on religious the tourism education (Interviewees 3, 4, and 6). Ideas being the second develop utilized in the

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examination as one of the tourism education dimensions; the tourism industry direction, showcasing touristic condition, markers of touristic future and restorative the tourism education rose as the new things crosswise over board related with ideas. While Interviewees (2, 5, and 6) distinguished recovery the tourism education and Interviewees (3, 4, and 6) recognized nature of touristic item as the new things separately. Abilities being one of the builds utilized in the estimation of tourism education dimensions, four new items rose up out of the oral meeting as prior announced. The interviewees crosswise over board concur that positive managing vacationer and hardworking aptitudes are new things related with attitudes. While Interviewees (4 and 5) recognized traveler direction aptitude and Interviewees (1, 2, and 3) distinguished arranging and sorting out a vacationer visitability as the new things that rose up out of the oral meeting as things related with aptitudes. The last yet not the slightest is patterns. Four new items rose up out of the oral meeting as well, acknowledging God gifts and profession of the tourism education guide and its significance were concurred crosswise over board by the interviewees while comprehend the earth (Interviewees 2, 3, and 4) and keeping up nation's legacy (Interviewees 1, 2, and 4) were distinguished as new things related with patterns.

4.5 PATH FORWARD TO ENHANCE THE TOURISM EDUCATION

This subject "Path Forward to enhance the tourism education" endeavors to distinguish from the impression of the interviewees the significance of the tourism education measurements that ought to be incorporated into the courses of social investigations of the middle of the road and optional schools. Interviewee 1 recommends the need to initiate the tourist gatherings to visit vacationer and archeological zones while in school as an understudy. Likewise, the Interviewee says "to combine the idea of the tourism education among the understudies and build up the understudy aptitudes in understanding the necessities and pertinence of the travel industry to KSA" Interviewee (1 and 3) further recommends increment in the job of educators in making the understudies practice the idea of the tourism education by means of undertaking works and handy preparing amid summer excursion.

Interviewee 2 proposes that "The Service of Instruction, Service of Data, the General Expert for The tourism education and National Legacy and the colleges ought to incorporate with the end goal to make arrangements and thoughts that will be incorporated into the educational module and furnish instructors equipped for giving understudies the aptitudes and learning about this idea " The Interviewee likewise prescribe " increment the job of educators in making the understudies practice the idea of the tourism education through exercises amid the school day "The appropriation of tasks by school understudies identified with the vacationer side" And ordinary preparing workshops for social investigations instructors to outfit them with more information, ideas, abilities, and patterns related with measurements in the tourism education with a view to enhance the mindfulness among the understudies; and foundation of a handout on the tourism industry from middle to college level with accumulation of visitor locales crosswise over KSA and greater ad of the idea to the world to draw in venture and openings for work (Interviewees 3 and 5). This is one of the significances of the tourism education, in spite of the fact that it has some negative impact yet the constructive outcomes out ways the negative impacts. While Interviewee 3 recommends giving recreational visits to recognized understudies to vacationer destinations and advising them of their significance and visitor direct appended with each course "While Interviewee 4 proposes the need to build up a

handbook that ought to be joined to the course that condenses the traveler territories and possibilities in the KSA.

Interviewees (5 and 6) proposes more the tourism education projects and presentations in unmistakable visitor destinations with association with worldwide advertisers with accentuation on the Islamic, traditions and custom foundation to develop the business and pull in investment. The result of this would be monetary and social improvement and the final product would be increment in Gross domestic product from the tourism industry area, more occupations creation, riches creation among others. Interviewee 6 is of the feeling that the execution of different program to characterize the elements of the tourism education.

5. DISCUSSION

Every educational institution has its own organizational culture that has an impact on students' self-perceived skills and competencies. In the first reading of the reality of the curricula of social studies in the intermediate and secondary stages, as well as the results of some previous studies, especially in the intermediate stage, a lack of some knowledge, concepts, skills, and trends related to tourism within these curricula. So particularly strong attention should be paid to develop an agreed institutional profile from educational Institutions in Kingdom of Saudi Arabia. To develop topics related to tourism in an attractive manner of knowledge, concepts skills, and trends, suitable for the age of the students and the course of study with practical application of the information received them. To build education programs to relevant students' in the field of tourism. Only teachers, staff, students and employers can build teaching quality continually assessing the development of tourism relevant knowledge, concepts, skills, and trends.

Through an initial survey of the aviews of some social studies teachers in general education schools in the region of Jazan, South of Saudi Arabia found deficiencies in understanding some of the skills and concepts, in addition to the traditional teaching method which does not fit with the reality of education today, in addition to the educational environment inappropriate to apply some lessons within the school or in the surrounding environment. The general education program should develop transient critical thinking, problem-solving skills, good communication skills, and creativity. These are all skills and competencies for the next decades that are expected and needed by the tourism industry. Tourism skills and competencies cannot be developed only theoretically. They must be developed and tested in the real tourism circumstances. However, it is definitely the responsibility of the educational institutions to change the program and make it more tourism process oriented and transient at the same time. To change the actual learning culture, educational institutions must primarily change the teacher's teaching style and the learning environment where strong leadership and consulting skills of the teacher dominate. The new teacher's teaching style is to be designed, organized, and managed with a focus on student success in Intermediate and secondary education, the workplace, and community life of the 21st Century.

6. CONCLUSION

The study finds that tourism education for the Kingdom of Saudi Arabia is required for the

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students in all stage education to achieve results in the field of tourism development outcomes. The experts' analysis of the social studies curricula in intermediate and secondary schools in Jazan city reveals lack dimensions of tourism education in educational curricula especially two levels (intermediate and secondary schools) that consider where the students get more information before moving onto the new stage. Therefore, the students need these dimensions that related tourism education. The lack of coordination between the KSA Ministry of Education and Saudi Commission for Tourism and National Heritage has impeded the development of a more effective and enabling institutional framework for curricula planning. Despite having implemented various programs shaping, regulation, and stimulus instruments, the KSA Ministry of Education is yet to introduce the more inclusive approach of capacity building to bridge this interaction gap**.**

7. ACKNOWLEDGEMENT

The authors would like to acknowledge the KSA Ministry of Education for funding this research and Universiti Sains Malaysia.

8. REFERENCES

Abu-Romman, A. H. (2013). Tourist Awareness and its role in the enhancement of Competitive Ability for Tourist and Travel Sectors in Jordan: A Field Analytical Study *TANMIAT AL-RAFIDAIN, 35*, 22.

AL Dosary, F. (2014). Analysis of the content of books of social and national education the top three grades of primary school in the light of the tourist values. *International Journal of Educational specialist*, 21.

AL Omerre. (2013). Tourism Education in Social Studies and National Textbooks for Intermediate Level in the Kingdom of Saudi Arabia. *Journal of Education Sciences in Jordan,9(4) 389-402*

Apple, M. W. (2004). *Ideology and curriculum*: School of Government, Harvard University: Routledge.

Ashley, C., De Brine, P., Lehr, A., & Wilde, H (2007). *The role of the tourism sector in expanding economic opportunity*, John F. Kennedy.

Awhen, O., Abunimye, U., & Ipuole, O. (2014). Repositioning social studies curriculum for national transformation in Nigeria. *International Journal of Education and Research, 2*(2), 1-8

Baraidh, E. A., Asmaa. (2011). Tourism Education applications and models. Retrieved from www.kau.edu.sa/GetFile.aspx?id=194233&fn

Busby, G. (2003). The concept of sustainable tourism within the higher education curriculum: A British case study. *Journal of Hospitality, Leisure, Sport and Tourism Education, 2*(2), 48-58

Cole, R. W. (2008). *Educating everybody's children: Diverse teaching strategies for diverse learners*: ASCD.

Connolly, P., & McGing ,G. (2006). Graduate education and hospitality management in Ireland. *International Journal of Contemporary Hospitality Management, 18*(1), 50-59

Cooper, C., & Shepherd, R. (1997). The relationship between tourism education and the tourism industry: Implications for tourism education. *Tourism Recreation Research, 22*(1), 34-47

Hunter, A. D., & Brewer, J. (2002). Multimethod research in sociology *Handbook of mixed methods in social & behavioral research*: SAGE Publications, Inc

Illich, I. (1973). *Deschooling society*: p (46) Harmondsworth, Middlesex

Inui, Y., Wheeler, D., & Lankford, S. (2006). Rethinking tourism education: What should schools teach. *Journal of Hospitality, Leisure, Sport and Tourism Education, 5*(2), 25-35

Kelly, I. (2006). Tourism education the peace proposition and the conscientization of the tourism industry. *Journal of Teaching in Travel & Tourism, 6*(1), 1-16

Markovic, S. (2006). Expected service quality measurement in tourism higher education. *Nase Gospodarstvo: NG, 52*(1/2), 86

McGladdery, C. A., & Lubbe, B. A. (2017). Rethinking educational tourism: proposing a new model and future directions. *Tourism Review, 72*(3), 319-329

McLaren, D. (2003). *Rethinking tourism and ecotravel*: United States of America: Kumarian Press.

Mofleh, G. (2011). *The Important Of curriculum* Paper presented at the Curriculum and educational role, AL gonfetah - Umm Al Qura University.*1-11*

Outhwaite, W., & Turner, S. (2007). *The SAGE handbook of social science methodology*: Sage The tourism education futures initiative (TEFI):

Sheldon, P. J., Fesenmaier, D. R., & Tribe, J (2011) Activating change in tourism education. *Journal of Teaching in Travel & Tourism,11*(1), 2-23.

Shulman, L. S. (1986). Those who understand: Knowledge growth in teaching. *Educational Researcher, 15*(2), 4-14

Wang, J., Ayres, H., & Huyton, J. (2010). Is tourism education meeting the needs of the tourism industry? An Australian case study. *Journal of Hospitality & Tourism Education, 22*(1), 8-14.

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THE EFFECT OF TV HAMOUN CHANNEL ON NATIONAL AND RELIGIOUS IDENTITY OF PEOPLE LIVING IN SIS TAN AND BALUCHISTAN, IRAN

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ARTICLEINFO

Article history:
Received 12 November 2018
Received in revised form 22 February 2019
Accepted 28 February 2019
Available online
01 March 2019

Keywords:
People identity; Iranian identity; Effect of communication; TV program; Cultural-based economic, National show; Confirmatory analysis.

ABSTRACT

This study was conducted to analyze the effect of provincial TV channel called Hamoun on the national and religious identity of people living in Sis tan and Baluchistan, Iran. The survey method is used in this research. The questionnaire consists of two parts as well as the open and close-ended questions. Statistical society of this study focused on educated people who were older than 19 living in Sis tan and Baluchistan. From the 2011 census, there were over a million people living in rural and urban areas; of them, almost half a million members were educated people, 19 years old and older. Sample size was calculated (n = 383) using Cochran's formula. The sample size in each construction block was determined using systematic method based on the proper sampling method (based on the classification and convenient assignment) after determining the sample size in each category (construction blocks) then the questionnaires were filled out by the selected members. It is found that Hamoun Channel's attention to the participation of citizens of Sis tan and Baluchistan Province in different fields has been related with the national and religious identity of people at significance level of 1%. This relationship was direct so that an increase in people's attention to the programs of Hamoun Channel in different scopes of traditions and customs, ethnics, products, economics, historical issues, and participation of people leads to increment in national-religious identity of people living in Sis tan and Baluchistan. In this case, Hamoun Channel has performed successful programs related to the national and religious identity.

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1. INTRODUCTION

Identity is one of the most important key factors of human and social sciences in recent years, which has been considered by scholars and scientists. Undoubtedly, national and religious identity and relevant subjects are the recent phenomena at this era. In traditional communities, various relations such as tribe, religion and the government created solidarity in the society; while industrial developments and reconstruction have made an imbalance between the old coherent and interrelated components. Hence, the issue of alliance at the cultural, social and national level is one of interesting subject in developing societies and systems. Reconstruction and industrialization process leads to collapse of traditional relations; on the other hand, the modern links cannot be deployed easily. Under such circumstances, policy-making should be employed as a priority to protect the solidarity [1]. National identity is the most substantial identity playing a vital role in culture, community, politics, and economics. In other words, national identity is the most inclusive and legitimate identity in all of social systems without consideration of ideological tendencies [2]. The most important function of identity is creation of solidarity and homogeny [3]. The more the solidarity among the nation, the higher the political power will be in the country. National identity strengthens social cohesion and national solidarity using symbolic abilities such as language, religion, history and mutual interests in order to create national awareness and direct the social life [4]. The identity of each society depends on the national, religious and cultural information of that society so that any change in information should be conveyed gradually based on the needs of audiences in order to prevent from unity collapse in religious patterns. In other words, it can be stated that media can affect the behavioral methods, styles and public tastes in society; among this media, television acts as the most powerful tool. As a mass media and a powerful cultural center, TV have positive or negative effect on the kinship system, customs, social and ethical values, language, art and literature, which are the foundations of the community identity. TV can affect the cultural ideas and attitudes of people based on the communicational techniques. Furthermore, it is essential to know that first, how TV programs affect their audiences culturally; second, whether these effects are creative or destructive and third, how can direct effectiveness of this media in protecting national-religious identity of the society because the mass media and TV particularly are the most significant sources affecting the values, beliefs, and formation of individual and social identities in all of communities also our society [5].

Nowadays, identity of people is influenced and formed by the media. Considering the increasing expansion of mass media particularly the new communicational technologies, the experts and researchers have more studied the effect of mass media on the culture and national identity of people. As the communication era can be used as the proper title for current time, the mass media can be in relation with national beliefs and values or national identity affecting them. This issue may harm the culture of country by creating cultural delay since exposure to the mass media may affect the attitudes, behavior and identity of people. Continuous attention to mass media may lead to negative impacts in long term by lacking empathy and sense of national-religious belonging [6].

Accordingly, ethnical diversity is associated with a larger community, which can be defined as a society consisting of different ethnics with various identities [7]. When defining the Iranian national identity based on some elements such as the language, history, culture, and common land, it is seen that these elements are rooted in the past, and create relationship between Iranian people over time. Intercultural relationship can be defined in different forms such as interracial, interethnic, intercultural and interregional relationships. In total, there are two types of relationships including the government-ethnic (political approach) and ethnic-ethnic (social approach) relationships if the ethnical relations are correlated with the national solidarity. Mass media are responsible to transfer and direct a wide range of symbols, norms, values, beliefs, messages and common thoughts of communities so that many experts believe that mass media can change the cultural and social life [8]. Mass media are significant social components of social and cultural identities, which their function is to attract people's interest. Identical harms (identity crisis) are debatable issues of societies, which have been created by mass media in viewpoint of intellectuals. It means that the effect of mass media on the culture, social structures and international system has led to the identity crisis in the world [5]. Cultural system of the Iran depends on a thousand-year history of the country and a social interaction between ethnical groups, which have formed cultural identity of Iran. Each group can add positive or negative layer to the system to form the macro cultural identity. In fact, the cultural identity of Iran is an inclusive shield, which covers all of ethnical groups and tribes. To this end, some substantial subjects are mentioned under the title of ethnicity and security. The accepted coexistence of ethnical identities, which forms the national identity, looks for some security and integrity-based approaches to unity and removal of ethnical identities in framework of national identity. (An experience, which was provided by the modern government of Reza Shah trying to create a unique clothing and language and expanding the Iranian culture with emphasis on the western teachings and before-Islam Iran) [9]. One of problems in this case is lack of an acceptable theoretical strategy for ethnical and national identity, which leads to conflicting security, cultural and social policies making trouble for the planners and managers when making decisions and developmental plans and misleading the main process due to numerous changes. The advent of TV opened a new window to the world of mass media so that many of intellectuals could express their ideas via TV [10]. Owing to numerous capabilities and using modern communicational technologies (satellite), TV has expanded its influence and attractiveness more and more. TV benefits from some specifications distinguishing it from the other kinds of media; hence, the effect of TV on national and religious identity has been addressed in this research. Accordingly, this study aimed to analyze the effect of Hamoun Channel on national-religious identity of people who live in Sistan and Baluchistan, Iran.

2. RESEARCH METHODS

Survey method was used in this research to collect data. Questionnaire is the most proper instrument in this method; a questionnaire including open and close-ended questions with

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two parts. The designed questionnaire and items were evaluated and revised before the final implementation. 40 questionnaires were distributed among people in order to evaluate reliability of the instrument at the pretest step. Statistical population comprised the educated individuals at the age of 19 and older who live in Sis tan and Baluchistan. According to the census of 2011, there were 1048000 people living in rural and urban areas; of them, 467049 members were educated people at the age of 19 years old and older. Sample size was calculated to 383 (n=383) using Cochrane formula. The sample size in each construction block was determined using systematic method based on the proper sampling method (sampling based on the classification and convenient assignment) after determining the sample size in each category (construction blocks) then the questionnaires were filled out by the selected members. Statistical tests of Chi-square, t student, ANOVA and correlation coefficient were used to analyze the obtained data. All of statistical calculations were done through the SPSS®19 Software.

3. FINDINGS

It should be explained about descriptive findings that 50.7% of respondents were men and 49.3% were women. Majority of respondents (30.6%) were at age range of 30-39 and 4% were at age range of 60 and older. 51.3% of respondents had diploma and3.9% of them had MA and higher degree. 68.6% of respondents came from Baloch tribe, 28.6% came from Sis tan and 2.8% from other tribes.67.3% of respondents were at middle class of society, 31.3% was from the low class and1.4% from the high class.68.7% of respondents were Sunni and 31.3% were Shia.

3.1 INFERENTIAL FINDINGS

3.1.1 TESTING HYPOTHESES

Hypothesis 1: Attention of Hamoun Channel to the national-religious identity of people living in Sis tan and Baluchistan can affect their national and religious identity. The Pearson correlation coefficient Table 1 shows that Hamoun channel and its programs related to national-religious identity has heightened sense of national and religious belonging among people who live in this province. In other words, there is a direct linear relationship between attention level of Hamoun channel to the national-religious identity of people and their national-religious identity. Therefore, the more attention the Hamoun channel pays to the national-religious identity, the higher the national-religious identity of people will be. Therefore, there is a relation between Hamoun channel's attention to the national-religious identity and national-religious identity of people in accordance with the obtained Pearson correlation coefficient at the confidence level of 99%.

Table 1: Pearson correlation coefficient between Hamoun channel's attention to the national-religious identity of people and their national-religious identity

Variable	National-religious identity of people	
Hamoun channel's attention to the national-religious identity of people	Correlation coefficient value	0.838
	Significance level (Sig)	0.000
	Number	400

Hypothesis 2: increase in Hamoun Channel' programs, which are watched by people in Sis tan and Baluchistan improves their national and religious identity.

The Pearson correlation coefficient Table 2 shows that increase in Hamoun Channel' programs, which are watched by people in Sis tan and Baluchistan improves their national and religious identity. In other words, there is a direct linear relationship between the programs of Hamoun channel watched by people and their national-religious identity. Therefore, this hypothesis is accepted at the significance level of 1%.

Table 2: Pearson correlation cefficient between the programs of Hamoun channel watched by people and their national-religious identity

Variable	National-religious identity of people	
How much people watch the Hamoun channel	Correlation coefficient value	0.712
	Significance level (Sig)	0.000
	Number	400

Hypothesis 3: content production of national-religious identity by program makers and participants of Hamoun channel leads to increased use of programs in viewpoint of respondents. The Pearson correlation coefficient Table 3 shows that content production of national-religious identity by program makers and participants of Hamoun channel has led to increased use of programs in viewpoint of respondents. In other words, there is a direct linear relationship between content production of national-religious identity by program makers and participants of Hamoun channel and watching programs of this channel by people. Therefore, content production of national-religious identity by program makers and participants of Hamoun channel leads to increased use of programs in viewpoint of respondents. According to the obtained Pearson correlation coefficient (r=0.811),there is a relationship between content production of national-religious identity by program makers and participants of Hamoun channel use of programs by people at the significance level of 99%.

Table 3: Pearson correlation coefficient between content production of national-religious identity by program makrs and participants of Hamoun channel use of programs by people

Variable	National-religious identity of people	
content production of national-religious identity by program makers and participants	Correlation coefficient value	0.811
	Significance level (Sig)	0.000
	Number	400

Hypothesis 4: attention of Hamoun channel paid to the traditions of people living in Sis tan and Baluchistan has effect on their national and religious identity. The Pearson correlation coefficient Table 4 shows that Hamoun channel has expanded the sense of national and religious belonging of people in studied province by making programs related to theirs customs and traditions. In other words, there is a direct linear relationship betwe en customs and traditions of people and their national-religious identity. Therefore, increased attention of Hamoun channel paid to the traditions and customs of people has expanded their national-religious identity. According to the obtained Pearson correlation coefficient (r=0.794), there is a relationship between attention of Hamoun channel paid to the traditions of peoples and their national-religious identity at the significance level of 99%.

*Corresponding author (Gholamreza Ibrahim) E-mail: ebrahimireza81@yahoo.com Volume 10 No.3 ISSN2228-9860 eISSN1906-9642 http://TUENGR.COM/V10/361.pdf DOI: 10.14456/ITJEMAST.2019.36

Table 4: Pearson correlation coefficient between customs and traditions of people and their national-religious identity

Variables	National-religious identity of people	
Attention of Hamoun channel paid to the traditions and customs of people	Correlation coefficient value	0.794
	Significance level (Sig)	0.000
	Number	400

Hypothesis 5: attention of Hamoun channel to the ethnics and tribes living in Sis tan and Baluchistan has effect on their national and religious identity. The Pearson correlation coefficient shows Table 5 that Hamoun channel has expanded the sense of national and religious belonging of people in studied province by making programs related to tribes. In other words, there is a direct linear relationship between attention of Hamoun channel paid to tribes of people and their national-religious identity. Therefore, increased attention of Hamoun channel paid to the tribes and ethnics of people has expanded their national-religious identity. According to the obtained Pearson correlation coefficient (r=0.831), there is a relationship between attention of Hamoun channel paid to the tribes of people and their national-religious identity at the significance level of 99%.

Table 5: Pearson correlation coefficient between the attentions of Hamoun channel paid to the tribes of people and their national-religious identity

Variables	National-religious identity of people	
Attention of Hamoun channel paid to the ethnics and traditions of people	Correlation coefficient value	0.831
	Significance level (Sig)	0.000
	Number	400

Hypothesis 6: attention of Hamoun channel to products of Sis tan and Baluchistan has effect on the national and religious identity of people. The Pearson correlation coefficient shows that Hamoun channel has expanded the sense of national and religious belonging of people in studied province by making programs related to the products of Sis tan and Baluchistan. In other words, there is a direct linear relationship between attention of Hamoun channel paid to products of Sis tan and Baluchistan and national-religious identity of people. Therefore, increased attention of Hamoun channel paid to the products of the province has expanded national-religious identity of people. According to the obtained Pearson correlation coefficient (r=0.646), there is a relationship between attention of Hamoun channel paid to the products of the province and national-religious identity of people at the significance level of 99%.

Table 6: Pearson correlation coefficient between the attentions of Hamoun channel paid to the products of the province and national-religious identity of people

Variables	**National-religious identity of people**	
Attention of Hamoun channel paid to the products of the province	Correlation coefficient value	0.646
	Significance level (Sig)	0.000
	Number	400

Hypothesis 7: attention of Hamoun channel to the economy of Sis tan and Baluchistan has effect on national and religious identity of people. The Pearson correlation coefficient Table 7 shows that Hamoun channel has expanded the sense of national and religious belonging of people in studied province by making programs related to the economy of Sis

tan and Baluchistan. In other words, there is a direct linear relationship between attention of Hamoun channel paid to the economy of Sis tan and Baluchistan and national-religious identity of people. Therefore, increased attention of Hamoun channel paid to the economy of the province has expanded national-religious identity of people. According to the obtained Pearson correlation coefficient (r=0.631), there is a relationship between attention of Hamoun channel paid to the economy of the province and national-religious identity f people at the significance level of 99%.

Table7: Pearson correlation coefficient between the attentions of Hamoun channel paid to the economy of the province and national-religious identity of people

Variable	National-religious identity of people	
Attention of Hamoun channel paid to the economy of the province	Correlation coefficient value	0.631
	Significance level (Sig)	0.000
	Number	400

Hypothesis 8: attention of Hamoun channel to the historical issues in Sis tan and Baluchistan has effect on national and religious identity of people. The Pearson correlation coefficient Table 8 shows that Hamoun channel has expanded the sense of national and religious belonging of people in studied province by making programs related to the historical issues of Sis tan and Baluchistan. In other words, there is a direct linear relationship between attention of Hamoun channel paid to the historical issues of Sis tan and Baluchistan and national-religious identity of people. Therefore, increased attention of Hamoun channel paid to the historical issues of the province has expanded national-religious identity of people. According to the obtained Pearson correlation coefficient (r=0.731), there is a relationship between attention of Hamoun channel paid to the historical issues of the province and national-religious identity of people at the significance level of 99%.

Table 8: Pearson correlation coefficient between the attentions of Hamoun channel paid to the historical issues of the province and national-religious identity of people

Variables	National-religious identity of people	
Attention of Hamoun channel paid to the historical issues of the province	Correlation coefficient value	0.731
	Significance level (Sig)	0.000
	Number	400

Hypothesis 9: attention of Hamoun channel to art issues in Sis tan and Baluchistan has effect on national and religious identity of people. The Pearson correlation coefficient Table 9 shows that Hamoun channel has expanded the sense of national and religious belonging of people in studied province by making programs related to the art issues of Sis tan and Baluchistan. In other words, there is a direct linear relationship between attention of Hamoun channel paid to the art issues of Sis tan and Baluchistan and national-religious identity of people. Therefore, increased attention of Hamoun channel paid to the art issues of the province has expanded national-religious identity of people.

Table 9: Pearson correlation coefficient between the attentions of Hamoun channel paid to the art issues of the province and national-religious identity of people

Variable	**National-religious identity of people**	
Attention of Hamoun channel paid to the art issues of the province	Correlation coefficient value	0.651
	Significance level (Sig)	0.000
	Number	400

According to the obtained Pearson correlation coefficient (r=0.651), there is a

relationship between attention of Hamoun channel paid to the art issues of the province and national-religious identity of people at the significance level of 99%.

Hypothesis 10: attention of Hamoun channel to participation of citizens of Sis tan and Baluchistan in different scopes has effect on their national and religious identity. The Pearson correlation coefficient Table 10 shows that Hamoun channel has expanded the sense of national and religious belonging of people in studied province by making programs related to their participation in different scopes. In other words, there is a direct linear relationship between attention of Hamoun channel paid to participation of citizens of Sis tan and Baluchistan and their national-religious identity. Therefore, increased attention of Hamoun channel paid to the participation of citizens of the province has expanded their national-religious identity. According to the obtained Pearson correlation coefficient (r=0.751), there is a relationship between attention of Hamoun channel paid to the participation of citizens of the province in different scopes and their national-religious identity at the significance level of 99%.

Table10: Pearson correlation coefficient between the attentions of Hamoun channel paid to the participation of the citizens of province in different scopes and their national-religious identity

Variables	National-religious identity of people	
Attention of Hamoun channel paid to the participation of citizens of the province	Correlation coefficient value	0.751
	Significance level (Sig)	0.000
	Number	400

3.2 CONFIRMATORY ANALYSIS OF TRADITIONS AND CUSTOMS, TRIBES, PRODUCTS, HISTORICAL ISSUES AND MONUMENTS, ECONOMY, CITIZENSHIP RIGHTS, AND NATIONAL-RELIGIOUS IDENTITY

Confirmatory analysis for variable of traditions and customs consists of six components and indicates that “use of custom cloths in programs of the channel” has the highest factor load (0.75) on its variable (traditional customs) showing that almost 57% of changes in this variables can be explained by the above-mentioned component. Confirmatory analysis for variable of products consists of two components and indicates that “introduction of handicrafts” has the highest factor load (0.64) on its variable (products) showing that almost 41% of changes in this variables can be explained by the above-mentioned component, Table 11. Confirmatory analysis for variable of traditions and customs consists of 6 components and indicates that “use of custom cloths in programs of the channel” has the highest factor load (0.75) on its variable (traditional customs) showing that almost 575 of changes in this variables can be explained by the above-mentioned component. In case of confirmatory analysis, variable of historical works and monuments is measured with factor load of 0.36 on the component of “introduction of important historical events of the province” with effectiveness of 13% changes in the variable; economy with factor load of 0.28 on “providing economic information and news” with effectiveness of 8% changes in the variable; art issues with factor load of 0.26 on “paying attention to the music in the province” with effectiveness of 7%; citizens’ participation with factor load of 0.21 on “paying attention to activities of people in field of revolution issues in the province” with 4% effectiveness; tribes with factor load of 0.18 on “common communicational language” with 3%

effectiveness; and national-religious construct is measured with factor load of 0.72 on "traditional customs" with 52% effectiveness of changes in national-religious identity.

Table 11: Model fit indicators, obtained from competitiveness model

Index	Benchmark index	Traditions and customs	Tribes	Products	Historical woks and monuments	Economy	Art issues	Citizens' participation	National-religious identity
χ^2	df<3	0.000	0.000	0.000	0.009	0.008	0.005	0.002	0.001
AGFI	Between 0 and 1; close to 1	0.980	0.991	0.814	0.910	0.921	0.896	0.912	0.982
GFI	Between 0 and 1; close to 1	1.000	1.000	0.938	0.982	0.960	0.912	1.000	1.000
RMR	Between 0 and 1; the smaller the index, the better the value	0.000	0.005	0.066	0.034	0.022	0.014	0.000	0.001
RSMEA	0.05 and lower	0.268	0.061	0.174	0.000	0.321	0.021	0.157	0.042
NFI	0.8 or greater than 0.9	0.989	0.887	0.727	0.929	0.912	0.817	1.000	1.000
CFI	Greater than 0.9	1.000	1.000	0.938	0.942	0.958	0.943	1.000	1.000

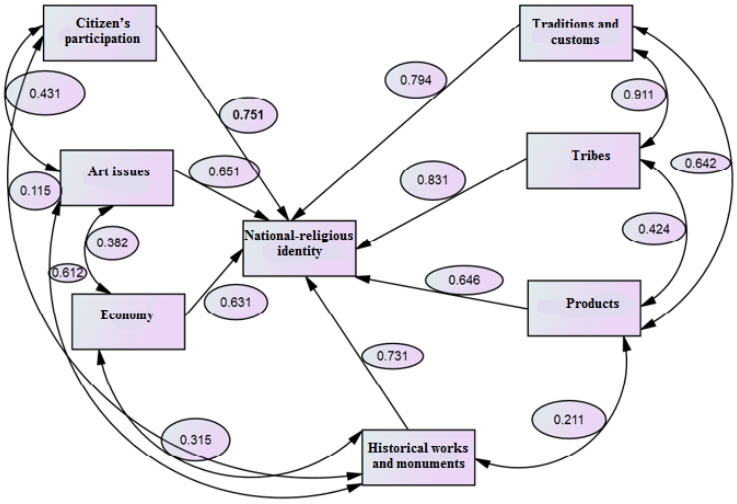

Figure 1: The regression results from path analysis.

Table 12: Coefficients of independent variables entered into the regression equation.

Entered variable	Non-standard coefficients		Standard coefficients	t-test	Sig.	Co-linearity value
	B	SD	BETA			Tolerance factor
Constant value	0.586	1.314		0.446	0.656	
Traditions and customs	1.104	0.171	0.328	6.472	0.000	1
Tribes	0.101	0.032	0.155	3.110	0.002	0.845
Products	0.257	0.048	0.278	5.396	0.000	0.798
Historical works and monuments	0.067	0.011	0.322	6.321	0.000	0.891
Economy	0.156	0.036	0.222	4.345	0.000	0.891
Art issues	0.089	0.049	0.083	1.831	0.000	0.814
Citizens' participation	0.051	0.10	0.261	5.084	0.000	0.799

Path analysis, considering the regression results at this step (Figure 1), those significant variables in relation with the dependent variable of study (national-religious identity) are inserted into the regression equation; it means that independent variable with highest beta coefficient with dependent variable is selected then considered as the next dependent variable. This process continues up to the last equation. According to the multivariate correlation analysis, it was concluded that traditions and customs, tribes, products, historical

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works and monuments, art issues and citizens' participation had significant relationship with national-religious identity at the thousandth level. Among the mentioned variables, traditions and customs had the highest beta; hence, it was selected as the next dependent variable, which other variables were addressed in relation with this component. Table 12 demonstrates the results of this equation.

All of research hypotheses were significant at 1% level. These relations were direct so that an increase in the programs of Hamoun channel watched by people in different scopes of traditions and customs, tribes, products, economy, historical issues and participation of people led to increase in national-religious identity of them. The effect of people's use of programs of Hamoun channel in field of traditions and customs, tribes, products, economy, historical issues and participation of people on the national-religious participation of them was tested using linear regression and this effect on all of the above-mentioned variables was confirmed at the significance level of 1%. Stepwise multivariate linear regression indicates that these variables can predict more than 89.9% of changes in dependent variable (national-religious identity of people living in Sis tan and Baluchistan). Traditions and customs, tribes, historical issues, people's participation, products, art issues and economy had the highest effect, respectively. In addition, determination coefficient of 89.9% indicates that these factors could predict national-religious identity of people very well and only 10.1% of changes in national-religious identity of people was related to stochastic and unpredictable factors. According to the structural equations and confirmatory factor analysis on the factors affecting national-religious identity, traditions and customs, tribes, historical issues, people's participation, products, art issues and economy could affect national-religious identity of people in Sis tan and Baluchistan both in direct and indirect ways.

Considering the above-mentioned objectives, there have been various activities in different radio and TV channels in recent years and numerous radio and TV programs and festivals have been produced. This study was conducted to examine the relation between attention of Hamoun channel (Sis tan and Baluchistan) paid to some issues such as traditions and customs, tribes, historical issues, people's participation, products, art issues, economy and national-religious identity of people. The results obtained from correlation tests showed that those audiences who estimated high attention of Hamoun channel paid to traditions and customs, tribes, historical issues, people's participation, products, art issues and economy, had stronger national-religious identity. In other words, there is direct relation and correlation between use of program contents in fields of traditions and customs, tribes, historical issues, people's participation, products, art issues, economy and national-religious identity of audiences. Therefore, the hypothesis associated with the relation between audiences' use of the contents including traditions and customs, tribes, historical issues, people's participation, products, art issues and economy presented by Hamoun channel and national-religious identity of people with direct effect on it.

Another objective of producing programs particularly documentary and fiction films is to broadcast them from national channels; in fact, this is done to show the culture and different issues of the province for people who live in other parts of the country. Therefore,

some films and programs are produced to convey the mentioned messages to the future generations. Handicrafts can perform as an activity composed of the culture and economy of every society to transfer the culture and create an economic space. In this case, the effect of this variable on national-religious identity of people was tested and accepted.

TV has an inclusive but indirect effect on families and audiences fostering them within long term and making worldview, roles and values in their minds. According to proponents and founders of cultivation theory, TV forms thoughts, life style, intra and extra-individual relationships more effectively compared to other ones since this media is highly used in daily life.

Cultivation theory does not imply driver-response model or simple linear relation between the media's content and audiences, but indicates the increasing long-term implications, fixed contact and frequent messages not short-term responses. According to the research hypotheses, there was a relation between age and effect of paying attention to the programs associated with traditions, tribes, historical issues, people's participation, products, art issues and economy. According to the cultivation theory, effect of TV viewing means that it is possible to create some of beliefs or keep some viewpoints throughout the increasing and stable contact with the TV world.

4. CONCLUSION

According to the research results and accepted hypotheses, the process of persuading the audience can be mentioned based on the cultivation theory. People have positive attitude toward the way TV pays attention to programs related to traditions, tribes, historical issues, people's participation, products, art issues and economy and the studied channel has performed successfully in producing cultural programs. Therefore, the hypothesis about effect of Hamoun channel's attention to the programs about traditions, tribes, historical issues, people's participation, products, art issues and economy was accepted. Media can expand their effectiveness using such techniques. Mass media create mutual interaction between audiences and media by creating a suitable field for elites. To realize audience persuasion, various media should focus on the mental layers and feelings (emotionally and rationally) to create a link between audience's needs and their goals in order to make the audiences to benefit from the message, deepen their attitudes and behaviours, and feel satisfaction. Among the common media, TV plays a vital role in affecting audiences. The main assumption of this research stated that all of audiences are persuaded if their needs are met by the media and their position is reproduced on TV programs.

5. REFERENCES

[1] Boshrieh, H.Intellect in politics, Tehran: A Contemporary View, 2004.

[2] Sani Ejlal, M. Introduction of Iranian culture and identity, Tehran: National Studies Institute, Iranian Civilization, 2005.

[3] Afroogh, E. Iranian identity, Tehran: Monument, 2001.

[4] Zahiri, A. What is national identity. *Journal of Political Science*, 2005, 29-31.

[5] Montazer Ghaem, M. Mass media and identity. *Journal of National Requisitions*, 1998, 2(4).

[6] Funk JB, Buchman DD. Playing violent video and computer games and adolescent self-concept. Journal of communication. 1996 Jun 1; 46(2):19-32.

[7] Salehi Amiri, S. R. Managing ethnic diversity based on the social capital theories, Strategies Journal, 2006, Issue 40.

[8] Tampson, J. The Media and Modernity. Standford University, 1995.

[9] Ramezanzadeh, A. Development and ethnic challenges, Proceedings of the Conference on Development and Public Security, Ministry of the interior, 1995.

[10] Rashidpour, I. Mr. McLohan's Pocket Mirrors, Tehran, National Radio and Television of Iran, 1973.

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International Transaction Journal of Engineering, Management, & Applied Sciences & Technologies

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ANALYSIS OF HORIZONTAL SHEAR STRENGTH OF PRECAST PRESTRESSED CONCRETE SLAB AND CONCRETE TOPPING COMPOSITES

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ARTICLEINFO

Article history:
Received 16 November 2018
Received in revised form 22 February 2019
Accepted 01 March 2019
Available online
06 March 2019

Keywords:
Composite section;
Horizontal shear stress;
Roughened surface;
Three-point load test.

ABSTRACT

This study aims to compare the horizontal shear strength at the interface between precast prestressed concrete slabs and concrete toppings under three different slab surface conditions: smooth or unintentionally roughened (Type 1), intentionally roughened by 3mm latitudinal indentations (Type 2), and intentionally roughened by 6mm latitudinal indentations (Type 3). The theoretical values for shear strengths for all types of the concrete slab-topping composites were compared to the experimental values calculated from vertical deflection and strain values which were obtained using the Three-Point Bending Test. The characteristics of the failures were also examined. The study shows that the horizontal shear strength and the deflection depend on the roughness of the surface of the concrete slabs. When compared to Type 1 concrete slabs under the load of 1,300kg, the concrete slabs with roughened surfaces showed stronger horizontal shear stress (by the factor of 0.898 for Type 3 and 0.953 for Type 2) and less deflection (by the factor of 1.113 for Type 3 and 1.053 for Type 2). The results highlight the importance of the roughened surface of the concrete slabs in enhancing the horizontal shear strength in the concrete slab-topping composites which could be of great benefit to engineering applications.

1. INTRODUCTION

The globally increasing demand in housing due to population growth has posed a concern for modern buildings to be constructed in a fast and cost-effective way [1]–[3]. One of many possible solutions is to establish housing estates in which each building is constructed using the same designs and materials. Using economical ready-made materials such as precast prestressed concrete slabs, also called concrete planks or concrete slabs, can save a considerable amount of time and materials used during the construction process [4]. In addition, factory-made precast concrete slabs can be manufactured to be higher quality and can tolerate heavier loads than in-situ concrete materials. Because of these benefits, concrete slabs have become widely-used for floor and bridge construction

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in modern architectures [5], [6]. After aligning concrete slabs on the floor, reinforcement steel bars are generally placed on top, followed by a layer of in-situ concrete in order to enhance the strength, increase the load capacity, and even out the weight distribution throughout the concrete slabs [7], [8]. There are two flat sides to the concrete slabs – one with a smooth surface and the other with a rough surface. In practice, in-situ concrete is poured on top of the rough sides of the concrete slabs. However, according to the ACI 318 Building Code and Commentary, the composite section designed for handling horizontal shear stress has to be clean and free of laitance and needs to have 6mm indentations on its rough side in order to maximize the horizontal shear strength [9]. In order for the precast prestressed concrete slabs to form a composite section with concrete toppings, the surfaces of the concrete slabs need to be sufficiently rough so that the horizontal shear force between the interfaces of the two materials can be effectively distributed [10]–[12]. However, in practice, the process of surface roughening is usually carried out when the newly-formed slabs begin to harden by brushing the top surface of the concrete slabs with a hard-bristle brush [13]. This gives an uneven texture on the surface, and the indentation pattern on the surface is generally less than 6mm. To highlight the importance of using concrete slabs with sufficiently roughened surfaces, this study aims to compare the horizontal shear strength achieved by different types of concrete slabs topped by in-situ concrete using Three-Point Bending Test. Three types of concrete slabs were studied: 1) concrete slabs with a smooth surface, 2) with a 3mm latitudinally indentation pattern, and 3) with a 6mm latitudinally indentation pattern.

2. MATERIALS AND METHODS

2.1 MATERIALS

2.1.1 PRECAST PRESTRESSED CONCRETE SLABS

Precast prestressed concrete slabs (clean and free of laitance) have a compressive strength of 350kg/cm^2 and are 5cm thick, 35cm wide, and 210cm long. Each concrete slab was reinforced with 4 PC-wires (4mm in diameter). The slabs were separated into three types according to their surface property. Three specimens of each type were used in this study.

Type 1: Unintentionally roughened concrete slabs
Type 2: Intentionally roughened concrete slabs (3mm latitudinally indented)
Type 3: Intentionally roughened concrete slabs (6mm latitudinally indented)

2.1.2 CONCRETE TOPPINGS

The 5cm-thick toppings have a compressive strength of 245kg/cm^2. The same concrete toppings were used for all concrete slabs-topping composites.

2.2 CONCRETE SLAB-TOPPING COMPOSITES PREPARATION

2.2.1 PRECAST PRESTRESSED CONCRETE SLABS

In Type 1 precast prestressed concrete slabs, the surface of the slabs was smoothened using a trowel to give an unintentionally roughened finish. Type 2 and 3 carry the same materials and dimensions as Type 1. However, they were intentionally roughened by pressing metal frames on top of the concrete slabs during the moulding process to create a latitudinally raked pattern on their top surfaces. The metal frames were created using two long parallel round bars (12mm in diameter) as the outer frame attached to 31 latitudinally aligned round bars (6mm in diameter, each pair is 50mm separated when measured from center to center of the two bars). The indentations for the roughened

surface were 3mm for Type 2 concrete slabs and 6mm for Type 3 concrete slabs. The pattern designs for Type 2 and Type 3 are shown in Figure 1A and Figure 1B.

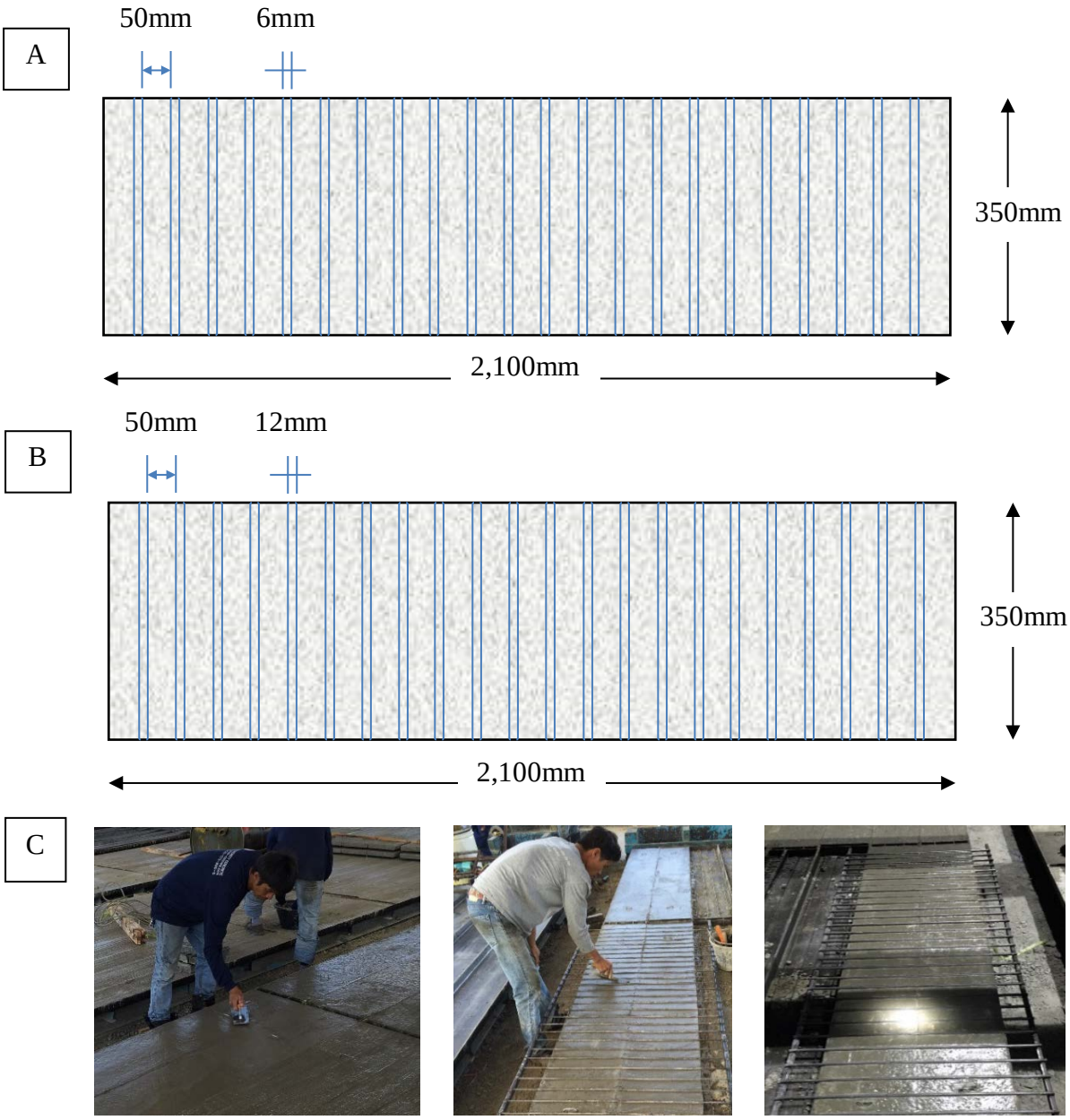

Figure 1: (A) Dimensions of concrete slabs with 3mm latitudinally indented surface, (B) with 6mm latitudinally indented surface (figures are not drawn to scale). (C) Concrete slabs in preparation (left: Type 1, centre: Type 2, right: Type 3)

2.2.2 STRAIN GAUGE ATTACHMENT

The concrete slabs were left dry for 24 hours in order for them to develop at least 75% of the desired strength. The metal frames were then removed and the outlines for attachment were drawn on the clean, polished surfaces of the concrete slabs. Seven strain gauges were then attached to the marked locations using cyanoacrylate adhesive (Figure 2A-B). Next, six electrical wires were connected to each end of the strain gauges. Each wire was tested for electrical voltages to ensure no faults or damages. A liquid coating material made of wax at a high temperature was applied on top of the strain gauges and the surrounding areas using a paint brush and left until dry (Figure 2C).

*Corresponding author (Duttawan Wilaiwong) E-mail: d.s.0629799935@gmail.com Volume 10 No.3 ISSN 2228-9860 eISSN 1906-9642 http://TUENGR.COM/V10/373.pdf DOI: 10.14456/ITJEMAST.2019.37

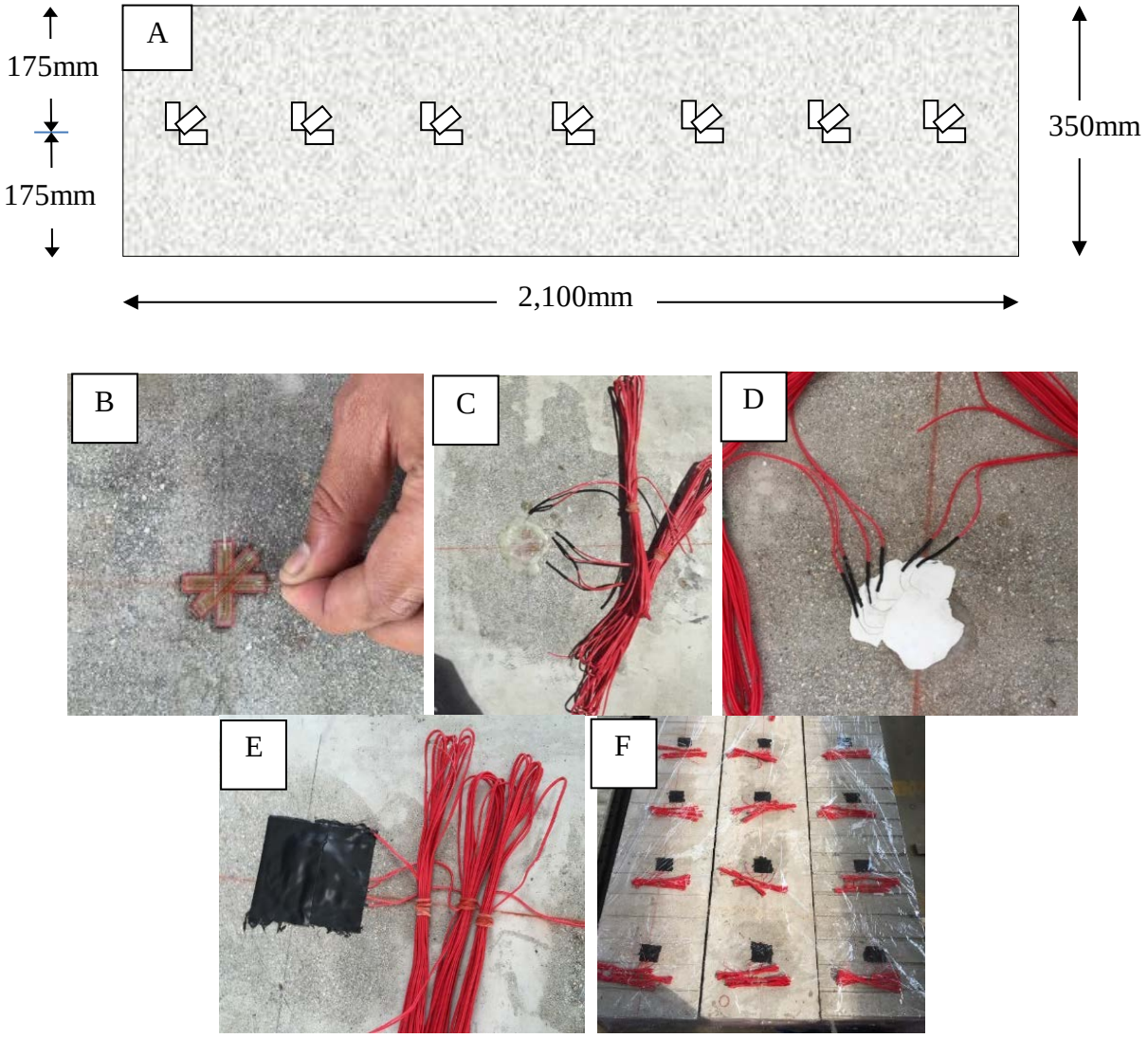

Figure 2: (A) The placement outline for strain gauges (not to scale). (B) strain gauges attached on to the cleaned and polished surface of a concrete slab. (C) Strain gauges after connected with electrical wires and coated with hot wax. (D) SB tape was placed underneath the six electrical wires extending from the strain gauges. (E) Strain gauges and wires were sealed with VM tape. (F) Concrete slabs with strain gauges attached were wrapped in plastic film to protect from dust (left: Type 2, center: Type 1, right: Type 3).

SB tape was then placed under the electrical wires. Each wire was separated and pressed to secure on the SB tape surface so that no pairs of electrical wires are in physical contact which can make short circuits (Figure 2D). Next, the devices were sealed with vinyl mastic tape (VM tape) to prevent water contained in the concrete topping from entering the devices (Figure 2E). The concrete slabs were then wrapped in plastic film to protect the materials from dust (Figure 2F).

2.2.3 CONCRETE TOPPINGS

Nine steel forms for pouring concrete topping were constructed using hollow rectangular tubes made of steel. The tube size was 2 inches wide and 4 inches long. Each formwork was drilled on its side to allow electrical wires to extend to the side through the holes. The nine concrete slabs (three

types, each type has three specimens) were then assembled into each steel form and topped with in-situ concrete (Figure 3A). A concrete vibrator was employed to compress the concrete topping. The top surface of each concrete composite was smoothened using a trowel and a concrete float. Once the concrete toppings hardened, they were sprayed on top with a concrete curing compound and left for 24 hours. The concrete slab-topping composites were then removed from the steel formworks and rested for 28 days before being tested for horizontal shear strength (Figure 3B).

Figure 3: (A) In-situ concrete toppings were poured into each formwork. (B) The concrete slabs and toppings were left dry before being removed from the formworks.

2.3 TEST OF HORIZONTAL SHEAR STRENGTH

The Three-Point Bending Test (in accordance with ASTM Standards Building Codes [14]) was employed for the test (Figure 4). A 250-tonne universal testing machine was used for pressing the slabs through a 10-tonne load cell. A displacement transducer was placed at the center position of the machine. A concrete slab-topping composite, with strain gauges embedded, was then placed on top, supported by two steel legs at both ends. The values for 1) load pressure, 2) vertical displacement, and 3) horizontal shear strain were recorded using Portable Data Logger (Model: TDS-530) with Automatic Switching Box (Model: ASW-50B).

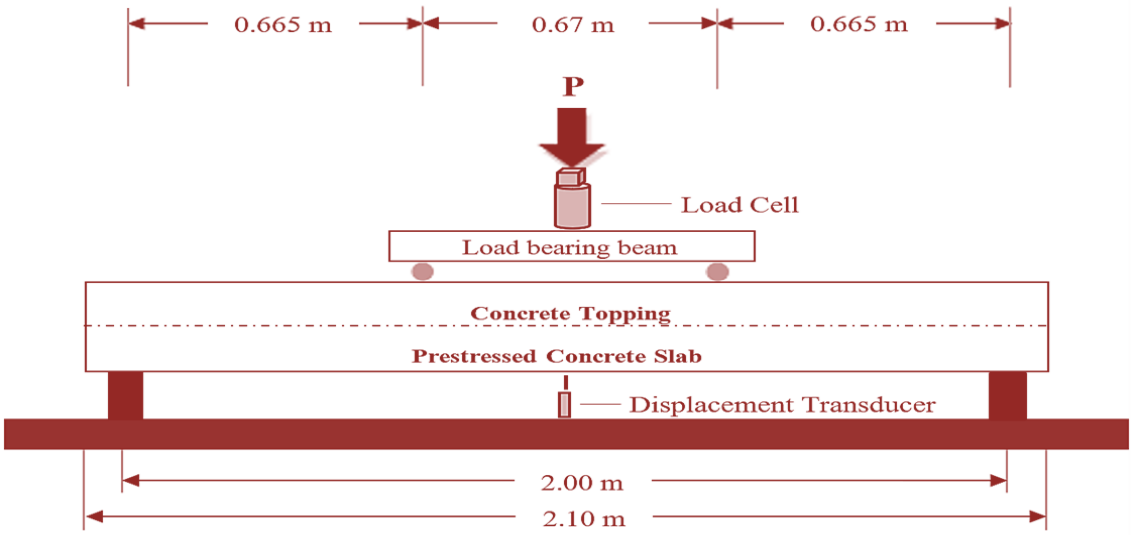

Figure 4: Test of horizontal shear strength of the concrete slab-topping composites using Three-Point Bending Test.

*Corresponding author (Duttawan Wilaiwong) E-mail: d.s.0629799935@gmail.com Volume 10 No.3 ISSN 2228-9860 eISSN 1906-9642 http://TUENGR.COM/V10/373.pdf DOI: 10.14456/ITJEMAST.2019.37

The pressure on the load bearing beam was gradually increased by 50kg until the first crack was observed. The characteristic of the crack on the concrete topping's surface was examined and the displacement transducer was then removed from the base of the machine. The experiment was repeated by further increasing the load by 50kg each time until failure. The characteristics of the concrete slab composite and the value for a load of failure were examined and recorded.

2.4 PARAMETERS AFFECTING HORIZONTAL SHEAR STRESS OF COMPOSITE SLABS

The horizontal shear stress on the interface between concrete slabs and concrete toppings (τ_{xy}) can be calculated according to the following pre-derived equation [15], Equation (1).

$$\tau_{xy} = \frac{\gamma_{xy} E}{2(1+\nu)} \quad (1),$$

where γ_{xy}, E, and ν are the shear strain on the interface between the two concrete materials, the elastic modulus of the composite section, and the Poisson's ratio of the composite section, respectively.

	Unintentionally roughened (Type 1)	Intentionally roughened by 3mm (Type 2)	Intentionally roughened by 6mm (Type 3)
Specimen 1			
Specimen 2			
Specimen 3			

Figure 5: Characteristics of the concrete slab composites at their points of failure.

3. RESULTS AND DISCUSSION

Nine concrete slab-topping composite specimens were tested for horizontal shear strength using the three-point bending test method (Figure 5). In all cases, the crack lines were observed near the middle section of the specimens. These indicate that the vertical shear strength, as well as the horizontal shear strength between the concrete slabs and the concrete toppings, were not large enough to cause the failures due to shear stress. The failures of these specimens were caused by the bending moment. However, the loads at failure were the highest for the specimens made of 6mm intentionally

roughened concrete slabs (Type 3), followed by the specimens made of 3mm intentionally roughened concrete slabs (Type 2) and then followed by the specimens made of unintentionally roughened concrete slabs (Type 1). On average, the load at failure of Type 3 and Type 2 concrete slabs were 1.035 and 1.020 times higher than that of Type 1.

Next, the deflections in nine concrete slab-topping composite specimens were measured and plotted in Figure 6. The points of the first crack varied from 1,320kg to 1,740kg, regardless of the types of concrete slabs. Therefore, it is inconclusive whether roughened surfaces of the concrete slabs could result in higher load required for the first crack to occur and further investigation concerning more variables and factors is needed. However, it can be observed from the figure that the slab-topping composite specimens from the same type tend to have broadly similar deflection characteristics, suggesting that the roughness on the surface of the concrete slabs affects the amount of the deflection when the concrete slab-topping composites were suppressed by the machine. When the deflection values of all specimens were closely examined under the same load of 1,300kg, Type 3 and Type 2 concrete slabs showed less average deflection by the factor of 0.898 and 0.950 when compared to Type1. In addition, when the same amount of deflection (2.80mm) was considered, Type 3 showed 1.078 times heavier load capacity, while Type 2 showed 1.034 times, compared to Type 1.

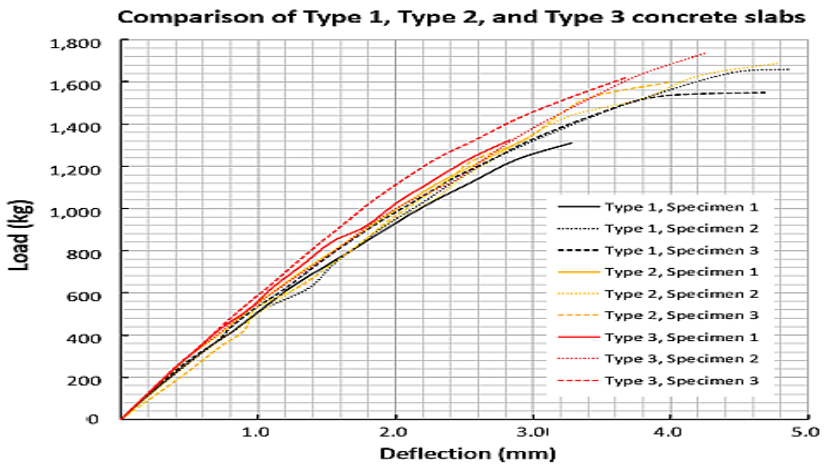

Figure 6: Comparison of the deflections of three types of concrete slab composites: with unintentionally roughened surface (Type 1, black lines), intentionally roughened by 3mm (Type 2, yellow lines), and intentionally roughened by 6mm (Type 3, red lines). Thick lines denote specimens no. 1 of each type. Dotted lines denote specimens no. 2, and dashed line, specimens no. 3. The top ends of each line denote the points where the first cracks appeared.

The horizontal shear stress can be obtained by substituting the measured experimental values (in the elastic range) into equation (1). The experimental values (τ_{xy}) were found to be in broad agreement with the theoretical values ($\tau_{xy,cal}$) (Tables 1-3). The horizontal shear stress was proportional to the vertical shear stress. Additionally, the horizontal shear stress was found to be highest at both ends of the load bearing beam and lowered proportionally towards the center of the beam. Under the load of 1,300kg and at position 0.10L, the average values for the horizontal shear stress for Type 3 and Type 2 concrete slabs were 1.148 times and 1.089 times stronger than that of Type 1. In general, the experimental horizontal shear stresses at other positions were also in broad agreement with the corresponding theoretical ones.

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Table 1: Measured shear, shearing strain, and horizontal shear stress from the concrete composite specimens made of unintentionally roughened concrete slabs and concrete toppings (Type 1, top: specimen 1, middle: specimen 2, bottom: specimen 3).

0.10L				0.40L				0.70L				CL			
Shear	γ_{xy}	τ_{xy}	$\tau_{xy,cal}$	Shear	γ_{xy}	τ_{xy}	$\tau_{xy,cal}$	Shear	γ_{xy}	τ_{xy}	$\tau_{xy,cal}$	Shear	γ_{xy}	τ_{xy}	$\tau_{xy,cal}$
113.60	0.00	0.00	0.70	88.40	0.00	0.00	0.54	63.20	0.00	0.00	0.39	38.00	0.00	0.00	0.23
179.67	0.76	0.75	1.10	154.47	0.72	0.71	0.95	129.27	0.69	0.68	0.79	104.07	-0.42	-0.42	0.64
279.62	1.42	1.41	1.72	254.42	1.36	1.35	1.56	229.22	1.30	1.29	1.41	204.02	-1.05	-1.04	1.25
323.67	1.76	1.75	1.99	298.47	1.48	1.46	1.83	273.27	1.45	1.44	1.68	248.07	-1.28	-1.27	1.52
381.27	2.32	2.30	2.34	356.07	1.68	1.66	2.18	330.87	2.13	2.12	2.03	305.67	-1.66	-1.65	1.88
432.09	2.60	2.58	2.65	406.89	2.26	2.24	2.50	381.69	2.13	2.11	2.34	356.49	-1.98	-1.97	2.19
481.22	2.71	2.68	2.95	456.02	2.48	2.46	2.80	430.82	2.38	2.36	2.64	405.62	-2.30	-2.28	2.49
526.96	2.88	2.86	3.23	501.76	2.77	2.75	3.08	476.56	2.71	2.69	2.92	451.36	-2.56	-2.54	2.77
579.48	3.32	3.29	3.56	554.28	2.84	2.82	3.40	529.08	2.75	2.73	3.25	503.88	-2.69	-2.67	3.09
626.91	3.73	3.70	3.85	601.71	3.60	3.57	3.69	576.51	3.48	3.45	3.54	551.31	-3.19	-3.16	3.38
676.04	3.89	3.86	4.15	650.84	3.86	3.83	3.99	625.64	3.79	3.76	3.84	600.44	-3.51	-3.48	3.68
730.25	4.22	4.19	4.48	705.05	4.20	4.17	4.33	679.85	4.06	4.03	4.17	654.65	-3.80	-3.77	4.02
784.46	4.67	4.63	4.81	759.26	4.56	4.52	4.66	734.06	4.40	4.36	4.50	708.86	-4.16	-4.13	4.35

0.10L				0.40L				0.70L				CL			
Shear	γ_{xy}	τ_{xy}	$\tau_{xy,cal}$	Shear	γ_{xy}	τ_{xy}	$\tau_{xy,cal}$	Shear	γ_{xy}	τ_{xy}	$\tau_{xy,cal}$	Shear	γ_{xy}	τ_{xy}	$\tau_{xy,cal}$
113.60	0.00	0.00	0.70	88.40	0.00	0.00	0.54	63.20	0.00	0.00	0.39	38.00	0.00	0.00	0.23
228.80	1.24	1.23	1.40	203.60	1.12	1.11	1.25	178.40	1.09	1.09	1.09	153.20	-0.74	-0.73	0.94
286.40	1.38	1.37	1.76	261.20	1.35	1.34	1.60	236.00	1.32	1.31	1.45	210.80	-1.08	-1.07	1.29
323.67	1.61	1.59	1.99	298.47	1.50	1.49	1.83	273.27	1.49	1.48	1.68	248.07	-1.32	-1.31	1.52
376.19	2.21	2.19	2.31	350.99	1.93	1.92	2.15	325.79	1.81	1.80	2.00	300.59	-1.62	-1.61	1.84
425.31	2.24	2.22	2.61	400.11	2.19	2.17	2.45	374.91	1.89	1.87	2.30	349.71	-1.96	-1.94	2.15
476.14	2.67	2.65	2.92	450.94	2.45	2.43	2.77	425.74	2.45	2.43	2.61	400.54	-2.23	-2.22	2.46
526.96	2.86	2.84	3.23	501.76	2.82	2.80	3.08	476.56	2.77	2.75	2.92	451.36	-2.55	-2.53	2.77
577.78	3.10	3.08	3.54	552.58	3.02	3.00	3.39	527.38	2.99	2.96	3.24	502.18	-2.86	-2.84	3.08
630.30	3.58	3.55	3.87	605.10	3.47	3.45	3.71	579.90	3.43	3.40	3.56	554.70	-3.23	-3.20	3.40
682.82	3.90	3.87	4.19	657.62	3.79	3.76	4.03	632.42	3.66	3.63	3.88	607.22	-3.50	-3.48	3.73
731.95	4.28	4.24	4.49	706.75	4.23	4.20	4.34	681.55	4.11	4.08	4.18	656.35	-3.83	-3.80	4.03
775.99	4.61	4.58	4.76	750.79	4.36	4.33	4.61	725.59	4.30	4.26	4.45	700.39	-4.12	-4.09	4.30
831.90	5.02	4.98	5.10	806.70	4.65	4.62	4.95	781.50	4.53	4.50	4.79	756.30	-4.43	-4.40	4.64
882.72	5.07	5.03	5.42	857.52	4.97	4.93	5.26	832.32	4.79	4.75	5.11	807.12	-4.66	-4.62	4.95
935.24	5.39	5.34	5.74	910.04	5.31	5.27	5.58	884.84	5.30	5.25	5.43	859.64	-5.06	-5.02	5.27
969.12	5.64	5.59	5.95	943.92	5.45	5.40	5.79	918.72	5.29	5.36	5.64	893.52	-5.19	-5.15	5.48

0.10L				0.40L				0.70L				CL			
Shear	γ_{xy}	τ_{xy}	$\tau_{xy,cal}$	Shear	γ_{xy}	τ_{xy}	$\tau_{xy,cal}$	Shear	γ_{xy}	τ_{xy}	$\tau_{xy,cal}$	Shear	γ_{xy}	τ_{xy}	$\tau_{xy,cal}$
113.60	0.00	0.00	0.70	88.40	0.00	0.00	0.54	63.20	0.00	0.00	0.39	38.00	0.00	0.00	0.23
238.01	1.36	1.34	1.46	212.81	1.20	1.19	1.31	187.61	0.95	0.95	1.15	162.41	-0.76	-0.76	1.00
296.56	1.66	1.65	1.82	271.36	1.32	1.31	1.66	246.16	1.47	1.46	1.51	220.96	-1.12	-1.12	1.36
335.53	1.92	1.90	2.06	310.33	1.71	1.70	1.90	285.13	1.65	1.63	1.75	259.93	-1.38	-1.37	1.59
377.88	2.02	2.01	2.32	352.68	1.99	1.98	2.16	327.48	1.74	1.73	2.01	302.28	-1.64	-1.63	1.85
425.31	2.38	2.36	2.61	400.11	2.34	2.32	2.45	374.91	2.17	2.15	2.30	349.71	-1.92	-1.90	2.15
479.53	2.77	2.75	2.94	454.33	2.60	2.58	2.79	429.13	2.42	2.40	2.63	403.93	-2.24	-2.23	2.48
528.65	3.05	3.03	3.24	503.45	2.93	2.91	3.09	478.25	2.79	2.77	2.93	453.05	-2.57	-2.55	2.78
586.25	3.26	3.23	3.60	561.05	3.17	3.15	3.44	535.85	2.97	2.95	3.29	510.65	-2.94	-2.92	3.13
633.69	3.37	3.34	3.89	608.49	3.47	3.44	3.73	583.29	3.41	3.38	3.58	558.09	-3.21	-3.18	3.42
684.51	3.97	3.94	4.20	659.31	3.89	3.86	4.05	634.11	3.75	3.72	3.89	608.91	-3.56	-3.53	3.74
726.86	4.28	4.24	4.46	701.66	4.07	4.04	4.30	676.46	3.99	3.96	4.15	651.26	-3.82	-3.79	4.00
775.99	4.59	4.55	4.76	750.79	4.46	4.42	4.61	725.59	4.04	4.01	4.45	700.39	-3.98	-3.95	4.30
835.29	4.82	4.78	5.12	810.09	4.63	4.60	4.97	784.89	4.59	4.55	4.82	759.69	-4.48	-4.45	4.66
879.33	5.12	5.08	5.39	854.13	4.82	4.78	5.24	828.93	4.75	4.71	5.09	803.73	-4.76	-4.72	4.93
930.16	5.42	5.37	5.71	904.96	5.31	5.26	5.55	879.76	5.28	5.24	5.40	854.56	-5.07	-5.03	5.24

Table 2: Measured shear, shearing strain, and horizontal shear stress from the concrete composite specimens made of 3mm intentionally roughened concrete slabs and concrete toppings (Type 2, top: specimen 1, middle: specimen 2, bottom: specimen 3).

0.10L				0.40L				0.70L				CL			
Shear	γ_{xy}	τ_{xy}	$\tau_{xy,cal}$	Shear	γ_{xy}	τ_{xy}	$\tau_{xy,cal}$	Shear	γ_{xy}	τ_{xy}	$\tau_{xy,cal}$	Shear	γ_{xy}	τ_{xy}	$\tau_{xy,cal}$
113.60	0.00	0.00	0.70	88.40	0.00	0.00	0.54	63.20	0.00	0.00	0.39	38.00	0.00	0.00	0.23
227.10	1.33	1.32	1.39	201.90	1.22	1.21	1.24	176.70	0.96	0.95	1.08	151.50	-0.73	-0.73	0.93
274.54	1.65	1.64	1.68	249.34	1.60	1.59	1.53	224.14	1.33	1.32	1.38	198.94	-1.09	-1.08	1.22
323.67	1.86	1.85	1.99	298.47	1.84	1.82	1.83	273.27	1.61	1.60	1.68	248.07	-1.43	-1.42	1.52
377.88	2.32	2.30	2.32	352.68	2.13	2.11	2.16	327.48	2.10	2.08	2.01	302.28	-1.83	-1.82	1.85
428.70	2.48	2.46	2.63	403.50	2.37	2.35	2.48	378.30	2.31	2.29	2.32	353.10	-2.16	-2.14	2.17
476.14	2.93	2.91	2.92	450.94	2.84	2.82	2.77	425.74	2.65	2.63	2.61	400.54	-2.56	-2.54	2.46
526.96	3.19	3.16	3.23	501.76	3.00	2.98	3.08	476.56	2.90	2.88	2.92	451.36	-2.83	-2.81	2.77
579.48	3.45	3.42	3.56	554.28	3.42	3.39	3.40	529.08	3.37	3.34	3.25	503.88	-3.14	-3.11	3.09
630.30	3.82	3.79	3.87	605.10	3.69	3.66	3.71	579.90	3.68	3.65	3.56	554.70	-3.47	-3.44	3.40
677.74	4.19	4.15	4.16	652.54	3.99	3.96	4.00	627.34	3.82	3.79	3.85	602.14	-3.76	-3.73	3.69
725.17	4.33	4.30	4.45	699.97	4.30	4.27	4.29	674.77	4.19	4.15	4.14	649.57	-4.11	-4.08	3.99
775.99	4.83	4.79	4.76	750.79	4.65	4.61	4.61	725.59	4.38	4.35	4.45	700.39	-4.32	-4.29	4.30
830.20	5.08	5.04	5.09	805.00	5.00	4.96	4.94	779.80	5.04	5.00	4.78	754.60	-4.76	-4.72	4.63
875.95	5.32	5.28	5.37	850.75	5.21	5.17	5.22	825.55	5.19	5.15	5.06	800.35	-5.11	-5.07	4.91
928.46	5.71	5.67	5.70	903.26	5.65	5.60	5.54	878.06	5.52	5.47	5.39	852.86	-5.47	-5.42	5.23
975.90	5.97	5.92	5.99	950.70	5.91	5.87	5.83	925.50	5.86	5.82	5.68	900.30	-5.75	-5.70	5.52

0.10L				0.40L				0.70L				CL			
Shear	γ_{xy}	τ_{xy}	$\tau_{xy,cal}$	Shear	γ_{xy}	τ_{xy}	$\tau_{xy,cal}$	Shear	γ_{xy}	τ_{xy}	$\tau_{xy,cal}$	Shear	γ_{xy}	τ_{xy}	$\tau_{xy,cal}$
113.60	0.00	0.00	0.70	88.40	0.00	0.00	0.54	63.20	0.00	0.00	0.39	38.00	0.00	0.00	0.23
215.25	1.25	1.24	1.32	190.05	1.23	1.23	1.17	164.85	1.21	1.20	1.01	139.65	-0.64	-0.64	0.86
276.23	1.77	1.76	1.69	251.03	1.63	1.62	1.54	225.83	1.44	1.43	1.39	200.63	-1.14	-1.13	1.23
325.36	2.05	2.04	2.00	300.16	1.82	1.81	1.84	274.96	1.72	1.71	1.69	249.76	-1.47	-1.46	1.53
377.88	2.43	2.41	2.32	352.68	2.21	2.19	2.16	327.48	2.12	2.10	2.01	302.28	-1.84	-1.82	1.85
428.70	2.70	2.68	2.63	403.50	2.52	2.50	2.48	378.30	2.46	2.44	2.32	353.10	-2.17	-2.15	2.17
482.91	3.01	2.98	2.96	457.71	2.82	2.80	2.81	432.51	2.69	2.67	2.65	407.31	-2.57	-2.54	2.50
532.04	3.28	3.25	3.26	506.84	3.00	2.98	3.11	481.64	2.99	2.96	2.95	456.44	-2.88	-2.86	2.80
577.78	3.64	3.61	3.54	552.58	3.41	3.38	3.39	527.38	3.25	3.23	3.24	502.18	-3.20	-3.18	3.08
635.38	3.94	3.91	3.90	610.18	3.84	3.81	3.74	584.98	3.66	3.63	3.59	559.78	-3.60	-3.57	3.43
679.43	4.43	4.39	4.17	654.23	4.04	4.01	4.01	629.03	3.94	3.91	3.86	603.83	-3.89	-3.86	3.70
725.17	4.57	4.54	4.45	699.97	4.41	4.37	4.29	674.77	4.03	4.00	4.14	649.57	-3.81	-3.78	3.99
779.38	4.80	4.77	4.78	754.18	4.52	4.49	4.63	728.98	4.48	4.45	4.47	703.78	-4.20	-4.17	4.32
835.29	5.12	5.08	5.12	810.09	5.12	5.08	4.97	784.89	4.78	4.74	4.82	759.69	-4.58	-4.54	4.66
874.25	5.43	5.39	5.36	849.05	5.30	5.26	5.21	823.85	5.22	5.18	5.05	798.65	-4.81	-4.77	4.90
928.46	5.76	5.71	5.70	903.26	5.74	5.70	5.54	878.06	5.47	5.42	5.39	852.86	-5.20	-5.15	5.23

0.10L				0.40L				0.70L				CL			
Shear	γ_{xy}	τ_{xy}	$\tau_{xy,cal}$	Shear	γ_{xy}	τ_{xy}	$\tau_{xy,cal}$	Shear	γ_{xy}	τ_{xy}	$\tau_{xy,cal}$	Shear	γ_{xy}	τ_{xy}	$\tau_{xy,cal}$
113.60	0.00	0.00	0.70	88.40	0.00	0.00	0.54	63.20	0.00	0.00	0.39	38.00	0.00	0.00	0.23
215.25	1.30	1.29	1.32	190.05	1.18	1.17	1.17	164.85	0.94	0.94	1.01	139.65	-0.65	-0.64	0.86
283.01	1.75	1.73	1.74	257.81	1.70	1.68	1.58	232.61	1.52	1.51	1.43	207.41	-1.17	-1.16	1.27
325.36	2.00	1.99	2.00	300.16	1.80	1.79	1.84	274.96	1.77	1.75	1.69	249.76	-1.53	-1.51	1.53
376.19	2.37	2.35	2.31	350.99	2.24	2.22	2.15	325.79	2.07	2.06	2.00	300.59	-1.88	-1.87	1.84
430.40	2.73	2.71	2.64	405.20	2.45	2.43	2.49	380.00	2.28	2.26	2.33	354.80	-2.22	-2.20	2.18
476.14	3.07	3.05	2.92	450.94	2.91	2.89	2.77	425.74	2.77	2.75	2.61	400.54	-2.51	-2.49	2.46
525.27	3.23	3.20	3.22	500.07	2.95	2.93	3.07	474.87	2.82	2.80	2.91	449.67	-2.76	-2.74	2.76
582.87	3.54	3.51	3.58	557.67	3.47	3.45	3.42	532.47	3.19	3.17	3.27	507.27	-3.13	-3.10	3.11
626.91	3.93	3.90	3.85	601.71	3.78	3.75	3.69	576.51	3.72	3.69	3.54	551.31	-3.46	-3.43	3.38
682.82	4.18	4.15	4.19	657.62	4.06	4.03	4.03	632.42	3.94	3.91	3.88	607.22	-3.70	-3.67	3.73
728.56	4.58	4.54	4.47	703.36	4.42	4.39	4.32	678.16	4.41	4.37	4.16	652.96	-3.82	-3.79	4.01
775.99	4.97	4.93	4.76	750.79	4.76	4.73	4.61	725.59	4.61	4.58	4.45	700.39	-4.11	-4.08	4.30
840.37	5.14	5.10	5.16	815.17	5.06	5.02	5.00	789.97	4.84	4.80	4.85	764.77	-4.52	-4.48	4.69
879.33	5.52	5.48	5.39	854.13	5.41	5.37	5.24	828.93	5.23	5.18	5.09	803.73	-4.76	-4.73	4.93
931.85	5.78	5.73	5.72	906.65	5.71	5.66	5.56	881.45	5.47	5.42	5.41	856.25	-5.06	-5.02	5.25

Table 3: Measured shear, shearing strain, and horizontal shear stress from the concrete composite specimens made of 6mm intentionally roughened concrete slabs and concrete toppings (Type 3, top: specimen 1, middle: specimen 2, bottom: specimen 3).

0.10L				0.40L				0.70L				CL			
Shear	γ_{xy}	τ_{xy}	$\tau_{xy,cal}$	Shear	γ_{xy}	τ_{xy}	$\tau_{xy,cal}$	Shear	γ_{xy}	τ_{xy}	$\tau_{xy,cal}$	Shear	γ_{xy}	τ_{xy}	$\tau_{xy,cal}$
113.60	0.00	0.00	0.70	88.40	0.00	0.00	0.54	63.20	0.00	0.00	0.39	38.00	0.00	0.00	0.23
234.37	1.64	1.63	1.44	209.17	1.44	1.43	1.28	183.97	1.29	1.28	1.13	158.77	-1.04	-1.04	0.97
276.23	1.98	1.96	1.69	251.03	1.90	1.88	1.54	225.83	1.56	1.55	1.39	200.63	-1.36	-1.35	1.23
327.06	2.20	2.18	2.01	301.86	2.01	1.99	1.85	276.66	1.80	1.79	1.70	251.46	-1.72	-1.71	1.54
379.57	2.47	2.45	2.33	354.37	2.28	2.26	2.17	329.17	2.26	2.25	2.02	303.97	-2.14	-2.12	1.86
425.31	2.83	2.81	2.61	400.11	2.64	2.62	2.45	374.91	2.55	2.53	2.30	349.71	-2.44	-2.43	2.15
479.53	3.14	3.11	2.94	454.33	3.00	2.98	2.79	429.13	2.87	2.84	2.63	403.93	-2.79	-2.77	2.48
535.43	3.51	3.49	3.28	510.23	3.47	3.45	3.13	485.03	3.16	3.14	2.98	459.83	-3.15	-3.12	2.82
571.01	3.75	3.72	3.50	545.81	3.49	3.46	3.35	520.61	3.31	3.29	3.19	495.41	-3.25	-3.22	3.04
625.22	4.08	4.04	3.84	600.02	3.96	3.93	3.68	574.82	3.79	3.76	3.53	549.62	-3.49	-3.47	3.37
677.74	4.34	4.31	4.16	652.54	4.31	4.27	4.00	627.34	4.07	4.04	3.85	602.14	-3.88	-3.85	3.69
731.95	4.68	4.64	4.49	706.75	4.54	4.50	4.34	681.55	4.39	4.36	4.18	656.35	-4.25	-4.22	4.03
775.99	4.86	4.82	4.76	750.79	4.83	4.79	4.61	725.59	4.75	4.71	4.45	700.39	-4.56	-4.53	4.30
826.82	5.25	5.21	5.07	801.62	5.19	5.15	4.92	776.42	5.06	5.02	4.76	751.22	-4.78	-4.74	4.61
881.03	5.57	5.52	5.41	855.83	5.45	5.40	5.25	830.63	5.33	5.29	5.10	805.43	-5.15	-5.11	4.94
921.69	5.98	5.94	5.65	896.49	5.78	5.74	5.50	871.29	5.62	5.58	5.35	846.09	-5.57	-5.53	5.19
975.90	6.12	6.08	5.99	950.70	6.02	5.97	5.83	925.50	5.81	5.76	5.68	900.30	-5.73	-5.69	5.52

0.10L				0.40L				0.70L				CL			
Shear	γ_{xy}	τ_{xy}	$\tau_{xy,cal}$	Shear	γ_{xy}	τ_{xy}	$\tau_{xy,cal}$	Shear	γ_{xy}	τ_{xy}	$\tau_{xy,cal}$	Shear	γ_{xy}	τ_{xy}	$\tau_{xy,cal}$
113.60	0.00	0.00	0.70	88.40	0.00	0.00	0.54	63.20	0.00	0.00	0.39	38.00	0.00	0.00	0.23
252.52	1.77	1.76	1.55	227.32	1.68	1.66	1.39	202.12	1.52	1.51	1.24	176.92	-1.17	-1.16	1.09
271.15	1.92	1.90	1.66	245.95	1.79	1.78	1.51	220.75	1.65	1.64	1.35	195.55	-1.32	-1.31	1.20
327.06	2.23	2.22	2.01	301.86	2.01	1.99	1.85	276.66	1.82	1.81	1.70	251.46	-1.78	-1.77	1.54
374.49	2.57	2.55	2.30	349.29	2.32	2.30	2.14	324.09	2.24	2.22	1.99	298.89	-2.05	-2.04	1.83
423.62	2.92	2.89	2.60	398.42	2.71	2.69	2.44	373.22	2.54	2.52	2.29	348.02	-2.35	-2.33	2.14
476.14	3.10	3.08	2.92	450.94	2.99	2.96	2.77	425.74	2.84	2.82	2.61	400.54	-2.66	-2.64	2.46
525.27	3.55	3.52	3.22	500.07	3.32	3.29	3.07	474.87	3.12	3.09	2.91	449.67	-2.98	-2.96	2.76
577.78	3.83	3.80	3.54	552.58	3.57	3.54	3.39	527.38	3.44	3.41	3.24	502.18	-3.30	-3.27	3.08
626.91	4.11	4.08	3.85	601.71	3.90	3.87	3.69	576.51	3.74	3.71	3.54	551.31	-3.56	-3.53	3.38
677.74	4.48	4.44	4.16	652.54	4.35	4.32	4.00	627.34	4.03	3.99	3.85	602.14	-3.89	-3.86	3.69
726.86	4.82	4.78	4.46	701.66	4.57	4.54	4.30	676.46	4.38	4.35	4.15	651.26	-4.23	-4.19	4.00
781.08	5.18	5.14	4.79	755.88	4.93	4.89	4.64	730.68	4.73	4.69	4.48	705.48	-4.55	-4.52	4.33
831.90	5.37	5.32	5.10	806.70	5.20	5.16	4.95	781.50	5.04	5.00	4.79	756.30	-4.82	-4.78	4.64
881.03	5.62	5.57	5.41	855.83	5.52	5.48	5.25	830.63	5.34	5.29	5.10	805.43	-5.15	-5.11	4.94
930.16	5.98	5.93	5.71	904.96	5.70	5.65	5.55	879.76	5.55	5.51	5.40	854.56	-5.48	-5.43	5.24
980.98	6.16	6.12	6.02	955.78	5.98	5.93	5.86	930.58	5.77	5.72	5.71	905.38	-5.67	-5.62	5.55

0.10L				0.40L				0.70L				CL			
Shear	γ_{xy}	τ_{xy}	$\tau_{xy,cal}$	Shear	γ_{xy}	τ_{xy}	$\tau_{xy,cal}$	Shear	γ_{xy}	τ_{xy}	$\tau_{xy,cal}$	Shear	γ_{xy}	τ_{xy}	$\tau_{xy,cal}$
113.60	0.00	0.00	0.70	88.40	0.00	0.00	0.54	63.20	0.00	0.00	0.39	38.00	0.00	0.00	0.23
238.96	1.63	1.62	1.47	213.76	1.60	1.59	1.31	188.56	1.39	1.38	1.16	163.36	-1.19	-1.18	1.00
271.15	1.90	1.88	1.66	245.95	1.80	1.78	1.51	220.75	1.59	1.58	1.35	195.55	-1.49	-1.47	1.20
333.83	2.29	2.27	2.05	308.63	2.03	2.02	1.89	283.43	1.92	1.90	1.74	258.23	-1.63	-1.62	1.58
379.57	2.51	2.49	2.33	354.37	2.33	2.32	2.17	329.17	2.24	2.22	2.02	303.97	-2.03	-2.01	1.86
427.01	2.82	2.80	2.62	401.81	2.66	2.64	2.47	376.61	2.49	2.47	2.31	351.41	-2.37	-2.35	2.16
477.83	3.13	3.11	2.93	452.63	2.93	2.91	2.78	427.43	2.77	2.75	2.62	402.23	-2.70	-2.68	2.47
526.96	3.45	3.43	3.23	501.76	3.28	3.25	3.08	476.56	3.07	3.05	2.92	451.36	-3.01	-2.98	2.77
576.09	3.76	3.73	3.53	550.89	3.53	3.51	3.38	525.69	3.29	3.26	3.23	500.49	-3.25	-3.23	3.07
628.61	4.17	4.14	3.86	603.41	3.85	3.82	3.70	578.21	3.76	3.73	3.55	553.01	-3.55	-3.52	3.39
676.04	4.51	4.47	4.15	650.84	4.22	4.19	3.99	625.64	3.96	3.93	3.84	600.44	-3.88	-3.85	3.68
730.25	4.81	4.77	4.48	705.05	4.53	4.49	4.33	679.85	4.33	4.30	4.17	654.65	-4.25	-4.22	4.02
775.99	4.93	4.89	4.76	750.79	4.89	4.85	4.61	725.59	4.67	4.63	4.45	700.39	-4.58	-4.54	4.30
828.51	5.37	5.33	5.08	803.31	5.21	5.17	4.93	778.11	5.05	5.01	4.77	752.91	-4.90	-4.86	4.62
877.64	5.67	5.62	5.38	852.44	5.44	5.40	5.23	827.24	5.35	5.31	5.08	802.04	-5.23	-5.19	4.92
925.07	5.79	5.74	5.68	899.87	5.67	5.62	5.52	874.67	5.47	5.42	5.37	849.47	-5.41	-5.36	5.21
977.59	6.22	6.17	6.00	952.39	6.00	5.96	5.84	927.19	5.78	5.74	5.69	901.99	-5.63	-5.59	5.53

4. CONCLUSION

The results of this study showed that the increase in roughness on the surface of the concrete slabs directly affects the horizontal shear strength. Under the same load, the 6mm intentionally roughened concrete slabs had the greatest horizontal shear strength, the heaviest load capacity, and the smallest deflection, followed by the 3mm intentionally roughened concrete slabs, and then the unintentionally roughened concrete slabs, respectively. All the failures of the composite slabs were due to the bending moment and the bending moments, causing the failures to occur near the middle of the specimens and no slips separating the concrete slabs and the concrete toppings were detected. The results highlight the key role of roughened surfaces of the concrete slabs and suggest that 6mm indentations should be used in order to achieve the maximum horizontal shear strength of the concrete slab-topping composites.

5. ACKNOWLEDGEMENT

We would like to thank Italian-Thai Development PLC and Prosperity Concrete Ltd for their kind support to this study.

6. REFERENCES

[1] L. W. Tao, “The drawbacks of housing overcrowding characteristic to rural migrants’ life in Beijing”, *HBRC J.*, **2015**, vol. 13, pp. 315–320.

[2] A. Karantonis, “Population growth and housing affordability in the modern city-Sydney a case study”, 14th Pacific Rim Real Estate Society, **2008**, pp. 1–16.

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[3] B. Doris, "Overpopulation and the Impact on the Environment", *Masters Thesis*, **2017**, City University of New York, USA.

[4] A. A. Yee and H. D., "Structural and Economic Benefits of Precast/Prestressed Concrete Construction", *PCI J.*, **2014**, vol. 46, no. 4, pp. 34–42.

[5] J. Wairaven, J. Frenay, and A. Pruijssers, "Influence of Concrete Strength and Load History on the Shear Friction Capacity of Concrete Members", *PCI J.*, **1987**, vol. 32, no. 1, pp. 66–84.

[6] American Association of State Highway and Transportation Officials, "AASHTO LRFD Bridge Design Specifications", 3rd ed., American Association of State Highway and Transportation Officials, Washington D.C., **2004**.

[7] G. W. Saemann, J. C., and Washa, "Horizontal Shear Connections between Precast Beams and Cast-in-Place Slabs", *ACI J.*, **1964**, vol. 61, no. 11, pp. 1383–1408.

[8] P. W. Birkeland and H. W. Birkeland, "Connections in Precast Concrete Construction", *ACI J. Proc.*, **1966**, vol. 63, no. 3, pp. 345–368.

[9] ACI Committee 318, "318-14 Building code requirements for structural concrete and commentary", vol. 11, ACI Standard and Report, **2014**.

[10] T. T. C. Hsu, S. T. Mau, and B. Chen, "Theory on Shear Transfer Strength of Reinforced Concrete", *ACI Struct. J.*, **1987**, vol. 84, no. 2, pp. 149–160.

[11] M. Gohnert, "Horizontal shear transfer across a roughened surface," *Cem. Concr. Compos.*, **2003**, vol. 25, no. 3, pp. 379–385.

[12] T. E. Banta, "Horizontal Shear Transfer Between Ultra High Performance Concrete And Lightweight Concrete", *Masters Thesis*, **2005**, Virginia Tech, USA.

[13] R. Day, "Brushed and tamped surface finishes", Concrete Society, Camberley, **2018**.

[14] American Society for Testing and Materials., "ASTM standards in building codes : specifications, test methods, practices, classifications, terminology". ASTM, **1998**.

[15] S. Vivithkeyoonvong, "Mechanics of Materials", 3rd ed, Kasetsart University Press, Bangkok, **1999**.

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A NOVEL SECURE WIRELESS HEALTHCARE APPLICATIONS FOR MEDICAL COMMUNITY

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ARTICLEINFO

Article history:
Received 07 January 2019
Received in revised form 05 March 2019
Accepted 08 March 2019
Available online 08 March 2019

Keywords:
Community Cloud for Healthcare (CCH); Community Cloud of Certifying Authority (CCCA); Wireless Medical Sensor Networks (WMSN); Scyther tool; BAN logic.

ABSTRACT

The exponential advancements in the realm of wearable biosensor and wireless communication technologies has paved the way to a new technology called Wireless Medical Sensor Networks (WMSNs) which is revolutionizing mobile healthcare. This work is motivated from ABI research report that all the healthcare infrastructures are prone to attacks which includes Cloud, IOT Wearable Devices, Mobile Network Operator (MNO) and Secure Element (SE) of the patient. There are many challenges in implementation including adversaries exploiting vulnerabilities in Information and Communication Technologies (ICT) thereby compromising patient's vital information. This article proposes a Secure and Anonymous Health (SAH) Monitoring System using Wireless Medical Sensor Networks (WMSN). SAH overcomes all the flaws in the existing literature by adopting Community Cloud for Healthcare (CCH) and Community Cloud of Certifying Authority (CCCA). SAH framework ensures all the security properties and withstands all the known attacks. SAH protocol is verified with scyther tool and BAN logic so we claim that SAH framework ensures all the security properties such as confidentiality, integrity, non-repudiation, and authentication are ensured and withstands all the known attacks which includes multi-protocol attacks.

1. INTRODUCTION

The exponential advancements in the realm of wearable biosensor and wireless communication technologies has paved the way to a new technology called Wireless Medical Sensor Networks (WMSNs) which is revolutionizing mobile healthcare. Using WMSN patients 'health-related parameters can be monitored remotely in the real time and transferred to hospital thereby increasing the efficiency of health services. Adopting Mobile cloud computing (MCC) in the healthcare will enhance the services. But there are many challenges in implementation of these services which includes adversaries exploiting vulnerabilities in Information and Communication Technologies (ICT) thereby

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compromising patient's vital information. So to overcome these challenges we propose a Secure and Anonymous Health (SAH) Monitoring System using Wireless Medical Sensor Networks (WMSN). SAH overcomes all the flaws in the existing literature by adopting Community Cloud for Healthcare (CCH) and Community Cloud of Certifying Authority (CCCA). SAH framework ensures all the security properties and withstands all the known attacks. This article is organized in sections, section 2 is about Methods in the SAH system, section 3 provides results using scythe tool and BAN logic, section 4 provides discussion. We have observed very few publications/works in the literature of mobile health-care over Wireless Medical Sensor Networks (WMSN) proposing secure framework in mobile healthcare systems, but there are many publications/works in the literature such as which only focuses on authentication only but never ensures security framework. This paper ensures security in the realm of mobile healthcare so we consider only (Ruhul Amina & Hafizul Islam, 2018; Khan & Kumari, 2014) as related work for our proposed framework.

Following are the limitations in the proposed model:

a) Proposed scheme does not ensure Non-repudiation property.
b) There is no clarity how data is secured in the cloud
c) There is no clarity how privacy is ensured in the scheme
d) There is no clarity how HIPAA standard is implemented
e) Prone to multi-protocol attacks
f) Formal verification is not done

Following are the limitations in the security model proposed:

a) Proposed scheme doesn't ensure Non-repudiation property
b) There is no clarity how data is secured in the cloud
c) There is no clarity how privacy is ensured in the scheme
d) There is no clarity how HIPAA standard is implemented
e) Prone to multi-protocol attacks

The paper have the following objectives:

a) We have proposed a secure and anonymous health monitoring system architecture used for WMSN as shown in the figure 1 ensuring end to end security and consumes fewer resources.
b) We have proposed protocols for personalizing the sensor node, health monitoring mobile application (in UICC) and healthcare application in the Community Cloud for Healthcare (CCH), which ensures all the security properties including patient anonymity for Doctors.
c) We have used Scyther tool in order verify our proposed protocol and found to be safe and is free from any type of attacks (which include active and passive attacks).
d) Our proposed protocol overcomes all the known attacks in addition to Multi-Protocol attacks as our proposed protocol is successfully verified using BAN logic and Scyther (Kumar et al, 2013).

2. METHODS

2.1 Stakeholders in the SAH System

Following are the stakeholders

a) **IOT Wearable Device (WD):** This device contains a Secure Element (SE) and a healthcare application in the SE, which is personalized by the Patient (P).

b) **UICC (UC):** UICC is the secure element in the mobile phone of patient.

c) **Mobile Network Operator (MNO):** This entity provides network connectivity OTA (Over The Air).

d) **Doctor: D is** assumed with mobile phone having a Secure Element (SE) in our proposed system.

e) **Patient: P is** assumed with mobile phone having a Secure Element (SE) in our proposed system.

f) **Community Cloud for Healthcare (CCH):** CCH is a Community Cloud of all the hospitals in the country under the supervision of Regulatory Authority such as CHA (Central Healthcare Authority). CCH allocates one HSM (Hardware Security Module) for each hospital in order to keep their data. Following are the components of CCH (Li et al, 2015).

2.2 Authentication Manager (AM)

This entity authenticates all the stakeholders I the ecosystem by their credentials issued by CA/TSM.

a. **Communication Manager (CM):** CM ensures end to end reliable communication security using SSL/TLS.
b. **Time Stamping Authority (TSA):** TSA performs Time stamping and nonce services in CCA.
c. **Personalization Manager (PM)**: PM personalizes mobile healthcare applications of patients and doctors. PM manages the credentials of all the stakeholders including public keys and symmetric keys.
d. **Auditor:** Auditor acts as an adjudicator, it keeps a copy of the evidence. Auditor presents these evidences in the court.
e. **Community Cloud of Certifying Authority (CCCA):** CCCA is the community cloud of the CA (Certifying Authority), it supports both Wireless PKI and PKI. CCCA has the Registration Authority (RA), Time Stamping Authority and Directory. CCCA supports OCSP service and generates and manages Certificates (Wu et al, 2015).

3. RESULTS AND DISCUSSION

3.1 Registration Phase

a) **Step 1:** Hospital (H) is the Registration Authority (RA) and verifies the credentials. Credentials include Secure Elements and National Identities. After successful verification it recommends CA to issue Anonymous certificates for patients and doctors. Patients and doctors generate their credentials using the

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procedure given in (Shaik Shakeel Ahamad et al, 2014). These certificates are mapped with the Secure Element certificate and National Identity.

b) **Step 2:** Traceable Anonymous Certificate (TAC's) are issued to Patient (P) as per the RFC 5636 (Cremers, 2006: Xu & Wu, 2015).

c) **Step 3:** Mobile Healthcare Application is downloaded and installed on the SE by both Doctor (D) and Patient (P).

3.2 Personalization Phase

IoT wearable device has a Secure Element (SE) and a healthcare application. IoT wearable device is issued by the hospital with unique identity of the device. CA issues a certificate for both Secure Element (SE) and healthcare application in IoT wearable device. IoT wearable device will only communicate with the healthcare application in the UICC of patient's mobile phone using Bluetooth low energy. Healthcare application in the UICC and Healthcare application in IoT wearable device share the same secret Key where W= IoT wearable device and P= Patient. Healthcare application in IoT wearable device is personalized by the Healthcare application in the UICC. Healthcare application in IoT wearable device will only communicate with the Healthcare application in the UICC. Body Sensor Networks (BSN) collects patient's data and sends to the UICC of the patient in an encrypted form with an interval of 5 to 10 min using Bluetooth low energy. Symmetric key shared between Healthcare application in the UICC and IoT wearable device is used to encrypt messages. The patient's data is sent by the BSN in encrypted form by encrypting the data with the shared symmetric between IoT wearable sensor and the healthcare application in the UICC. Following are the steps involved in the Personalization of Mobile healthcare application by CCH. Figure 2 depicts these steps

Step 1: Patient downloads healthcare application from CCH

Step 2: CCH personalizes patient's healthcare application installed in the UICC

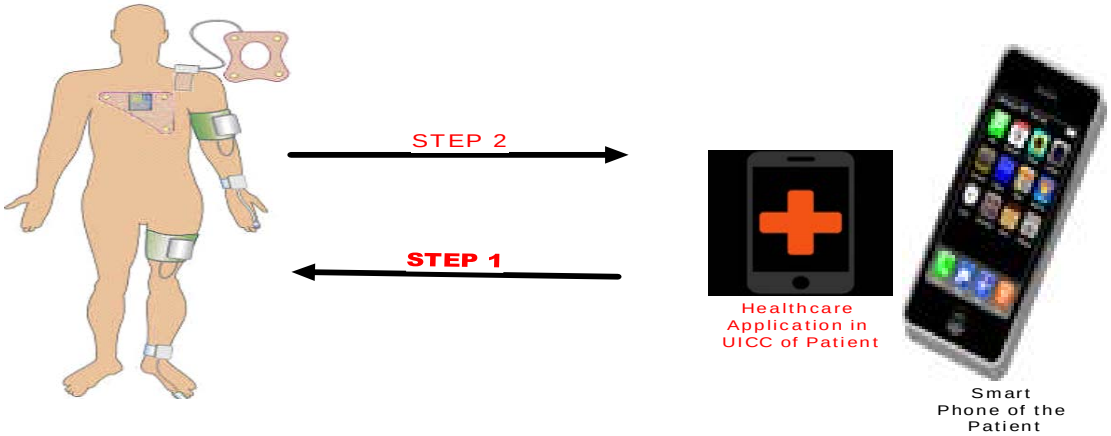

Figure 1: Personalization of Healthcare Application in IOT Wearable Device by the Patient.

3.3 PERSONALIZATION PHASE

IoT wearable device has a Secure Element (SE) and a healthcare application. IoT wearable device is issued by the hospital with unique identity of the device. CA issues a certificate for both Secure Element (SE) and healthcare application in IoT wearable device. IoT wearable device will only communicate with the healthcare application in the UICC of

patient's mobile phone using Bluetooth low energy. Healthcare application in the UICC and Healthcare application in IoT wearable device share the same secret Key $\mathbf{SYYKEY_{WP}}$ where W= IoT wearable device and P= Patient. Healthcare application in IoT wearable device is personalized by the Healthcare application in the UICC. Healthcare application in IoT wearable device will only communicate with the Healthcare application in the UICC. Body Sensor Networks (BSN) collects patient's data and sends to the UICC of the patient in an encrypted form with an interval of 5 to 10 min using Bluetooth low energy. Symmetric key shared between Healthcare application in the UICC and IoT wearable device is used to encrypt messages. The patient's data is sent by the BSN in encrypted form by encrypting the data with the shared symmetric between IoT wearable sensor and the healthcare application in the UICC. Following are the steps involved in the Personalization of Mobile healthcare application by CCH. Figure 2 depicts these steps.

Step 1: Patient downloads healthcare application from CCH

Step 2: CCH personalizes patient's healthcare application installed in the UICC

Step 2a.

$$\boldsymbol{Step\ 1: UC \rightarrow CCH: \{MS1, SIG\{MS1\}_{PrKEY_{UC}}\},\ Cert_{uc}}$$

$$\boldsymbol{MS1: \{PID, Phno, NRP, T_{uc}, N_{uc}\}}$$

/* In order to personalize mobile healthcare application in UICC mutual authentication between UICC and CCH should be ensured.*/

Step 2b.

$$Step2: \text{MCS} \rightarrow P: \{MS2, SIG_P^{MCS}(MS2)\}_{k_p}, cert_{MCS}$$

$$MS2 = \{\text{PID}, phno, K_{mp}, N_{mcs}, T_{mcs}, N_p\}$$

$$\boldsymbol{Step\ 2: CCH \rightarrow UC: \{MS2, SIG\{MS2\}_{PrKEY_{cch}}\}}$$

$$\boldsymbol{MS2: \{PID, Phno, SYYKEY_{uccch}, T_{uc}, N_{uc}, T_{cch}, N_{cch}\}}$$

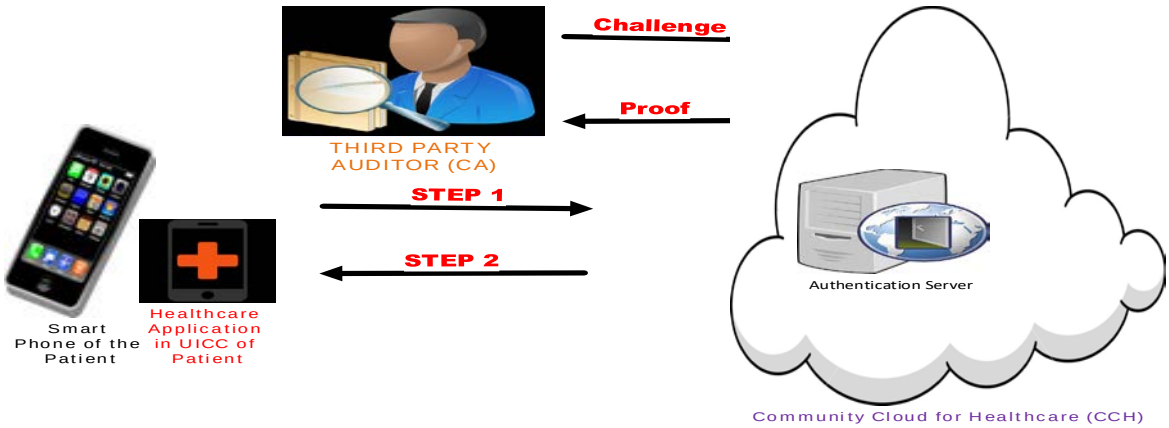

Figure 2: Personalization of Healthcare Application in the UICC by CCH

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Following is the proposed Secure and Anonymous Healthcare (SAH) Protocol. Figure 3 depicts these steps

$$\boldsymbol{Step\ 1}: \boldsymbol{WD} \rightarrow \boldsymbol{UC}: \{\boldsymbol{MS1}\}$$
$$\boldsymbol{MS1}: \{\boldsymbol{PLoc}, \boldsymbol{sensorreading}. \boldsymbol{T_{wd}}, \boldsymbol{N_{wd}}\}$$

$$\boldsymbol{Step\ 2}: \boldsymbol{UC} \rightarrow \boldsymbol{WD}: \{\boldsymbol{MS2}\}$$
$$\boldsymbol{MS2}: \{\boldsymbol{Ack}. \boldsymbol{PLoc}, \boldsymbol{sensorreading}. \boldsymbol{T_{uc}}, \boldsymbol{N_{uc}}, \boldsymbol{T_{wd}}, \boldsymbol{N_{wd}}\}$$

$$\boldsymbol{Step\ 3}: \boldsymbol{UC} \rightarrow \boldsymbol{CCH}: \{\boldsymbol{MS3}\}_{\boldsymbol{SYYKEY_{HP}}}$$
$$\boldsymbol{MS2}: \{\boldsymbol{PLoc}, \boldsymbol{PID}, \boldsymbol{sensorreading}, \boldsymbol{T_{uc}}, \boldsymbol{N_{uc}}, \boldsymbol{T_{wd}}, \boldsymbol{N_{wd}}\}$$

$$\boldsymbol{Step\ 4}: \boldsymbol{CCH} \rightarrow \boldsymbol{D}: \{\boldsymbol{MS4}\}_{\boldsymbol{SYYKEY_{HD}}}$$
$$\boldsymbol{MS3}: \{\boldsymbol{PLoc}, \boldsymbol{PID}, \boldsymbol{sensorreading}, \boldsymbol{T_{cch}}, \boldsymbol{N_{cch}}, \boldsymbol{T_{uc}}, \boldsymbol{N_{uc}}, \boldsymbol{T_{wd}}, \boldsymbol{N_{wd}}\}$$

$$\boldsymbol{Step\ 5}: \boldsymbol{CCH} \rightarrow \boldsymbol{CHA}: \{\boldsymbol{MS5}\}_{\boldsymbol{SYYKEY_{HCHA}}}$$
$$\boldsymbol{MS4}: \{\boldsymbol{PID}, \boldsymbol{PLoc}, \boldsymbol{sensorreading}, \boldsymbol{T_{cch}}, \boldsymbol{N_{cch}}, \boldsymbol{T_{uc}}, \boldsymbol{N_{uc}}, \boldsymbol{T_{wd}}, \boldsymbol{N_{wd}}\}$$

$$\boldsymbol{Step\ 1}: \boldsymbol{WD} \rightarrow \boldsymbol{UICC}: \{\boldsymbol{MS1}\}$$
$$\boldsymbol{MS1}: \{\boldsymbol{PLoc}, \boldsymbol{sensorreading}. \boldsymbol{T_S}, \boldsymbol{N_S}\}$$

Step 1: IOT Wearable Device (WD) sends the sensor readings of patient to UICC along with the location of patient.

$$\boldsymbol{Step\ 2}: \boldsymbol{UICC} \rightarrow \boldsymbol{CCH}: \{\boldsymbol{MS2}\}_{\boldsymbol{SYYKEY_{HP}}}$$
$$\boldsymbol{MS2}: \{\boldsymbol{PLoc}, \boldsymbol{PID}, \boldsymbol{sensorreading}, \boldsymbol{T_P}, \boldsymbol{N_P}\}$$

Step 2: UICC sends MS2 to CCH by encrypting with the symmetric shared between UICC and CCH.

$$\boldsymbol{Step\ 3}: \boldsymbol{CCH} \rightarrow \boldsymbol{D}: \{\boldsymbol{MS3}\}_{\boldsymbol{SYYKEY_{HD}}}$$
$$\boldsymbol{MS3}: \{\boldsymbol{PLoc}, \boldsymbol{PID}, \boldsymbol{sensorreading}, \boldsymbol{T_P}, \boldsymbol{N_P}, \boldsymbol{T_H}, \boldsymbol{N_H}\}$$

Step 3: CCH sends MS3 to D by encrypting with the symmetric shared between Doctor and CCH. CCH sends the shared key to the Doctor allocated in case of an emergency. Message also contains Timestamp, Nonce and PID (Patient Identity).

$$\boldsymbol{Step\ 4}: \boldsymbol{CCH} \rightarrow \boldsymbol{CHA}: \{\boldsymbol{MS4}\}_{\boldsymbol{SYYKEY_{HCHA}}}$$
$$\boldsymbol{MS4}: \{\boldsymbol{PID}, \boldsymbol{PLoc}, \boldsymbol{sensorreading}, \boldsymbol{T_P}, \boldsymbol{N_P}, \boldsymbol{T_H}, \boldsymbol{N_H}\}\}$$

Step 4: CCH sends MS4 to CHA by encrypting with the symmetric shared between CCH and CHA.

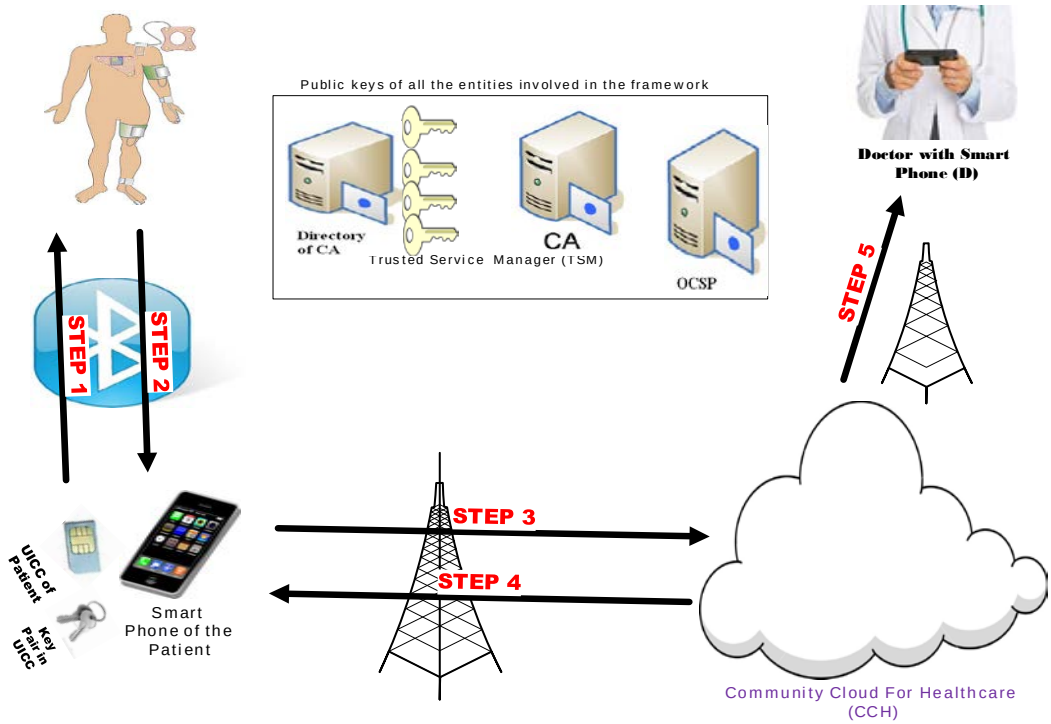

Figure 3: Steps involved in SAH Protocol.

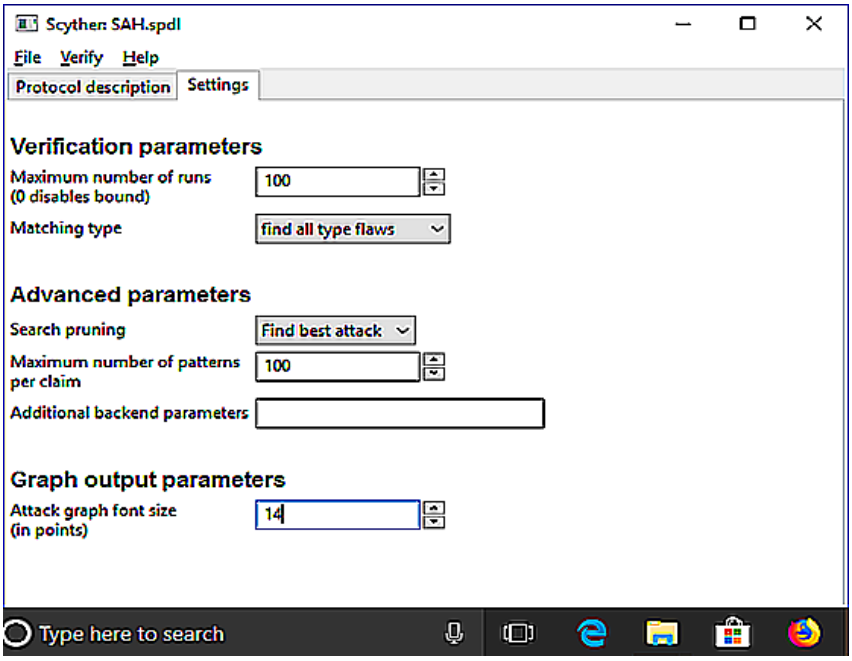

Figure 4: Parameters of SAH Protocol using Scyther Tool

SAH uses Scyther tool for verifying the proposed protocol. Scyther provides reliable simulation environment. SPDL (Security Protocol Description Language) is used to write code in Scyther tool. Following are the motivations in selecting Scyther tool compared to AVISPA tool (Armando, et al, 2005: Muhammad et al, 2006).

a) This tool assumes that each and every protocol runs with other protocols in the same network.

b) It uses SPDL language

c) Good in verifying Multi-Protocol attacks

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d) When attacks are found in the protocol attack graphs are generated

e) Verification of protocols in scyther tool is done by bounded/unbounded number of sessions.

f) Unbounded or bounded number of sessions are supported in scyther tool

Table 1: Differences between AVISPA and Scyther tool

AVISPA Tool	Scyther Tool
Assumes that every protocol runs in isolation.	Assumes all the protocols runs with other protocols in the same network.
HLPSL language is used	SPDL language is used
Multi-Protocol attacks are not verified	Multi-Protocol attacks are verified
Attack graphs are not generated	When attacks are found attack graphs are created by scyther tool
Verification of protocols are done using only bounded number of sessions.	Verification of protocols are done by bounded/unbounded number of sessions.

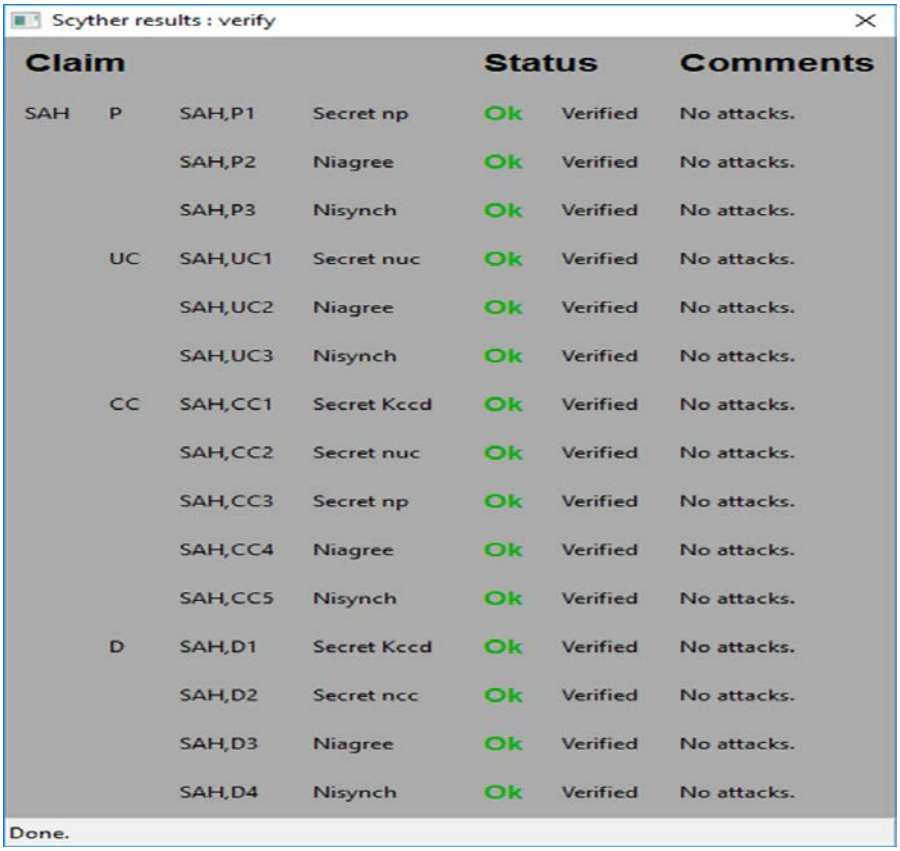

Figure 5: Result of SAH Protocol using "Verification Claim" Procedure of Scyther Tool.

3.4 BAN Logic Proof and Security Analysis

Protocols designed perfectly in the past were found to be error prone (Abadi et al, 1993). Authentication and correctness of the SAH protocol is verified using BAN logic (Burrows et al, 1990).

$$\boldsymbol{Step\ 1}: \boldsymbol{WD} \rightarrow \boldsymbol{UC}: \{\boldsymbol{MS1}\}$$
$$\boldsymbol{MS1}: \{\boldsymbol{PLoc}, \boldsymbol{sensorreading}. \boldsymbol{T_{wd}}, \boldsymbol{N_{wd}}\}$$

$$\boldsymbol{Step\ 2}: \boldsymbol{UC} \rightarrow \boldsymbol{WD}: \{\boldsymbol{MS2}\}$$
$$\boldsymbol{MS2}: \{\boldsymbol{Ack}. \boldsymbol{PLoc}, \boldsymbol{sensorreading}. \boldsymbol{T_{uc}}, \boldsymbol{N_{uc}}, \boldsymbol{T_{wd}}, \boldsymbol{N_{wd}}\}$$

$$\boldsymbol{Step\ 3}: \boldsymbol{UC} \rightarrow \boldsymbol{CCH}: \{\boldsymbol{MS3}\}_{\boldsymbol{SYYKEY_{HP}}}$$
$$\boldsymbol{MS2}: \{\boldsymbol{PLoc}, \boldsymbol{PID}, \boldsymbol{sensorreading}, \boldsymbol{T_{uc}}, \boldsymbol{N_{uc}}, \boldsymbol{T_{wd}}, \boldsymbol{N_{wd}}\}$$

SAH	P	SAH,P4	Secret Kucp	Ok	Verified	No attacks.
		SAH,P5	Secret np	Ok	Verified	No attacks.
		SAH,P6	Alive	Ok	Verified	No attacks.
		SAH,P7	Weakagree	Ok	Verified	No attacks.
		SAH,P8	Niagree	Ok	Verified	No attacks.
		SAH,P9	Nisynch	Ok	Verified	No attacks.
	UC	SAH,UC4	Secret Kuccc	Ok	Verified	No attacks.
		SAH,UC5	Secret Kucp	Ok	Verified	No attacks.
		SAH,UC6	Secret nuc	Ok	Verified	No attacks.
		SAH,UC7	Secret np	Ok	Verified	No attacks.
		SAH,UC8	Alive	Ok	Verified	No attacks.
		SAH,UC9	Weakagree	Ok	Verified	No attacks.
		SAH,UC10	Niagree	Ok	Verified	No attacks.
		SAH,UC11	Nisynch	Ok	Verified	No attacks.
	CC	SAH,CC6	Secret Kccd	Ok	Verified	No attacks.
		SAH,CC7	Secret Kuccc	Ok	Verified	No attacks.
		SAH,CC8	Secret ncc	Ok	Verified	No attacks.
		SAH,CC9	Secret nuc	Ok	Verified	No attacks.

one.

Figure 6: Result of SAH Protocol using "Automatic Claim" Procedure of Scyther Tool

$$\textbf{Step 4}: CCH \rightarrow D: \{MS4\}_{SYYKEY_{HD}}$$

$$MS3: \{PLoc, PID, sensorreading, T_{cch}, N_{cch}, T_{uc}, N_{uc}, T_{wd}, N_{wd}\}$$

$$\textbf{Step 5}: CCH \rightarrow CHA: \{MS5\}_{SYYKEY_{HCHA}}$$

$$MS4: \{PID, PLoc, sensorreading, T_{cch}, N_{cch}, T_{uc}, N_{uc}, T_{wd}, N_{wd}\}$$

3.5 ASSUMPTIONS

3.5.1 SECRETS AND KEYS

CA contains all the certificates (valid) of all the participants (**AS1, AS2)**.

AS1. All the participants knows their own certificates

AS2. $S \in \{WD, \text{UC}, \text{CCH}, \text{D and CA}\}$ S **believes** $\overset{K_{ca}}{\mapsto} CA)$. CA's certificate is with all the participants.

3.5.2 FRESHNESS

AS3 signifies freshness and AS4 signifies validity period of X.509 certificates

AS3. WD believes freshness(N_{wd}) **, CCH believes freshness** (N_{cch})**, UC believes freshness** (N_{uc})**.**

AS4. TS_x& TS_y signifies time stamps

3.5.3 TRUST

AS5. CA is trusted by all the participants.

AS6. IoT Sensor transmits encrypted data and is trusted by CA.

AS7. Certification Authority (CA) believes that W/UICC relays Patient's beliefs.

3.5.4 VERIFICATION OF SAH

$\boldsymbol{Step\ 1}: \boldsymbol{WD \rightarrow UC}: \{\boldsymbol{MS1}\}$

$\boldsymbol{MS1}: \{\boldsymbol{PLoc, sensorreading}. \boldsymbol{T_{wd}}, \boldsymbol{N_{wd}}\}$

UC decrypts the received $\{\boldsymbol{MS1}\}_{\boldsymbol{SYYKEY_{PUC}}}$

UC believes $\{\boldsymbol{MS1}\}_{\boldsymbol{SYYKEY_{PUC}}}$ statement (1)

UC checks P's certificate (**AS7**)

After successful verification

UC **believes fresh** N_p from **AS4** statement (2)

UC **believes P said** $\{\boldsymbol{MS1}\}_{\boldsymbol{SYYKEY_{PUC}}}$ statement (3)

UC **believes fresh** T_P from **AS3** statement (4)

UC believes $\{\boldsymbol{MS1}\}_{\boldsymbol{SYYKEY_{PUC}}}$

$\boldsymbol{Step\ 2}: \boldsymbol{UC \rightarrow WD}: \{\boldsymbol{MS2}\}$

$\boldsymbol{MS2}: \{\boldsymbol{Ack. PLoc, sensorreading}. \boldsymbol{T_{uc}}, \boldsymbol{N_{uc}}, \boldsymbol{T_{wd}}, \boldsymbol{N_{wd}}\}$

UC receives the MS1 message from WD and sends MS2 message with an acknowledgement to WD. statement (5)

$\boldsymbol{Step\ 3}: \boldsymbol{UC \rightarrow CCH}: \{\boldsymbol{MS3}\}_{\boldsymbol{SYYKEY_{UCCCH}}}$

$\boldsymbol{MS2}: \{\boldsymbol{PLoc, PID, sensorreading}, \boldsymbol{T_{uc}}, \boldsymbol{N_{uc}}, \boldsymbol{T_{wd}}, \boldsymbol{N_{wd}}\}$

UC sends MS3 message encrypted with the symmetric key shared between UC and CCH. statement (6)

$\boldsymbol{Step\ 4}: \boldsymbol{CCH \rightarrow D}: \{\boldsymbol{MS4}\}_{\boldsymbol{SYYKEY_{HD}}}$

$\boldsymbol{MS3}: \{\boldsymbol{PLoc, PID, sensorreading}, \boldsymbol{T_{cch}}, \boldsymbol{N_{cch}}, \boldsymbol{T_{uc}}, \boldsymbol{N_{uc}}, \boldsymbol{T_{wd}}, \boldsymbol{N_{wd}}\}$

CCH decrypts the received message MS3

CCH **believes** $\{\boldsymbol{MS3}\}_{\boldsymbol{SYYKEY_{UCCCH}}}$ statement (7)

CCH checks UC's certificate (**AS7**)

After successful verification

CCH **believes UC said** $\{\boldsymbol{MS3}\}_{\boldsymbol{SYYKEY_{UCCCH}}}$ statement (8)

CCH believes **fresh** $\boldsymbol{T_{uc}, N_{uc}}$ from **AS4 & AS3** statement (9)

CCH believes $\{\boldsymbol{MS3}\}_{\boldsymbol{SYYKEY_{UCCCH}}}$

Doctor (D) verifies the received message as follows

D decrypts the received message MS4 from CCH

D **believes** $\{MS4\}_{SYYKEY_{HD}}$ statement (10)

D checks D's certificate (**AS7**)

D trusts $MS4$

$Step\ 5: CCH \rightarrow CHA: \{MS5\}_{SYYKEY_{HCHA}}$

$MS5: \{PID, PLoc, sensorreading, T_{cch}, N_{cch}, T_{uc}, N_{uc}, T_{wd}, N_{wd}\}$

CHA decrypts the received message MS5 from CCH

CHA **believes** $\{MS5\}_{SYYKEY_{HCHA}}$

CHA checks CCH's certificate (**AS7**)

CHA believes $\{MS5\}_{SYYKEY_{HCHA}}$

3.6 ASSUMPTIONS

Following are the assumptions

Assumption 1: In our proposed system IOT Wearable Device (WD) is issued by the manufacturer to the Hospital. Hospital gets certificate from CA for the Secure Element (SE) embedded in the WD. Before issuing WD to the patient hospital maps WD's certificate with the certificate of the patient.

Assumption 2: In our proposed SAH system all the participants trust CA. TAC ensures anonymity for the Patient.

Assumption 3: TAC ensures anonymity for the Patient.

Assumption 4: Patient generates his own credentials in the secure area of secure element. ECDSA algorithm is used to digitally sign the messages

Assumption 5: Patient's and doctor's Application is personalized by the Community Cloud for Healthcare (CCH).

3.7 PROOFS OF SAH

Proposition 1: *Healthcare Application (HA) in UICC is personalized by the CCH*

Proof: Procedure is used by CCH Server to personalize Healthcare Application in the UICC

Proposition 2: *Messages exchanged among the participants during the transmission cannot be intercepted by the intruder*

Proof: In SAH system messages are exchanged in encrypted form and digitally signed using ECDSA algorithm.

Proposition 3: ***A****nonymity of the patient is ensured;*

Proof: CA issues TAC which ensures anonymity of the patient

Proposition 4*:* *Patient consumes fewer resources in SAH*

Proof: Patient uses digital signature based on ECDSA and the communication cost of the patient is very less.

Proposition 5: *SAH system ensures communication security*

Proof: SSL/TLS protocol is used in order to ensure communication security

Proposition 6: *SAH system generates Qualified Electronic Signatures*

Proof: CCH also uses TPM (Trusted Platform Module) which is considered as SSCD and UICC is also SSCD.So SAH generates Qualified Electronic Signatures.

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Proposition 7: *SAH system withstands all the known attacks*

Proof: SAH protocol has been successfully verified using Scyther tool so SAH overcomes all the known attacks.

4. SUMMARY

The exponential advancements in the realm of wearable biosensor and wireless communication technologies has paved the way to a new technology called Wireless Medical Sensor Networks (WMSNs) which is revolutionizing mobile healthcare. This work is motivated from ABI research report that all the healthcare infrastructures are prone to attacks which includes Cloud, IOT Wearable Devices, Mobile Network Operator (MNO) and Secure Element (SE) of the patient. There are many challenges in implementation including adversaries exploiting vulnerabilities in Information and Communication Technologies (ICT) thereby compromising patient's vital information. This article proposes a Secure and Anonymous Health (SAH) Monitoring System using Wireless Medical Sensor Networks (WMSN). SAH overcomes all the flaws in the existing literature by adopting Community Cloud for Healthcare (CCH) and Community Cloud of Certifying Authority (CCCA). SAH protocol is verified with scythe tool and BAN logic. SAH framework ensures all the security properties and withstands all the known attacks.

Comparative analysis of SAH with related works is given in Table 2.

Table 2: Comparative Analysis of SAH with the Literature

Protocols / Functionality/Features	Khan, and Kumari (2014)	Amin et al. (2018)	SAH (Our Proposed)
Personalization of IOT Wearable Device by the Patient	No	No	Yes
Personalization of SE in the Mobile Phone by the Patient	No	No	Yes
Personalization of Mobile Healthcare Application (in the Secure Element such as UICC) by Community Cloud of Healthcare (CCH)	No	No	Yes
Multi-Protocol Attack	No	No	Yes
Three-Factor authentication	No	Yes	Yes
Confidentiality	No	Yes	Yes
Two-Factor authentication	Yes	No	Yes
Anonymity of the Patient	Yes	Yes	Yes
Mutual authentication	Yes	Yes	Yes
Session key agreement	Yes	No	Yes
Replay attack	Yes	Yes	Yes
Impersonation attack	Yes	Yes	Yes
Stolen Secure Element attack	Yes	Yes	Yes
Formal Verification using Scyther and BAN Logic	No	No	Yes
Non-Repudiation	No	Yes	Yes
Data Integrity	Yes	Yes	Yes
HIPAA standards are ensured	No	No	Yes
MITM Attack	Yes	Yes	Yes

Yes: Provides the feature; No: Doesn't provide the feature. N.A.: Not Applicable

5. CONCLUSION

This work was motivated from ABI research report that infrastructure related to healthcare are prone to attacks which includes Cloud, IOT Wearable Devices, Mobile Network Operator (MNO) and Secure Element (SE) of the patient. This article proposes a Secure and Anonymous Health (SAH) Monitoring System using Wireless Medical Sensor

Networks (WMSN). SAH overcomes all the flaws in the literature using Community Cloud for Healthcare (CCH) and Community Cloud of Certifying Authority (CCCA). SAH framework ensures all the security properties and withstands all the known attacks.

6. ACKNOWLEDGEMENT

The author would like to thank Deanship of Scientific Research at Majmaah University for supporting this work under Project Number No. 1440-37.

7. REFERENCES

Amin, R., Islam, S. H., Biswas, G. P., Khan, M. K., & Kumar, N. (2018). A robust and anonymous patient monitoring system using wireless medical sensor networks. *Future Generation Computer Systems*, 80, 483-495.

M.K. Khan, S. Kumari (2014). An improved user authentication protocol for healthcare services via wireless medical sensor networks. Int. J. Distrib. Sens. Netw.10 (4), 1-10.

D. He, N. Kumar, J. Chen, C.-C. Lee, N. Chilamkurti, S.-S. (2013). Yeo; Robust anonymous authentication protocol for health-care applications using wireless medical sensor networks. Multimedia Syst. 21 (1) 49–60.

F. Wu, L. Xu, S. Kumari, X. Li (2015). An improved and anonymous two-factor authentication protocol for health-care applications with wireless medical sensor networks. Multimedia Syst. 1–11 http://dx.doi.org/10.1007/s00526-015-0476-3.

X. Li, J. Niu, S. Kumari, J. Liao, W. Liang, M.K. Khan (2015). A new authentication protocol for healthcare applications using wireless medical sensor networks with user anonymity. Secur. Commun. Netw. 9 (15), 2643-2655.

Shaik Shakeel Ahamad, V.N. Sastry, Siba K. Udgata (2014).Secure mobile payment framework based on UICC with formal verification. IJCSE 9(4), 355-370.

C. J. F. Cremers. (2006). Scyther-Semantics and Verification of Security Protocols. Ph.D. Dissertation. Eindhoven University of Technology.

Armando, A. et al. (2005). The AVISPA tool for the automated validation of internet security protocols and applications. In Proceedings of Computer Aided Verification'05 (CAV) (LNCS 3576, pp. 281-285).

Muhammad, S., Furqan, Z. and Guha, R.K. (2006). 'Understanding the intruder through attacks on cryptographic protocols', Proceedings of the 44th ACM Southeast Conference (ACMSE2006), March, pp.667–672.

Abadi, M., Burrows, M., Kaufman, C. and Lampson, B. (1993). Authentication and delegation with smart-cards. Science of Computer Programming, 21(2), 93–113.

Burrows, M., Abadi, M. and Needham, R. (1990). A logic of authentication, ACM Transactions on Computer Systems, 8 (1), 18–36.

L. Xu, F. Wu, (2015). Cryptanalysis and improvement of a user authentication scheme preserving uniqueness and anonymity for connected health care. J. Med. Syst.39 (2), 1–9.

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EFFECT OF MYCORRHIZAL FUNGI ON MACRONUTRIENTS AND MICRONUTRIENTS IN THE WHITE SEEDLESS GRAPE ROOTS UNDER THE DROUGHT CONDITIONS

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ARTICLEINFO

Article history:
Received 19 December 2018
Received in revised form 08 March 2019
Accepted 11 March 2019
Available online
12 March 2019

Keywords:
Water stress condition;
Drought resistance;
Mycorrhiza plant;
Glomus fungi;
Horticulture;
Grapevine.

ABSTRACT

To determine effect of infected roots of seedless white currant grape with three species of Mycorrhizal fungi (Glomus fasiculatu, intraradices Glomus, and Glomus mosseae) and macro and micronutrients in leaves and roots under the water stress conditions, this factorial experiment in the randomized complete block design with four treatments. The results indicated that increase in drought stress led to reduction in the factors including shoot growth, number of leaves, leaf level, root dry weight, and shoot dry weight. Inoculation with mycorrhizal fungi had a positive effect on the above-mentioned traits compared with control group; in this case, the highest positive effect was on the root phosphorus uptake, root dry weights and root zinc uptake among the fungal treatment traits. Intraradices Glomus fungi had the highest positive effect on the interaction between the fungi and water stress for copper in the root and the least amount of manganese. There was not any different treatment between irrigation levels of 25% and 50% under the water stress conditions.

1. INTRODUCTION

Grape is one of the main horticultural products in Iran with the first rank among fruit trees in terms of cultivation area and ranked after pistachio and date palm economically [1]. Herbal archeological studies suggest that grape domestication has begun since the second half of the fourth millennium BC in two neighboring areas, Mezopotamia (southern Anatolia, Syria, northern Lebanon, Kurdistan, and western Iran) and south of Caspian Sea. Water scarcity is a factor, which limits the function of fruit trees in arid and semi-arid areas. Sustainable agriculture has been at the center of

*Corresponding author (Mohammad Aslanpour) E-mail: Aslanpour.mohammad@gmail.com ISSN2228-9860 eISSN1906-9642 http://TUENGR.COM/V10/397.pdf DOI: 10.14456/ITJEMAST.2019.39

attention in recent years and the objective of this subject is to emphasize on the sustainable management of the soil and water resources. The term of Mycorrhizalin indicates the coexistence relation between fungi and plant roots, which is the most common coexistence. Although there are several groups of mycorrhizae, Vesicular Arbuscular Mycorrhizae (VAM) end mycorrhizae are the most popular type of them. These funguses are significant microorganisms in the soil, which can coexist with 90% of roots of all types of plants [2]. The most prominent feature of Arbuscular Mycorrhizae symbiosis is material transfer between cortex cells of the roots of the colonized plant with the fungi and arbuscules. In such symbiosis, the fungus receives carbohydrates from the plant in form of sucrose and sends nutrients (mostly phosphorous) to the plant. In this process, nutrients are transferred from the arbuscule membrane into the plant throughout the membrane carriers, which acts with proton slope so that the existing carbohydrates are converted to the glucose and fructose in the floodplain then adsorbed by the carriers. Mycorrhizal fungi, in particular, Arbuscular Mycorrhizae, play a vital role in providing water and nutrients for plants so that symbiotic mycorrhizal plants can tolerate higher concentrations of heavy metals, salinity and soil dryness with resistance against various pathogens and high soil heat.

2. THEORETICAL LITERATURES

2.1 WHITE SEEDLESS GRAPE

Grapevine is from the Ampelidaceae family called Saramantaceae or Vitacae. This family belongs to the Rhamnales species, which is Dialypetalae belonged to the angiosperms from the Spermatophytes. Such species include shrubs with Knitted shoot sand grows upward due to their ivies. This cultivar, which is also called Sultana, can be found in abundance around the grapevine areas in Iran. There are two types of white to yellow and red seedless grape and these two types are the best table grapes. Drought is defined as an environmental condition of the soil or air and or both of them, which prevents the plant from getting enough water requiring for life leading to water loss in plant's tissues [3]. Drought is one of the most important factor limiting the production of agricultural products and harming these products due to such conditions. Average rainfall in Iran is less than the third of global average [4]. About 65% of the Iran's area consists of the arid and semi-arid regions with rainfall level of <150mm. Under the water deficit conditions, herbal cells lose their turgor mode and transpiration rate is higher than the uptake speed [5]. Reduction in water level of the soil and lack of water replacement leads to water potential in roots and the plant; on the other hand, the higher the water stress rate, the lower the photosynthesis speed will be. Furthermore, water stress disrupts physiological processes and plant functions leading to plant drying.

2.2 DROUGHT RESISTANCE

Drought resistance in agriculture is the economic ability to produce a product under the water deficit conditions. A drought-resistant plant is a plant, which can ensure survival under conditions of water-limited availability [6].

In terms of genetics, drought resistance mechanisms are classified into two categories of drought avoidance and drought tolerance [7]. However, plants develop more than one mechanism for drought resistance. The ability of the plants for growth and functioning with minimum loss after the end of stress period is defined as the drought compensation [3].

The plant growth is influenced by mutual effects of several internal processes such as photosynthesis, respiration, transmission, water relations, and nutrients balance. Growth is a process of increase in the dry matter, volume, length or level of cell. Water stress effect on the cellular development is more obvious than the cell division because growing cell occurs due to turgor pressure. Hence, any water deficit leads to growth pause [8].

Severe water deficit at grape growth step wilts the leaves and diminishes moisture in shoots. This wilting can be seen in grapes, which are cultivated in the pot with the soil, which is wilting. Such condition is observable in hot weather and sand low-deep soils, which all parts of them reach to the wilting point under the farm conditions. This situation is rarely seen in deep soils, as the soil around the growth area does not wilt within short time [9].

2.3 MYCORRHIZAL FUNGI IN GRAPE

The term "mycorrhizal", introduced by Frank in 1885, is composed of two words "Myco", which means fungus and "Rhiza", which means roots indicating symbiosis between the fungus and plant roots. In this system, the fungus forms broad cover of the filamentous called hyphae around the host plant's root. Many of plants can form mycorrhizal system; 83% of Dicotyledon and 79% of Monocotyledon plants can develop my corrhizal system [2]. Fungal hyphae, which grow from the soil spurs or roots of adjacent plant contact with the root surface during the VAMs formation and then divided in this place to form an Appressorium and start the initial colonization; this is the first difference factor between the fungi and plant. Appressoriums are not formed on the non-host plants' roots. Penetration into the roots occurs throughout the Appressoriums and distances between two epidermis cells in the outer skin [10]. The symbiotic relationships of mycorrhizal play a vital role in decomposition of soil organic materials, mineralization of plants' nutrients and nutrients cycle [11]. Increased absorption of water and nutrients by the mycorrhizal can be stem from growth fungus hyphae up to 20mm from the root surface compared to 1.5mm growth in hairy roots (HRs) as well as the low penetration power of root compared with the penetration potential of hyphae into the soil pores. Hyphae of these funguses penetrates into the areas of soil, which are not penetrable by roots; hence, this conditions increases the transmission level between mineral nutrients, water and soil soluble compounds [12]. Various studies indicate that Phosphorous, Nitrogen, Potassium, Zinc, Copper, Sulfur, Magnesium, Manganese, Calcium, and Iron are absorbed and transferred into the plant by the mycorrhiza system. In general, adsorption mechanism is done through increasing available soil volume by the fungus hyphae. Mycorrhiza uptakes high amount of phosphorous among other nutrients. Mycorrhiza plays a minor role in nitrogen uptake owing to its high emission rate. If there is low amount of phosphorous in the soil, mycorrhiza considerably increase phosphorous absorption and therefore plant growth. Hyphae can receive phosphate from the 15cm distance from the root surface to the several meters in depth of the soil under the roots. Moreover, hyphae can penetrate into the soil pores, which are not penetrable by root hairs (diameter of root hairs is 20µm at least, while maximum diameter of hyphae is 1-2µm). In addition, hyphae would increase nutrient uptake considerably by increasing contact level or effective root length. There are 2-4cm roots, 1-2m root hairs and greater than 50m hyphae at each $1cm^3$ soil [13].

The major portion of phosphorous in the soil is insoluble and unusable directly for the plant.

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Various studies have shown that mycorrhiza can synthesize Phosphatase enzyme in order to expand the phosphorus availability. Some types of mycorrhiza produce chelating acids to increase phosphorous solubility for absorption [14]. Arbuscular Mycorrhizae funguses create association between geochemical and living parts of the soil ecosystem by phosphorous uptake and transferring it to the plants and therefore affect the speed and patterns of phosphorous cycle in both of agriculture and natural ecosystems. This process protects the plant health against environmental stresses and improves the soil structure by forming aggregates requiring for a good soil [10]. Drought leads to some changes in the root structure, which may affect the colonization percent and frequency of different fungal structures of mycorrhiza. Nevertheless, different types of funguses show different behaviors under the drought stress conditions. For instance, some experiments on the citrus show that drought stress decreases colonization of G. vermiform and G. mosseae funguses, which have root and reduces volume of hyphae in the soil considerably [15]. Changing moisture rate of the soil leads to change in the root form, pores size and penetration angle of roots. Hairy roots are highly sensitive to the water deficit and root system function, as well as nutrient adsorption, will be reduced under such conditions [3]. Phosphorous ion can be highly adsorbed by clay soil under the drought conditions and therefore a small part phosphate ion is soluble. Under the drought conditions, phosphate ion will be reduced not only due to its low solubility but also for reducing uptake potential of roots [16]. [17] evaluated the response of six grapevines to the nutrient uptake under drought conditions. Their results showed a significant difference between grapevines in terms of nutrients uptake including nitrogen, phosphorus, potassium, calcium, and magnesium. Grafted cultivar had a significant effect on the phosphorous adsorption. A study inoculated micro propagated pomegranate with four types of mycorrhiza fungus examining some parameters such as shoots length, root length, fresh and dry weight of root and seedling survival percentage. It was observed that the mentioned parameters in symbiotic plants were significantly different with control plants (absence of fungus) 60-90 days after inoculation; however, there was not any significant difference between mycorrhiza treatments. This research suggested the improved nutrients uptake and water associations as well as the increased photosynthesis as causes for enhanced plant biomass. Symbiosis between mycorrhiza fungus and grape roots expands the nutrients uptake by the fungus and the vine sends photosynthesis materials to the fungus in exchange. Mycorrhiza contribution can be expressed as follows: 1- increasing nutrients uptake 2- protecting against pathogens living in the soil 3- protecting and stabilizing the soil structure by connecting soil particles to the hyphae network 4- improving drought resistance by absorbing higher water and phosphorous amounts 5- increasing soil moisture [18]. In [19], the study carried out to observe on the effect of mycorrhiza fungus on the minerals uptake by the grapevine root in poor soils and reported that besides the highest effect of fungus on the phosphorous uptake, other minerals such as Zinc, Copper, Nitrogen, Potassium, Calcium, and Iron can be influenced under different conditions.

The work of [20] carried out a study on effect of nitrogenous fertilizers like urea, calcium nitrate, ammonium sulfate and ammonium nitrate on the activity of fungal type of Glomus Mosseae, grapevine nutrition, and its aggregation variations and it was determined that nitrogen fertilizer could vary rootstock colonization by mycorrhiza funguses and sporulation of these funguses, grapevine growth, nutrition, and aggregation structure. On the other hand, urea stops the rootstock colonization and fugal sporulation. Grapevine rootstock inoculation by mycorrhiza and adding calcium nitrate as

the nitrogen source increase the weight of dry shoots and number of leaves compared with the control trees. In addition, there was a high density of micronutrients like iron, molybdenum, zinc, and copper in non-mycorrhiza plants compared to mycorrhiza ones. [18] conducted a study on the role of mycorrhiza in grapevine nutrition and reported that external hyphae on the grapevine root surface transfer the nitrogen between the grapevine and resources of organic nitrogen in the soil; therefore, symbiosis between mycorrhiza and grapevine is a prominent case for suitable nutrition in improper soils. There is lack of a comprehensive study on identification of Arbuscular Mycorrhizae funguses in the grape rhizosphere in Iran.

3. MATERIALS AND METHODS

This study was conducted to improve nutritional situation, soil moisture and optimal growth of the white seedless grape under drought stress conditions. In this research, effects of annual grape seedling roots inoculated with several mycorrhiza funguses was examined on the water and nutrition relations under low irrigation conditions in the pot compared with the control group (without inoculation). This study was done during two years (2013-2014) in form of a factorial experiment in the randomized complete block design with four treatments. The factors included inoculation with three mycorrhiza fungus species (Glomus mosseae, G. fasciculatum, and G. intraradices) and without inoculation (four levels), and irrigation at three levels (stress levels). The soil bed of the pot composed of wind sand and crop soil in equal amount. The white seedless grape cuttings were prepared then rooted in the wind and using Mamarov method. Half of the seedlings were inoculated in the Arbuscular Mycorrhizal (AM) fungi suspension at the same bed and rest of them were used as the control samples.

3.1 PREPARATION OF MYCORRHIZA PLANTS

Mycorrhiza fungus inoculums (spore, mycelium, mycorrhizal roots, and soil) were taken from the Turan Biotechnology Company of Shahrood and propagated on Sorghum roots.

3.2 MACRO AND MICRO-MINERALS IN ROOT AND LEAF

Amounts of nitrogen, phosphorus, potassium, magnesium, iron, and zinc in the leaf and amounts of nitrogen, phosphorus, potassium, calcium, magnesium, iron, zinc and manganese in root were measured. Leaf samples, which had been selected for growth parameters measurement, were prepared at the final growth steps. The prepared samples were washed, dried in the oven (under the 72°C for 48 hours), then powdered with the mill and finally, the extract was prepared using digestion with dry burning. Amount of phosphorous was measured using Colorimetric method (Vanadate molybdate yellow) and spectrophotometer within 470nm wavelength then phosphorous rate was calculated as

P= concentration in the regression chart × given dilution (10) × 1.33 × 100/ (3g) sample × 10000 (1).

Potassium amount was determined using flame emission and Flame Photometer (Jenway PFP10, England); zero, 20, 30, 40 and 50mg standard solutions in potassium chloride (KCl) were prepared and their standard chart was plotted using flame photometer. Then, 10ml plant extract was diluted using distilled water and reached to 100ml then the sample potassium was calculated based on ml/l

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using flame photometer. Finally, equation 3-6 was used to estimate the amount of potassium based on mg/100g herbal dry leaves [10] and then one gram of the milled sample of each treatment was weighted and nitrogen percentage of samples was determined within different experiment steps using Kjeldahl flask:

$$(a-b)\times\frac{1}{1000}\times\frac{V}{W}\times\frac{100}{D.M} \quad (2),$$

where

a: potassium concentration in diluted sample (mg/l)
b: potassium concentration in control (mg/l)
v: volume of the extract obtained from digestion (ml)
w: weight of plant sample (g)
D.M: percent of dry plant.

3.3 STATISTICAL ANALYSIS OF DATA AND APPLIED SOFTWARE

Before data analysis, normal distribution of data was examined using Kolmogorov-Smirnov test (K-S) through SPSS® Software. Variables with non-normal distribution were standardized using suitable conversions. SPSS® software was employed for analysis of variance (ANOVA) and comparison of the measured traits. Means were compared using Duncan's multi-domain test.

4. RESULTS AND DISCUSSION

ANOVA Results of effects of mycorrhizal fungus treatments and water stress on the macro and micronutrients in plant roots

Table1. ANOVA of macro and micronutrients in the plant root

Change source	df	Mean square								
		Nitrogen	Phosphorous	Potassium	Calcium	Magnesium	Iron	Zinc	Copper	Manganese
Fungus	3	08.0^{ns}	01.0 *	02.0^{ns}	00.0^{ns}	10.0^{ns}	21.0^{ns}	69.11^{ns}	70.1^{ns}	57.24^{ns}
Irrigation	2	01.0^{ns}	01.0^{ns}	00.0^{ns}	00.0^{ns}	05.0^{ns}	31.0^{ns}	32.2^{ns}	95.1^{ns}	76.22^{ns}
Fungus × irrigation	6	03.0^{ns}	00.0^{ns}	00.0^{ns}	00.0^{ns}	43.0^{ns}	08.0^{ns}	40.15*	80.7*	46.86**
Error	36	06.0	05.0	01.0	00.0	03.0	04.0	47.5	76.2	80.23
Change percentage		12	9	15	11	8	9	13	16	15

ns: lack of significant difference, ** and * indicate significant difference at 1% and 5% levels, respectively

4.1 PHOSPHOROUS IN ROOTS

ANOVA results indicated significant fungal and water treatments for phosphorous amount in roots of the white seedless grapevine at 1% level (Table 1). According to comparison between means, the highest amount of phosphorous was observed in Glomus fasiculatum, which was significantly different with the control treatment (Figure 1).

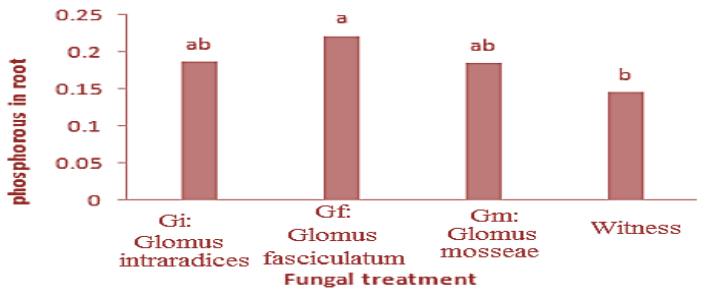

Figure1. Comparing average amounts of phosphorous in root under the effect of fungus treatments. GM: Glomus mosseae, GF: Glomus fasciculatum, GI: Glomus intraradices, Witness (control).

Increased phosphorous uptake is facilitated by transferring phosphorous from the soil to the plant roots and phosphatase solubility. expressed that increase in plants' function is one of the most important effects of mycorrhizal funguses, in particular in low-moisture soils. Such functional improvement occurs due to increases adsorption rate of roots through penetration of fungus hyphae in the soil as well as the higher volume soil availability for the plant. Increased phosphorus absorption by the host plant associated with numerous internal hyphae branches of mycorrhiza inside of the epidermis cells of the plant roots, which provide a wide surface to transfer nutrients, in particular, phosphorous into the host plant [21]. Phosphorous uptake rate in mycorrhizal plant is 3-6 times greater than non-mycorrhiza plants [22]. [23] introduced the phosphorous uptake for plant's root as the main role of mycorrhizal funguses as the phosphorous is a nutrient with highly low mobility in the soil. If phosphorous solution is added to the soil, it will be stabilized in form of calcium phosphate or other forms becoming non-movable. In addition, production and secretion of enzyme phosphatase by mycorrhizal hyphae converts the insoluble and stabilized phosphate in the soil as a soluble nutrient, which can be absorbed by roots. Therefore, mycorrhizal funguses play an effective role in expanding minerals (in particular, phosphorous) and accumulating biomass of many of products in the soils, which contain low amount of phosphorous. To uptake this nutrient, the root should be in direct contact with phosphorous resource. Physically, mycorrhizal plant's use of soil phosphorous can be facilitated by hyphae with small diameter. It is estimated that about 80% of phosphorus uptake by the plant is done throughout the mycorrhizal funguses [24]. [25] carried out a study on effect of mycorrhizal fungus on minerals uptake by grapevine roots in poor soils and reported that besides the highest effect of fungus on phosphorous uptake, the other minerals such as Zinc, Copper, Nitrogen, Potassium, Calcium and Iron can be also effective; this result is not in line with the findings obtained in present paper except for the phosphorous case.

4.2 ZINC IN ROOTS

ANOVA results showed that fungal and water treatments had significant effect on the zinc amounts in roots of the white seedless grapevine at confidence level of 5% (Table 1). Mutual effects of the fungus and different moisture levels on the amounts of zinc on the roots are shown in Figure 2. The amount of zinc in the roots was influenced by the stress and fungus so that these comparisons indicated that the highest photosynthesis rate of zinc in roots occurred in GF fungus at each stress level. The highest amount of zinc in rootstocks of grapevines inoculated with Glomus fasiculatum was seen at stress levels of 75% and 25%; while this treatment obtained the lowest amounts at 50% level.

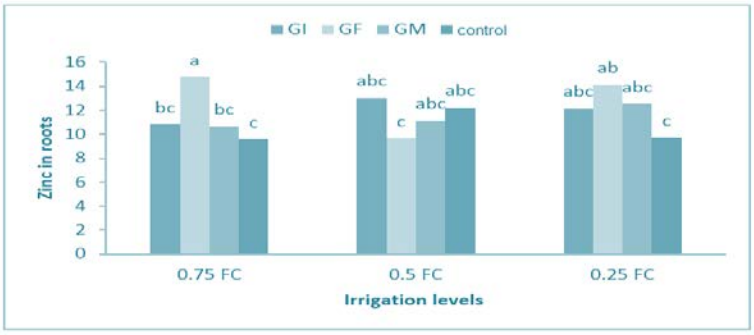

Figure2. Comparing average amounts of zinc in root under the mutual effects of fungus treatments and different water stress levels.

In [26], it was found that mycorrhiza could expand the concentration of zinc in aerial organs of almond up to 25-35% and underground organs up to 26-37%. Such expansion may occur due to more soil draining from the zinc owing to penetration of thin fungal hyphae into the fine soil pores.

Mycorrhiza symbiosis can expand non-movable nutrients such as zinc by increasing roots length and adsorption rate by fungal hyphae, while zinc expansion mechanisms are not similar to phosphorous uptake mechanisms. Increasing uptake rate, which is done by fungal hyphae in mycorrhizal corn plants leads to 22% increase in zinc concentration [27].

AVM funguses have higher potential to uptake zinc from the soil compared to Octavirucid Mycorrhiza. Symbiosis between plants and AVM funguses can provide about 25% of the zinc-requiring for the host plant [24]. This process has been observed in many plants such as corn, sorghum, soybeans [29], and field bean [30]. Figure 2 shows mutual effects of mycorrhizal fungus of Glomus fasiculatum and irrigation on expansion of zinc uptake in roots, which is in line with the results of conducted studies.

4.3 COPPER IN ROOTS

ANOVA results showed that fungal and water treatments had significant effect on the amount of copper in roots of the white seedless grapevine at 5% level (Table 1). Copper showed a behavior like zinc so that the amount of this nutrient in roots of grapevine inoculated by Glomus fasiculatum was higher than the control and other funguses at irrigation levels of 75% water need and stress of 25% water requirement. Although this difference between funguses was not significant at stress level of 25%, fugal Glomus fasiculatum species could uptake the copper at average water stress (50% water requirement) compared with other fungus types or even the control group and indicated the lowest amount of copper in rootstocks; nevertheless, intraradices Glomushad higher efficiency compared to other funguses. In other words, there was not any significant difference between mycorrhizal fungus and other grapevine inoculated by three fungus species under normal water conditions (75% water requirement), while funguses except for Glomus fasiculatum showed a better performance in acquiring copper from the soil compared to the soil under the 50% water requirement stress (Figure 3).

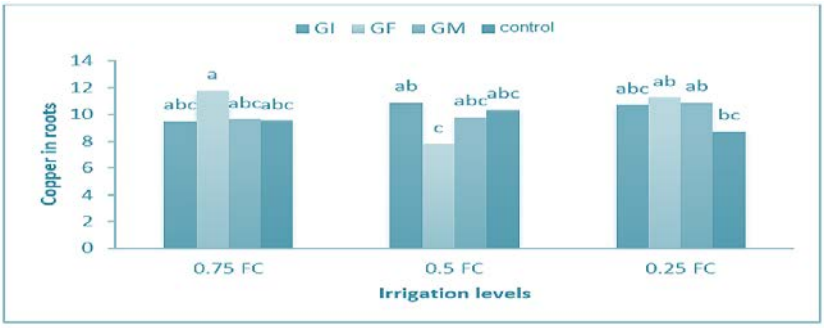

Figure 3. Comparing average amounts of copper in root under the mutual effects of fungus treatments and different water stress levels

Although concentration of copper in almond plant was not affected by the mycorrhizal symbiosis, 150kg increase in amount of phosphorous in each hectare of the soil led to 40-44% expansion in copper concentration in aerial and underground organs of the almond plant [26]. An increase in soil phosphorous amount reduces longitudinal growth of roots and as the copper is a non-movable

nutrients in the soil and plant, increased concentration of phosphorus in plant owing to its simple uptake in fertilized soils may lead to relative reduction in copper concentration in plant. As mycorrhizal phosphorous acquisition has not led to any significant difference in copper concentration, it can be found that despite to lack of significant of mycorrhiza on copper concentration in symbiotic plant but it can increase copper uptake compared to those plants, which do not provide the required phosphorous through mycorrhizal symbiosis.

Copper acquisition is not a similar process in different mycorrhiza plants; for instance, presence of mycorrhizal fungus in some plants such as field beans [29], white clover [30], and soybean [28] leads to expanded copper uptake. Mycorrhizal fungus in mycorrhiza symbiotic corn plant could expand copper concentration in aerial organs, while it had no significant effect in underground organs [27]. In present paper, increased copper concentration in roots was significant when mycorrhizal fungus of Glomus intraradices was used in fugal and irrigation treatments; it seems that such observed positive effect was associated with the hyphae expansion and presence of the penetrable soil.

4.4 MANGANESE IN ROOTS

ANOVA results showed that fugal and water treatments had significant effect on amount of manganese in roots of the white seedless grapevine at 5% level (Table 1). The highest amount of manganese in root of grapevine, which was inoculated by Glomus fasiculatum obtained within treatment of 75% water requirement. There was not any significant difference between the control sample and other funguses under normal water conditions. The first stress level reduced the performance of Glomus fasiculatumin manganese uptake while Glomus intraradices species could uptake the highest amount of manganese. By intensifying the stress condition, three funguses could perform better than control samples in case of manganese uptake (Figure 4).

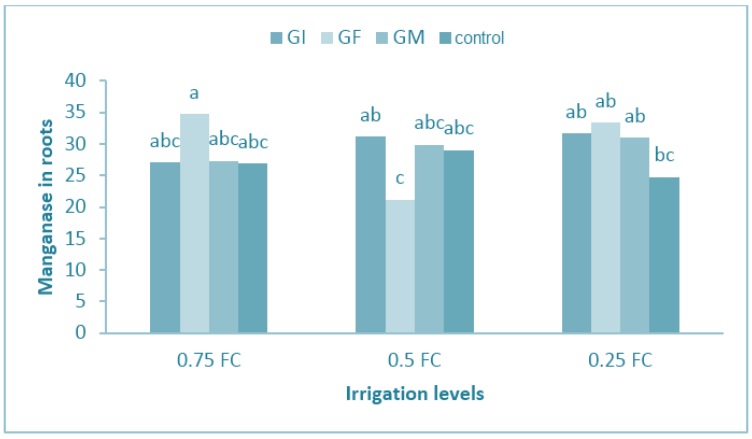

Figure4. Comparing average amounts of manganese in root under the mutual effects of fungus treatments and different water stress levels

The study [32] found significant increase in amounts of nitrogen, potassium, manganese, magnesium, and zinc in corn grains under the moisture stress conditions for the corn, which is inoculated by mycorrhizal funguses.

The work [26] conducted a study on almond plant and found significant concentration of manganese within mycorrhizal symbiosis at confidence level of 5%; this amount experienced about 15% increase in roots about 40% reduction in aerial organs. Increased 150kg phosphorous in each

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hectare of soil led to 50% expansion in manganese concentration in plant roots as well as 30% reduction in aerial organs. According to the mentioned points, increase in phosphorous concentration in plant blocks the absorbed manganese preventing it from transferring to young tissues and lower organs. The opposite process has been observed in mycorrhizal soybean plant; manganese concentration was increased in leaves and reduced in roots [29].

Although mycorrhizal inoculation of corn reduces manganese concentration in aerial organs and plant roots [27], mycorrhizal funguses of Glomus intraradices and Glomus mosseae have reduced manganese in roots compared to control samples, have prevented from manganese transfer to the leaf, and have removed its toxic effect on leaves. According to Figure 4, mycorrhizal fungus of Glomus fasiculatum has the lowest amount with lower uptake compared to the control sample; this indicates mycorrhizal effect on reducing toxic effect of some nutrients such as manganese in the plant.

5. CONCLUSION

The reported work was designed to increase knowledge about the role of arbuscular mycorrhizal fungi on the phyto availability and allocation of some of the principal macroelements and microelements in white seedless grape roots growing in the drought conditions. The results obtained from ANOVA analysis suggest that fungal and water treatments had significant effect on the zinc and phosphorous amounts in roots of the white seedless grapevine. In conclusion, the results of this paper show that the use of mycorrhizal fungi in terms of drought stress has had a positive effect on the improvement of plant characteristics.

6. REFERENCES

[1] Nazmiyeh, A. Fine-grained supplementary fruits, MA pamphlet, Faculty of Agriculture, Tabriz University, 1999.

[2] Mostajeran, A., Vozoee, F. Mycorrhizal symbiosis, Isfahan University Press, 2006, P. 226.

[3] Levitt, J. Responses of plants to environmental stress.1980, Vol. 2, Academic Press. New York.

[4] Islamian, S., Soltani, S. Flood frequency analysis (translation), Arkan Publications, 1381,P. 344.

[5] Kozlowski, T.T. and Pallardy, S.G. Physiology of woody plants, 2nd edition. Academic Press, San Diego,1997.

[6] Abedmishani, S. Shah Nejat Bushehri, A. Correcting supplementary plants, 1997, Vol.I, P. 205.

[7] Mitra, J. Genetics and genetic improvement of drought resistance in crop plants. Current Science 2001, 80: 758-763.

[8] Lambers, H., Chapin, F.S. and Pons, T. Plant physiological ecology. Springer-Verlag, New York, 1998.

[9] Hesabi Isfahlan, P. Effect of different levels of drought stresses and reduction of soil moisture in growth of several grape cultivars, MA thesis, Faculty of Agriculture, Tabriz University,1999, P.65.

[10] White, Philip J., Hammond, John P. Plant ecophysiology, Translated by Hossein Ali Alikhani; Gholam Abbas Akbari, Mehdi Ghorchiani, Tehran University Press, 2013, P. 322.

[11] Panwar, J. and Tarafdar, J.C. Arbuscular mycorrhizal fungal dynamics under Mitragyna parvifolia (Roxb.) Korth. in Thar Desert. Applied Soil Ecology, 2006, 34: 200–208.

[12] Khan, A.G. Mycorrhizas and phytoremediation. In: Willey, N. (Ed.), Method in Biotechnology-Phytoremediation: Methods and Reviews. Totowa, USA: Humana Press, 2005.

[13] Allen, E.B. and Allen, M. water relations of xeric grasses in the field interactions of mycorrhizas and competition. New Phytol, 1986, 104:559-571.

[14] Orcutt, D.M. and Nilsen, E.T. The physiology of plants under stress, John Willey & Sons, USA. osmotic strees, new perspectives for molecular studies. Mycorrhiza. 1996, 13: 309-317.

[15] Wu, J., Capp, C., Feng, L., Hsieh, T.S. Drosophila homologue of the Rothmund-Thomson syndrome gene: essential function in DNA replication during development, 2008. Dev.Biol. 323(1): 130-142.

[16] Kafee, M., Damghani, A. Resistance mechanisms of plants against environmental stresses, Translation, Ferdowsi University Press in Mashhad, 2000, P.476

[17] Patakas, A . and Noitsakis .B. Mechanisms involved in diurnal changes of osmotic potential in grapevines under drought conditions .J. plant. physiol, 1999, 154: 767-774.

[18] Baumgartner, K. The role of beneficial mycorrhizal fungi in grapevine nutrition. ASEV Technical update. 2006, 1(1): 3.

[19] Schreiner, R.P. Mycorrhizas and mineral acquisition in grapevines. American Society of Enology and Viticulture. Davis, CA, 2005b, pp 49-60.

[20] Karagiannidis, N., Nikolaou, N and Mattheou, A. Influence of three VA-mycorrhiza species on the growth and nutrient uptake of three-grapevine rootstock and one table grape cultivar. Vitis., 1995, 34: 85-89.

[21] Abbott, L. K. and A. D. Robson. Formation of external hyphae in soil by four species of vesicular-arbuscular mycorrhizal fungi. New Phytol. 1985, 99: 245-255.

[22] Bolan, N.S. A critical review on the role of Mycorrhizal fungi in the uptake of phosphorus by plants , 1991, 134: 189-207

[23] Turk, M.A., Assaf, T.A., Hameed, K.M., and Tawaha, A.M. Significance uptake on phosphorus by plants. Plant Soil. 2006, 134: 187-207.

[24] Marschner, H., and Dell, B. Nutrient uptake in mycorrhizal symbiosis, 1994.

[25] Schreiner, R.P. Spatial and temporal variation of roots, arbuscular mycorrhizal fungi, and plant and soil nutrients in a mature Pinot Noir (Vitis vinifera L.) vineyard in Oregon, USA. Plant and soil. 2005a, 276: 219-234

[26] Aghabebaee, F., Reissi, F. The effect of mycorrhizal symbiosis on chlorophyll content, photosynthesis and water use efficiency in four almond genotypes in Chaharmahal and Bakhtiari province, Journal of Agricultural Science and Technology, Water and Soil Sciences, Fifteenth century,2011, Issue 56: 99-101.

[27] Kothari, S. K., H. Marschnnere, and U. Romheld. Contribution of VA mycorrhizal hyphae in acquisition of phosphorus and zinc by maize. New Phytol. 1991, 117:649-665.

[28] Pacovsky, R.S., Micronutrient uptake and distribution in mycorrhizal or phosphorus-fertilized soybeans. Plant Soil 95, 1986, 379_388.

[29] Kucey, R. M. N and H. H. Janzen, Effect of VAM and reduced butrient availability on growth and phosphors and micronutrient uptake of wheat and field beans under greenhouse. Plant Soil.1987, 104:71-78.

[30] Lie, X. L., George, E. & Marschner, H. Extension of phosphorus depletion zone in VA mycorrhizal white clover in a calcareous soil. Plant and Soil, 1991, 135, 41–48.

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[31] Subramanian, K. S., Charest, C., Dwyer, L. M. & Hamilton, R. Z. Effects of mycorrhizal arbuscular on leaf water potential, sugar content, and P content during drought and recovery of maize. Canadian Journal of Botany, 1997, 75, 1582-1591.

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International Transaction Journal of Engineering, Management, & Applied Sciences & Technologies

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ANALYSIS OF ORGANIZATIONS WITH A CIRCULAR STRUCTURE (DEMOCRATIC HIERARCHY)

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ARTICLEINFO

Article history:
Received 04 January 2019
Received in revised form 11 March 2019
Accepted 12 March 2019
Available online
13 March 2019

Keywords:
Organizational structure;
Structural variables;
Content variables;
Circular organizational structure.

ABSTRACT

The main objective of this study was Analysis of organizations with a circular structure (democratic hierarchy). This was an analytical descriptive study and library resources are used to gather information, and content analysis is used to analyze the data. Results showed that circular structures have little management levels and small senior management team. The structure can meet lots of hierarchical limitations and can also cause slowdown of decision making and implementation process. It can also decrease high costs of management for inter-department relates and organizational hierarchy. It enables organization to consume its resources to provide service for customers (whether the customers within organization or out of organization). Circular structures are rounded structures, which pay attention to processes and try to preserve the advantages of vertical and horizontal nature.

1. INTRODUCTION

Organizational structure and how it has been formed has always been one of the tense discussions of the field of management. This issue is at the center of attention and in today's conditions, it has been updated in the form of new contingency theories, reengineering of the organization, and so on. Organizational structure is a set of ways and means by which the organization divides its workforce into different tasks and then coordinates them. The organization, according to its goals and missions, places tasks on its agenda and employs the staff members, and the distribution of authority and responsibility in the organization is formed. The organizational structure shows itself in a set of lines and forms called organizational chart. At the same time, the organizational chart also reflects the views of the minds of managers and designers (Robbins, 2017).

Since organizations are open systems and interact with their surroundings, they need to be redesigned when needed, because of changing the strategy of rival companies, changing technology and changing the environment. When designing the structure, the dimensions of

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the organization should be analyzed. Organizational dimensions include content variables and structural variables. Objectives, strategy, environment, technology, and size are among the most important content variables. These variables represent the whole organization and its status and are between the organization and the environment and are derived from the environment (Richard, 1997).

Complexity, formalization, and concentration are important examples of structural variables. Structural variables represent the internal characteristics of an organization and provide a basis for measuring organizations and comparing their structural features. Content variables affect the structural variables and their integration and integration into a variety of structural designs that are theoretically divided into organic and mechanical structures, and organizational structure can be found in terms of organizational chart. For deep understanding, the main concepts presented by scientists are at the first analyzed (Hammer, 2006). This study tends to define the desired concept in each section with presentation of a good question.

2. LITERATURE REVIEW

An organization is a kind of social unit that consists of individuals who are managed to achieve collective goals. For example, organizations are game systems that are heavily influenced by the environment. Each organization has its own management structure, which defines the relationships among different employees, the tasks they perform, and the roles and responsibilities that are provided to perform different tasks. A well-organized organization gains effective coordination, identifies the structure, formal communication channels, and links individual activities to each other. An organizational structure defines a way in which roles, powers, responsibilities, and responsibilities are determined and managed and how the information is transmitted between different levels of hierarchy in an organization. Organizational structure depends considerably on its goals and strategy in achieving those goals. An organizational chart is a visual representation of the organizational structure. This structure should clearly define the reporting relationships and the flow of power, as this will make a good connection and result in efficient and effective flow of work. Managers should seriously consider how they want to organize an organization. Some of the key factors that need to be addressed include size of organization, business nature, goals, and business strategy for achieving them and the organization's environment (Rahmanzadeh Heravi, 2003).

2.1 Functional organizational structure

Organizational structure is the most common model in most organizations. Organizations with such a structure are divided into smaller groups such as operational, financial, marketing, human resources, IT, and so on. The top management team consists of several performance supervisors, such as sales and marketing operations manager. Communication occurs in each of the functional sections and is communicated across sections through the supervisors of that department. This structure provides more operational efficiency. It also allows each group of specialists who have more expertise to

act independently. In spite of the above benefits, there are some issues and problems with this structure. When different functional areas arise, people focus only on their responsibilities and do not support other functional areas. Specialization is also limited to a specific field of activity, which limits the field of learning and growth (Frankel, 2003).

2.2 The organizational structure of the product

This is another common structure in which organizations are organized with a particular type of product. Each product category is considered as a separate unit. For example, in a retail business, the structure can be grouped according to production lines (Blue and William 1969).

2.3 The organizational structure of the product

A structured organization with the product classification method, by creating completely separate processes from other production lines inside the organization, facilitates internal autonomy. This leads to a deep understanding of the particular product and also promotes innovation. This possibility focuses on responding to the results (Perrow, 1970; Hage and Mickael 1967).

2.4 Circular organizational structure

A matrix structure is organized for managing various dimensions. Functional teams are also used to report the level of specialized performance in both horizontal and vertical. In this way, employees may belong to a specific functional group, but they will also help another team. This type of structure brings employees and managers across sectors together to achieve common organizational goals, leading to efficient information exchange and efficiency, and also enables the sectors that cooperate with each other, often for Solve issues with each other. This structure strengthens incentives among employees and creates a democratic management mode that searches for team members' inputs before directors decide. However, the matrix structure often increases the complexity of the organization. As reporting is not limited to a single supervisor, employees can show their willingness to the supervisor who wants to follow it. Such discretion and dual communication lead to communication gaps and the division of staff and managers (Paul et al, 1990).

3. METHODOLOGY

This is an analytical descriptive study and library resources are used to gather information, and content analysis is used to analyze the data.

4. RESULTS AND DISCUSSION

Over the organizational study history, different people have always tried to classify organizations based on a basis and foundation and apply some features for each group, in which the organizations have same features. To study the organizations, scholars need a logic, using of which they can increase organizational ability to achieve organizational goals. Organizational study means we can derive some features of similar organizations and apply them for other organizations to have more effective management.

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Organizational structure specifies the in-organization information and type, amount and the way of distributing information within the organization. It can be specified that what units gets what information and to whom the information should be given and from whom the information should be received. Organizational structure shows strategy of organization and the interaction of organization with the environment and response to environmental phenomena. (Robbins, 2017).

4.1 ORGANIZATIONAL STRUCTURE FEATURES

Organizational structures have criteria to be specified and there are factors affecting the criteria and bringing different structures for people. Hage (1967) counted some features for organizational structure, which are known today as structural variables. Other scientists also presented content variables, which determine structural variables. In fact, these are same features attributed to organizations in same class and are known as organizational plan:

4.1.1 STRUCTURAL VARIABLES

Complexity, formalization, centralization, standardization, professionalization, and personnel positions are structure variables, the most important of which (complexity and formalization) are analyzed here.

4.1.1.1 COMPLEXITY

When person enters to an organization, the first thing encountered is labor division, hierarchy and job titles. Complexity can be investigated in three levels:

- Horizontal complexity
- Vertical complexity
- Geographical complexity

4.1.1.2 FORMALIZATION

The more complicated technology is, the less formalization would be and the more repetitive technology is, the more formalization is increased.

Increased size of organization and its growth can make organization be directed towards bureaucracy to control and to have indirect supervision on people and solving problems in low levels and can ultimately increase formalization. The more the organizational personnel are educated and specialized, the more they can bring rules to the organization and the organization has to codify less regulations and standards. In fact, the profession of experts can adjust the organization (Blue and William 1969).

4.1.1.3 CENTRALIZATION

Centralization is in direct relationship with power and decision making within the organization. In fact, centralization shows the distribution of power within the organization. The aim by power is power in decision making. Power distribution in organization can cause formation of different forms of organizational structure. Each group with more power in the organization has more centralization and forms organizational structure in its own benefit.

Power has some source and origin, which can't be explained in this study (Rahmanzadeh Heravi, 2003).

4.1.2 CONTENT VARIABLES

Content variables are those variables affecting structural variables directly. In fact, the amount of complexity and formality and centralization of organization is depended on these variables. Content variables include environment, technology, strategy, size and culture and are explained in the following.

Environment: every organization is surrounded by the environment. The first step to analyze environment is to identify that. Hence, to identify the environment, the events happened there should be identified. On the other hand, all said events are taken by the organizations and human communities. Hence, all organizations and societies should identify the events they create, which are not under control of organization but can affect that. To this end, organization has been divided to different departments. The longitudinal instrument of the environment includes far or public environment, near or work environment. The latitudinal instrument of the environment includes 10 separated sections.

In lateral environment tool, for the analysis of far environment, PESTEL is used and to analyze near environment, it is used. The difference of near (work) and far (public) environment is that the work environment can affect organizational action daily and directly and public environment can affect organizational performance and public environment can affect all organizations of industry indirectly.

For analysis of work environment, the industry analysis method, competitor groups' nature and product lifecycle should be applied.

Another method for industry analysis is using product lifecycle. In the Figure 1, this cycle is illustrated.

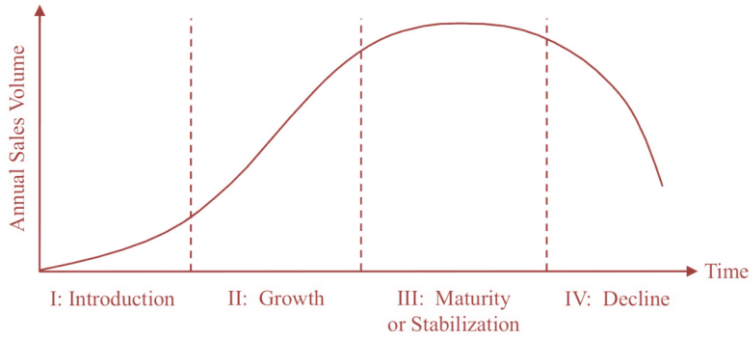

Figure 1: Product life cycle.

This kind of classification helps investors to assess the potential growth of different companies in an industry.

In analysis of competitor groups based on two underlying criteria from all existing criteria, all competitor organizations manufacturing same product or alternative products are

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classified and competitiveness places of the market can be specified using the classification. Moreover, the scopes with no competitor can be also specified.

At the end of explanation of PESTEL, it should be mentioned that conditions in different scopes of far environment can affect each other significantly. For example, political changes can significantly affect approval of regulations or regulations can significantly affect economic conditions.

For the longitudinal tool, environment is divided to 10 sections and all organizations and communities affecting the organization are determined in each section. In the Figure 2, the 10 sections are illustrated.

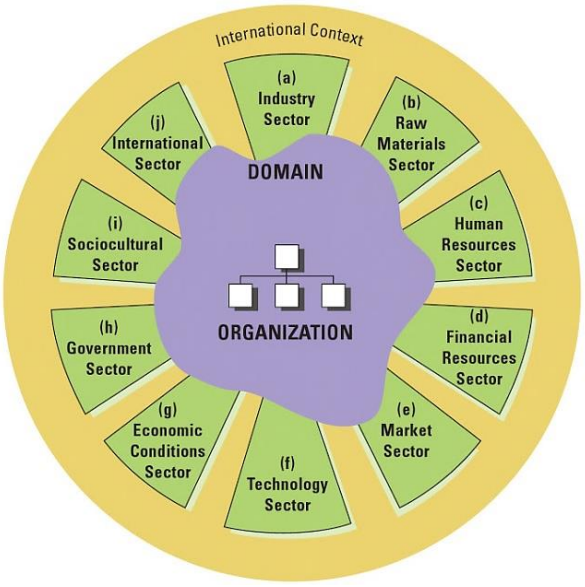

Figure 2: Environment 10 sections (after Daft, 1998)

With division of organizational environment to the 10 sections, the dominance of organization in each section is also determined. In fact, using this method, all organizations in each section and affecting the organization are determined.

The environment can be also classified in terms of analytical dimensions. Organization needs its environment in terms of information or resource. The type of organizational need can have some effects on organizational structure.

If the dependence of organization is on available information at the environment, environmental phenomena can be analyzed in terms of complexity and sustainability.

Complexity of the environment means that the more the number of events in the environment is and the more they're scatter in the environment, their heterogeneity and the more their relationship with each other is, the more complicated the environment would be. On the other hand, the more the events are unpredictable and the less their survival is, the less the stability of the environment would be. In the section of strategy, it will be mentioned that what are the upcoming strategies of the organization to deal with these cases.

For business organizations, all efforts for analysis of the environment are directed to answer a question that what effect the environmental changes can have on understanding, needs, and desires of customers?

Strategy: organizational strategy determines the way of interaction of organization with the environment. In previous section, the data were obtained from the environment. Now the way of encountering the information and the interaction with environmental phenomena is relevant to desired strategy. Strategy is determined and the power groups determine that. In fact, the power groups in the organization determine the interaction with the environment and organizational strategy due to the insight, attitude, and priorities of the groups. The final response given by organizational strategy is that why customer should buy from us instead of buying from competitors? Answering this question can make huge structural, cultural and leadership changes.

To codify strategy, three stages should be passed and each stage has some steps. The three stages include strategic analysis, strategy design and strategy implementation.

The mission declaration includes perspective, mission, and axial values. Futuristic perspective is based on the past insights and experiences and can provide an overall image of future. The perspective can be adjusted by means of environmental changes and should be changed from time to time. Perspective is of type of wanting; although mission is from type of becoming. In mission, individuals can determine that what capabilities are needed for realization of perspective and what are the capabilities needed for realization of perspective. Axial values include norms of company, which should be considered at the time of writing the perspective and mission. Axial values can adjust the perspective and organizational mission. At the end, mission declaration should answer the main question:

1- What is desired business? What need is responded in form of desire?
2- Who are the customers? The need of what part of market is met?
3- What is the way to be different? What are features of the desired product or services chosen by the customer?

After analysis of the environment and codification of the organizational mission declaration, the in-organization status should be analyzed. Using different modes such as value chain analysis, the in-organization environment, and organizational process can be analyzed. Every organization takes a chain of activities to produce product or service; although the main question is that how much each activity can affect realization of the main objective and perspective of the organization? It should be analyzed that to what extent the organizational activities are in line with realization of organizational goals; meaning that how much value they can make. The value is the result of dividing the price of activity by customer in that activity. Is the activity taken valuable for the customer?

After completing strategic analysis, the strategy should be designed. Strategy can be designed in three levels of company, business, and operating level. Porter introduces three strategies of cost leadership, differentiation leadership and centralization leadership for company. To design strategy in business level, various tools such as SPACE matrix and SWOT can be used.

With interpretation of SPACE matrix and the data obtained from environmental studies,

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overall organizational status under current conditions and desired conditions of organization can be obtained:

- Meeting the weaknesses
- Revising and accumulating existing capabilities for realization of goals
- Taking benefit of consistent capabilities
- Increasing powers or strengths

After doing the relevant calculations of SPACE matrix, the matrix was drawn for the organization and it was found that strategic status of organization in which section is placed. With analysis of key environmental factors and interpretation of SPACE matrix, the basic and strategic problems of organization should be identified and solved.

Afterward, the strategies are extracted and codified and proposed based on mission, perspective, goals and overall policies of organization (which were previously analyzed, codified and approved) and under effect of the results obtained from SPACE matrix, which can specify the overall schema of existing status, desired status and strategic organization status in two environments of work (near) and public (far) operating environments under present and future times and based on general strategies identified in SPACE matrix. To identify, design and propose possible strategies, SWOT matrix is used.

SWOT matrix proposes some strategies based on strengths and weaknesses and opportunities and threats of the organization. Perspective can be divided to long-term, mid-term and short-term goals and the matrix can be drawn for short-term goals. SO strategies are aggressive. The ST and WO cells are adaptive and one should try to cope with them. The strategies in this section are to preserve the balance and to return to aggressive goals, so that the environmental threats can be met using strengths or the weaknesses can be met with the environmental opportunities. The TO cells are the worst cells and all organizations try to leave them and go to other parts.

Now, according to the environment and technology used, the organization can assign more strategic decision to operating levels, so the centralization is reduced and the ability of organizations is increased to decrease the conflicts caused by non-repetitive technology or rapid response too complicated and unstable phenomena.

The strategies in this field are in kind of changing the environment and try to overcome environmental phenomena. It was mentioned before that the more the poor environment is, the more dependence on environmental resources would be:

Technology: technology is one of the most complicated organizational concepts. Before this, the technology of the environment was explained; although technology as a content variable is definitely different from technology as one of the factor changing organizational public environment. In first section, it was mentioned that it could be specified in organizational structure that what organizational units should be created and what kind of activities they should take and how is the relationship of these units. However, an underlying question was unanswered: how the tasks should be completed? Technology can answer the question.

Technology means classification of techniques. The organizational activities can be taken through different techniques and methods. When the techniques of taking action are classified based on logic and criterion, the technology is specified.

Technology is in kind of method and manner. The issue that how boundary extension units collect data from surrounding environment, how power groups process them and how the structure can circulate the information in the organization and how the organization can solve the problems are associated with organizational technology.

Various scientists worked on technology are introduced here:

a) Woodward: the study was done in 1920 with the technology of that time (age of machinery). The firm sizes were from 250 to 1000 people (small firms). Studied organizations were manufacturing companies and not service companies and the aim was answering the question that is there any correlation between organizational structure and organizational effectiveness or not?

In this study, the scholar found that structural variety is too m\high, which they can't be classified and no correlation can be created between structure and their effectiveness; although he could find an interesting result. If organizations are classified based on used technology, then correlation can be created between organizational structure of each class and the effectiveness. Woodward used the manufacturing technology as the basis of working. He classified organizations based on technical complexity as mechanized degree of production process.

b) Perrow: the definition presented by Perrow (1970) for technology is the measure or method took by person to make change an object, concept or destination; whether the method is mechanical and using instruments or not. It means that there is no correlation between technology with machinery and applied instruments. The analytical level of Perrow's work is in level of organizational units and departments. Perrow emphasized knowledge-based technology. Perrow introduced 2 components and could pave the way for analysis of technology for manufacturing and service companies and also for companies using old and modern technologies and for both small and large departments.

Changeability of function means that the exceptions created for person while working are analyzed in a changeability-repetitiveness process. Analyticity of problem means analysis of type of search procedures to find successful methods to respond exceptions in certain to uncertain process. Perrow (1970) designed a 10-item questionnaire to measure the organizational knowledge-based technology. The questions were asked from employees and the answers were finally presented in the following matrix and organizational technology was determined. Perrow's questionnaire is presented in Table 2.

Perrow mentioned that changeability or task and analyticity of problem are in positive correlation with each other. For example, in jobs with least exceptional tasks, the problems

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can be defined properly and it is hardly possible that a problem happens with low analyticity. Therefore, the four technologies can be combined with two repetitive and non-repetitive dimensions.

Table 1: Perrow's Questionnaire (after Daft, 1998)

Changeability	How much you can say that your work is routine?
	Whether majority of people in this job use same actions or methods?
	Whether the members of circle take repetitive activities?
Analyticity	To what extent the known methods are existed to take major part of your job?
	How much you use known steps in your activities?
	To what extent you use empirical methods and skills in your activities?

The more repetitive technology is, the more formalization, hierarchy, centralization and the more strict control would be. In spite, non-repetitive technology is considered.

c) Thompson: the basis of Thompson is on this basis that each technology can basically cause a kind of technology. Technological dependence of different organizational departments can deform organizational design. The dependence can specify the degree of reliance of an office on other offices (resources and materials to work). Low dependence of departments means that there is no need to match departments since they act independent from each other.

Technology has been divided to 3 classes:

- Operational technology
- Technology in terms of materials
- Knowledge technology or same management and administration knowledge

1. Size: in the studies conducted in this field, it could be claimed that firm size plays insignificant role; although factors in addition to size should be also considered. Kim Burley introduced firm size aspects and measurement indices in 1976:
2. Physical capacity: for example, number of beds in hospital or number of assembly lines in automotive industry
3. Number of employees: the first index coming to mind is this case
4. Volume of inputs and outputs: for example, number of students or faculty members of a university
5. Net properties and capital

The indices are interdependent and can affect each other; although they can be separated.

Organizations grow for various reasons. The main reason for growth of organizations can be organizational goals, achievement to more resources for competition in world scale, achievement to saving caused by scale, attraction of powerful managers, availability and profitability and economic health.

With the growth of organizations and specialization of affairs, separation of departments is increased and the complexity can be caused by this since in addition to increase in number of organizational departments, they should be matched.

In regard with size and technology, it should be mentioned that if organization takes

measure to employ expert people and creates professional departments, this means non-repetitive nature of activities and in fact, non-repetitive nature of technology.

Another important discussion referred in study of firm size can be lifecycle of organization. It means that organization encounters ups and downs during its lifetime and some problems are created for them, which should be met using managerial solutions. If an organization can't solve the problems in the way of its growth, it may encounter retreatment and be collapsed gradually. In rest of paper, the pretreatment process and lifecycle of organization are explained more exactly.

Lifecycle means that an organization is created one day and is grown and is destroyed finally. The studies show that organizations pass 4 important stages:

1) Entrepreneurship stage: while establishment of an organization, it is totally focused on supplying a kind of product and preservation of organization in the market and the founders take whole effort for technical affairs of products and for selling. Organization is informal and bureaucracy is canceled and controlling them is applied by the manager and supervisor. Crisis: leadership is needed. A powerful manager should be employed.

2) Teamwork stage: if the leadership problem of organization is solved, the path of targets is specified, the explanation of duties and administrative hierarchy is created, and the employees become familiar with their responsibilities and cooperate each other in way of success of organization for long time. Relations are informal; although formal teams can be also appeared. Crisis: needs allocation of power and authority

3) Formalization stage: the stage needs integration of attitudes and applying regulations, methods, and implementation of control systems. Relations are weak and mostly formal. Non-centralized groups are created. Experts and staff forces join the organization. Senior management is involved in determining organizational policy and strategy. Crisis: extreme bureaucracy

4) Decision-making stage: organization creates working groups and is divided to various departments and circles. Formal teams change into small and simple departments. It is probable for bureaucracy reach its peak. Social control and continence of people reaches to a point that the formal control problem is canceled. Crisis: needs revitalization: the organization need to revise itself and needs to be renewed after reaching maturity.

5. CONCLUSION

An organization with a vertical structure cannot adequately meet the needs of the technology revolution. Firstly, its multi-layered management structure makes it difficult to exchange ideas and perform new ones. Ideas that form on top or bottom of the organization (especially ideas that are formed in the bottom) must pass through several layers before they reach the other end of the organization. New measures of both layers may be subject to resistance. In multiple layers, the probability that a manager or system will be found that

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causes the idea to be delayed or eliminated increases. The second problem is that specialized teams of professionals gather in one place and outline their boundaries, and sometimes their loyalty to their discipline is more than their loyalty to the entire organization (this can also be seen in the structure). The third problem, the cost of multiple layers and reacting to the changes. The competition in today's world that requires new innovations and quick response to market developments does not work well with vertical organizations, which has led many companies (especially advanced technology companies) to abandon such a structure and face Horizontal and circular structure.

The wave of new thinking calls for a change in the vertical and traditional organizational structure, by removing the boundaries between sectors and tasks and eliminating the organizational hierarchy. In new organizational structures, tasks are accomplished by multi-disciplinary teams organized around a pivotal process (and not a specific task). Commodity development is an example of a central process that requires a team of design engineers, market analysts, strategy designers, and process coach. Sales are also another pivotal process that has its own trustee. This process can also be a team consisting of sales, production, transportation and pricing specialists. After-sales service is also the third pivot process that involves the presence of a team of researchers, service personnel and advertisements that co-operate with the process facilitator to ensure customer engagement. The whole organization is flat (with limited layers) and is run by a boss and a group of senior executives (representing specific tasks such as financial and human resources).

Circular organization structures follow different logic. In this organization structure, multi-expertise groups are defined on basis of organizational processes. Types of services are presented in groups by different people. Organizational relations are usually horizontal. All functions are taken in line with presenting a service (or producing a product) in a common branch under supervision of a person, who is owner and custodian. These structures have little management levels and small senior management team. The structure can meet lots of hierarchical limitations and can also cause slowdown of decision making and implementation process. It can also decrease high costs of management for inter-department relates and organizational hierarchy. It enables organization to consume its resources to provide service for customers (whether the customers within organization or out of organization). There is no doubt that redesign of organization based on process-oriented attitude in sectional organizations is not simple to do and it is not expected that this can be implemented in short-term. However, there are various solutions, which can change the attitude and make culture and support managers and make stages and making integrated plan to make such change possible. This is because; in large international companies with about 10.000 people such changes are taken. The important part is change in thinking paradigm and moving towards process-orientation.

6. REFERENCES

Blue, R., William M. (1969).” Ideas. Complexity, and innovation.” Administrative since quarterly.

Daft, L. (1998). Theory of Organization and Design of Structure, Richard Translation of Parsayeans and Aarabi Publisher: Office of Cultural Studies,

Frankel, S. (2003). *Model Driven Architecture: Applying MDA to Enterprise Computing*, OMG Press, Wiley Publishing.

Hage, J., and Mickael A. (1967). "Relationship of Centralizational to Other Structural properties." Administrative Quarterly, 12

Hammer, M. (2006). Beyond Reengineering, Translation by Abdolreza Rezaee Nejad, Rasaya Publication.

Paul S., Segerstrom T. and Elias D. (1990). "A Schumpeterian Model of the Product Life Cycle" The American Economic Review. Vol. 80, No. 5 (Dec. 1990), pp. 1077-1091

Perrow, C. (1970), "organization analysis. Belmont, CA: wads worth publishing co.

Rahmanzadeh Heravi, M. (2003). Process-oriented Organization, Samain-e-Sarmad Farda Engineering Company.

Richard, H. (1997). Organization. Translation of the Parsaiyan and Aarabi Publisher: Office of Cultural Studies,

Robbins, S. (2017). Organization Theory (Structure, Design, Applications), Dr. Alwani, Dr. Danai Fard, Publisher: Saffar Publications

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GEOMETRIC ANALYSIS OF TIBIOFEMORAL KNEE JOINT: TOWARDS COMPUTER AIDED TREATMENT (CAT) PLANNING

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ARTICLEINFO

Article history:
Received 07 January 2019
Received in revised form 05 March 2019
Accepted 12 March 2019
Available online 14 March 2019

Keywords:
Bone Modeling; Joint Modeling; Varus; Valgus; Joint space width; Anatomic axis Angle; Condylar angle.

ABSTRACT

Two Dimensional Geometric Analysis and Modeling become increasingly important in computer-aided treatment (CAT) planning, non-invasive surgical processes, computer-aided diagnostic (CAD), computer aided modeling (CAM) and disease progression. The purpose of this article is to present a computer-aided geometrical analysis of tibiofemoral joint from knee radiographs from a computing perspective. Lateral and Medial Joint Space Width (JSW), anatomical axis angle (AAA), Femorotibial angle (FTA), Condylar Plateau Angle (CPA), Condylar Angle (CA) and Tibial Plateau Angle (TPA) has been Quantified with novel linear algebra abstractions with an intention to use in 3D Joint Modeling and Animation. Edge pixel Detection, curve modeling, and linear regression have been expended as key methods to estimate anatomical axes and respective angles. Implementation details of methodology have been presented in the form of code listing. Quantification of aforementioned knee parameters has been successfully quantified with 85% accuracy over an originally acquired patient dataset in DICOM (Digital Imaging and COmmunications in Medicine) Format.

1. INTRODUCTION

Bone and Joint Modeling in 2D and 3D become increasingly important with recent advancement in Medical Sciences (Imhauser and Schafer, 2019; Burleson and Dipaola, 2019) for e.g. Orthopedic surgeons need specialized software to decide about bone and joint measurements for treatment and replacement purpose (Belvedere et al., 2018). This new dimension of science and technology lies at the intersection of interesting Engineering and computer science subjects namely: (1) Digital Image Processing (2) Computer Graphics (3) Kinetics and kinematics (Ghorbel et al., 2018; Alnouri et al., 2015; Gonzalez and Woods, 2008; Hill, 2007; Aguado, & Alberto, 2018). This particular paper is written for early-stage computer scientists, engineers, and researchers to build understanding about

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utilizing higher level mathematics and computing for the purpose of building CAD/CAT/CAM software. Figure 1 shows lines and angles to be extracted from human knee radiograph. In Figure 1, Line No. 1 is drawn to visualize femoral anatomic axis. Line No. 2, 3 and 4 represents tibial anatomic axis, Condylar line and Tibial Plateau line respectively (Harvey et. al., 2008). Associated with four lines, there also lies four angles 'a', 'b', 'c', and 'd' which represents anatomic axis angle (AAA), Femoral condylar angle(FCA), tibial plateau angle (TPA) and Condylar plateau angle (CPA) respectively. This work is an extension of previously done edge pixel detection on Knee radiographs [10].

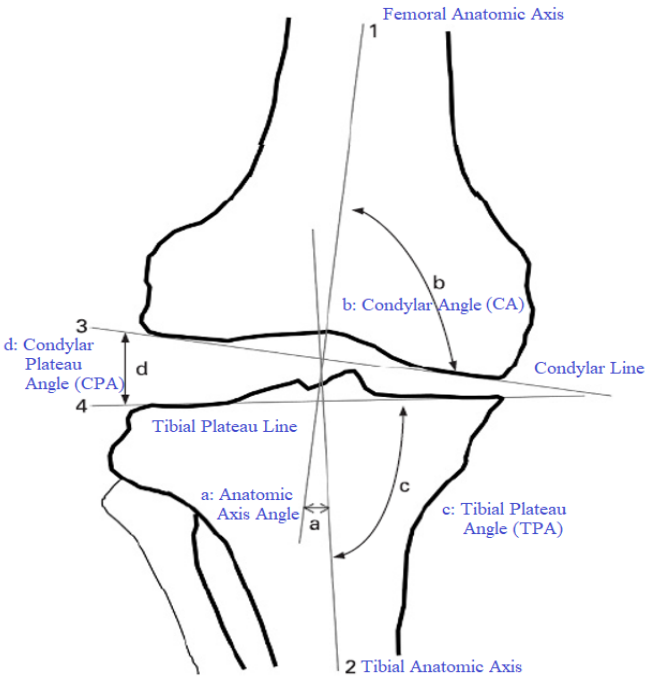

Figure 1: Lines and Angles to be extracted from the Knee (after Harvey et. al., 2008; Harvey and Hundter, 2007).

This paper is organized as follows: Section 2 discusses data acquisition and data preparation. Section 3 and Section 4 revives the theory of drawing lines and curves from edge pixels so that novice programmers and technologists grasp the mathematics and logic that are working behind commercial software which usually acquires point data from spreadsheets (Vitković et al., 2018). Section 5 contains qualitative experimental results and discussion which follows quantification in the same section. Finally, conclusion and future work are presented in Section 6.

2. PRELIMINARIES

Bone and Joint modelings start with acquiring point data which is simply a list of (x,y) pairs of coordinates. These coordinates are basically detected edge pixel from appropriate imaging modality for e.g. this work chooses DICOM images of Knee. All the Processing is done on MATLAB® due to its simplicity and built-in image processing library routines. The very first step is to write code for loading DICOM images, remove patient information and to organize them as per processing criteria for e.g. discriminate them as Male (M) and Female (F) patients as shown in Figure 2.

The first step is to prepare data for processing by automation of four preliminary steps: (1) Isolate Knee Images (2) Renaming (3) Cropping (4) Resizing. After Organizing data separately into two folders, the next step is to determine whether the current DICOM image contains the right knee or

```
clearvars;
close all;
workspace;

% Define some top-level folder.
start_path = cd
topLevelFolder = uigetdir(start_path)

datasets=dicom_folder_info(topLevelFolder,true);

[m n] = size(datasets)

for i = 1:n
      if(strcmp(datasets(i).SeriesDescription,'Knee AP'))

       datasets(i).SeriesDescription;
       info = datasets(i).DicomInfo;
       pName = info.PatientName;
       pName = char(struct2cell(pName(1:end)));

       fileName = char(strcat(pName,{'.dcm'}));

       I = dicomread(char(datasets(i).Filenames));
       dicomwrite(I, fileName,info, 'CreateMode', 'copy');
       age = char(info.PatientAge);
       age = age(1:end-1)
       d = sscanf(age,'%d')
       if(strcmp(info.PatientSex,'M'))
          movefile(fileName,strcat('Male/',fileName));

       else
          movefile(fileName,strcat('Female/',fileName));
       end

      end
end
```

Figure 2: Code Listing I- DICOM loader and Organizer.

left knee or both within single image space. If it contains both knees, then it needs to split into left and right knee through cropping. Cropping is comparatively a simple operation which involves extracting a pre-select rectangle portion from image space as shown in Figure 3. The images have been acquired in an entirely raw format from Esa Lab, Karachi, Pakistan for research purpose. The raw data needs specialized preprocessing for e.g. Figure 4 shows collect data from Esa lab. It contains per day scan of all types of scan for e.g. chest, knee, arm, foot in a multi-level folder of size 7GB on disk. Different libraries use different origin for cropping and spatial operation. The most frequent origin is considered right top corner instead of the bottom left corner of the whole image. With respect to the right top corner, the left half rectangle comprises of (right, top, width/2, height) while right half rectangle becomes (width/2, 0, width/2, height), see Figure 4. The third basic operation is resizing. The size property of DICOM image is not exposed or read directly, instead dedicated lines of code has been written to capture properties of DICOM in an 'info' series data structure as shown in Figure 4. DICOM are high-resolution images for e.g 3480 X 2125 and thus need resizing to 128 x 128 keep processing time optimal and uniform across all images, Figure 5.

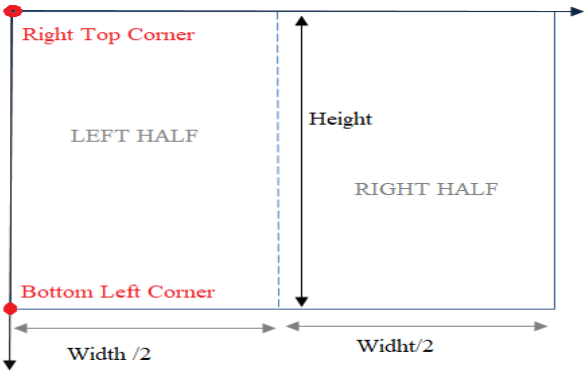

Figure 3: Cropping DICOM into Two Halves.

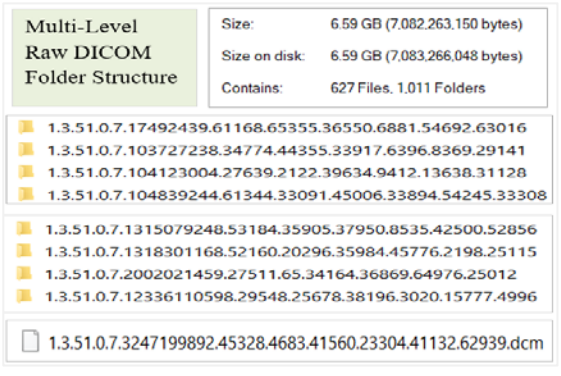

Figure 4: DICOM File Structure.

```
im = dicomread([filepath filelist{ind}]);
size(im);
info = dicominfo([filepath filelist{ind}]);
im=imresize(im,[256 256],'bicubic');
```

Figure 5: Code Listing II- Image Resizing.

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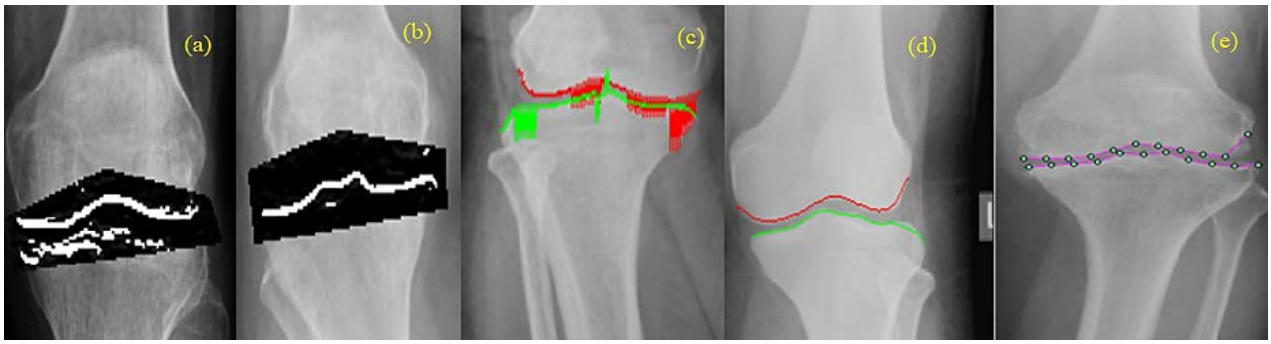

Figure 6: Code Listing II- Image Resizing

3. LITERATURE REVIEW

As we told in Section I that current work is an extension of existing work (Tariq, and Burney, 2012). Previous work covers pixel edge detection and contour formation of femoral and tibial condyle as shown in Figure 6. The Edge pixel detection process is done twice to detect upper and lower condyle pixels respectively as showing in Figure 6 (a) and Figure 6 (b). Special care is taken while selecting ROI for lower condyle otherwise noise increases afterward. Multiplying (dot multiply in MATLAB) this mask with the original image results in a new image with all the undesired (masked) parts of the image set to black. This masked image is of type single. The original image is of type uint8; Mask is of type logical; Multiplication with original image yields single (just like float takes 4 bytes, value b/w 0 &1) as shown in Figure 7. Two new images J1 and J2 have been created by applying Prewitt edge detector and its reflected counterpart as follows:

```
J1 = roifilt2(h1 ,im,inMaskImage);
J2 = roifilt2(h2 ,im,inMaskImage);
```

Figure 6 (a) and Figure 6 (b) are actually J1 and J2. Conditions have been designed to modify J1 and J2 So that they only contain condylar pixels and rest of the false detection will be eliminated. The very first condition demands for restoring original pixel values outside the mask area while the second condition requires setting the value of the pixel to white if it is true candidate condylar edge pixel, See Figure 7. The reader easily observes the appearance of false detections by edge detectors which need special attention for excluding them from the candidate pixel list. Masking is an intelligent idea to restrict processing to particular pixels to save computation over the whole image of size N X N. Function roipoly is used to get the desired portion of the image from the user through mouse interaction at runtime as shown in Figure 8, Code Listing III.

```
if  ( i< min(X) || i> max(X) && j > min(Y) || j < max(Y))
                    J1(i,j) = round(J1(i,j) *0.95) ;
                    J2(i,j) = round(J2(i,j) *0.95) ;
```

```
[r c] = find(inMaskImage> 0);
for i = 1 : length(r)
for j =1 :length(c)
   if  (inMaskImage(r(i),c(j))> 0 && J1(r(i),c(j)) > 40)
                    J1(r(i),c(j)) = 255;
end
end
```

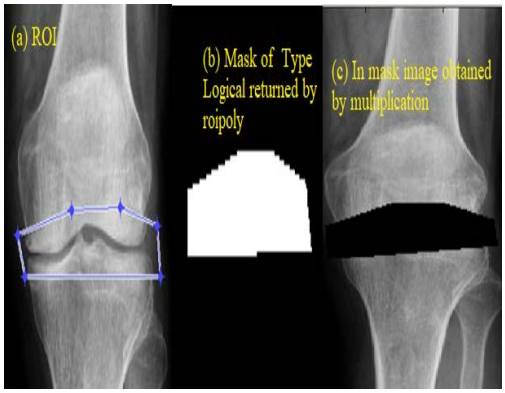

Figure 7: (a) ROI Selection (b) Logical Mask (c) In-Mask Image.

```
[BW X Y] = roipoly();
if (length(X) < 6)
message = sprintf('Wrong input,Select ROI
again');
uiwait(msgbox(message));
          axes(hAxes(ind));
          [BW X Y] = roipoly(im);
end

line(X, Y, 'Parent',hAxes(ind),'color','w')
 ROI = [X  Y];

%row vector with x1 y1 x2 y2
ROI_array = reshape(ROI',1,[]);

for i =1: length(ROI_array)
ROI_Matrix(ind,i)= ROI_array(i);
end

ROI_Matrix;

mask = poly2mask(X,Y,size(im,1),size(im,2));

imshow(mask);
class(mask)   % logical type image
inMaskImage = mask .* single(im);
imshow(inMaskImage);
```

Figure 8: Code Listing III- Masking and ROI Selection

4. SMOOTHING AND SAMPLING

Till this end, we were able to visualize edge pixels as white pixels overlay on original images namely J1 and J2 showing upper and lower condyle pixels respectively. Next step is to connect edge pixel to form a curve. Consider a few observations from sample data obtained during experimentation and analysis:

Edge-Pixels = [(80,128), (80,129), (81,128), (81,129), (81,130), (82,129), (82,130),
(82,140), (82,141), (83,129), (83,130)]

Frequency analysis of the above data yields the following results:

Frequency = [2 3 4 5 6 5 6 6 7 6]

For every x-coordinate, there exist multiple values for e.g: for x=82, there exist four possible outcomes y= 129,130,140,141 i.e. one to many correspondences exist which need to transform into one to one mapping. The rule is to pick minimum y-coordinate for the upper femoral condyle curve while picking maximum y-coordinate for lower tibial condyle curve. Comments are also shown for reader convenience and reproducibility of work. There still need another step to get smooth condylar curve namely interpolation. Below is sample data after noisy observation elimination which now shows that there are many missing values against given x-coordinate and thus need fixing this issue. Here comes spline to rescue the situation. To do so, we need to find the minimum, maximum and missing values of observations. To create equal space samples, we have used a spacing of $(\max - \min)/(samplePoints)$. The drawing approach just discussed is the parametric approximation of curve $P(t) = \big(x(t), y(t)\big)$ $0 \le t \le 1$. Sequence $\{t_i\}$ is chosen and for each $\{t_i\}$, x *and* y is found at that particular instance t (Hill, 2007). Code to do spline interpolation is shown in Figure 10 as Code Listing V. Figure 11 shows an important scenario when two curve overlap each other. Computation and analysis of along vertical axis is presented in Code Listing IV.

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```
n11=length(UniXY11(:,1));
xplot=min(UniXY11(:,1)):(max(UniXY11(:,1))-
min(UniXY11(:,1)))/10000:max(UniXY11(:,1));

yplot=spline(UniXY11(:,1),UniXY11(:,2),xplot);

yplot = smooth(yplot,0.1);
plot(xplot,yplot,'color', 'r');
```

Figure 10: Code Listing of Spline Interpolation

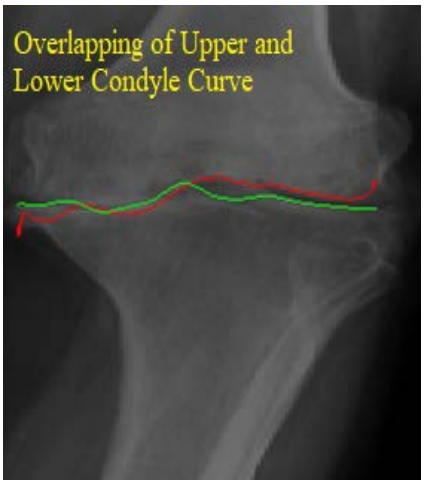

Figure 11: curve overlapping

```
for z = 1: length(Number1)                % z is row no and Number1 is x value i.e.
                                          %80,81,82.....
if ( numTimesInMatrix1(z) >1)       % if frequency is greater than 1 which
                                          %is almost true for everyx
            count1 = numTimesInMatrix1(z); % get frequency in count1 say 4 times
            num1 = Number1(z);             % get x value in num1 say 80
            id1 = find(UniXY1(:,1)==num1); % find index corresponding to multiply
                                          % x values say 80
            X1 = UniXY1(id1,1);            % get x at that indexes
            Y1 = UniXY1(id1,2) ;           % get y at that indexes
            Ymin = min(Y1);    % get the miny value amongst all for upper condyle
            UniXY1(id1,1) = X1 ;     % now x remains same in uppercondyle array
            UniXY1(id1,2) = Ymin;% replace all y's with min Y
end
end
for z = 1: length(Number2)  % z is row no.
if ( numTimesInMatrix2(z) >1)
            count2 = numTimesInMatrix2(z);
            num2 = Number2(z);
            id2 = find(UniXY2(:,1)==num2);
            X2 = UniXY2(id2,1);
            Y2 = UniXY2(id2,2) ;
            %Ymax = max(Y1);  % lower condyle
            Ymax = mean(Y2);  % lower condyle
            UniXY2(id2,1) = X2 ;
            UniXY2(id2,2) = Ymax;
end
end
imshow(im);
hold on;
%plot of unique spatial coordinates of upper condyle
[UniXY11,Ix]=unique(UniXY1,'rows'); plot(UniXY11(:,1),UniXY11(:,2),'color','r');
%plot of unique spatial coordinates of lower condyle
[UniXY22,Ix2]=unique(UniXY2,'rows'); plot(UniXY22(:,1),UniXY22(:,2),'color','g');
```

Figure 9: Code Listing IV Eliminating noisy and redundant observations

5. GEOMETRIC ANALYSIS AND RESULTS

Linear regression has been in practice since long by surgeons in literature for drawing of the anatomical axis from knee radiographs (Okamoto et. al., 2014), (Goulston et. al., 2016), (Colebatch et. al., 2009), (Harvey, and Hundter, 2007). In our case, samples have been successfully generated using spline interpolation in the form of two vectors $X_{Upper} = [x_1, x_2, x_3, \ldots\ldots x_n]$and $Y_{upper} = [y_1, y_2, y_3, \ldots\ldots y_n]$. Similarly $X_{lower} = [x_1, x_2, x_3, \ldots\ldots x_n]$ and $Y_{lower} = [y_1, y_2, y_3, \ldots\ldots y_n]$.

It has been observed from Figure 1 that Condylar Line labeled as 3 and Tibial Plateau Line labeled as 4 has been passing through extreme points of the upper and lower condylar curve thus regression through curve points employ subset of both $P_{upper} = (x_{upper}, y_{upper})$ and $P_{lower} = (x_{lower}, y_{lower})$. Selection requires trimming at both ends of upper and lower point lists. Linear Regression to draw Condylar and Tibial Plateau Line is expressed as follows:

$$y_{condyler} = \beta_0 + \beta_1 X_{Upper}^{Extreme} \quad (1).$$

The notation $X_{Upper}^{Extreme}$ is used to represent selected extreme xy coordinates from Upper Point list. These points are shown in magenta color on upper condyle while with Pale yellow on lower condyle as Candidate pixels for Regression. Similarly,

$$y_{tibeal\ plaeau} = \alpha_0 + \alpha_1 X_{Upper}^{Extreme} \quad (2).$$

To determine midpoint as anatomical axis passes through it mean of estimated spline curve data has been used as shown in EQ (3) and Figure 13 (a):

$$P_{mid-central} = (mean(X_{lower}), mean(Y_{lower}) \quad (3)$$

Next User is asked to input two points manually on the femur and tibial bone with the help of which further mid-points has been determined. Joining femur and central midpoint results in femoral anatomical axis (FA) while joining tibial and central mid-point results in tibial axis (TA) as shown in Figure 13 (b). The line has been drawn parametrically using Equation (4):

$$P(t) = A + (B - A)t \quad 0 \le t \le 1 \quad (4)$$

Since both anatomical axes have drawn successfully so it is now easy to determine anatomic axis angle (AAA) or Femoral Tibial Angle (FTA) as follows:

$$\bar{v}_{FA} = P_{mid}^{Femur} - P_{mid-central} \text{ , and}$$

$$\bar{v}_{TA} = P_{mid}^{Tibia} - P_{mid-central}$$

$$\theta_{AAA}\,(degrees) = cos^{-1}\left(\frac{\bar{v}_{FA}.\bar{v}_{TA}}{\vdots\widehat{v_{FA}}\vdots\ .\vdots\widehat{v_{FA}}\vdots}\right) * \left(\frac{180}{PI}\right) \quad (5)$$

The Condylar Plateau angle (CPA) between two regression lines can be estimated similarly by finding two appropriate direction vectors and taking cosine inverse of them. First direction vector $\bar{v}_{TP}$ is along tibial plateau regression line, shown in Magenta color on the right side in Figure 12, Figure 13 and Figure 14 respectively. The second direction vector $\bar{v}_{FP}$ is along Femoral Plateau regression line shown in Blue in same figures. Thus CPA calculation is possible by implementing Equations (6) and (7) in a system. Same direction vector logic is used to find the Tibial Plateau angle (TPA) and condylar angle (CA).

$$\bar{v}_{FP} = P_{FP}^{B} - P_{FP}^{A} \quad (6),$$

$$\bar{v}_{TP} = P_{TP}^{B} - P_{TP}^{A} \quad (7),$$

$$\theta_{CPA}\,(degrees) = cos^{-1}\left(\frac{\bar{v}_{FP}.\bar{v}_{TP}}{\vdots\widehat{v_{FP}}\vdots\ .\vdots\widehat{v_{TP}}\vdots}\right) * \left(\frac{180}{PI}\right) \quad (8).$$

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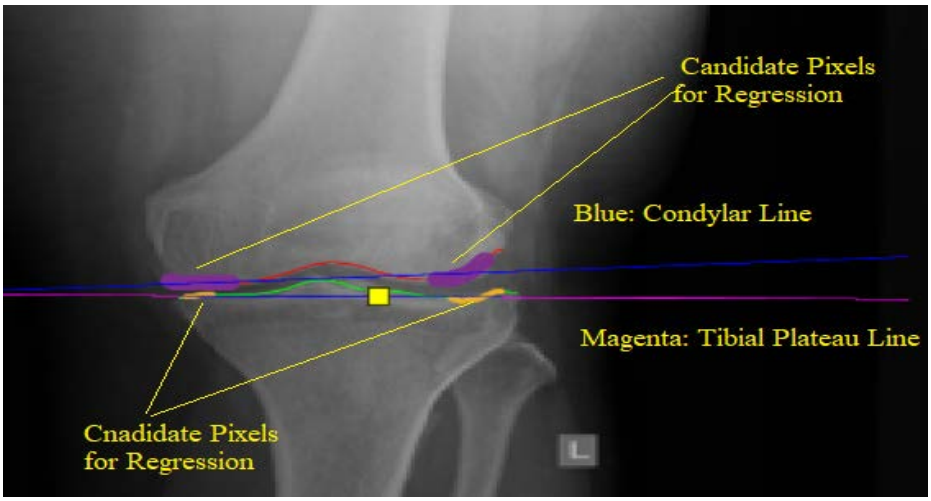

Figure 12: Candidate Pixels for Regression

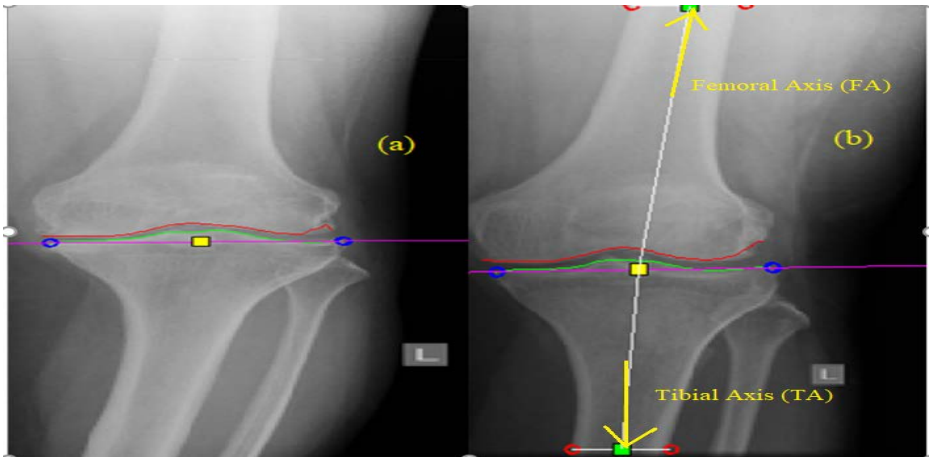

Figure 13: (a) Mid-Point (b) Femoral and Tibial Anatomic Axis.

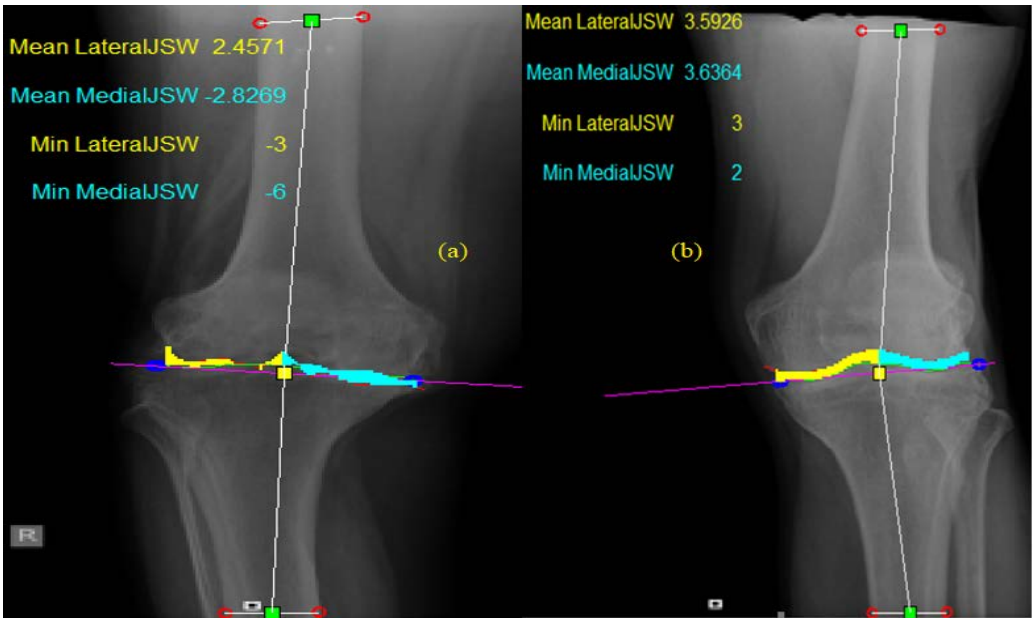

Figure 14: Joint Space Width (JSW) (a) negative JSW (b) Positive JSW

After building geometric interpretation of four angles Anatomical Axis Angles (AAA), Condylar Plateau Angle (CPA), Tibial Plateau Angle (TPA) and Condylar angle (CA), it is also possible to measure lateral and medial Joint space width between two condylar curves. This build a six-

dimensional feature vector x to represent a tibiofemoral joint ***x***=(AAA ,CPA,TPA,CA,MJSW,LJSW) for further analysis. The intersection between lower and upper condylar spline curves has been used to measure Joint space width (JSW) along y-axis:

$$Y_{common} = Y_{lower} \cap Y_{upper} \tag{9}$$

Intersection list of y-coordinate is used to search (x,y) points on the lower and the upper Condylar curve. Once the corresponding list of (x', y') pairs has been found, JSW measurement simply become the matter of finding the vertical distance between these pairs as shown in Equation (10) and Figure 14. The more detailed visualization and results can be read from Figure 15.

$$JSW = Y'_{lower} - Y'_{upper} \tag{10}$$

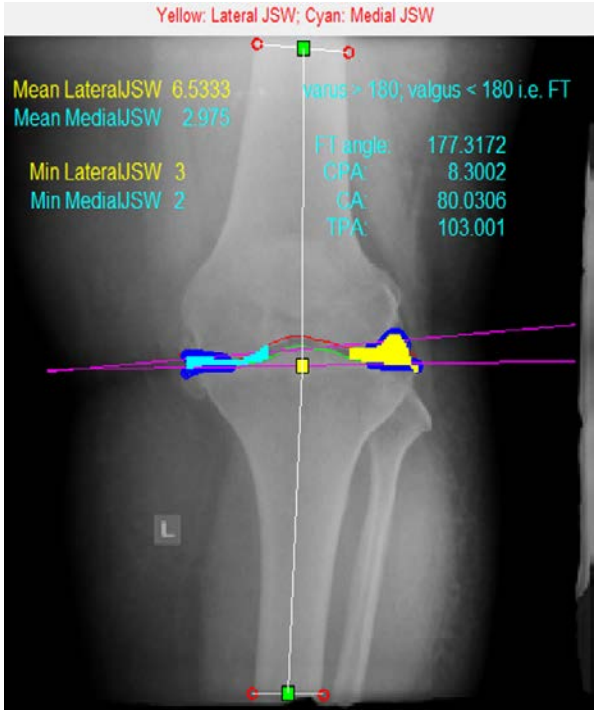

Figure 15: Results of Geometric Analysis

Table I: Statistical analysis.

NO	Quantified Results		
	Parameter	***mean***	***std***
1	Mean/Min Median JSW	3.6400 / 2	1.5
2	Mean/Min Median JSW	2.8393/2	2.0
3	Anatomical Axis Angle (AAA)	175.1981	3.3407
4	Condylar Angle (CA)	92.7556	17.0083
5	Tibial Plateau Angle (TPA)	86.6046	11.3131
6	Condylar Plateau Angel (CPA)	6.2177	4.4069

Table I shows the results computer over 40 osteoarthritis patients showing all six mentioned knee parameters. Condylar angle seems to have maximum standard deviation showing some serious improvements needed.

6. CONCLUSION AND FUTURE WORK

Geometric Analysis of Knee Anteroposterior (AP) radiograph has been successfully done to quantify six important knee parameters as shown in Table I. Geometric analysis is accompanied with interesting linear algebra constructs to be used in computer-aided software for automation and treatment planning. All the work has been implemented on MATLAB® and the complete software can be downloaded from the authors' website. Future work comprises validation and improvement of discussed techniques from medical experts especially orthopedic surgeons. Another future dimension is an extension of 2D analysis into 3D analysis for 3D modeling of bone and joints.

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7. ACKNOWLEDGMENT

We are thankful to ESSA LABORATORY, KARACHI, PAKISTAN for providing data for academic and research purpose.

8. REFERENCES

Aguado, & Alberto. (2018). *U.S. Patent No. 10062197, 15/421852*. Washington, DC: U.S. Patent and Trademark Office. Animating a virtual object in a virtual world

Alnouri, M., Saei, J. A., Younis, M., Bouri, F., Habash, M. A., Shah, M. H., & Dosari, M. A. (2015). Comparison of Edge Detection Algorithms for Automated Radiographic Measurement of the Carrying Angle. *Journal of Biomedical Engineering and Medical Imaging,2*(6). doi:10.14738/jbemi.26.1753

Belvedere, C., Siegler, S., Fortunato, A., Caravaggi, P., Liverani, E., Durante, S., Leardini, A. (2018). A New Comprehensive Procedure For Custom-Made Total Ankle Replacements: Medical Imaging, Joint Modeling, Prosthesis Design, And 3D Printing. *Journal of Orthopaedic Research*. doi:10.1002/jor.24198

Burleson, J., & Dipaola, C. (2019). 3D Printing in Spine Surgery. *3D Printing in Orthopaedic Surgery,*105-122. doi:10.1016/b978-0-323-58118-9.00010-5

Colebatch, A. N., Hart, D. J., Zhai, G., Williams, F., Spector, T. D., & Arden, N. K. (2009). Effective measurement of knee alignment using AP knee radiographs. *The Knee,16*(1), 42-45. doi:10.1016/j.knee.2008.07.007

Ghorbel, E., Boutteau, R., Boonaert, J., Savatier, X., & Lecoeuche, S. (2018). Kinematic Spline Curves: A temporal invariant descriptor for fast action recognition. *Image and Vision Computing,77*, 60-71. doi:10.1016/j.imavis.2018.06.004

Gonzalez, R. C., & Woods, R. E. (2008). *Digital image processing*. New Jersey: Parson.

Goulston, L., Sanchez-Santos, M., Dangelo, S., Leyland, K., Hart, D., Spector, T., . . . Arden, N. (2016). A comparison of radiographic anatomic axis knee alignment measurements and cross-sectional associations with knee osteoarthritis. *Osteoarthritis and Cartilage,24*(4), 612-622. doi:10.1016/j.joca.2015.11.009

Harvey, W. F., Niu, J., Zhang, Y., Mccree, P. I., Felson, D. T., Nevitt, M., . . . Hunter, D. J. (2008). Knee alignment differences between Chinese and Caucasian subjects without osteoarthritis. *Annals of the Rheumatic Diseases,67*(11), 1524-1528. doi:10.1136/ard.2007.074294

Harvey, W. F., & Hundter, D. J. (2007). *Knee alignment and Incident Osteoarthritis*(Rep.). Boston University Medical Cneter.

Imhauser, C., & Schafer, K. (2019). *U.S. Patent No. US010198968B2*. Washington, DC: U.S. Patent and Trademark Office.

Method for Creating a Computer Model of a joint for Treatment Planning

Oka, H., Yoshimura, N., Muraki, S., Mabuchi, A., Nakamura, K., & Kawaguchi, H. (2007). 331 Fully Automatic Quantification Of Knee Osteoarthritis Severity On Standard Radiographs By A Novel Computer Assisted System. *Osteoarthritis and Cartilage,15*. doi:10.1016/s1063-4584(07)61962-1

Okamoto, S., Mizu-Uchi, H., Okazaki, K., Hamai, S., Tashiro, Y., Nakahara, H., & Iwamoto, Y. (2014). Two-dimensional planning can result in internal rotation of the femoral component in total knee arthroplasty. *Knee Surgery, Sports Traumatology, Arthroscopy,24*(1), 229-235. doi:10.1007/s00167-014-3370-1

S., H. J., & M., K. J. (2007). *Computer Graphics Using OpenGl*. Upper Saddle River NJ: Prentice Hall.

Tariq, H., & Burney, S. M. (2012). Contour Extraction of Femur and Tibia Condyles on Plain Anteroposterior (AP) Radiograph. *International Journal of Computer Applications, 52*(15), 26-30. doi:10.5120/8278-1893

The MathWorks, Inc. (n.d.). MATLAB Image Processing and Statistics Toolbox (Version 2014a) [Computer software].

Vitković, N., Mladenović, S., Trifunović, M., Zdravković, M., Manić, M., Trajanović, M., . . . Mitić, J. (2018). Software Framework for the Creation and Application of Personalized Bone and Plate Implant Geometrical Models. *Journal of Healthcare Engineering,2018*, 1-11. doi:10.1155/2018/6025935.

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INVESTIGATION OF THE SHOOT LENGTH, NUMBER OF LEAVES, LEAF AREA, FRESH AND DRY WEIGHT OF BRANCH, ROOT, AND LEAF OF THE WHITE SEEDLESS GRAPE

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ARTICLEINFO

Article history:
Received 24 December 2018
Received in revised form 11 March 2019
Accepted 12 March 2019
Available online
15 March 2019

Keywords:
Water stress condition; Drought resistance; Growth Traits, Drought Stress, Mycorrhiza; Horticulture; Grapevine.

ABSTRACT

To determine impacts of infected roots of seedless white currant grape with three species of Mycorrhizal fungi (Glomus fasiculatum, Glomus intraradices, and Glomus mosseae) on growth traits (shoot length, number of leaves, leaf area, fresh and dry weight of branch, root and leaf) under the water stress conditions, this factorial experiment was implemented in the randomized complete block design with four treatments. The obtained results showed that the increase in drought stress led to a reduction in the factors including shoot growth, number of leaves, leaf area, dry weight of root and shoot. Inoculation with mycorrhizal fungi had a positive effect on the above-mentioned traits compared with the control group; in this case, among fungal treatment traits, the Glomus mosseae had the highest effect on the shoot length. All of three funguses had an impact on the fresh weight of leaf and reduced temperature of leaf area. There was not any difference between irrigation levels of 25 and 50% under the water stress; there was not also any difference between the average length of the shoot at irrigation levels of 50 and 75%.

1. INTRODUCTION

Being one of the main horticultural products in Iran, the grape is the first rank among fruit trees in terms of cultivation area and ranked after pistachio and date palm economically [1]. The origin of grape cultivars is a debatable issue for experts. In particular, there is no agreement on the early or second places of domestication grapevine from the wild grape, introduced the Near East Region as the early place for grape creation based on the plant geological and archaeological studies. Herbal archeological studies suggest that grape domestication has begun since the second half of the fourth

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millennium BC in two neighboring areas, Mezopotamia (southern Anatolia, Syria, northern Lebanon, Kurdistan, and western Iran) and south of Caspian Sea. Water scarcity is an important factor, which limits the function of fruit trees in arid and semi-arid areas. Functional assessment of fruit trees under stress conditions and application of beneficial soil microorganisms as biological fertilizers to reduce damages caused by environmental stresses are novel solutions in sustainable agriculture in arid and semi-arid regions to reduce pollutions and environmental degradation [2, 3]. The term of Mycorrhizal indicates the symbiotic association between fungi and plant roots, which is the most common symbiosis. Mycorrhiza is formed by the fungal penetration into the intercellular spaces of rootstock in which, a network of fungus hyphae form a colony over the root. The fungal coating can expand itself in the soil and facilitate the water uptake [4]. Reduced atmospheric precipitation and improper distribution of rainfall, as well as water stress during sensitive grape growth periods, are the factors decreasing function and quality of grape in many regions in Iran.

2. THEORETICAL LITERATURE

Grapevine is from the Ampelidaceae family called Saramantaceae or Vitacae. This family belongs to the Rhamnales specie, which is Dialypetalae belonged to the angiosperms from the Spermatophytes. As drought is the significant geographical characteristic of Iran, there is not any way out of this natural phenomenon, and as there is increasing consumption of energy resources, water, and nutrients, some practices such as correct exploitation of water should be done through correct farming methods like planting resistant species, recognizing the relation between water deficit, soil and growth of products at each step, assessing morphological, physiological and metabolic reactions, identifying the beneficial associations in plants in exposure to the stress, transferring resistant traits to abundant but sensitive cultivars into the land and some other cases, which develop plantation in arid regions [5]. The most important Iranian cultivars include white and red seedless grape, Askari, Yaghooti, Shahroodi, Shahani, Rishbaba, Peykani, Fakhri, Reshe, Sahebi, and other cultivars. All of the edible grapes in Iran belong to the Vinifera species [6].

2.1 DROUGHT STRESS

Drought is defined as environmental conditions in which, soil or air prevent from enough water uptake by the plant, which leads to loss of critical function and water in plant's tissue [7]. Drought is a factor, which limits the production of agricultural products in the world leading to considerable damage to such produces. Average rainfall in Iran is lower than one-third of the world [8]. Drought stress affects the morphological traits of the plant such as leaf area, shoot growth and root expansion, plant pigments, fresh and dry weight of leaf and root, physiological traits such as leaf's water potential, stomatal resistance, relative water rate of leaf, photosynthesis activity, photosynthetic adsorption of CO2, evaporation and Proline accumulation [9, 10].

2.2 DROUGHT STRESS AND PHOTOSYNTHESIS

Under water stress conditions, plant apertures are closed and therefore CO_2 concentration in Mesophile tissue is reduced; such condition disturbs dark photosynthesis reactions and the products obtained from light reactions (ATP and NADPH) are not consumed. Under such conditions, consumption of NADP+ is reduced for electron capture due to lack of ADPH oxidation; therefore, Oxygen molecule performs as an electron substitute receiver through the electron transfer chain forming superoxide radical (O_2^-), hydrogen peroxide (H_2O_2) and Hydroxyl radical (OH^-)[11].

Drought stress in grapevine dries the petioles, ivy and young leaves on the shoots. Moreover, long drought stress may create necrotic spots on the margin of grape leaves; these spots can be seen in lower leaves on the branch. Leaf color also indicates the effect of drought stress so that young leaves on the shoots are green to yellow and mature leaves show gray-green color. Drought stress leads to early aging in lower leaves. Severe drought stress reduces the number of branches and leaves as well as evaporation rate [12].

2.3 MYCORRHIZAL FUNGI

The term "mycorrhizal" was introduced by Frank in 1885; this term is composed of two words "Myco", which means fungus and "Rhiza", which means roots indicating symbiosis between the fungus and plant roots. In this system, the fungus forms the broad cover of the filamentous called hyphae around the host plant's root. Many plants can form mycorrhizal system; 83% of Dicotyledon and 79% of Monocotyledon plants can develop a mycorrhizal system [13, 27].

2.4 MYCORRHIZAL FUNGI IN GRAPE

Nowadays, Vinifera grape species is cultivated in regions with enough rainfall within rain fed form and due to its drought and limestone soil resistance [14]. However, severe drought stresses in some years reduce the function rate at sensitive phonological steps such as fruit formation time. On the other hand, plantation of one-year-old seedlings in these arid regions makes problem in initial years owing to water deficit and improper soil. In addition to the use of resistant and premature cultivars, resistant bases and water management (rainwater harvesting, limited irrigation, and regional irrigation or PRDI), rootstock of grapevine is infected with mycorrhiza fungus (*Arbuscular* Mycorrhizal fungi(AMF)) in order to develop gardens in arid and semi-arid regions [15].

It is reported that medium drought stimulates mycorrhiza colonization. Under limited irrigation conditions (30% of water requirement), a number of arbuscular in grapevine hairy root is higher than its number under the standard irrigation conditions (60% of water requirement). Accordingly, an increase in mycorrhiza colonization and stimulation of grapevine to create deeper roots leads to drought condition, which creates higher resistance. Nevertheless, grape resists against the drought stress by using stomatal adjustments and moving leaves to prevent the contact between leaf and light beside the two mentioned factors [16].

3. MATERIALS AND METHODS

3.1 EXPERIMENTAL MATERIALS, PLAN, AND TREATMENTS

This study was conducted to improve nutritional situation, soil fertility and growth of white seedless grape under drought stress conditions; in this case, effects of inoculated one-year grape seedlings with several mycorrhiza funguses was examined on the water and nutrition relations under low irrigation conditions in the pot compared with the control group (without inoculation). This study was done during two years (2013-2014) in the form of a factorial experiment in the randomized complete block design with four treatments. The factors included inoculation with three mycorrhiza fungus species (Glomus mosseae, G. fasciculatum, and G. intraradices) and without inoculation (four levels), and irrigation at three levels (stress levels). The soil bed of the pot composed of wind sand and crop soil in equal amount. The white seedless grape cuttings were prepared then rooted in the wind sand using Mamarov method. Half of the seedlings were inoculated in the Arbuscular

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Mycorrhizal (AM) fungi suspension at the same bed and rest of them were used as the control samples.

3.2 PREPARATION OF MYCORRHIZA PLANTS

Mycorrhiza fungus inoculums (spore, mycelium, mycorrhizal roots, and soil) were taken from the Turan Biotechnology Company of Shahrood and propagated on Sorghum roots. To produce mycorrhizal seedlings, woody white seedless grape were put on the rhizogenic antiseptic rootstock sand bed, which has been mixed with Mycorrhizal fungus inoculum based on the 15:1000 ratio then sampling was done at each week in order to make sure of root colonization. Staining the root with Trypan blue 05% and making sure of colonization, colonization percent of roots was determined at the final step. Rooted seedlings, which were inoculated with mycorrhiza fungus at next step (end of winter), were put in 20-liter plastic pots. The seedlings were pruned as twin buds in early spring. After 20-cm vegetative growth and plantation of seedlings, drought stresses were imposed as follows: the usable water for the plant was calculated based on the weight percent of agricultural capacity and wilting point then this rate was expressed as weight vale by consideration of the pot soil weight. Accordingly, the obtained usable water and stress treatments were applied. Irrigation treatments included 35, 55 and 75% of usable water (agricultural capacity), which were not applicable in 100% capacity due to constant need of water. According to the surveys, the irrigation plan was implemented within 2 days, 4 days and 6 days. To determine the physiochemical situation of the soil composition used for plantation of rooted seedlings, a soil sample was sent to the laboratory. The obtained results are reported in Table 1.

Table1. Results of soil analysis

Row	Characteristic	Unit	Value	Value	Value	Optimal range
1	Depth	cm	0-30cm	30-60cm	60-90cm	-
2	Electrical conduction (EC*10^3)	Ds/m	1.61	-	-	<2
3	Acidity (PH)	-	7.43	-	-	5.5-6.7
4	Saturation percent (SP)	-	34	-	-	40
5	Lime percent ($Caco_3$) (T.N.V)	%	9.4	-	-	<15
6	Organic carbon percent (O.C)	%	0.16	-	-	>2
7	Total nitrogen percent (T.N)	%	0.02	-	-	>0.2
8	Available phosphorous (P_{ava})	Mg/kg	2.5	-	-	>15
9	Available potassium (K_{ava})	Mg/kg	154	-	-	>350
10	Clay percent	%	14	-	-	20-30
11	Silt percent	%	14	-	-	30-40
12	Sand percent	%	72	-	-	30-40
13	Soil texture	-	Sa.L	-	-	Loam, clay loam
14	Copper (Cu)	-	1.23	-	-	-
15	Iron (Fe)	-	5.91	-	-	-
16	Manganese (Mn)	-	4.03	-	-	-
17	Zinc (Zn)	-	0.528	-	-	-

Grape shrubs were monitored completely during the growing season and irrigation regimes were done for seedlings during 3 months. Before applying water treatments, length of branches and number of leaves were measured in all treatments. At the end of the experiment, morphological traits during growth season and end of the season were measured in order to examine effects of treatments on various traits such as leaf area, fresh and dry weight of leaf and shoot growth.

3.3 FRESH AND DRY WEIGHT OF ROOT AND SHOOT

To examine the effect of treatments on some of the vegetative traits of grape in all water treatments at the end of the experiment, one pot was selected randomly from each experimental unit

and shrubs with their roots were removed from the pot. Measuring the height of shrub (by using a ruler), each shrub was divided into three parts of leaves, shoot and roots. Then, a number of leaves, leaf area (using graph paper) and fresh and dry weight of leaves, shoots, and roots (using a digital scale with a precision of 001 / g) were measured. To determine dry weight, different organs were put on the oven under 70°C for 72 hours.

3.4 MEASURING HEIGHT OF PLANT

The height of the plant from the soil surface to nodes 8 and 9 and the end of shrub was measured separately in two steps within the one-month interval.

3.5 STATISTICAL ANALYSIS OF DATA AND APPLIED SOFTWARE

Before data analysis, normal distribution of data was examined using a Kolmogorov-Smirnov test (K-S) through SPSS® Software. Variables with non-normal distribution were standardized using suitable conversions. SAS® software was employed for analysis of variance (ANOVA) and a comparison of the measured traits. Means were compared using Duncan's multi-domain test. Moreover, Excel software was used to plot charts.

4. RESULTS AND DISCUSSION

4.1 ANOVA RESULTS

Table 2 shows ANOVA results of the effects of mycorrhizal fungus treatments and water stress on the growth traits of leaf and branch length.

Characteristics of leaf and branch (fresh weight, area, and number of leaves, branch length)

To examine and compare mean values of different fungal and water treatments for variables with significant effect, LSD test was performed at 5% level.

Table 2: ANOVA of leaf and branch's characteristic

Change source	df	Mean square			
		Fresh weight of leaf	Leaf area	Average number of leaves	Average length of branch
Fungus	3	0.431**	321.335*	30.28*	328.29**
Irrigation	2	0.032^{ns}	123.216^{ns}	37.66*	575.63**
Fungus × irrigation	6	0.207^{ns}	76.692^{ns}	7.56^{ns}	45.97^{ns}
Error	36	0.095	108.946	8.66	42.01
Change (%)		15	12	16	14

ns: lack of significant difference ** and * indicate significant difference at 1% and 5% levels, respectively.

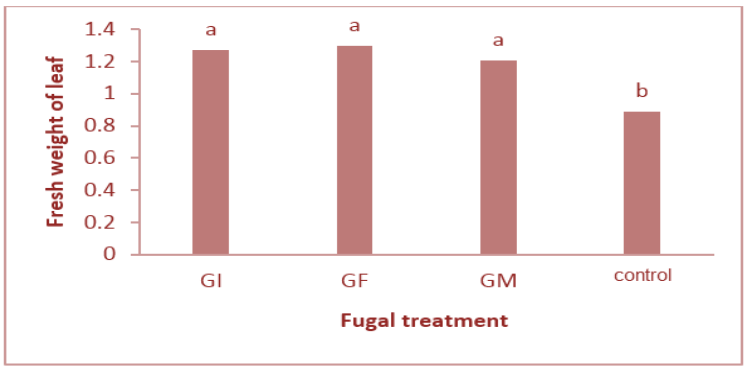

Figure 1: Comparing the average fresh weight of leaf affected by fungus treatments

4.2 FRESH WEIGHT OF LEAF

Effects of three types of inoculating mycorrhiza fungus were significant on fresh weight of leaf

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at 1% level (Table 2). The highest fresh weight of leaf was seen in grapevine inoculated by all of three mycorrhiza funguses and this rate was significantly greater than grapevines, which was not infected with fungus (control subjects) (Figure 1).

4.3 LEAF AREA

Effects of three types of inoculating mycorrhiza fungus were significant on leaf area at 1% level (table 2). According to the effects of fungus treatments on leaf area, the highest leaf area was seen in treatments with Glomusintraradices and Glomus mosseae and the difference between experimental and control subject was significant. The significant increase in leaf area in grapes inoculated with Glomus intraradices and Glomus mosseae compared with control subjects can be attributed to expanded nutrients uptake, which leads to increase in leaf area and therefore to improved photosynthetic activity and CO2 fixation. There was not any significant difference between the fungal treatment of Glomus fasiculatum and other treatments in terms of average leaf area (Figure 2).

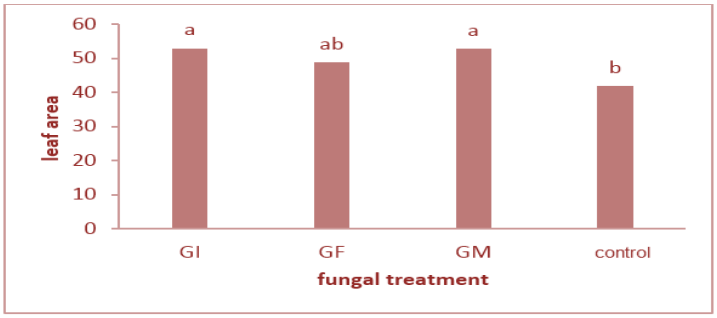

Figure 2: Comparing average leaf area affected by fungus treatments

Depending on drought severity, the plant loses less water through transpiration by decreasing the number of leaves [17]; limited leaf area is the first resistance mechanism of the plant against drought [7]. Reduction in the area and number of the leaf is a resistive mechanism of the plant against stress [18]. Declined leaf area in the control sample was seen in this research, which is in line with studies conducted by [19]. A study [20] found a significant increase in leaf area of mycorrhizal basil compared to non-mycorrhizal plants and attributed this to increased nutrients uptake. A reported that symbiosis with intraradices Glomusfungus in pepper plant leads to expanded leaf area and water uptake. A study [21] carried out on the vetch and found that mycorrhiza fungus increases leaf area, relative growth speed and growth speed of the product.

Use of mycorrhiza leads to an increase in plant dry material owing to the increase in water and nutrient uptake as well as higher leaf area. Such function of mycorrhiza develops the photosynthetic activity, fixes CO2 and increases aerial organ's biomass [22]. It has been reported that symbiosis with mycorrhiza can develop photosynthesis through morphological changes such as increased leaf area. This research is matched with relevant studied in terms of leaf area.

4.4 AVERAGE NUMBER OF LEAVES

Effects of three types of inoculating mycorrhiza fungus were significant on leaf area at 5% level (Table 2). The largest number of leaves was seen in Glomus mosseae treatment, which was significantly different from other treatments. In other words, Glomus mosseae fungus increases the number of leaves (Figure 3). There were more leaves at 75% water requirement compared with other stress levels. In other words, water stress led to a decline in the number of leaves (Figure 4).

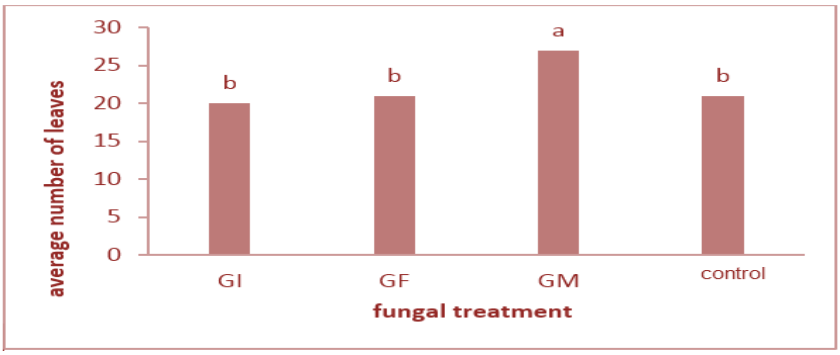

Figure3: Comparing the average number of leaves under the effect of fungal treatments**.**

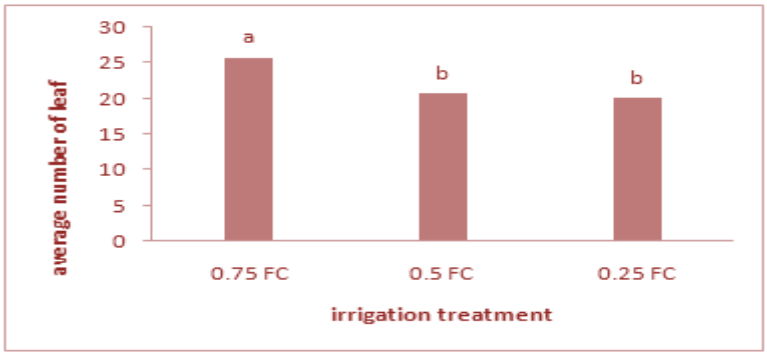

Figure 4: Comparing the average number of leaves under the effect of different irrigation levels

Vegetative growth of branch highly depends on the growth medium. As the growth phenomenon associates with vital activities when there is enough water available for the plant, water deficit leads to growth reduction due to decline in tungsten pressure of growing cells and its impact on length of cells [23]. Studies [19, 24] reported a decline in grape shrub growth and subsequent decrease in a number of leaves per shrub due to drought stress. Fungal treatment with Glomus mosseaemodified effect of drought stress by an increasing the number of leaves and improved the function by increasing nutrients uptake; this result matches with the conducted studies in this field.

4.5 AVERAGE BRANCH LENGTH

ANOVA results showed that fungal and water treatments had a significant effect on the average length of white seedless grapevine' branch at 1% and 5% levels, respectively (Table 2). According to comparisons between average lengths of branch, this variable was significantly different in Glomus mosseae and Glomus fasiculatum compared with other treatments (Figure 5). Water stress had an impact on longitudinal growth of grapevines so that average branch length showed a significant difference at stress levels of 75% and 25% (Figure 6).

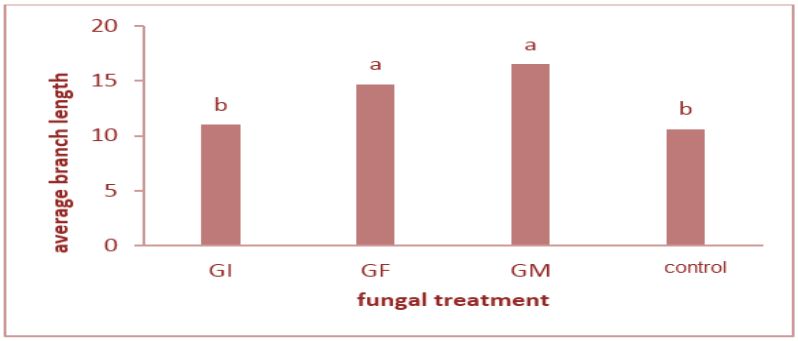

Figure 5: Comparing average branch lengths between different fugal levels

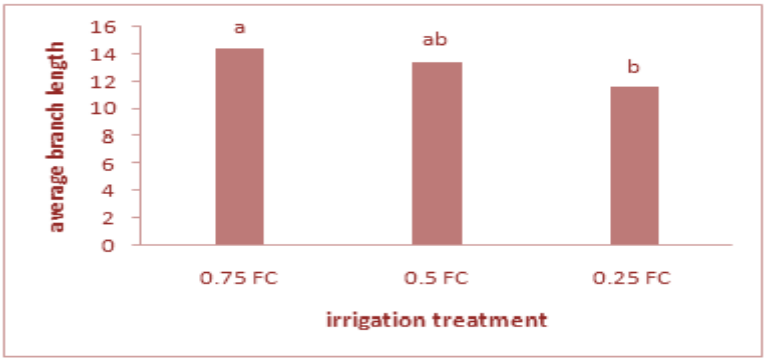

Figure 6: Comparing average branch lengths under the effect of different irrigation levels

A study [25] examined the effect of different moisture levels on growth traits including shrub height, number of nodes, leaf area, number of leaves, and dry weight of leaf in 5 grape cultivars and reported a different reduction in all of the growth parameters in cultivars after an increase in stress severity.

A study conducted on the effect of mycorrhiza fungus on growth nutrients uptake in grapevine planted in poor soils and reported higher growth of seedlings inoculated with mycorrhizal fungi to relate to control ones; this result is matched with findings of this work. In the mentioned study, two fungal species expanded the growth, which was a significant increase in growth. [16] carried out some studied and showed that symbiotic association rate between rootstock and fungus can stimulate growth rate so that mycorrhiza-inoculated root of grapevine may vary due to the fungus species and cultivar. In general, the currant white seedless cultivar of the grape has medium vegetative growth genetically; hence, inoculation with mycorrhizal fungus could increase branch growth by improving water conditions and nutrients uptake.

According to research reports, Glomus intraradices is one of the most efficient funguses in improving water uptake in Lettuce, while Glomus mosseae leads to a reduction in water uptake of lettuce; these differences are associated with different genetic regulation of Akupurins by the fungus [25]. According to a study on the effect of different arbuscular mycorrhizal funguses on the growth of Coleusforskohlii**,** shrub height of plants under the mycorrhizal fungus treatment was increased compared to control [26]. As seen in Figure 5, fungal treatment of Glomus mosseae indicates a positive effect by increasing branch length, reducing drought stress and branch growth. This result was in line with the conducted studies.

5. CONCLUSION

This paper investigated the impact of Mycorrhiza Fungi on Growth Traits (Shoot Length, Number of Leaves, Leaf Area, Fresh and Dry Weight Of branch, Root, and Leaf) of the White Seedless Grape under Drought Stress. According to the effects of fungus treatments on leaf area, the highest leaf area was seen in treatments with Glomusintraradices and Glomus mosseae and the difference between experimental and control subject was significant. The significant increase in leaf area in grapes inoculated with Glomus intraradices and Glomus mosseae compared with control subjects can be attributed to expanded nutrients uptake, which leads to increase in leaf area and therefore to improved photosynthetic activity and CO_2 fixation. There was not any significant difference between the fungal treatment of Glomus fasiculatum and other treatments in terms of

average leaf area. According to research reports, Glomus intraradices is one of the most efficient funguses in improving water uptake in Lettuce, while Glomus mosseae leads to reduction in water uptake of lettuce; these differences are associated with different genetic regulation of Akupurins by the fungus fungal treatment of Glomus mosseae indicates a positive effect by increasing branch length, reducing drought stress and branch growth.

6. REFERENCES

[1] Nazmiyeh, A. Fine-grained supplementary fruits, MA pamphlet, Faculty of Agriculture, Tabriz University, 1999.

[2] Wilson, S.B., Stoffella, P.J. and Graetz, D.A. Compost-amended media for growth and development of Mexican heather. Compost Science & Utilization , 2001, 9(1): 60-64.

[3] Ebhin Masto, R., Chhonkar, P.K., Singh, D. and Patra, A.K. Changes in soil biological and biochemical characteristics in a long-term field trial on a sub-tropical incept soil. Soil Biology and Biochemistry ,2006, 38: 1577–1582.

[4] Salehi Jouzani, Gh. Biotechnology and its importance in agriculture, Publication of the Committee on Extension and Communication of the Head of Technology of the country, 2008, Pp. 10-31.

[5] Hasani, A. Effects of water stresses and salinity of sodium chloride on some of the morphological and physiological characteristics of basil, University of Tarbiat Modares, 2003, P. 199.

[6] Dolatibaneh,H., Nazimyeh, A., Mohammadi, S.,Hasani, Gh.,Mashhid, H. Identification and evaluation of local grape cultivars in West Azarbaijan province using ampography and ampometric methods, Journal of Plant Production Technology, 2005, Vol. 10, Issue 1, Summer 9, Tehran.

[7] Levitt, J. Responses of plants to environmental stress. 1980, Vol. 2, Academic Press. New York.

[8] Islamian, S., Soltani, S. Flood frequency analysis (translation), Arkan Publications, 2002, P. 344.

[9] Sadrzadeh, M., N. Moalemi, N., Alemzadeh Ansari, N. Effect of irrigation and potassium on some vegetative properties of seedlings in two olive citrus cultivars and Malek Garden, The 5th Iranian Horticultural Science Congress, Shiraz, 2007, 204.

[10] Zarabi, M., Talaee, A. Response of some biochemical changes and physiology of six olive cultivars to drought stress, Sixth Congress of Iranian Horticultural Science, Gilan, 2009, Pp. 1672-1674.

[11] Wu, Q.-S. and R.-X. Xia. Arbuscular mycorrhizal fungi influence growth, osmotic adjustment and photosynthesis of citrus under well-watered and water stress conditions. Journal of Plant Physiology ,2006, 163:417-425.

[12] Rabiei, V. Study of physiological and morphological responses of some grapevinecultivars to drought stress, Ph.D. dissertation in Horticulture, University of Tehran, 2003.

[13] Mostajeran, A., Vozoee, F. Mycorrhizal symbiosis, Isfahan University Press, 2006, P. 226.

[14] Bavaresco, L., and Fogher, C. Lime-induced chlorosis of grapevine as affected by rootstock and root infection with arbuscular mycorrhiza and Pseudomonas fluorescens.1996, Vitis.35 (3): 119-123.

[15] Linderman, R.G and Davis, E.A. Comparision response of selected grapevine rootstock and cultivars to inoculation with different mycorrhizal fungi. Am. J. Enol.2001, Vitic. 52: 8-11

[16] Menga, J,A., Raski,D,J., Lider, L,A., Johnson, E,L., Jones, N,O., Kissler,J,J., and Hemstreet,C. Interaction between mycorrhizal fungi, soil fumigation and growth of grapes in California. Am.J. Enol.Vitic.1993, 34: 117-121.

[17] Jones,H.G.andCortlett,J.E .Current topics in drought physiology. J.Agric.1992, 119:291-296.

[18] Patakas ,A . and Noitsakis .B. Mechanisms involved in diurnal changes of osmotic potential in grapevines under drought conditions .J.plant .physiol ,1999,154: 767-774.

*Corresponding author (Mohammad Aslanpour) E-mail: Aslanpour.mohammad@gmail.com Volume 10 No.3 ISSN2228-9860 eISSN1906-9642 http://TUENGR.COM/V10/435.pdf DOI: 10.14456/ITJEMAST.2019.42

[19] Barkoki, M., Hifnny, H.A. and Baghdad, G.A.. Some effects of water stress on growth of grape vine Vitis Vinifera .Acta Horticulture. 1997, 84:199-214.

[20] Aslani, Z., Hassani, A., Rasooli Sadaghiyani, Sefidkon, F., and Barin, M. Effect of two fungi species of arbuscular mycorrhizal (Glomus mosseae L. and Glomus intraradices L.) on growth, chlorophyll contents and P oncentration in Basil (Ocimum basilicum L.) under drought stress conditions. Iranian Journal of Medicinal and Aromatic Plants ,2011, 27(3): 471-486. (In Persian with English Summary)

[21] Demir, S. Influence of arbuscular mycorrhiza on some physiological growth parameters of pepper. Turk. J,2004.

[22] Smith, S. E. and Read, D. J. Mycorrhizal symbiosis. Third Edition. Elsevier 2008, 815 p.

[23] Ahmadi, A., Baker, D. Stomatal and non-stomatal factors limiting photosynthesis in wheat under drought stress conditions, *Iranian Journal of Agricultural Science*, 2000, 31 (4): 813-825.

[24] Rezaei, T. A Study on some physiological characteristics of five grapevine cultivars for selection of drought tolerant cultivar, *Hamadan University*, 2007, P. 61.

[25] Marulanda, A., Azcón, R and Ruiz-Lozano, J.M. Contribution of six arbuscular mycorrhizal fungal isolates to water uptake by Lactuca sativa plants under drought stress. *Physiologia Plantarum*. 2003, 119(4): 526-533.

[26] Sailo, G.L. and Bagyaraj, D.J. Influence of different AM-fungi on the growth, nutrition and forskolin content of Coleus forskohlii. Mycological Research, 2005, 109: 795-798.

[27] Aslanpour, M., Baneh, H.D., Tehranifar, A., Shoor, M. Effect of Mycorrhizal Fungi on Macronutrients and Micronutrients in the White Seedless Grape Roots Under the Drought Conditions. *International Transaction Journal of Engineering, Management, & Applied Sciences & Technologies*. 2019, 10(3): 397-408.

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International Transaction Journal of Engineering, Management, & Applied Sciences & Technologies

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OPTIMUM SELECTION OF TUNNEL BORING MACHINE BY USING FUZZY ANALYTICAL HIERARCHY PROCESS: A CASE STUDY OF BEHESHT ABAD TUNNEL

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ARTICLEINFO

Article history:
Received 14 January 2019
Received in revised form 12 March 2019
Accepted 12 March 2019
Available online
15 March 2019

Keywords:
Optimum selection of mechanical excavator; Tunnel Boring Machine (TBM); Fuzzy AHP; Behesht Abad water transfer tunnel.

ABSTRACT

Tunnel boring machines (TBMs) are one of the most important miners in an excavation of tunnels and underground spaces. These machines can bore all circular cross-sections all at once. Designers and managers are to choose the most suitable type of TBM as the high price of these machines can affect the economics of the project. The main objective of this research work is to select proper TBM using multiple criteria decision-making (MCDM) approaches for excavation of Behesht Abad water transfer tunnel in central Iran. As there are many opposite criteria for machine selection, therefore, this issue is considered as a multi-criteria and complex problem. Various methods have been used and developed for the evaluation and selection of a suitable machine. One is using applicable decision making such as fuzzy analytical hierarchy process (AHP). Fuzzy logic can help the tunneling designers in the process of the TBM selection under a fuzzy environment where the vagueness and uncertainty are taken into account with linguistic variables parameterized by triangular fuzzy numbers. The fuzzy AHP applied to form the structure of the TBM selection problem and to determine weights of the evaluation criteria, and this method utilized to acquire final ranking. Results of this study showed that doubled shielded TBM is the most suitable option for excavating Behesht Abad tunnel.

1. INTRODUCTION

In the current era, the tendency to use underground spaces is increasing and mechanized boring machines are vastly used in tunnel construction as in the future the mechanized boring machines can be considered as an essential part of tunneling industry for the speed, high safety and finally increasing efficiency in the projects. Tunnel boring machine (TBM) is one of the most useful equipment of boring tunnel. This type of machine has the ability to create underground structures in every type of ground including strong rock formations such as sandstone. TBMs are divided into different types including open TBM, Single shield and

*Corresponding author (Arash Ebrahimabadi) E-mail: Arash.xer@gmail.com Volume 10 No.3 ISSN 2228-9860 eISSN 1906-9642 http://TUENGR.COM/V10/445.pdf DOI: 10.14456/ITJEMAST.2019.43

double shield TBM. Each of these types has specific pros and cons and are suitable for specific conditions and goals. As the cost of these devices is very high and affect the economics of the project the designers and managers are to select the most suitable type among different types [1].

As TBM selection is based on different criteria they usually do not have the same weight, thus one of the most reliable multiple criteria decision making (MCDM) techniques, Fuzzy AHP, is utilized in this paper to choose the most appropriate machine for the case study, Behesht Abad water transfer tunnel. On the other hand, due to uncertainty in the modeling process, using Fuzzy method is very valuable.

Fuzzy Analytic Hierarchy Process is also one of the most complete systems designed for multi-criteria decision-making which was first stated by Saaty in 1980 [2]. This technique provides the formulation of the problem in the Analytical Hierarchy and also provides considering different quantitative and qualitative determinants in a problem. The combination of analytic hierarchy process with Fuzzy logic leads to considering lack of assurance and precision in issues for more accordance to the reality. Up to now, various methods and standards are provided for tunnel machine selection in different geological conditions. In 2009, Khademi et al. selected tunneling machine by Fuzzy Analytic Hierarchy Process based on risk [3]. Shahriar et al (2008) selected tunneling machine in rock tunnels based on reducing geotechnical dangers [4].

In this study, we tried to choose the suitable TBM by Fuzzy Analytic Hierarchy Process which the most common methods in multi-criteria decision-making approaches in Behesht Abad water transfer tunnel.

2. FUZZY ANALYTIC HIERARCHY PROCESS (FAHP)

Analytic Hierarchy Process (AHP) is a decision support method developed to complete problem by breaking the solution problems, grouping them, and then arranging them into a hierarchical structure. To obtain priority criteria, this method uses a comparison of criteria paired with a measurement scale that has been determined. The main input of the AHP method is the perception of experts or experts, so there is a factor of subjectivity in retrieval decision. This method also takes into account data validity with inconsistency limits. However, considerable uncertainty and doubt in giving an assessment will have an impact on the accuracy of the data and the results obtained. Based on this, the further theory was developed, namely, the method of Fuzzy Analytic Hierarchy Process. Fuzzy Analytic Hierarchy Process is a method of Analytic Hierarchy Process (AHP) developed with fuzzy logic theory. Fuzzy AHP method is used similarly to the method of AHP. It is just that the Fuzzy AHP method sets the AHP scale into the fuzzy triangle scale to be accessed priority. In this section, the FAHP method was developed. In this study, Chang strategy (1996) has been used [5,6]. This methodology is as follows:

First step: Formation of Fuzzy decision-making matrix: for every matrix row of paired comparison, S_k is calculated. S_k is a Fuzzy triangular number, given as

$$S_k = \sum_{j=1}^{n} M_{kl} \times \left[\sum_{i=1}^{m} \sum_{j=1}^{n} M_{ij} \right]^{-1} \quad (1).$$

In this equation, *k* indicates the number of *i* and *j* rows which show the alternatives and criteria, respectively. Finally, the variable matrix is as follows for variable *x*:

$$\tilde{x} = \begin{bmatrix} \tilde{x}_{11} & \tilde{x}_{12} & \cdots & \tilde{x}_{1n} \\ \tilde{x}_{21} & \tilde{x}_{22} & \cdots & \tilde{x}_{2n} \\ \cdots & \cdots & \cdots & \cdots \\ \tilde{x}_{n1} & \tilde{x}_{n2} & \cdots & \tilde{x}_{nn} \end{bmatrix} \tag{2}$$

Step two: Finding the possibility degree of S_k compared to each other. In overall, if M1 and M2 are two triangular Fuzzy numbers, M_1 and M_2 degrees of possibility which are shown as V(M1≥M2) are defined as follows:

$$\begin{cases} V(M_1 \geq M_2) = 1 & , \quad M_1 \geq M_2 \\ V(M_1 \geq M_2) = 0 & , \quad M_1 \leq M_2 \\ V(M_1 \geq M_2) = hgt(M_1 \geq M_2) & , \quad otherwise \end{cases} \tag{3}$$

Based on Figure 1, the parameters of fuzzy u_1, u_2, l_1, l_2, m_1, and m_2 are presented in the hgt function as:

$$hgt(M_1 \geq M_2) = \frac{u_1 - l_2}{(u_1 - l_2) + (m_2 - m_1)} \tag{4}$$

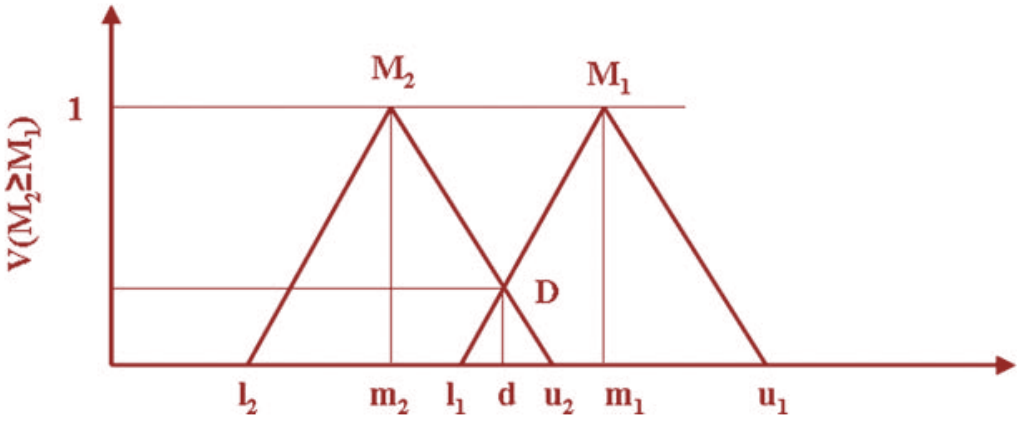

Figure 1: The intersection between M1 and M2 by fuzzy parameters

Step three: Finding possibility degree of a triangular Fuzzy number from k of another Fuzzy number: The following equation is used for calculating the degree in improved method [6]:

$$V(M_1 \geq M_2, ..., M_k) = \min\left[(M_1 \geq M_2), ..., (M_1 \geq M_k)\right] \tag{5}$$

The following equation is used for calculating the weight of vectors in dual comparison matrix:

$$w'^{(x_i)} = \min\left\{V(S_i \geq S_k)\right\}, \quad k = 1, 2, ..., n \tag{6}$$

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Finally, normalized vectors are as follows

$$w' = [w'(c_1), w'(c_2), ..., w'(c_n)]^T \quad (7)$$

3. BEHESHT ABAD WATER TRANSFER TUNNEL

Behesht Abad tunnel is located Latitude: 32° 39' 59.99"N; Longitude: 50° 37 27.27" E, with the length of 64970 meters and the diameter of 6 meters is used for transferring water from Chahar Mahal Bakhtiari province to Isfahan city in central Iran. Investigations on Behesht Abad project for transferring water was accomplished in 2004. Project comprises Behesht Abad Reservoir Dam after intersection of Behesht Abad and Koohrang Rivers, 65 kilometer tunnel from Tang-e Behesht Abad to Baghbahadoran city with a capacity of 1100 million cubic meters per year (initial plan), 746 million cubic meters per year (in the first phase studies) and 580 million cubic meters annually in a water allocation letter [7]. Factors that make Beheshtabad tunnel project complex include: maintaining vital balance of water resources, the long length of the tunnels, the need for heavy structures, high investment, expansion of areas disturbed, risks of water transfer, political issues and finally optimum selection of mechanical miner (TBM) which is the objective of this research.

Price per cubic meter of water in the inter-basin water transfer projects are often based on the quantity and quality of investment, operation and management of the project according to the conditions of and consumers and the demand and supply of water. With this respect, the type of excavator machine plays a major role in the project's productivity.

The complexity of the issues involved in implementing such projects, especially from the technical and management view, is very important. However, to avoid the various problems caused by reduced water level in the aquifer and challenges such as drying of wells, reduced revenues, increased costs, undermining the economic situation of farmers, rising unemployment, migration and prevention of land collapse, integrated management of water resources in the catchment area and to calculate supply and demand of water in the region, simulation and analysis of groundwater level was conducted using Modflow software with respect to the scenario of establishment of Behesht Abad tunnel and therefore analysis of water balance equation in the whole region and provision of integrated management plan for aquifer, and provision of strategies for strengthening water resources of Shahrekord aquifer are necessary. Therefore, knowledge of the behavior of the aquifer and catchment area with a focus on the establishment of Beheshtabad tunnel on Shahrekord aquifer, the estimation of the real needs of consumers in different sectors (agriculture, industry, and drinking) and calculating and predicting the water supply are necessary [7]. Furthermore, special attention was paid on the method of excavation and optimum selection of mechanical excavator (TBM), the aim of this research work.

From a geological point of view, the range of this tunnel is in Zagros Mountains. In most zones, the main thrust of Zagros is introduced as the border between Sirjan-Sanandaj zone and Zagros thrust. Therefore from the opening of the tunnel to about 17 km is located in

Zagros thrust and from this distance to the existing point is located in Sirjan-Sanandaj zone.[7]. In Fig (2) the location of the project is shown.

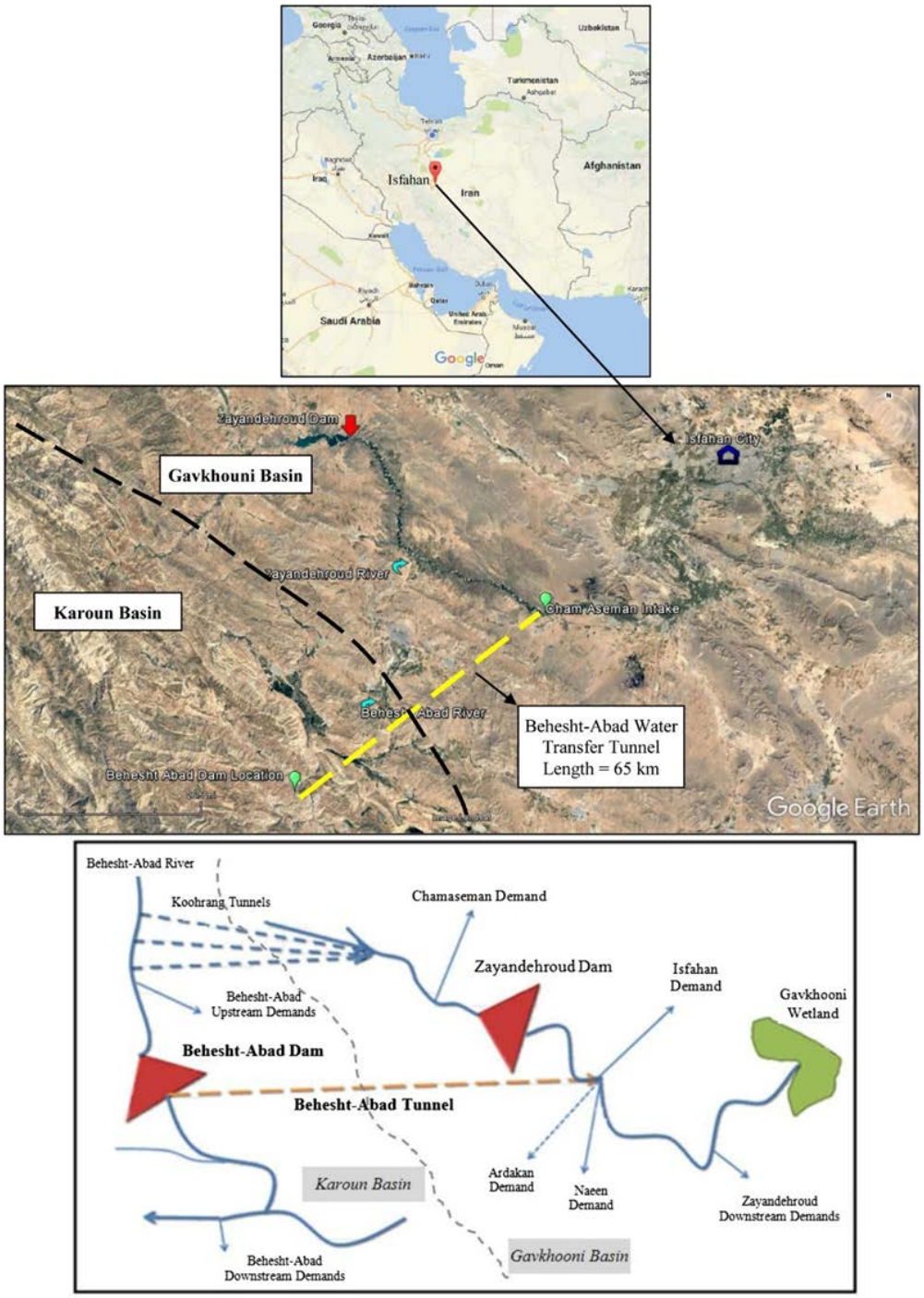

Figure 2: The location of the Behesht Abad water transfer tunnel.

From the point of stratigraphic view, the site consists of two Jahrom & Asmari carbonate formations [8-12].

4. TUNNEL BORING MACHINE SELECTION FOR BEHESHT ABAD WATER TRANSFER TUNNEL

TBM selection is one of the most important decision makings for underground space performances which can be constructed by TBM. Various criteria affect the selection of the machine and the sub-criteria are illustrated in table (1) along with the influence of each of them.

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At first, a literature survey was conducted and affecting parameters on TBM selection were studied. In order to reach the goal, a questionnaire was designed and distributed to the experts so that they could comment on the performance of each alternative. In this regards, the most important affecting criteria were chosen based on the comments of the experts so that a questionnaire would be devised for alternatives and the weight of them.

Table 1: Criteria and sub-criteria used in this research

Main criteria	Sub-criteria	Sign
Geological and geotechnical parameters	Face stability	C1
	Rock permeability	C2
	Distribution of rock aggregates	C3
	Underground water	C4
Technical parameters(CC2)	Safety	C5
	Boring speed	C6
	Risk	C7
Economical parameters(CC3)	Operational costs	C8
	Capital costs	C9
Environmental parameters(CC4)	Earth subsidence	C10
	Environmental pollutions	C11

In the next step, pair-wise comparison matrix is formed based on criteria relations and the weight of each criterion is determined with the help of experts. The relative weight of criteria is calculated based on described scales in Table (2).

Table 2: Used scale for pair-wise comparisons;

Term	Definition	Importance degree
Equal importance(E)	Two elements have similar importance	1
Relatively preferred	An element is relatively preferred compared to the other	3
High preference	An element is highly preferred compared to the other	5
Very high preference	An element is very highly preferred compared to the other	7
Extreme preference	An element is extremely preferred compared to the other	9

After formation of Fuzzy decision-making matrix, possibility degrees of *Sk* are obtained compared to one another and the possibility degree of a triangular Fuzzy number is calculated from k number of another Fuzzy number and finally, the vector of criteria are calculated by analytical hierarchy method.

Three tunnel boring machines candidate were first taken into account for the project of Behesht Abad water transference including open TBM(A1), single shield TBM(A2) and double shield TBM(A3). These machines ranked by fuzzy analytical hierarchy method mentioned before. Some ranking data are as follows.

In this stage, pair-wise comparison was conducted in order to provide the weight of the matrix and finally, the results are obtained as shown in Table 3. After normalization of the matrix of the decision and multiplying the weight values of obtained criteria by Fuzzy analytical hierarchy method, the final matrix is obtained as shown in Table 4.

Then, the importance of each alternative is calculated according to the criteria. Finally, the alternatives are ranked based on the weight of each one according to Table 5.

Table 3: Matrix of the importance of the alternatives

	A1	A2	A3
C1	0.273	0.273	0.727
C2	0.443	0.557	0.557
C3	0.500	0.567	0.700
C4	0.330	0.250	0.697
C5	0.500	0.250	0.670
C6	0.393	0.210	0.727
C7	0.233	0.300	0.533
C8	0.277	0.500	0.750
C9	0.277	0.197	0.670
C10	0.330	0.110	0.750
C11	0.260	0.147	0.667

Table 4: Weighed decision matrix

	A1	A2	A3
C1	0.017	0.017	0.046
C2	0.022	0.027	0.027
C3	0.017	0.019	0.023
C4	0.013	0.010	0.028
C5	0.057	0.028	0.076
C6	0.011	0.006	0.020
C7	0.023	0.030	0.053
C8	0.020	0.036	0.055
C9	0.028	0.020	0.069
C10	0.016	0.005	0.036
C11	0.035	0.020	0.090

Table5: The importance of each option

Alternative	The weight of each alternative	Importance Order
A1	0.259	2
A2	0.219	3
A3	0.522	1

According to the presented cases in Fuzzy analytical hierarchy method, the highest score is for alternative A3 i.e. double shield TBM.

5. CONCLUSION

In this study, TBM selection was conducted in Behesht Abad tunneling project by a hybrid methodology of analytical hierarchy method and Fuzzy logic. The advantages of Fuzzy method along with the methods of multi-criteria decision making has caused this strategy to be as one of the leading methods in machine evaluation and selection. High advantages compared to classic methods, clarifies its necessity and superiority of use of FAHP in TBM selection and evaluation. Fuzzy analytical hierarchy method can prioritize the current candidate alternatives based on the importance of each alternative compared to criteria and by using suitable combination methods can improve sub-conditions such as

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simplicity and understandability and Fuzzy method can interfere in modeling the uncertainty in expert knowledge, leading to more realistic results. Therefore, this paper deals with using fuzzy analytical hierarchy method for optimized TBM selection for water transfer tunnel of Behesht Abad. Results imply that double shield TBM with the weight of 0.522 is prioritized relative to other machines.

6. REFERENCES

[1] Maidl, B., schmid, L., ritz,w., Herrenknecht, m. hardrock tunnel borring machins. Ernst& sohn, 2008

[2] Saaty, T., The analytic hierarchy process . NewYork: McGraw Hill. 1980

[3] Khademi, J., A methodology for selection of TBM according to geotechnical conditions. MSc Thesis, Amirkabir University of Technology (Tehran Polytechnic), Iran, 2006.

[4] Shahriar, K., Sharifzadeh, M., Khademi, J., Haddadi, M.R., Selection of rock TBM based on geotechnical hazards mitigation. In: 7th Iranian Tunneling Conference, Tehran, Iran, pp.1059–1070. 2006.

[5] Chang, D. Y., Applications of the extent analysis method on fuzzy AHP. European Journal of Operational Research, 95(3), 649–655, 1996.

[6] Zadeh LA, Fuzzy sets. Inf Control 8:338–353, 1965.

[7] Alimohammadi, R., Impact of establishment of Behesht Abad tunnel on Shahrekord aquifer, The Turkish Online Journal of Design, Art and Communication, Special edition, 397-404, 2016.

[8] Hashemi, M., Rock Mechanics reports, watter supply Project of the Centeral Plateau,Zayandehab Consulting, 2008.

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ISSN 2228-9860

eISSN 1906-9642