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The 4th International Conference of Biotechnology, Environment and Engineering Sciences

21-22 November 2018, Alexandria-Egypt

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The Proceeding of 4th ICBE

International Conference of Biotechnology, Environment and Engineering Sciences

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Welcome massage from Scientific Researchers Organization (SRO)

We would like to welcome you at the 4th International Conference on Biotechnology, Environment and Engineering Sciences (ICBE 2018). It is our pleasure to have you with us and being with you. The conference is being held at Alexandria, Egypt during the period of 21 to 22 November 2018.

SRO is a consulting organization that aims to promote science and research by enhancing networking, cooperation and communication between researchers, society and industry in order to share in solving society problems. Our scientific and consulting committee consists of multi-disciplinary members of scientists, researchers, consultants and professionals from universities, research centers, educational facilities and private companies from all around the world.

This conference is one of our activities which aims to connect between scientists, researchers, acedimics and industrial experts from different countries to share their views and discuss their advanced research work in the various topics of Biotechnology, Environment and Engineering Sciences. The conferene is an excellent platform for academic exchange and cooperation promotion. It provides an excellent opportunity for researchers, scientists and postgraduate students to interact and build up academic relationship.

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Keynote and Oral Presentations

Developing a Vetted Detoxification Biotechnology for Controlling Human Exposureto Aflatoxins

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Abstract

Aflatoxins are a class of carcinogenic mycotoxins produced by *Aspergillus* fungi and are known to contaminate a large portion of the world's food supply. Aflatoxin B1 (AFB1) is the most potent of these compounds and has been well-characterized to lead to the development of hepatocellular carcinoma in humans and animals. This presentationwill focus on the metabolism of AFB1 as it relates to its mechanism of carcinogenesis, biomarker formation, and detoxification pathways. Emerging toxicities of AFB1, such as growth suppression, malnutrition, and immunomodulation, will also be discussed. In addition to its biological fate, this presentation review information on human exposure to AFB1, detailing recent reports of AFB1 occurrence in food supplies as well as occupational exposures of AFB1. Lastly, a summary of recent detoxification methods is discussed to indicate the present state of the field in developing aflatoxin control methods with emphasis on our laboratory data on developing safe and effective new technology for detoxification of aflatoxin B1. This information highlights the significance of worldwide AFB1 exposure to public health and the need to implement the new detoxification method to reduce the global burden of AFB1 toxicity.

***Keywords*:** Aflatoxins, human exposure, biotechnology, detoxification

Substitution of Sugar with Stevioside in Preparation of Guava Drink

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Abstract

Stevia, a natural sweetenerhas been used to replace sucrose in order to reduce the caloric profile of guava drink. Various concentrations of stevioside (0.1%, 0.15% and 0.2%) were used in the present experiment with the control sweetened with 12% sucrose (table sugar). Guava drink samples were analyzed both physicochemically and organoleptically at 15 days storage interval during 3 months storage. The total soluble solids and pH decreased with the increasing level of stevioside while increase was observed in titratable acidity, ascorbic acid and total phenolic content with the increasing level of stevioside in the drink. In organoleptic evaluation, the scores were highest for control followed by the samples with stevioside. During storage, the total soluble solids increased from 4.7 to 4.8°brix, % acidity increased from 0.2% to 0.4%, pH decreased from 4.0 to 2.9, ascorbic acid content decreased from 14.4 to 9.6 mg/100g and total phenolic content decreased from 71.4 to 56.7 mg/100g. Decrease was perceived in all organoleptic properties during storage. The score for color decreased from 8.9 to 6.9, taste decreased from 8.9 to 6.6, odor decreased from 9.0 to 6.9 and overall acceptability decreased from 8.9 to 6.8. Based on physicochemical analysis, sample GD_3 with 0.2% stevioside turned out to be the best. In organoleptic evaluation, control sample gained maximum score; also the drink samples prepared with different levels of stevioside were liked very much by the consumers. There was a significant ($p<0.05$) influence of storage intervals and treatments on the physicochemical and sensory characteristics of low caloric guava drink samples. It was concluded that stevioside can be used to substitute sucrose in the preparation of ready to serve drink. In future, studies on the influence of stevioside to substitute sugar in the preparation of ready to serve drinks would prove beneficial for the diabetic patients.

***Keywords*:** Stevioside, Sucrose, Guava Drink, Storage Interval, Synthetic Sweeteners

Clean technology transfer in Tunisia: critical analysis

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Abstract

"Give a man a fish, you feed him for a day. Teach him to fish, and you feed him for lifetime." This Chinese wisdom shows the exact issues of our society especially if we talk about technology transfer. We assist now to era of the new and inventive technical solution to technical problems. Although, we didn't solve the problem of climate change, the problem that can wrap up human being! In fact, the technical progress is "frozen" in developed countries who transfer to developing one's products and bury the transfer of research and the "know how". However, climate changes can't be mitigated without planetary solidarity.

Studying the Tunisian example shows that we are still far away from the concept of "solidarity".We notice that economy guide the clean technology transfer which promotes a new business of Intellectual Property Rights (IPR). Stronger IPR protection in developed countries may enforce legal right, make invention tradable but from the other side it makes the knowledge and the technology transfer very expensive. Tunisia, a country that tried to attend the clean energetic transition is curbed with financial obstacles. We notice, in the era of clean technology inventions, that multinationals investors launch polluted projects, knowing that they are the holders of clean technologic inventions. Statistics are ambiguous and we can't findspecific one for the "clean technology transfer", it's the business affection in reality! The interpretation of the new free trade agreement proposed by the European Union to Tunisia evince the none consideration of the necessity of clean technology transfer by developed countries.

As a conclusion we can say that scientists are the last faith of this planet face to climate changes. Therefore, they should defend the idea of " knowledge and the know how" are "public goods"that contribute to "public good".

An Enzyme- Linked Immunosorbent Assay for Detection of Antibodies to *Mycoplasma synoviae* and *Mycoplasma Gallisepticum* in Eggs

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Abstract

Mycoplasmas are widespread in nature and infect a wide range of hosts. Species from the genus Mycoplasma (over 110 species) have been isolated from mammals, birds, reptiles and fish .For veterinary medicine, the most important Mycoplasma which have been isolated from domestic avian species are *M.gallisepticum*, *M.synoviae* , *M.meleagridis* and *M.lowae*.

Avian Mycoplasmosis transmitted vertically through the eggs or horizontally often by direct contact ill or unaffected carriers and sensible animals. Indirect transmission via people, wild birds, drinking water, litters or breeding materials may play major role in the initiation of out break because of possible persistence of mycoplasma in environment.

The diagnosis of mycoplasmainfection traditionally has been done by serology, culturing of the organism from clinical specimens and polymerase chain reaction (PCR). Themost common method of diagnosis of either M. *gallisepticum*or*M.synoviae*infection in poultry is determination by antibody status. The serum plat agglutination test (SPA) is commonly used to screen for mycoplasma infections and both haemagglutination inhibition (HI) and Enzyme-linked immuonsorbent assay (ELISA) are approved as confirmatory.

The aim of this study was detection and identification of *MS* and *MG* in eggs. In this work 431 fertile eggs and 220 unhatchering eggs wererandomly collected from 5 different hatcheries from Tripoli, Aljafarah area 35 km west of Tripoli and Tarhowna area 100 km south east of Tripoli.

Potential protective activity of *Moringa oleifera* leaf extract against diazinon induced biochemical alterations and oxidative stress in African catfish; *Clarias gariepinus*.

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Abstract

The present study was conducted to evaluate the protective roleof *Moringa oleifera* (*MO*) leaf extracton African catfish exposed to (1/20 LC_{50}) diazinon intoxication. (*MO*) leaf extract was administrated at (20 ml/30 L water) along with diazinon at a concentration of (0.3ppm./L) for 6 weeks. Serum biochemical parameters, alanine aminotransferase (ALT), aspartate aminotransferase (AST), glucose, cortisol, cholesterol, creatinine, urea, uric acid, total protein, albumin, and acetylcholinesterase (AchE) were estimated. In addition, the level of malondialdehyde (MDA), reduced glutathione (GSH) level, catalase (CAT) and superoxide dismutase (SOD) activities were analysed in liverand kidneys. The results revealed that diazinon intoxication increased serum ALT, AST, glucose, cortisol, cholesterol, creatinine, urea, uric acid, and tissue MDA, whereas, serum total protein, albumin, and (AchE) as well as level of GSH,CAT,and SOD activities were markedly decreased. The combined treatment of diazinon with *(MO*) leaf extract improved all altered serum biochemical parameters as well as tissue malondialdehyde and antioxidant biomarkers. Hence, addition of (*MO*) to the water could reduce the negative effects of diazinonon *C. gariepinus*.

Key words: African catfish, diazinon, Fish physiology, oxidative stress, *Moringa oliefera*

Biological and Chemical Synthesis of Silver Nanoparticles: Characterization, MIC and Antibacterial Activity against Pathogenic Bacteria

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Abstract

Silver nanoparticles were synthesized by chemical, Physical and Biological methods and many studies preferred that the AgNPs in biological synthesis where the biological synthesis of nanoparticles was achievement importance owing to its simplicity, eco-friendly benefits and extensive antimicrobial activity over chemical synthesis. This study was applied for evaluating the difference in characterization and effects on pathogenic bacteria between AgNPs synthesis by biological method by using marine green alga *Ulva fasciata* and chemical method by sodium borohydride (NaBH4). Also examines the synergistic or antagonisms that applied by loading AgNPs synthesis by biological and chemical methods on antibiotics. The results point to that there is difference in characterization of AgNPs synthesis by biological and chemical methods were spherical and size in a range of 8-17 nm in chemical while 9-21 nm in size in biological according to TEM and XRD that proved that AgNPs had formed by both biological and chemical methods differ in characteristics and the formation of chemical silver nanoparticle. Antibacterial activity of AgNPs tested against selective pathogenic bacteria such as Gram negative bacteria (*E.coli O157 (KY797670), Aeromonas hydrophila* and *Salmonella enteric (Em.1-EGY015)*) and Gram positive bacteria (*Staphylococcus aureus* and *Bacillus cereus*); meanwhile, Biological synthesis AgNPs had more effective against pathogenic bacteria than chemical synthesis AgNPs. The minimum inhibitory concentration (MIC) of AgNPs synthesis by biological method is less than that synthesis by chemicals methods. The synergetic or antagonism of AgNPs loading in antibiotics (Norfloxacin, Cefepime, Levofloxacin, Amoxicillin/Clavulanic Acid, Ampicillin/Sulbactam, Cephalexin, Ofloxacin, Neomycin, Cefoperazone and Amikacin) had different effects according to antibiotics, pathogenic bacteria and methods of synthesis AgNPs.

Keywords: Silver nanoparticles, Chemical synthesis, biological synthesis, Bacteria, Antibiotics

Future Simulation of Alexandria Drinking Water from El- Mahmoudia Canal

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Abstract

Egypt faces many challenges in terms of the water sector and water resources due to population growth and increasing water needs in exchange for the stability of water resources. Egypt's per capita share is continuously declining to the extent that Egypt is under the water poverty line. El Mahmoudia canal is one of the most important canals in the West Delta of Egypt. The canal feeds Alexandria and El Beheira governorates with drinking and industrial demands in addition to irrigate about 280,000 feddans. The main objective of this research is to investigate the problem of future shortage of drinking water in Alexandria city through studying different scenarios of using El-Mahmoudia canal as a main source HEC-RAS model is used for simulation of different proposal scenarios. The first scenario is pumping excess water through pipelines atupstream Kafr Al Dawar lock to El-Seyouf drinking water station in Alexandria. The second scenario is reshaping cross sections from Kafr Al Dawar lock in El Beheira governorate to El-Seyouf drinking water station to allow high waterlevel at El-Seyouf station to improve its operation and efficiency. The results have been analyzed for each scenario. The study showed that good agreements were obtained between the numerical model results and measuredwater levels. The results of the first scenario showed that the current status of the Mahmoudia canal by its hydraulic situation does not allow any expansion for future drinking water. Meanwhile, reshaping of El Mahmoudia cross sections as a second scenario, can improve water level along the canal, which in turn improve effacing of drinking water stations.

Keywords: Water balance, modeling (HEC-RAS), Water demand, water management, El-Mahmoudia canal.

Three-Dimensional Investigation of the Metric Properties of Parabolic Double Projection Involving Catadioptric Camera

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Abstract

This paper presents an analytical study for the metric properties of the paraboloidal double projection, i.e. central and orthogonal projections used in the catadioptric camera's system. Metric properties have not sufficiently studied in previous treatments of such system. These properties incorporate the determination of the true lengths of projected lines and areas bounded by projected lines.

The advantageous main gain of determining metric elements of the paraboloidal double projection is studying distortion analysis and camera calibration, which is considered an essential tool in testing camera accuracy. Also, this may be considered as a significant utility in studying comparison analysis between different cameras projection systems.

Keywords: Catadioptric Camera, Metric Properties, Paraboloidal Projection, Perspective Projection, True Length.

Developing Stubble Chopper Device Adequate for Small Livestick Barns

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Abstract

The aim of this research is to, suites an adequate sustainable feeding unit in the small barns to produces daily fresh feed, which mixed from dried hay and rough ingredients plus adding the useful liquid. As well, the storage of mixed fodder for long periods affects its validity because of exposure it to rancidity and oxidation, which reduces the nutritional value and the rate of seduction, that may sometimes occurs digestive problems for animals. So, it is important to provide barns with fresh feed with nutritional value and high rate of palatability. Using agricultural residues such as, rice straw in feed ingredients, contributes to improve the animals mechanical fill satiation that, increases its utilization. A new feeding machine is developed to soften the cutting lengths beside mixing the concentrated feed ingredients, as reviewed from breeders. Moreover, a multi power sources are attached between using small tractors or separated gasoline motors and easy to truck. Three experiments are conducted to test the developed unit without modification, with knifes vertical and helical distributions on the lower cutting rotor on the variable levels of the cutting speeds (7.540, 9.426 and 11.304m/s), three feeding rates of (0.3, 0.6 and 0.9 ton/h) and three knife interferences of (5, 10 and 15 mm) to measure the performance rates, efficiency and economic evaluation. The main results concluded that the maximum percentage in the smother cutting length >5 cm was 92.82 % at the helical distribution with the maximum speed of 11.304 m/s, feeding rate of 0.9 ton/h and the largest knife interference of 15 mm. Besides, the maximum feed mixing efficiency was 95.45 % recorded at the highest adaptable settings. Meanwhile, the maximum machine productivity was recorded at 0.85 ton/h at the same variables. Moreover, the maximum power consumption value 6.85 kWh/ton was obtained at the lowest cutting speed of 7.540 m/s, feeding rate of 0.85 ton/h and knife interference of 5 mm. Also, the maximum operation cost was 121.20 L.E/ton with the same factors. So its recommend to publishing this modified system in the small barns.

***Keywords*:**Rancidity, Oxidation, Palatability, Cutting , Mixing.

Classifying Balantidium Coli Parasite in Water Using Back Propagation Neural Network (BPNN) and K-Nearest Neighbors (KNN) Algorithms.

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Abstract

This paper describes harmful microorganisms and parasites in the point of view of computer vision, machine learning and the neural network such as back propagation neural network (BPNN) basedon the detection and classification by using segmentation of k-means clustering. In cytology, we will discuss how to identify these pollutants or harmful parasites such as Balantidium Coli using machine learning algorithms like K-nearest neighbors (KNN) algorithm depending on its morphology. The study uses the scale-invariant feature transform (SIFT) algorithm in computer vision for detection images keypoints. The K-nearest neighbors (KNN) classifier uses these key points as an input. After following the study of detection pollutants in water from the conception of the idea, we started to the running of the algorithm, thetraining, testing simultaneously. The accuracy of classification close to 96% obtained fromseveral shapes of B-Coli using features set.

Keywords: Balantidium Coli Parasite, KNN Classifier, SIFT algorithm, K-Means Clustering, Back Propagation Neural Network (BPNN) Classifier.

Identifying FurcocercusCercariaein Fresh Water Using Learning Vector QuantizationNeural Network (LVQNN) and Support Vector Machine (SVM) algorithms

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Abstract

Waterborne bacterial infections and many harmful microorganisms which cause vital diseasesfound in water so we concentrate on using machine learning technique (LVQ algorithm) to identify cercariae in water to help scientists and water company to examine water before use it or sell it, we are working on an important system which can provide a lot of efforts, time and money to detect the harmful microorganisms and get rid of them for people to avoid catching diseases.

Schistosomiasis infection has affected nine of the local cities of Egypt and a lot of people catch this bad and vital disease as well as many countries all over the world. In this trial, Learning Vector Quantization (LVQ) algorithm was combined to Mean-shift Clustering algorithm in the process of identification of disease image recognition to recognize this disease in water butting in mind swarm optimization techniques like Bat algorithm.

We discuss achieving disease detection which can be successful and effective to get results with accuracy of 96.5% in the ordinary conditions using electronic microscopes connected to a computer or laptop. Combination among stages of pre-processing with the scale-invariant feature transform (SIFT) algorithm, machine learning, and image processing then feedback system is created to fulfill the required results and errands.

Obtaining accurate results with the help of machine learning algorithms is the Preliminary required outcome from our work to identify how to Purifies and treat water from harmful organisms and knew the percentage of the parasite (cercariea) in this water to identify usingwhich type of treatment.

Keywords: FurcocercusCercariae, Learning Vector Quantization (LVQ) algorithm Schistosomiasis, Mean shift clustering algorithm, Bat swarm optimization algorithm.

Assessing Energy Status in Egyptian Industrial Sector

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Abstract

İn view of the current energy crisis worldwide due to the depelation of fossil fuels resources and increasing consumers demand, implementation of proper enrergy management (EM) become a must. The present study aims to evalaute the status of energy management practices in one of the top energy consuming sectors in Egypt, the industrial sector. That was done in order to assess the current level of energy management practices, consequntly recommend improvement options and further need for studies.

Data was collected from globally published documents related to energy management in Egypt during the period from 2000 till 2018. By studying and analyzing this data it was found that limited documents were published concerning the implimented cases of energy management systems in the Egyptian industrial sector, 97% of the published documents were case study reports and only 3% were research papers The published documnets represnted EM practices in 14 industries. The top local industries with publications were Steel, Petrochemicals, Gas and Oil, Cement and Equipment & appliances.

Results indicated that many challenges face the implementation of energy management system in the local industrial sector such as: non-availability of data for development of proper EM strategies, lack of awareness about EM among top management and shop floor employees, usage of old and inefficient machinery. Additionally there is a huge gap between the academic and industrial sector in terms of knowledge share, consultency and cooperation.

The potential of impelmenting EM practices in Egyptian industrial sector is a huge one, that can be encouraged by many practices like: raising awernsess about the importance of EM and its benefits among decision makers in the indsutry, archive energy related data for devlopemnt of proper EM strategies and replace inefficient machinary with efficient one. Furthermore, bridges of collaboration between the acedemic and industrial sector are highly ecouraged to study best practices for each industry. Only two research papers were found related to this important issue, further publications must be done studing the local industrial case and sharing this important knowledge with academics, reseacrhers and experts in the field.

Keywords: Energy management, Egypt, Publications, Industrial Sector, Electricity

Poster presentations

The development of biodiesel production using lipase producing mutant whole-cell yeasts

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Abstract

This research was conducted by selecting isolates of yeast from the soil and other materials in the palm oil mill area. The SLP27 strain which was isolated from the palm kernel after compression was selected. It produced the highest lipase activity (0.28U/ml). Then it was induced to mutate with UV for 38 sec, the UV79 strain. Then the UV79 strain was mutated with ethyl methane sulfonate for 58 min, the EM107 strain. After that EM107 strain was mutated with gamma rays at 2 kGy and GAM47 strain was selected. Due to, they produced maximum lipase activity of 0.30, 0.36 and 0.70 U/ml, respectively. Next, GAM47 strain was used to catalyze the transesterification reaction in the biodiesel production process. The result revealed that GAM47 was able to catalyze the reaction. Finally, the selected yeast strain was identified in species level by D1/D2 domain of 26S ribosomal RNA sequence, the result was that *Candida orthopsilosis*.

***Keywords**:* mutant, whole cell yeast, lipase, biodiesel

Biological Activities from *Murraya paniculata* L. Crude Extract

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Abstract

Murraya paniculata (L.) have been used as medicines. It has been adjusted to application as healthy food. It has been included in a flavoring agent in foods and cosmetics. Thus, the aims of this study relate to evaluate the biological activities and analyze the chemical compositionsfrom flower, leaves and barks crude extract. The crude extracts from flower, leaves, and barks were analyzed the antioxidant activity, total phenolic content, total phenolic content, antibacterial activity, minimum inhibitory concentration (MIC) and minimum bactericidal concentration (MBC), and the chemical compositions. The results revealed that, the highest antioxidant activity was barkscrude extract (IC_{50} = 1.36mg/ml). The highest content of phenolic was barkscrude extract (70.81 ± 0.31mgGAE/g extract) and the highest content of flavonoid was leaves crude extracts (115.73 ± 1.18mgQUE/g extract). Leaves crude extract showed the highest antibacterial activity on *Staphylococcus aureus* TISTR 1466, *Bacillus subtilis* ATCC 6633 and *Pseudomonas aeruginosa* ATCC 27853. Barkscrude extracts showed the highest antibacterial activity on *Micrococcus luteusn* TISTR 9341, *Escherichia coli* ATCC 1261, *Pseudomonas* sp., *Streptococcus* sp. and Methicilin Resistant *Staphylococcus aureus* (MRSA). The MIC value of all crude extracts against *M. Luteus* TISTR 9341 were 12.5mg/ml. The MBC value of leaves crude extracts against *B. subtilis* ATCC 6633 was 12.5mg/ml. While, the MBC value of flower, bark crude extracts and MBC against *S. aureus* TISTR 1466 were 25 mg/ml. In addition, the chemical composition of flower, leaves and stem barks crude extracts showed the major compound included 2-methoxy-4-vinylphenol, 2H-1-benzopyran-2-one, Hexadecanoic acid, Hexadecanamide, murrialongin and 9-Octadecenamide from all part crude extracts. These results indicated that leaves and bark crude extracts exhibited bioactivities higher than flower crude extract and it can be applied in pharmacy, medicine and agriculture.

Keywords: *Murrayapaniculata* L., Crude extract, Antioxidant, Antimicrobial

Environmetric Techniques for Water Quality: A Case Study of Al-Gharraf River in Thi Qar Province, Iraq

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Abstract

The most beneficial strategy of reporting the water quality condition of a river is the classification of data based on water quality, to manage water pollution in supervised areas. The current environmetric research combined with the explanation the monitoring data from the Al-Gharraf River in Thi Qar province. Twenty variables for water quality are measured to estimate and classify the water quality of the Al-Gharraf River at two sampling sites. In this study, factor analysis (FA) and cluster analysis (CA) have been applied to determine the characteristics quality of water, to get the source inputs-elements of water quality, and to estimate the pattern of water quality and its spatial in this area. The results of PCA for the region under study indicated that the first four components from the data sets of principal component analysis (PCA) recorded 92.7 % of the total variance. This research confirmed that the use of the multivariate statistical methods is an effective tool for the river-water category. Hence, it is suggested to comprise the data that are environmetric data counseling as a useful operation for assessment of water quality data.

***Keywords*:** water quality, cluster analysis, principal component analysis, Al-Gharraf River.

Subacute oral toxicity study of *Ephedra alata* ethanolic extract in mice

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Abstract

Ephedra alata is an endemic Saharan species that grows in Algeria, North Africa and other regions. It is known for their many uses in traditional medicine around the world. Recently it has become very used by Algerian patients to treat several diseases. The present study therefore was conducted to test the subacute oral toxicity of the ethanolic extract of the plant on Swiss female mice. The animals were orally administered daily dose of (250, 500, 1000, 2000 and 4000mg/kg body weight) and they were observed, with special attention given to the first 4 h and once daily further for a period of 21 days. The major vital organs (brain, heart, liver and kidney) were collected and body weight was analyzed to study the toxicity.

There were no variation among the control group and the treatment groups in vital organs weight (There were no change beginning the dose in low concentration to the dose in high concentration). Furthermore, there were no difference in body weight among the control and the treatment groups. Daily oral administration of the extract for 21 days did not show any treatment-related mortality occurred among female mice and any treatment-related abnormalities with regard to hematological and biochemical parameters during the observation period. Histological analysis did not show any morphological changes in the major vital organs (liver and kidney) tested. These results indicate the safety of the oral administration of ethanolic extract of *Ephedra alata.*

Keywords: *Ephedra alata*, subacute toxicity, Hematological, Biochemical parameters.

Mining Metallothionein gene of stressed Nile Tilapia (*Oreochromis niloticus)* with Heavy metals pollutions in Idku Lake, Egypt

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Abstract

In this investigation, 30 of random juvenile starlets *Oreochromis niloticus* (*Oreochromis niloticus*) fish samples ranging in mass from 18 to 38.50 g were collected from three sectors of the Idku Lake, Egypt were used for evaluating heavy metals influence. Different heavy metals concentrations were recorded. cDNA of Metallothionein gene was amplified, sequenced and alignments as *Oreochromis niloticus* (XM_003447045.5) and *Maylandia zebra* Metallothionein (XM_024803240.1) for second and third cadmium and Lead doses respectively. Furthermore, expose to Pb reflects superior genetic polymorphism comparing with Cd and control samples 0.4 mg/L of Cadmium treatment, reflected highest polymorphism (44.4 %) comparing with 0.14 mg/L of Lead treatment revealed highest polymorphism (66.6 %)

Keywords: Heavy metals, Metallothionein (MT), *Oreochromis niloticus.*

Prevalence of Tetracycline Resistant Bacteria and its Related Resistant Gene(s) in different Water Sources

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Abstract

Water is a main source of life in the world. However, it is one of the most risk disease transporters. Tetracycline-resistant bacteria can be transmitted to humans directly by contact with contaminated water. Therefore, the presence of tetracycline-resistant bacteria is increasing the probabilities of water contamination levels. The current study aims to determine the incidence of tetracycline resistant bacteria isolated from different water samples and the genes responsible for this resistance. Two hundred fifty isolates were isolated from different water samples from two different locations. A hundred isolates out of 250 bacterial isolates (40%) were resistant to (16 µg/ml) tetracycline. Only 31 (31%) were selected due to their resistance to (32 µg/ml) tetracycline for identification. All selected isolates were identified according to biochemical and the 16S sequence techniques. The 16S rRNA gene sequences of the bacterial isolates which are reported in this study were submitted to the NCBI database (accession No. MH266225- MH266252), accession No.MH423704-MH423705) and (accession No.MH469556). Of the 31 isolates analyzed by PCR, 41.9 % (13 of 31) harbor *tet* A gene, 74.2% (23 of 31) carry *tet* D gene, while 12.9 % (4 of 31) carry *tet* M gene. The three tested *tet* genes were not detected (*tet* B, *tet* C and *tet* O). Twenty-one isolates (67.7%) harbored a single *tet* gene, five isolates (16.1%) harbored two different *tet* genes while three isolates (9.7 %) harbored three different *tet* genes. Moreover, two isolates did not detect any type of the tested *tet* genes. It could be related to the other non-tested *tet* genes. The maximum detected *tet* genes combination in some strains were three, *tet* (A, D and M). It is obvious that tetracycline resistant bacteria are present in the River Nile; many reasons contribute to this distribution including sewage inflow, animal manures, wastewater disposal along with antibiotic misuse.

Effect of Nickel in the Irrigation water and Foliar Applied Malic Acid on Vegetative Growth, Flowering and Chemical Composting of *Salvia splendens* Plants

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Abstract

The present study was carried-out at Antoniadis Research Branch, Horticultural Research Institute, A.R.C. Alexandria, Egypt during the two successive seasons 2016 and 2017. The aim of this study was to evaluate the effects of irrigation water contaminated with nickel on *Salvia splendens* plants grown in sandy soil, the possibility of using malic acid spray treatments to overcome the effects of nickel pollution. Seedlings of *Salvia splendens* were planted individually in plastic pots (20 cm diameter) filled with 3 kg of sandy soil. Four concentrations of nickel 0, 100, 200 and 300 ppm were applied in the irrigation water. The plants were treated with malic acid at concentrations of 0, 250 and 500 ppm by monthly spraying in both seasons.

The results showed that for vegetative and flowering growth parameters, there was no significant interaction between nickel concentrations and foliar spray by malic acid, while a significant reduction was observed in all parameters after irrigation with contaminated water contained nickel and a significant increase in vegetative and flowering growth parameters was observed after 500 ppm malic acid application. For chlorophyll and carbohydrate content the highest significant value was obtained from plants irrigated with tap water and sprayed with 500 ppm malic acid while the highest significant nickel content in leaves, stem and roots was obtained in the treatment 300 ppm without application of malic acid.

Keywards: *Salvia splendens* - Nickel - Malic acid.

Environmental impact assessment of paints production in Egypt

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Abstract

Painting materials are being used worldwide for decoration, equipment and machinery refinishing among many other applications. The total value of the global paint market amounted to approximately 160.54 USD billion in 2017 and is expected to reach 209.36 USD billion by 2022. The local paint market in Egypt reached 764 USD million sales in 2016. The local expansion in both the industrial and real estate construction sectors is associated with increasing demand of painting materials. This raises the concerns of paint production impacts on the environment.

The aim of this study was to assess the environmental impacts of one of the most locally used painting materials "White alkyd enamel paint". This was done in order to identify the hot spots of local paint production process, and need for future studies. Life cycle assessment (LCA) was employed as a tool for assessing the environmental impacts.

LCA results indicated that white alkyd enamel production impacts on resources, ecosystem quality and Human health by 45.8%, 31.8% and 22.5%, respectively. Top impacted category is fossil fuels depletion which accounts for 44.8% of the total environmental impacts. The production of Alkyd resin is the main contributor to the different environmental impact categories. Overall environmental impacts of this industry can be reduced by implementing proper energy management practices that reduce energy consumption during Alkyd resin manufacturing.

Furthermore, no previous LCA studies were conducted concerning the environmental impact assessment of paint production process at local level. It is recommend to conduct further studies in this area taking into consideration other types of painting materials. Also comparing between the impacts of different painting colors can be studied.

Keywords: Environmental impacts, Life cycle assessment, Alkyd Enamel paints, Egypt

Monitoring land cover change due to urban expansion in Kafr El-sheikh Center,Egypt

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Abstract

Egypt, is one of the most vulnerable African countries to climate change impacts. As a developing country, urban areas expand with high growth rates and mostly in an unplanned manner, which causes a significant reduction in agricultural area. The decrease in vegetated areas causes negative impacts on urban environment. Land use/land cover changes have effects on the flux of mass and energy. As climate change would affect land cover patterns and land cover change in turn alters these fluxes. Climate change affects both the environment and human, in spite of that limited research was conducted to investigate the relationship between land cover change and urban expansionin Egypt.

This study aims to monitor the land cover change due to urban expansion in KafrEl-sheikh Center -Egypt, by using modern techniques of remote sensing and GIS. This study used Landsat images to monitor the land use / land cover change for the study area for four decades starting from 1987 till 2018. This was done in order to identify the change patterns and study how to mitigate the negative impacts of that change.

Study results show that the agricultural area in Kafr El-sheikh center decreased by 21.8% from 1987 to 2018, while the urban area increased by 71.7%. This urban expansion causes loss of productive agricultural lands. Further studies in this area will be useful for the decision maker to investigate and monitoring illegal use of agricultural land in the Nile Delta region.

Keywords: Urban expansion, land cover change, Urban environment, Kafr El-sheikh

Omega oils in leaves of Cono carpus

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Abstract

Plants still an important source of omega oils that help to healthy for human and animals. Fresh leaves, stem, flower and fruits samples from Cono carpus erectus family *Combartease* has been analyzed using {GLC} Gas and liquid chromatography. The results indicated high levels of Omega oils which related to growth of nerve cells in brain. pH of fresh leaves determined and alkaloids with 8.2 which could help patients of diabetic type II

Keyword: Cono carpus, Omega oils, diabetic type II

Full Papers

Assessing Energy Status in Egyptian Industrial Sector

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Abstract: İn view of the current energy crisis worldwide due to the depelation of fossil fuels resources and increasing consumers demand, implementation of proper enrergy management (EM) become a must. The present study aims to evalaute the status of energy management practices in one of the top energy consuming sectors in Egypt, the industrial sector. That was done in order to assess the current level of energy management practices, consequntly recommend improvement options and further need for studies.

Data was collected from globally published documents related to energy management in Egypt during the period from 2000 till 2018. By studying and analyzing this data it was found that limited documents were published concerning the implimented cases of energy management systems in the Egyptian industrial sector, 97% of the published documents were case study reports and only 3% were research papers The published documnets represnted EM practices in 14 industries. The top local industries with publications were Steel, Petrochemicals, Gas and Oil, Cement and Equipment & appliances.

Results indicated that many challenges face the implementation of energy management system in the local industrial sector such as: non-availability of data for development of proper EM strategies, lack of awareness about EM among top management and shop floor employees, usage of old and inefficient machinery. Additionally there is a huge gap between the academic and industrial sector in terms of knowledge share, consultency and cooperation.

The potential of impelmenting EM practices in Egyptian industrial sector is a huge one, that can be encouraged by many practices like: raising awernsess about the importance of EM and its benefits among decision makers in the indsutry, archive energy related data for devlopemnt of proper EM strategies and replace inefficient machinary with efficient one. Furthermore, bridges of collaboration between the acedemic and industrial sector are highly ecouraged to study best practices for each industry. Only two research papers were found related to this important issue, further publications must be done studing the local industrial case and sharing this important knowledge with academics, reseacrhers and experts in the field.

Keywords**:** Energy management, Egypt, Publications, Industrial Sector, Electricity

1) Introduction

Egypt is the largest oil producing country outside the Organization of Petroleum Exporting Countries (OPEC) in Africa and the third largest natural gas producer on the continent. Egypt's location reserved an important role in the international energy market. The country is determining to be an electricity hub in the Middle East. It already has grid connection with Jordan, Iraq, Syria, Turkey, and Libya and has the intention to expand the grid with other African countries. A $1.6 billion deal between the Egypt and Saudi Arabia to provide the two countries with 3.5 GW electricity cables was established. Egypt also has

signed a lot of agreements between 2013-2014 altering conventional ways of producing electricity and varying the national energy mix [1, 2].

Fossil fuels are the main resource for energy in Egypt especially Natural gas and Oil. This dependence on Natural gas is justified by the new expansion in natural gas exploration in the western desert and off shore [2]. However, Egypt has been suffering from the energy crises since 2011 due to the high rise in demand from the end users, absence of enough fuel to run the power stations, poor infrastructure of generating units and transmission lines, in addition to Egypt's growing population which helped to raise the energy demand. Egypt electricity generation relies on thermal power stations andthese power plants are in service for more than 20 years [2, 3]. Moreover, end users are rapidly increasing which is a burden on the supply grid and the current energy consumption is not an efficient one.With this in regard, energy efficiency became a must to tackle the problem [4].

Upon these stated facts, measures should be taken to reduce the increasing energy consumption in Egypt in an efficient way. The aim of this study was to assist in addressing the energy crisis in Egypt by identifying energy reduction opportunities in the Egyptian industrial sector and recommend related improvement options. The industrial sector in Egypt is the second highest consumer of energy accounting for 19.4% of the total energy consumption [5].

2) Methods and Data Collection

İn order to assess the energy management status of the industrial sector in Egypt, its application of energy saving measurements and potential for implementing energy reduction approaches, published documents related to energy management in Egypt were collected from 2000 till 2018 following the developed model by [6]. These published documents were screened, reviewed, studied and analyzed. Selection criteria included only the published documents related to energy management in Egypt which can be found by researchers and scholars though the Google search engine. Criteria also included published documents by both Egyptian and non-Egyptian scholars, companies and organizations. Published research papers, review articles, conference papers and case study reports were considered.

3) Results and discussion

3.1. Status of publication inEgypt

By reviewing the published docuemnts related to energy status in Egypt and its energy management applications it was found that there is no historical data and limited energy profiles are avilable. The total of publicatrions were only 66 documents. The majority of these documents (97%) were case study reports and only 3% were research papers (Figure 1). The published documnets represted conducted works in 14 industry, which are presented in figure (2).

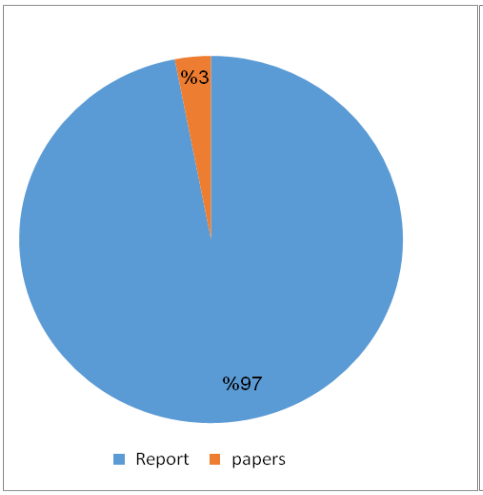

Fig.1. Percentage of published documents related to Energy Management in the Egyptian industrial sector

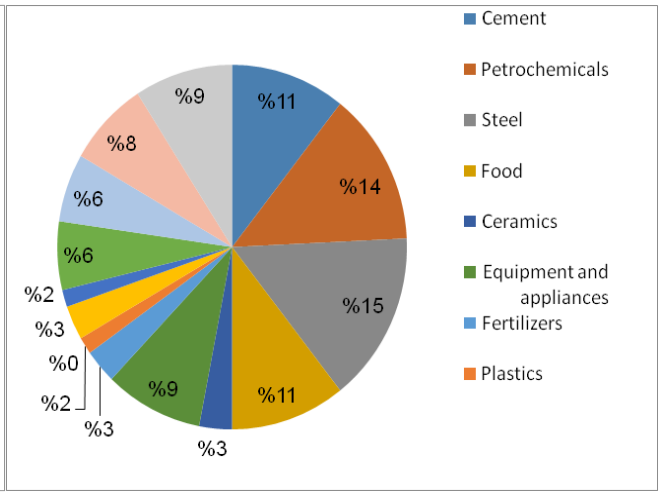

Fig.2. Percentage of published documents per type of industry

3.2.Covered industries

Study results show that the published documents related to energy management application in Egypt cover 14 industries. Figure (3) shows the addressed industies and related publications. Accordingly the top local industries with publications were the following heavy energy consuming industries: Steel, Petrochemicals,Cement, Gas and Oil, and Equipment & appliances, consecutively. As per the EIA (2016) [7] that classifies the industries according to their energy consumption; food industry is the most intensive energy consuming industry. Inspite of that the share of local food industry in the published documents was only 7 reports. While Petrochemicals industry has 9 reports and Oil & Gas industry has 5 publications.

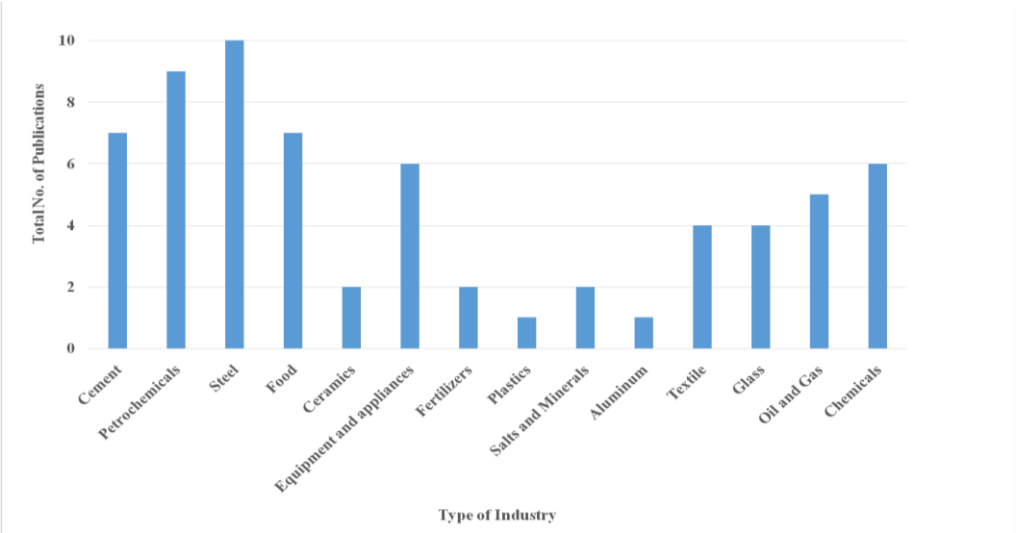

Fig.3. Number of publications per type of industry

3.3.Main findings:

By reviewing the published documents and case studies related to enrergy management applications in the Egyptian industrial sector several issues were identiyied, these issues can be summarized as following:

3.3.1. Data avilability

The avilable data is not sufficient to develop proper strategic energy plans and poilices for managers and decicion makers in the industrial sector. As presented in figure (1) the total number of published work is vey low. Most of the data was collected from reports from UNIDO project case studies except for only 2 published research papers. This indicates that there is no interest or proper awerness in the industrial sector to publish or even providing data for research purposes.

3.3.2. Challenges in enegy management implementation

İn accordence with UNIDO (2015) [8] the implementation of proper energy management systems and related approaches in local indusrial facilities face many obstacles such as:

- No avilabiltiy of a clear energy management plan or clearenergy management measures.
- Lack of communication between the board directors and top management who plan the energy management strategy in the company and shop floor personnel who implement the strategy.
- Beurocracy and inflexibility to implement the energy management strategy.
- Excessive inefficient energy conumption in the industrial sectordue to accumulated inefficient equipment and processes
- Capacity building for energy management training already started a few decades ago but has not been sustained
- Theres is No sufficient guidance to small and medium industries
- Micro-enterprises are difficult to target because of their large numbers, different locations and inefficient technical capacities. Additionaly, the informal industrial sector cannot be targeted directly before they are formalized

3.3.3.Awareness

Awareness about the importance of energy management opportunities and theirimplementation is a very important issue. It is a low cost opportunity for energy saving by changing human behavior in work environment. Spreading awareness on EMS through training sessions and flyers will ease the company strategy towards any future change in energy consumption.Furthermore, employee awareness leads to a reduction in energy costs [9]. Most of the published documents related to EM in Egyptian industrial sector complained about limited awareness either among board director or the technicians and personnel. Due to the recent minimize in energy subsidy, energy management became a must for the industrial facilities. Board directors in the industrial sector start paying attention to the potential savings

regarding their industry. In spite of that there is still lack of energy efficieny culture within both top management and shop floor employees.

3.3.4. ISO500001:2011

ISO 500001 is an international standard guideline for energy management that helps organizations save money using energy efficiently as well as helping to conserve resources and tackle climate change. The implementation of ISO 50001:2011 is done through the development of an energy management system (EMS) (ISO500001:2011). By reviewing the collected materials it was found that a total number of 35 case study companies had implemnted the EMS according to ISO 500001:2011 (Figure 4). Some companies such as EZDK, Amreyah Cement, El Araby, Galaxy Chemicals and El-Dawleya for Modern Food Industries were certified or crowned thier new policies by the ISO50001:2011 [10,11,12,13,14]. One case study in a local textile manufacturing facility reported the development steps of their EMS according to the ISO 50001 standard and the achived cost saving which reached about 70,000 USD/year [15,16].

3.3.5.Focus on few improvement options

The published cases focused on three main topics as shown in Figure (4) which are :a) Implemnetaion of EMS, b) Achiving optimum efficiency of motors, and c) Compressed Air System Optimization (CASO) :

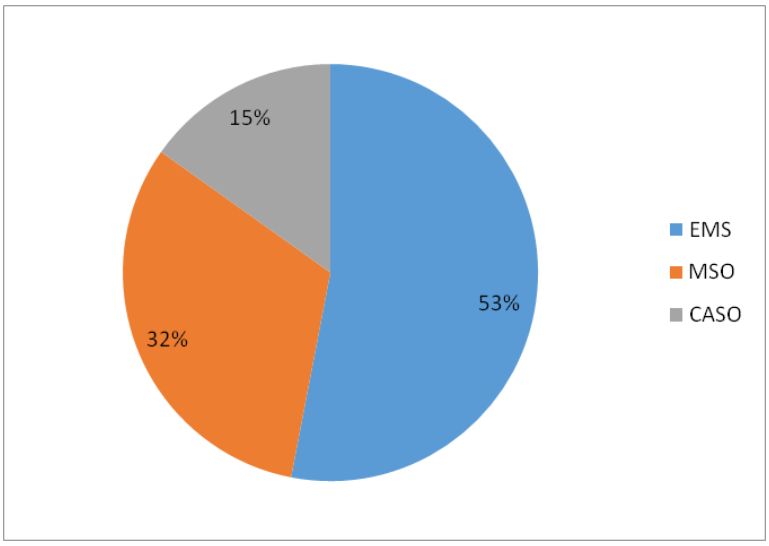

Fig.4. Percentage of focuse topics

- Regarding the implmentation of Energy Management Systems (EMS), the number of reported cases 35 and they focused mainly on electrical and thermal potential savings. In some cases water saving opportunities with an impact of energy minimzation was considered. In addition to several opportunities of no cost savings that was achieved by shutting down the equipment on down time, reducation of number of pumps, increase of chemical energy participation in the industry, usage of rice ash as insulation, optimizing the consumption of oxygen and reduction of tap to tap time [17,18].

-As for Motor System Optimization (MSO) it was found that 21case study focusd on this topic. MSO was done by selection of proper sizing of motor, usage of efficient motor and applying best maintenace practices. Some practises did not require any additional costs such as shuting off the cooling tower fan when there is no need for cooling during winter weather or night time [19]. Electric motors conume 70% of energy consumption of industrial sectors, as they are present in fans, pumps, electrical drives, ..etc [19]. Some companies focused only on EM opportunities related to MSO, others prefere to implement amore comprehensive EMS including other electrical and themal potential savings.

- In the case of Compressed Air System Optimization (CASO), total number of reported cases were only 10 cases. Main problems regrading CASO reports were inappropriate use of some machinery, usage of old control system, leakeges, poor maintenance. Addtionaly, waste heat recovery was available in some cases. The payback period of CASO modifications was immediate and most probably in near future less than one year [18,19,20,21,22,23].

3.4.Greenhouse Gases (GHG) Reduction

Climate change has a drastic impact on the ecosystem especially biodiversity. Rising temperature, burning forests, melting snow packs and sea level rising are all consequences of climate change [24]. The dominant cause for previous disasters is Greenhouse gases. These Greenhouse gases (GHG) are mainly emissions from burning fossil fuel which is the main source of energy [25]. Greenhouse gasses from energy sector represent two-thirds of all greenhouse gasses [26]. According to central agency for public mobilization and statistics [5] , electricity production is the largest carbon dioxide emitter preceding the industrial sector at the local level. The electricity production sector generates 43.28% carbon dioxide emission and the industrial sector is responsible of 15.4% of these emissions [5]. The reduction of energy consumption and related combustion process is a direct reduction of emitted GHG generated from the combustion process of energy production. Many cases reported their GHG reduction due to EM practices [13,14,18,19].

3.5.Utilities

In some companies, the industrial energy efficiency (IEE) scope targated improving the energy consumption by addressing water saving opportunities [8]**.** Some companies do have utilities that use water excessively. They managed to take many procedures in action to reduce water consumption which should be rationally used[11,12]. Regarding the local energy saving approches in the Egyptian industrial sector, it was found that the two sole companies who took water saving in consideration were food and chemmical indusrty companies[11,12] By saving water the company directly reduced the direct costs of both energy and water consumption. The addressed measures reported in this case for water saving included [27]**:**

- Adjusting cooling water temperature at refrigeration plant to reduce energy consumption.

-Connecting air conditioning plant with cooling water toreduce compressors consumptions.

-Usage of reject water after treatment.

- Control domestic water use, and water irrigation

4. Recommendation and improvment options and Future need of studies

İn was found that there is a lot of potential for energy saving opportunitie in the local industrial sector, which can be summarized as following:

4.1.Adaptation to proper energy consumption by

- Raising awareness of both top management and the employed stuff of the energy consumption and related economic and environmental impact of their industry.
- Archive all energy data and related documentsin the different industrial facilities.
- Set amendments to constitution or even imposing laws to force institutions to rationalize energy consumption

4.2.Introduce alternatives to fossil fuels:

- Switching fossil fuel to non-carbon based energy resource.
- Shifting from high carbon content to low carbon content.

4.3.Knowledge sharing

- Encourage collaboration between the researchers and industrial sector
- Build communication path between the researchers and industry
- Consider economic and practical aspects in future research studies related to energy management practices.
- Creation of a data bank for energy related issues that serves researchers in both the academic and industrial sector.

5. Conclusion

The local industrial sector has a lot of potential for energy saving opportunities and related green house gas reduction. Raising awerness about the importance of energy saving and related economic and enviromnetal impacts among decision makers, top management and shop floor employies is one of the most important ways to reduce energy consumption with no cost. Further potential applications include setting amendments for energy consumption rationalization, Introduce alternatives to fossil fuels and encourage Knowledge sharing between academic and non-academic experts in the energy field.

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Challenges of Life Cycle Assessment application in Thailand Biogas Production

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Abstract: Within the last few years, biogas became an important source of renewable energy. Today, Thailand ranks as the top biogas producer in Asia, it is witnessing a fast growth and expansion in biogas facilities all over the country. In spite of the importance and ongoing expansion in biogas production worldwide few studies investigated the environmental impacts of this production. Life Cycle Assessment (LCA) is a globally accepted tool used for sustainable development and for estimating the environmental impacts of products and services.

The aim of this paper is to study the conducted LCA investigations related to biogas production in Thailand to identify the limitations and challenges that face the employment of this tool in this area. The published documents related to biogas production and LCA in Thailand were studied, visits to local biogas production plants were conducted for data collection, interviews with biogas production experts and consultants toke place. It was found that no previous LCA of biogas production in Thailand were conducted, furthermore few documents were published regarding biogas production in Thailand. Lack of available data for conducting LCA, low awareness about potential usage of LCA for sustainable development and limited number of experts in LCA are key factors that face LCA application in Thailand.

In conclusion, LCA can be used in this area in order to compare between the different biogas production systems and recommend the more eco-friendly one. Promotion of LCA as a tool for sustainable development in Thailand can be done by capacity building activities and conference communications.

Keywords: Life cycle assessment, Biogas, Thailand

1. Introduction and plant description

One of the most recent reports of the World Market for Biogas Plants [1] stated that "The worldwide construction of new biogas plants will continue in the next 10 years between 2016 and 2025", the number of biogas plants will grow from 12,000 to 15,000 plant worldwide, and the generated power from this plants will increase from 7,000 MW to 9,600 MW. At the same time, many existing biogas plants are optimizing their operation conditions in order to increase their production capacity. Europe is the top market for biogas plants as it contains 90% of the existing ones and will continue the expansion in their construction. Asia and North America are next in the new construction of biogas plants market, they are becoming more important as individual advantageous schemes will produce positive outcomes specially in Thailand (Figure 1). As for South America, Australia and Pacific as well as Africa and Middle East the construction of biogas plants will remain limited to individuals and sometimes very large projects [1].

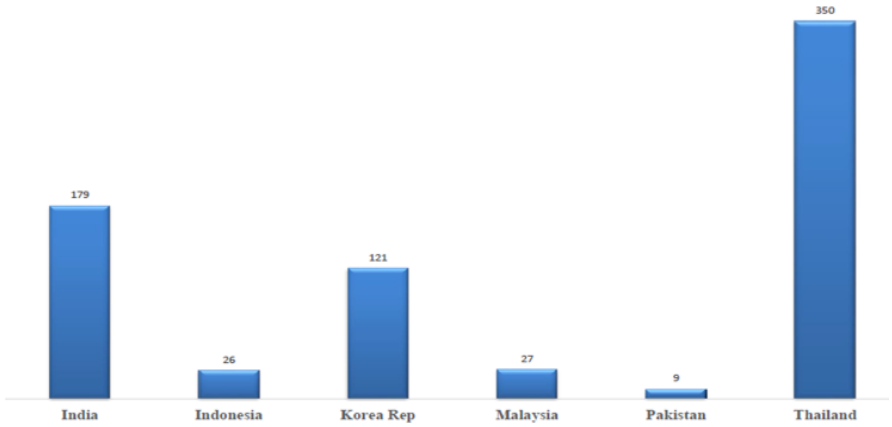

Fig.1. Biogas production in Asia by country (MW) [5]

Thailand obtains a wide variety of feedstock for biogas production as the agriculture and industrial sectors produce large volumes of wastewater with high organic content. Within the last few years, Thailand witnessed a rapid expansion of agricultural and industrial biogas facilities, which produce biogas from animal waste, agro-industrial waste and municipal solid waste. In 2008, Thailand's Renewable Energy Development Plan set a biogas target of 120 MW by 2022. This target was exceeded in 2011, consequently an Alternative Energy Development Plan was set to reach a new biogas target of 600 MW by 2021. In 2012, Thailand reached a total capacity of 138 MWfrom biogas production, this capacity increased to reach 372.5 MW in 2015. The new Alternative Energy Development Plan 2015-2036, set a new target for biogas production to reach 1,280 MW [2,3,4,5].

The production of biogas as a waste-to-energy approach does not only provide a sustainable and economic source of renewable energy, it also assists in presenting a safe solution for waste recovery and environmental conservation. One of the implemented projectsin Thailand during the period 1995 till 2010, was to install 150 biogas plant on medium and large swine farms using anaerobic digestion technology. The project proved to be economic, financial viable and reduced greenhouse gas by 698,030 metric tons of CO_2equivalent. In 2000, another project supported the installation of biogas systems in cassava starch mills, one of the post important agro-industrial processes in Thailand. This resulted in an estimated biogas production of 36 million cubic meters per year, which displaced 22 million liters of heavy fuel oil. Moreover, from 2008 to 2013 a third project targeted thebiogas production from 1,700 wastewater-generation sites of animal husbandry, food industry and municipal solid waste. About 40 percent of the country's livestock farms were involved in this project. As a results, 1.72 million metric tons of CO_2 equivalent were reduced [3, 6].

Biogas systems have proved to benefit farm & factory owners and local communities in many ways in addition to energy cost savings, like reduction of water pollution, odor and health risks by eliminating the dumping of waste in open ponds, additional revenue from sale of surplus electricity to the grid, carbon credits and valuable byproducts (such as sludge that can be used as organic fertilizer), treated wastewater can be used for farm or factory activities. Greater efficiency, competitiveness and creation of rural jobs, additionally, the

reduction of greenhouse gas emission from displacement of fossil energy and avoided methane emissions.

Currently, the Thailand market has a potential for expansion, but more important the performance of existing plants could be improved with enhanced technical & operational capabilities and improvements in current biogas technology designs [3,4]. In spite of the importance and ongoing expansion in biogas production in Thailand few studies investigated the different environmental impacts of this production. The aim of this paper is to study the conducted LCA investigations of biogas production in Thailand, identify related limitations and challenges in order to recommend improvement options that enable the usage of this important tool for sustainable development in Thailand.

2. Data collection, field visits and interviews

The investigation started by collecting published materials related to LCA and biogas production in Thailand from 2002 till 2017. Few documents were found in this area, no studies related to LCA of biogas in Thailand were found, and most of the published documents were related to biogas production only. Some studies investigated the possibility of using wastewater from dairy and milk processing for energy recovery through anaerobic treatment [7]. The mentioned studies were conducted at different scales "lab scale, semi-pilot and pilot scale".

Next, field visits and interviews with biogas production experts were done during the investigation in 2017. Two plant scale biogas production plants were visited. One established on 2012, located at Ang Thong province, one of the central provinces of Thailand. Plant capacity was around 40,000 m^3 biogas per day. The produced biogas is only used to generate electricity and sell it to the electrical company through a direct connection to the grid. Plant operating hours are 8 hours per day during peak time. The main source of feed stock for this plant is cassava starch. The other biogas production plant was located at Sarabuni province. Production process of biogas production was a batch process from different sources like manure, waste paper, and agriculture waste. Figure (2) shows the layout and system boundaries of biogas production from two different systems.

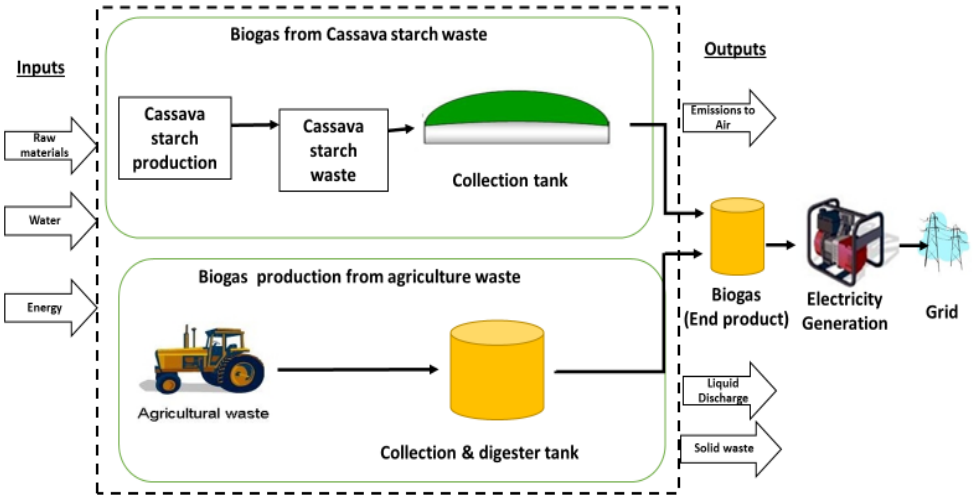

Fig.2. Layout and system boundaries of different Biogas production systems

3. Environmental impacts of biogas production

By reviewing the globally conducted studies related to LCA of biogas production. It was found that the main environmental impacts of this production can be summarized as following:

3.1. Global Warming Potential (GWP)

The production of biogas from different agricultural waste reduces the impact on GWP. This is mainly attributed to the avoided generation of CO_2 and CH_4 from fossil fuels combustion and waste to energy application of biogas production from waste. Prapaspongsa et al., [8] investigated the environmental impacts from different scenarios of pig manure management. They reported that anaerobic digestion of pig manure achieved the highest impact reduction in GWP as it reduced both CO_2 and CH_4 emissions. Similarly Mezzullo et al., [9] declared that the digester and digestate manufacture has major impact on GWP. Whiting and Azapagic [10] reported as well that usage ofgenerated biogas from waste can reduce up to 50% of GWP compared to fossil-fuels consumption.

3.2. Fossil Fuels Depletion (FFD)

Fossil Fuels Depletion is one of the most important impact categories taken into consideration in biogas production studies. Many Scholars [8, 9, 10, 11] studied LCA of biogas production from agricultural waste and agreed that this waste to energy application can lead to significant reductions compared to fossil-fuel alternatives.

Both [10, 11] agreed that the manufacturing, installation and operation of the biogas plant is the most energy-demanding process. FFD potential in this case was due to the energy consumed during the installation and operation of the biogas system. In spite of that, according to [9] who investigated LCA of an anaerobic digestion plant from cattle waste, they found that the most significant result came from the consequential displacement of the kerosene production, using biogas. They reported that the energy equivalent of kerosene showed a significant reduction in FFD over the life of the anaerobic digestion process.

3.3. Land Use (LU)

Land use is an important category affected due to the transformation of the agriculture land into industrial land for building the biogas plants. Mezzullo et al., [9] stated that the land was assumed to be converted from normal farming land to industrial land, which impacted the ecosystems, because of the change in land use. This impact can be mitigated in the first place by using industrial land for the biogas plant.

3.4. Respiratory Inorganic Formation Potential (RIFP)

One of the highly impacted categories due to biogas production was the potential emissions of the respiratory in-organic particulate matter. Both [8, 9] agreed that the most significant contributors to this category are ammonia, Sulfur dioxides (SO_x) and nitrogen oxides (NO_x) emissions generated from manure digestion. Biogas production from cattle and swine manure waste required about 30 days retention time and generate ammonia, sulfur dioxides (SO_x) and nitrogen oxides (NO_x) emissions. In order to reduce RIFP it is advisable to control ammonia emissions, since ammonia can form secondary particulate matter such as ammonium nitrate and ammonium sulphate [8,13].

3.5. Acidification Potential (AP)

Acidification potential is a direct indicator of SO_x emissions, the generated emissions from the digestion of cattle and swine manure specially ammonia is the main contributor to this category. Both [8,10] reported high impacts on this category. Whiting and Azapagic [10] suggested that the high acidification potential can occur due to ammonia leakage from the biogas storage tank. However, when they compared acidification potential from electricity generation using biogas production from agricultural waste with potential impact from natural gas, they found it 25 times higher [10]. The high impacts of biogas production from agricultural waste are influenced by the type and source of feedstock, digester storage and its application on land. In order to reduce these potential impacts [8] strongly advised to reduce the generated emissions by integrating energy recovery systems with high nutrient recovery such as incineration or thermal gasification and control manure emissions during their different handling stages.

3.6. Eutrophication Potential (EP)

Eutrophication potential is an indicator of NO_x emissions. Whiting and Azapagic [10] declared that ammonia and NO_xemissions from the digestion of cattle and swine manure are the main contributors to EP. Ammonia emissions are the primary responsible of this potential impact as they contribute with 97% of EP. Moreover, they reported that EP of electricity generation from biogas production using agriculture waste was 12 times higher than its generation by natural gas. The ammonia is produced in the liquid digester and escapes during its open-air storage. In order to reduce these emissions, Prapaspongsa et al., [8] recommended the control of greenhouse gases, ammonia, and nitrate emissions at the different stages of manure handling.

3.7. Ecotoxicity Potential (EP)

The ecotoxicity potential can be attributed to the discharge of heavy metals. Reported results by [9, 10] indicated that the use of coal as an energy source and chromium steel both used in the manufacture of the biogas plant are the major contributors to EP. Usage of coal causes short term emissions of nickel and long-term emissions of copper, which are the main cause of air and water toxicity. As for terrestrial eco-toxicity, released chromium emissions during the production of ferrochromium used for the biogas plant manufacture is the main contributor.

4. Potential applications, challenges,and limitationsof LCA in Thailand biogas production

LCA investigation can be conducted for several purposes like: assessing and comparing between the environmental impacts of different biogas production materials and used feed stocks, Identify the hot spots of biogas production systems to recommend improvement options and Comparing between different biogas production systems to suggest more ecofriendlyones.

However, LCA studies for biogas production in Thailand will be subjected to several uncertainties due to the unavailability of data in databases. The available data in the LCA database may not exactly represent the quantity being studied due to the geographical/regional location in Thailand. Although a recent Thai National Life Cycle

Inventory database was developed, the database did not contain any information related to biogas production in Thailand [14].

As for the main challenges facing the usage of LCA studies in Thailand, they can be summarized in: lack of local data to be used for conducting the studies, low number of LCA expertsarea in the country and limited information about LCA importance and its usage as a tool for sustainable development.

Accordingly, in order to encourage the application of LCA as a tool for sustainable development in Thailand for biogas production and other productions as well. It is recommended to update the developed "Thai National Life Cycle Inventory database" with more local data, especially the data that is distinguished in Thailand and Asia area such as Cassava production and related processes.

The promotion of LCA application and employment opportunities among academic and industrial researchers is highly recommend. This can be done by capacity building workshops and conference communication.

5. Conclusion

Waste to energy applications of biogas production from different wastes is highly recommend as it represents a valuable source for clean energy and an excellent alternative to fossil fuels with high economic and environmental benefits. LCA was used in several studies to assess the environmental impacts of different biogas production systems. The main impacted categories from this production were Global Warming Potential, Fossil Fuels Depletion, Land use, Respiratory Inorganic Formation Potential, Acidification Potential, Eutrophication Potential, and Ecotoxicity Potential.

It was found that no LCA studies were conducted related to biogas production in Thailand, however, few studies were published addressing biogas production at different scale "experimental, lab-scale and pilot scale" in Thailand. It is recommended to promote the usage of LCA as a tool for sustainable development in Thailand and encourage its employment in the area of biogas production as well as in different areas.

Acknowledgement

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Environmental impact assessment of paints production in Egypt

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Abstract

Painting materials are being used worldwide for decoration, equipment and machinery refinishing among many other applications. The total value of the global paint market amounted to approximately 160.54 USD billion in 2017 and is expected to reach 209.36 USD billion by 2022. The local paint market in Egypt reached 764 USD million sales in 2016. The local expansion in both the industrial and real estate construction sectors is associated with increasing demand of painting materials. This raises the concerns of paint production impacts on the environment.

The aim of this study was to assess the environmental impacts of one of the most locally used painting materials "White alkyd enamel paint". This was done in order to identify the hot spots of local paint production process, and need for future studies. Life cycle assessment (LCA) was employed as a tool for assessing the environmental impacts.

LCA results indicated that white alkyd enamel production impacts on resources, ecosystem quality and Human health by 45.8%, 31.8% and 22.5%, respectively. Top impacted category is fossil fuels depletion which accounts for 44.8% of the total environmental impacts. The production of Alkyd resin is the main contributor to the different environmental impact categories. Overall environmental impacts of this industry can be reduced by implementing proper energy management practices that reduce energy consumption during Alkyd resin manufacturing.

Furthermore, no previous LCA studies were conducted concerning the environmental impact assessment of paint production process at local level. It is recommend to conduct further studies in this area taking into consideration other types of painting materials. Also comparing between the impacts of different painting colors can be studied.

Keywords: Environmental impacts, Life cycle assessment, Alkyd Enamel paints, Egypt

1. Introduction

The total value of the global paint market amounted to approximately 160.54 USD billion in 2017 and is expected to reach 209.36 USD billion by 2022 [1]. Paints are being used worldwide for a number of applications like decoration, car refinish, steel structure, .etcthere are different types of paints based on their application and function either protective or decorative[2]. The fact that there are few objects which do not require coating is an indication of the enormous importance of coating technology. According to the Euro monitor International analyst production levels in the Egyptian domestic paint with coating sales reached USD 764 Million in 2016 the decorative paints segment holds the largest market share (74%), followed by wood coatings (10%) and industrial protective paints (9%)[3].

The most important task for coatings, in economic terms, is surface protection. Thus coatings help to retain value and enhance properties usage of almost all products, therefore they are of huge economic significance. However, coating paints should be manufactured in accordance to the environmental standards throughoutall their process steps from cradle to grave, starting from raw material production passing by processing to application till disposal whenever possible. Without coatings, a drastically decrease in product live might happened [3].

The current study aimed to assess the environmental impacts of paint production process in Egypt. This was done in order to recognize the hot spots of this industry, recommend improvement options and need of future studies in this area.

2. Life cycle assessment

In order to assess the environmental impacts of paint production process Life cycle assessment (LCA) technique was employed following the framework of the International Standard for Life cycle assessment (ISO14044 : 2006) [4] which includes (a) Identifying the goal and scope of study, (b) Data collection and inventory analysis, (c) Conducting the impact assessment and (d) Data and results interpretation.

2.1. Goal, scope and system boundaries

Presented in Fig. 1. Layout and system boundary of paint production process.

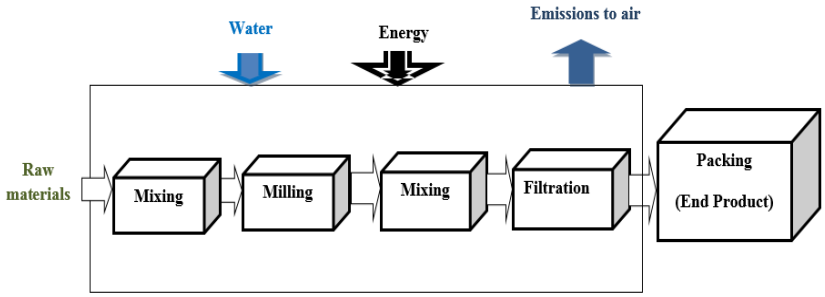

Fig. 1. Layout and system boundary of paint production process

2.2. LCA inventory, data collection and uncertainty

Input/output data was collected from a local case study plant for paint production located at Alexandria governorate, Egypt during 2018 and is presented in Table (1). Background data was compiled using the available data in the Eco-vent data base.

3. Results and Discussion

The study aimed to assess the environmental impacts of locally produced white Enamel paint in Egypt in order to identify hot spots of the process and recommend improvement options. A cradle to gate approach was selected for the study, starting from raw materials extraction till the end of the paint production stage.

Regarding the life cycle inventory the following was considered: a) different inputs from raw materials including: Alkyd resin, Titanium dioxide, Dolomite , Cobalt, Calcium, Zirconium, White spirit, Bentonite (Clay), Polycarboxylate as a dispersing agent, b) energy used for mixing, milling and packing, c) no water input was added as the process does not require any

water addition. As for the outputs: the end product (White alkyd enamelpaint) and generated air emissions in form of particulate matter and Hydrocarbons. The generated solid wastes are in form of empty bags and drums which are being reused so they were excluded from the study (Table 1). A cut off criteria of 1.5% was used in this study.

Table 1. Input / Output data for Life cycle assessment of 1000 kg Alkyd Enamel paint production

Item	Unit	Amount
Input		
Raw materials		
Alkyd resin	kg	520
Titanium dioxide	kg	200
Dolomite	kg	140
Cobalt	kg	3.6
Calcium	kg	4.8
Zirconium	kg	17
White spirit	kg	100
Bentonite (Clay)	kg	5
Dispersing agent :		
- Polycarboxylate	kg	5
Energy		
Electricity for mixing, milling and packing	Whr	25
Output		
End Product (Paint)	kg	1000
Emissions to air		
Suspended dust/Particulate matter	ppm	213.5
HC	ppm	166

LCA was evaluated based on the impact assessment methodology Eco-Indicator 99. The following impact categories were considered: global warming potential (GWP), acidification potential (AP), eutrophication potential (EP), carcinogens potential (CP), ecotoxicity potential (ETP), respiratory inorganic formation potential (RIFP), respiratory organic formation potential (ROFP), radiation potential (RP), ozone layer depletion (OLD), mineral depletion (MD), land use (LU) and fossil fuel depletion (FFD).

4. Life cycle analysis results

Analysis results show that top impacted category from white enamel production is resources (45.8%), followed by ecosystem quality and Human health, 31.8% and 22.5%, respectively. The production of Alkyd resinis the main contributor to the environmental impacts of enamel paint production as presented in the ecological impact network of white enamel production (Fig 2). Table (2) and Fig. (2 – 3) show the impact assessment of 1 ton production of white enamel paint on the environment. Fossil fuels depletion is the highest impacted category followed by land use and respiratory inorganic formation potential. Climate change impacts represent 3.5% of the total impacts. It was found that the production of alkyd resin and Titanium dioxide, the main raw materials used in the production process, are the main contributors to the different impacted categories.

Table 2. Environmental Impacts per category of white enamel Alkyd paint production

Impact category	Total (%)
Fossil fuels	44.8
Land use	29.1
Respiratory inorganics	14.6
Carcinogens	4.4
Climate change	3.5
Acidification/ Eutrophication	1.4
Ecotoxicity	1.3
Minerals	0.9
Respiratory organics	0.1
Radiation	-
Ozone layer	-

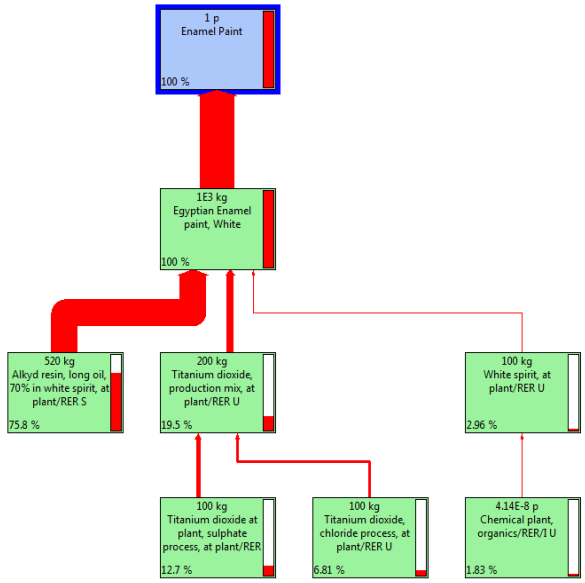

Fig.2. Ecological impact network of Alkyd Enamel paint process

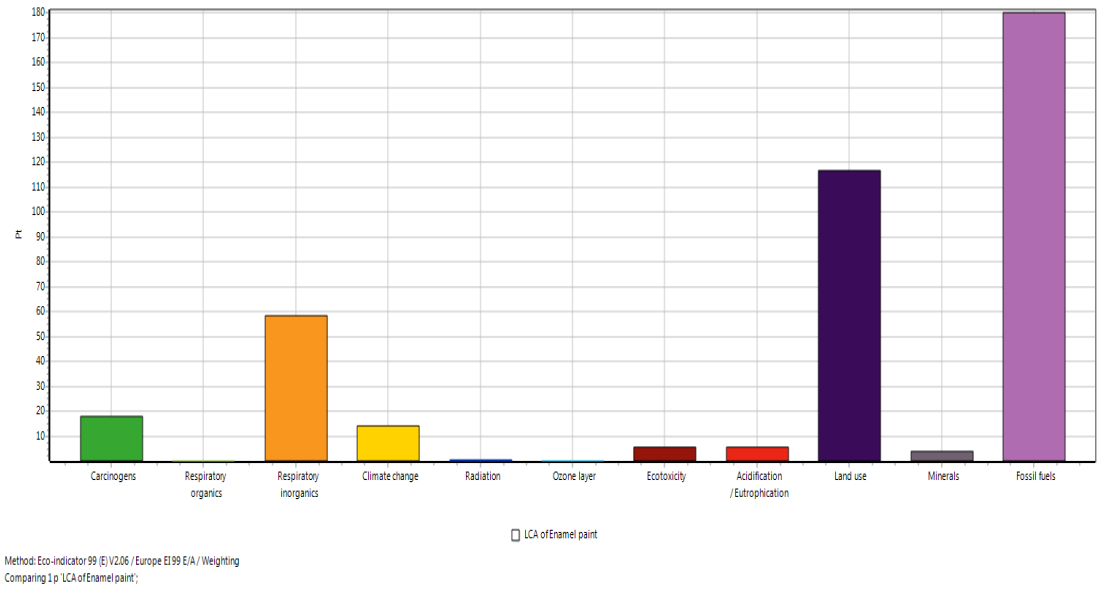

Fig.3. Impact assessment of white enamel Alkyd paint production on the environment (Weighting)

The top impacted category is fossil fuels depletion which accounts for 44.8% of the total environmental impacts due to generated emissions from Alkyd resin manufacturing process (Table 2 and 3). This manufacturing process is an energy consuming process[5]. Alkyd resins are synthetic polyester resins produced by esterifying polyhydric alcohols with polybasic carboxylic acids where at least one of the alcohols must be trihydric or higher. They are always modified with natural fatty acids or oils and/or synthetic fatty acids**.** Furthermore, Alkyd resin is manufactured through a Poly condensation reaction carried out in a reactor where raw materials are being heated in boiler ranged from 190 ^{o}C to 270 ^{o}C with the existence of almost 5% of hydrocarbon solvent. Water of the reaction is then transferred to condenser where water separated from the azeotropic mixture, and solvent returned back to

the reactor. Reactants are separated from residuals through filtration system. Heating source may be electric or an oil, gas or coal furnace [3] .

The second top impacted category was land use which accounts for 29.1% of the total environmental impacts (Table 3). This high impact can be attributed to the influence of oil used in the Long Alkyd resin manufacturing and illiminte ore used in the production of titanium dioxide (TiO_2). The used oil in the manufacturing process of alkyd resin as one of its inputs is being extracted from large amounts of vegetations crops such as cotton seeds or soybean [6]. As for titanium dioxide manufacturing, the main raw material used is illiminte ore which is extracted from mines. For each 1 ton production of titanium dioxide about two ton of raw material (ilmenite or ilmenite + slag) are being consumed meaning that 1 Ton of Alkyd enamel paint consumes 400 Kilogram of illiminte ore mines. Third major impacted category is respiratory inorganic formation potential accounting for 14.6% of the total impact. These impacts can be attributed to the generated air emissions from fossil fuel burning resulting in aerosols of sulphate and nitrates (Table 3). Also the use of fossil fuels in alkyd resin manufacturing generates air emissions. In the sulphate process for titanium dioxide manufacturing, Sulphuric Acid is being used to dissolve the feedstock resulting in ferrous sulphate monohydrated (MON), red gypsum and ferrous sulphateheptahydrated by products[7]

Table 3. Life cycle inventory of white Enamel Alkyd paint production process

Element	Unit	Amount	Impact indicator
Emissions to air			
Major elements			
CO_2	kg	2900.5	GWP
CH_4	kg	8.22	GWP
N_2O	kg	1.46	GWP
NOx	kg	7.82	RIFP, AP,EP
SO_2	kg	10.64	RIFP, AP,EP
Particulates, > 2.5 um, and < 10um	kg	1.2	RIFP
Minor elements			
Particulates, < 2.5 um	kg	0.54	RIFP
Ammonia	kg	0.96	RIFP, AP,EP
Sulphate	kg	0.94	RIFP, AP,EP
Cadmium	Kg	0.00014	ETP
Copper	kg	0.002	ETP
Nickel	kg	0.003	ETP
Zink	kg	0.003	ETP
Liquide discharge			
Arsenic	Kg	0.0017	CP
Emissions to Soil			
Zink	Kg	0.006	ETP
Cadmium	Kg	0.0009	CP
Resources Consumption			
Land use	m^2	1268	Land use
Energy	MJ	7943.9	FFD

Global warming potential (GWP), Acidification potential (AP), Eutrophication potential (EP), Carcinogens potential (CP), Ecotoxicity potential (ETP), Respiratory inorganic formation potential (RIFP), Respiratory organic formation potential (ROFP), Radiation potential (RP), Ozone layer depletion (OLD), Mineral depletion (MD), Land use (LU) and Fossil fuel depletion (FFD).

Regarding the carcinogenic potential, results in Table (2 - 3) and Fig (3) shows that this category is impacted by 4.4% of the total impact due to the Arsenic and cadmium emissions generated from the production of Alkyd resin. Climate change was impacted by 3.4% of the total impact due to the emission to air generated from the combustion process of energy generation (Table 2 and 3). Regarding Eutrophication, Ecotoxicity, Respiratory organics formation potentials and Minerals depletion, their combined impacts represented less than 4% of the total impact. These impacts were mainly attributed to the generated emissions during Alkyd resin manufacturing process. No impacts were detected on radiation or ozone layer potentials.

5. Improvement options and further needs for study

Furthermore, it was found that no previous LCA studies related to paint industry were conducted at local level. It is recommend to conduct further studies in this area taking into consideration other types of painting materials. Also comparing between the impacts of different painting colors can be studied. The drying time and application on the substrate for solvent based system as can be considered as well by incorporating the service life time of the substrate. This will have an effect on the different environmental impacts.

6. Conclusion

Paint production is expanding to meet the global demand. In order to determine the total environmental impact of Alkyd paint though its entire life cycle, a cradle to grave approach was conducted. The top environmental categories impacted by this production process are fossil fuels depletion, Land use, and Respiratory inorganics formation potential. Carcinogens potential, and Climate change were next in the impacted categories. Minor impacts were detected on acidification potential, Eutrophication, Ecotoxicity, Respiratory organics and Minerals depletion, their combined impacts represented less than 4% of the total impact. Alkyd resin manufacturing was the top source of impact on the different impacted categories due to the energy consumed in the different production processes and generated emissions from fuel combustion. Overall impacts can be reduced by applying proper energy management measurements in the pain industry.

No previous LCA studies addressing paint production were conducted at local level and very few one were done at global one. It is recommended to reduce the environmental impacts of paint production process worldwide by further studies in this area.

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Environmetric Techniques for Water Quality: A Case Study of Al-Gharraf River in Thi Qar Province, Iraq

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Abstract: The most beneficial strategy of reporting the water quality condition of a river is the classification of data based on water quality, to manage water pollution in supervised areas. The current environmetric research combined with the explanation the monitoring data from the Al-Gharraf River in Thi Qar province. Twenty variables for water quality are measured to estimate and classify the water quality of the Al-Gharraf river at two sampling sites. In this study, factor analysis (FA) and cluster analysis (CA) have been applied to determine the characteristics quality of water, to get the source inputs-elements of water quality, and to estimate the pattern of water quality and its spatial in this area. The results of PCA for the region under study indicated that the first four components from the data sets of principal component analysis (PCA) recorded 92.7% of the total variance. This research confirmed that the use of the multivariate statistical methods is an effective tool for the river-water category. Hence, it is suggested to comprise the data that are environmetric data counseling as a useful operation for assessment of water quality data.

***Keywords*:** water quality, cluster analysis, principal component analysis, Al-Gharraf River.

1) *Introduction*

Rivers play a part that is crucial in transporting domestic and industrial wastewater as well as the surface run-off of agricultural areas and tend to be one of the most vulnerable waters to pollutants [1-3]. The system of rivers is carry a load that is significant of materials in its dissolved and particulate stages in one direction from different sources that are natural and anthropogenic [4]. Presently, all around the world, great environmental interest is the contamination of surface water with physical, chemical and biological pollutants by some activities such as anthropogenic tasks [5-7]. As previously mentioned, the continual discharge of some wastewaters like domestic and industrial types as well as the effect of climate on the in-season surface run-off all have actually an impact on the river water quality and discharge. The land use changes, human activities, and utilization of chemicals in agricultural are the most factors that have a major impact on surface water quality [8,9].

As ended up being discussed earlier, the evaluation of water quality is determined based on its chemical, biological and physical parameters that are prepared making use of descriptive statistics and both of univariate and multivariate techniques [10,11].

Some particular problems were noticed in the monitoring of water quality, which are the difficulty linked with analyzing a large number of assessed variables and its large variability because of natural and anthropogenic effects [12,13].

The organic pollutants influence Al-Gharraf River basin. These pollutants coming from the effluents such as the industrial wastewater and the excess of nutrients caused by the agricultural runoff. For effective water resources management, the water quality classification is starting to become a concern for useful management possibilities [14]. As a result, the water quality classification of rivers is a valuable method of stating the condition of water quality in addition to identify more techniques that are significant for controlling water contamination in monitored areas [14].

Environmetric methods such as factor analysis (FA), cluster analysis (CA), and regression analysis, should be implemented to assess the data framework and to categorize and the data-sets model as well

as to present time patterns with pollution [15]. The most typical methods of multivariate analysis, which are unsupervised, used for classification are principal component analysis (PCA) and CA [14]. Recently, CA and PCA arise trusted when observing the interpretation units of complex-data to much had better assess the quality of water and other range of environmental concerns. These environmental problems like an evaluation of pollution resources, chemical material types concerning hydrological situations, and examining the trends (spatial and temporal) of water quality [16-21]. CA is a technique that its objective is to determine the normal groupings within the group of data [22]. It is utilized to classify entities with same characteristics. CA splits the big number of elements into a smaller number of homogeneous sets as stated by their correlation framework [23].

FA tries to explain the correlations between the findings when it comes to the elements, which are underlying which are usually not directly [24]. The effective use of PCA together with CA has offered a practical way that is beneficial for the management of water resources and control of pollution. PCA and CA have the ability of detection the possible aspects brought on some activities like the natural and anthropogenic strategies that manipulate the water systems [20]. PCA and CA have been utilized effectively in hydrochemistry for several years. They enable acquiring hidden information through the data go about the impacts which can be possible from the ecosystem regarding the water quality and provide greater possibilities for administrators in terms of assisting the process that is decision-making [25].

In the present study, the monitoring of water quality parameters was carried out by two monitoring stations in the area under investigation along one year [26]. The goals behind this research are to evaluate the physicochemical parameters of the studied river based on its water quality by using PCA and CA multivariate technique. The multivariate statistical techniques are practiced to the river water quality data set to find out the group monitoring stations for the study area. The other objective is to evaluate the important information from the similarity and dissimilarities between the two monitoring stations and further to be sure the influence associated with the sources' pollution regarding the water quality variables.

2) *Materials and Methods*

2.1) Study Area

The Al-Gharraf River in Thi Qar province shows the study area. The Al-Gharraf River has a total drainage area of approximately 435000 x 106 m^2 from its starts in Kut regulator to its ends in Al-Hammar marsh [27]. The total length of the River from its start to its end is about 230 km, and it is the longest river in Thi Qar province. This river is the main source of water for domestic use and a source of irrigation in this catchment area. The Al-Gharraf River has 52 canals with 968 irrigation ditches bifurcate from the main River that used for irrigation of 700,000 hectares [27]. Furthermore, fast industrialization and population growth in the last few decades have formulated an excessive concern on the ecological situations in the region. The described study area is shown in Fig.1. The geographical position of the river is longitude 45º47'25"E, and latitude 32º31'55"N. The climate of the study area is characterized by cold and wet in winter and hot and dry summer, and it's classified as semi-arid area.

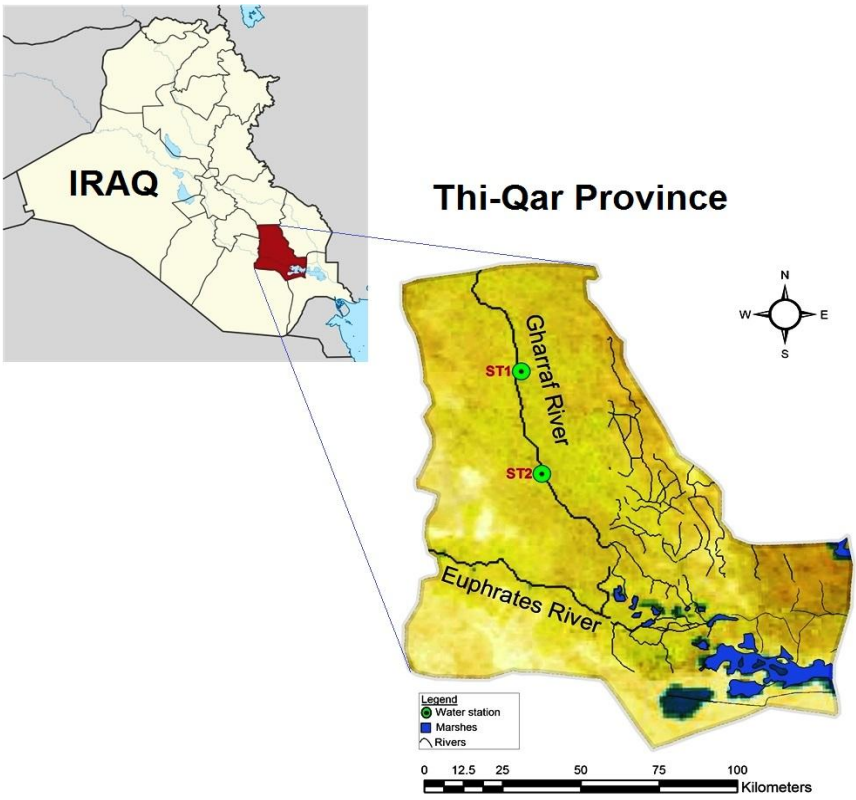

Fig.**1. The study area show Al-Gharraf River in Thi Qar province**

2.2) Raw Data

The two monitoring stations (Fig. 1) lies on the main River basin. The first monitoring station (ST1) is located in the Ar Rifa'i city with geographical position of longitude 46º06'53.9"E, and latitude 31º41'21.6"N. The second monitoring station (ST2) is located in the Ash Shatrah city with an estimate distance of 40 Km from the first station. The geographical position of the second station is longitude 46º06'53.9"E, and latitude 31º41'21.6"N.

The recorded data set contains the time of one year (summer 2014 to spring 2015) and is collected seasonally for a purpose of calculation of the water quality index in the studied area [26]. The data set includes twenty water quality parameters: water temperature (T), pH, chemical oxygen demand (COD), biochemical oxygen demand (BOD_5), dissolved oxygen (DO), total dissolved solids (TDS), electrical conductivity (EC), bicarbonates (HCO_3^-), total hardness (TH), total alkalinity (TA), calcium (Ca^{2+}), magnesium (Mg^{2+}), potassium (K^+), sodium (Na^+), sulfate (SO_4^{2-}), phosphate (PO_4), and fecal coliform bacteria (E-coli). The data matrix applied for categorization has 2 X 20 dimensions (i.e. two monitoring stations by seventeen-water quality parameters).

3) *Environmental Techniques*

One of the multivariate statistical method used in this study is the PCA, which is configured to convert the complexness of the input variables that have a large quantity of information towards principal components (PC) that are new uncorrelated variables. These new variables are linearly combined with the original parameters (ie. variables) [20]. Additionally, it meant to have a better interpretation of original parameters.

CA is a pattern that is an unsupervised technique which is unearths the innate framework or underlying behavior of an information set without the need of a priori assumption regarding the data, to categorize

the system's objects into groups or clusters considering their similarity or nearness [28]. Thereafter the CA results reveal high uniformity between the cluster and high heterogeneousness among clusters [29].

The method of grouping the clusters consecutive is called Hierarchical clustering (HC) which is the more common approach called dendrogram. In the dendrogram, the grouped clusters typically started with the most set that have similar objects and then developed higher clusters step-by-step. The dendrogram introducing the groups' map with reducing the dimensionality from the original data used with a visual overview of the processes of clustering. The Euclidean distance, which is used as measure of similarity. It gives the similarity from both the samples by representing the variation amongst its analytical values. In this method, the analysis of variance is utilized to measure the distances between the clusters. This method used for any two clusters by trying to reduce the sum of squares that can be create at each step [1,21,30].

The raw data sets of Al-Gharraf river water quality (twenty variables) are clarified by using three multivariate statistical techniques: Fa, CA, and PCA. In this research, a measure of similarity used the hierarchical CA by made use of Ward's method with squared Euclidean distances [31].

4) *Results*

The descriptive statistics recorded from the data-set are displayed in Table 1. The temperature of water samples in the study location varies from 8.10 to 28.30 ºC with mean value of 21.83 ºC. pH value of the water samples in the region varies from 6.80 to 8.45 with the mean pH value of 7.44. Dissolved oxygen (DO) concentration is a very important factor for aquatic life in rivers and lakes. DO ranges from 1.06 to 8.40 mg/l, mean concentration of DO was found to be 4.24 mg/l.

The measured concentration of biochemical oxygen demand (BOD_5) in the water samples ranges from 1.23 to 3.05 mg/l, with mean value was found to be 2.10 mg/l. The concentration of chemical oxygen demand (COD), in water samples ranges from 6.90 to 30.90 mg/l, the mean of the COD concentration was 15.82 mg/l. The electrical conductivity (EC) of the water samples varies from 674 to 1406 µS/cm, the mean EC concentration had been discovered to be 1156.13 µS/cm implies the water samples had considerably salinity nature. To find the suitability of water for drinking purpose, the measurement of total dissolved solids (TDS) must be carry out for water samples, and hence it is an important parameter for identifying the usage of water. The TDS concentrations varies from 336 to 798 mg/l, the mean TDS value was noticed to be 590.01 mg/l suggesting well for drinking target.

The turbidity (TU) measurement is a useful test for check the water's clean. The TU concentration in the water samples varies from 3.11 to 6.70 NTU, the mean value of TU was 5.07 NTU indicating well for drinking usage. The concentration of total hardness (TH) in the water samples ranges from 367 to 579 mg/l and mean value of TH is 468.88 mg/l. The measured of bicarbonate concentration in the water samples ranges from 342 to 605 mg/l, the mean value was found to be 453.25 mg/l. The concentration of total alkalinity (TA) in study area varies from 191 to 301 mg/l, the mean value was found to be 229.38 mg/l and its value was above the allowable limit.

Calcium (Ca) concentration in the water samples ranges from 52.03 to 175.00 mg/l, the mean value of Ca was 108.63 mg/l that not goes beyond the permitted limit (150 mg/l) and all water samples fall in acceptable with limits, which are allowable. The concentration magnesium ion (Mg) in the water samples varies from 36.06 to 131.00 mg/l and the mean value of Mg concentration was 70.38 mg/l not surpass the particular level that is allowable and there are a greatest water samples fall in the drinkable, permitted limit. The sodium (Na) concentration in the water samples ranges from 93 to 179 mg/l and mean value of Na concentration is 136.5 mg/l it does not surpass potable limit. Potassium (K) concentration varies from 3.30 to 13.37 mg/l, the mean value of K was 7.81 mg/l, it not exceeds above the potable type. The concentration chloride (Cl) ion of water samples in the study area ranges from

118 to 292 mg/l, the mean value was founded to be 194.38 mg/l and it exceeds above the suitable limit of potable type.

Table 1. Descriptive statistics for the data of water quality variables [26]

Variable	Unit	Mean	Median	Minimum	Maximum	Variance	Std. deviation	Skewness
T	º C	21.83	25.20	8.10	28.30	64.05	8.00	-1.32
pH	mg/l	7.44	7.20	6.80	8.45	0.44	0.67	0.93
DO	mg/l	4.24	3.70	1.06	8.40	8.39	2.90	0.34
BOD_5	mg/l	2.10	2.32	1.23	3.05	0.43	0.66	-0.16
COD	mg/l	15.82	13.90	6.90	30.90	75.14	8.67	0.99
EC	µS/cm	1156.13	1220.00	674.00	1406.00	59394.70	243.71	-1.17
TU	NTU	5.07	5.04	3.11	6.70	1.85	1.36	-0.29
TDS	mg/l	590.01	616.50	336.00	798.00	26855.01	163.87	-0.40
TH	mg/l	468.88	471.00	367.00	579.00	6312.13	79.45	0.11
HCO_3	mg/l	453.25	422.00	342.00	605.00	10507.93	102.51	0.68
TA	mg/l	229.38	202.50	191.00	301.00	2094.27	45.76	1.05
Ca	mg/l	108.63	108.00	52.03	175.00	1869.21	43.23	0.18
Mg	mg/l	70.38	57.00	36.06	131.00	1352.25	36.77	1.18
Cl	mg/l	194.38	185.00	118.00	292.00	4699.13	68.55	0.50
Na	mg/l	137.13	136.50	93.00	179.00	1113.55	33.37	-0.03
K	mg/l	7.81	7.44	3.30	13.37	15.83	3.98	0.19
PO_4	mg/l	0.20	0.13	0.06	0.40	0.02	0.15	0.59
NO_3	mg/l	2.54	2.33	1.35	4.10	1.35	1.16	0.20
SO_4	mg/l	242.63	214.50	204.00	399.00	4331.98	65.82	2.42
Ecoli	cfu/100ml	176.25	227.50	51.00	286.00	10379.36	101.88	-0.49

The phosphate (PO_4) concentration of water samples in the study region varies from 0.06 to 0.40 mg/l, the mean value was noticed to be 0.20 mg/l and it is within the allowable limit. Nitrate (NO_3) is another measure used as pollution indication. The measured NO_3 of water samples varies from 1.35 to 4.10 mg/l, the mean value was 2.54 mg/l does not exceed the drinkable limit. The sulfate (SO_4) concentration of water samples of the study area ranges from 204 to 399 mg/l, the mean value was noticed to be 242.63 mg/l and it is above the allowable limit.

For a better illustration of cations and anions dominance, the box plot is used for the representation [32,33]. In this study, the box plots has been utilized to symbolize the dominance of temporal concentration for major ions (Fig.2). In this plot, Specifies the top and bottom quarter of the data above and below the rectangle box. The interior line of the box signifies the median value whereas the box-sizing shows the spread of the central value [33]. According to Figure 2, the plot explains the water samples in the study area were dominated by the order of HCO_3>SO_4>Cl>NO_3>PO_4 for anions, and Na>Ca>Mg> K in cations. Furthermore, the plot shows variation that is remarkable for the median, mean and the standard deviation values of water quality parameters revealing that the study location is varied of process influenced the water for a variety of complicated contamination source.

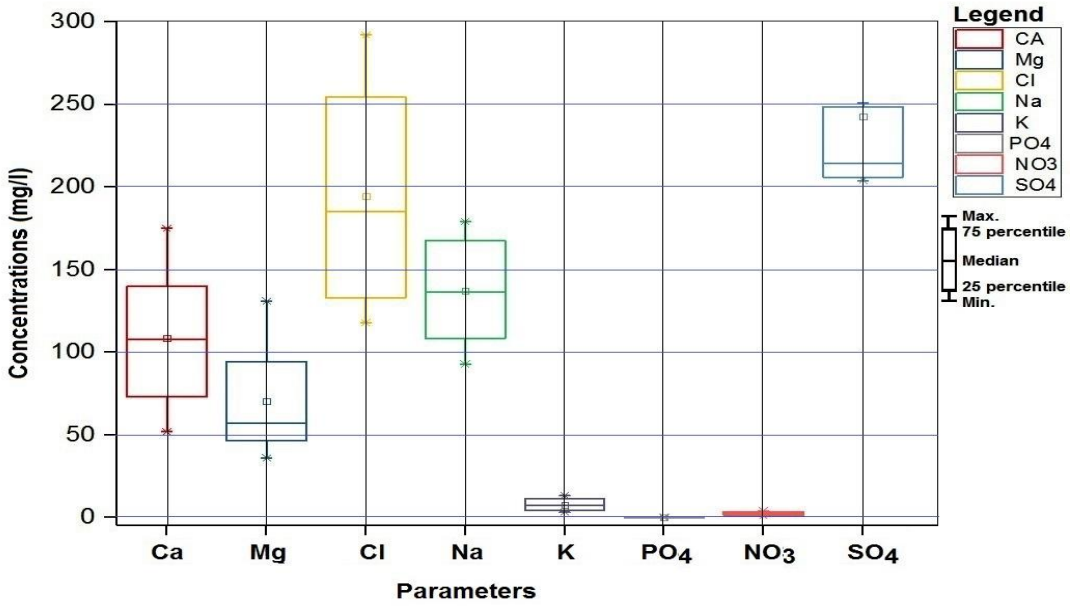

Fig.2. Box plot for chemical water quality variables.

The FA results for the data-set of chemical parameters that obtained from two sites along one year including eigenvalues, matrix of factor-loading, values of total and cumulative variance are displayed in Table 2. Figure 3 presents scree plot and its cumulative variance proportion of principal components.

In the current research, twenty variables (all the examined parameters) were utilized to discover the efficient varactors. The categorized method of the factor loadings based on the loading values is regarded as weak (0.30–0.50) moderate (0.50–0.75) and, strong (>0.75) [34]. The evaluation process for analyzing the principal components is taken as a criterion when the Eigenvalues was higher than one. As mention before, the analyzing the principal components were employed to explain the sources of variance in the data sets and based on table 2, four factors (4 PCs) explained 92.7 % of the total variance.

As a result of the factors that had been shown, and considering the factor loadings and hydrochemical aspects, it is recommended that, PC1 shows a weakly correlated as shown by the presence of EC, DO, K, PO_4, and NO_3. This first factor explored 38 % of the variance. PC_2 is also weakly correlated with Tu, COD, TH, and Na. Factor loadings for PC_3 were 0.344 and 0.305 for T and Ta varabiles, respectively. In addition, it has an inversely weakly correlated as shown by the presence of Ca and Mg. Factor loadings for PC_4were inversely weakly correlated with BOD_5, Cl, and SO_4.

Cluster analysis was implemented using Minitab software ver.18 on the score of principal components of the water quality parameters respectively, to determine the spatial similarity and dissimilarity in the recorded data sets from the monitoring stations that distributed in the main river under-investigated. Dendograms in cluster analysis produce a helpful graphical tool for finding the number of clusters typically explain the hidden process that causes spatial variation

The dendogram that produced from tree clustering is shown in Figure 4. Based on Clustering analysis results, two statistically appreciable clusters were formed: Cluster 1 matched to T, E-coli, K, NO_3, PO_4, COD, Ca, Na, and TDS, where were identified as the main polluted parameters in the investigated location. Cluster 2 matched to pH, TA, HCO_3, EC, BOD_5, DO, TU, Na, TH, Cl and SO4, where were determined as the biological pollutants of the investigated location.

Table 2. The matrix of factor-loading and the total variance.

Variable	PC1	PC2	PC3	PC4
T	-0.143	-0.266	0.344	0.041
pH	0.247	-0.219	0.261	-0.036
DO	0.325	0.157	-0.077	0.116
BOD	0.169	-0.121	0.242	-0.486
COD	-0.22	-0.305	-0.144	-0.021
EC	0.304	-0.153	-0.056	-0.065
TU	-0.013	0.361	0.223	0.094
TDS	0.191	-0.229	-0.249	0.191
TH	0.102	0.388	-0.05	-0.053
HCO_3	0.316	-0.101	0.202	0.045
TA	0.205	-0.239	0.305	-0.046
CA	0.033	-0.21	-0.449	0.025
Mg	-0.083	-0.275	-0.367	-0.061
Cl	-0.137	0.123	-0.03	-0.63
Na	0.014	0.394	-0.087	0.114
K	-0.346	-0.016	0.133	-0.082
PO_4	-0.317	0.052	0.132	0.167
NO_3	-0.35	-0.047	-0.068	-0.004
SO_4	0.106	0.132	-0.258	-0.486
E-coli	-0.273	-0.113	0.163	-0.076
Eigenvalue	7.5903	6.018	3.4749	1.4436
Proportion	38	30.1	17.4	7.2
Cumulative	38	68.1	85.5	92.7

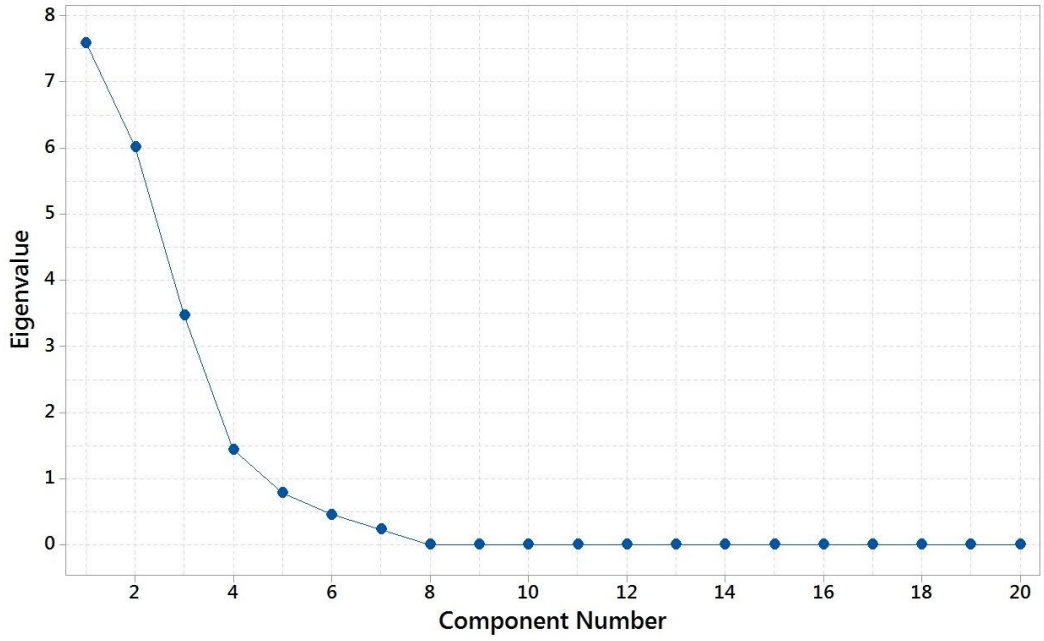

Fig.3 Scree plot of FA for the data-set in the study region

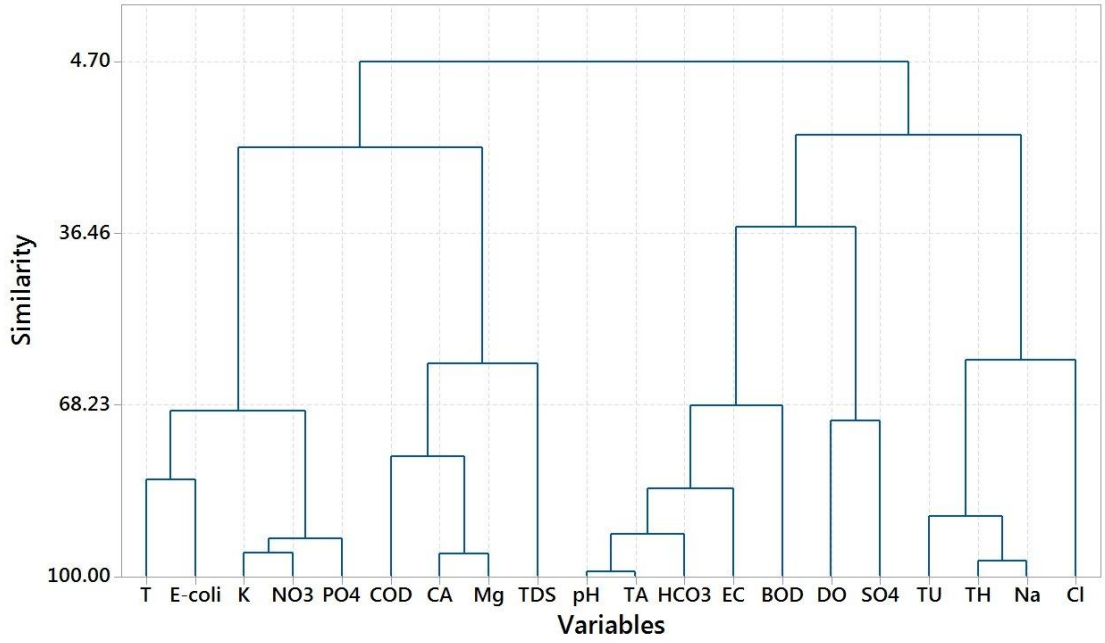

Fig.4 Dendogram diagram of factor analysis for the data set in the study region.

5) *Conclusion*

In this research environmetric methods particularly factor and cluster analyses (PCA and CA) were applied to the data set recorded by the mointoring stations located in the Al-Gharraf River. The target of applying these multivariate statistical methods were to categorize the two monitoring locations into classes of similar water quality characteristics depending on twenty selected water quality parameters in the study region. FA was applied also to demonstrate the correlations involving observations with regards to the hidden factors that are not exclusively observable.

The results from PCA and CA sorted the two monitoring stations into four clusters depending on similarities of the characteristics in water quality. Results presented that, FA were able to explain around 92.7 % of the total variance. It is concluded that the water quality variables can be grouped under two main clusters. Hence, the results from this paper recommend that both CA and PCA techniques are helpful tools to assist in water resources management and in water quality determination.

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Future Simulation of Alexandria Drinking Waterfrom El- Mahmoudia Canal

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Abstract: Egypt faces many challenges in terms of the water sector and water resources due to population growth and increasing water needs in exchange for the stability of water resources. Egypt's per capita share is continuously declining to the extent that Egypt is under the water poverty line. El Mahmoudia canal is one of the most important canals in the West Delta of Egypt. The canal feeds Alexandria and El Beheira governorates with drinking and industrial demands in addition to irrigate about 280,000 feddans. The main objective of this research is to investigate the problem of future shortage of drinking water in Alexandria city through studying different scenarios of using El-Mahmoudia canal as a main source HEC-RAS model is used for simulation of different proposal scenarios.The first scenario is pumping excess water through pipelines at upstream Kafr Al Dawar lock to El-Seyouf drinking water station in Alexandria. The second scenario is reshaping cross sections from Kafr Al Dawar lock in El Beheira governorate to El-Seyouf drinking water station to allow high water level at El-Seyouf station to improve its operation and efficiency. The results have been analyzed for each scenario. The study showed that good agreements were obtained between the numerical model results and measured water levels. The results of the first scenario showed that the current status of the Mahmoudia canal by its hydraulic situation does not allow any expansion for future drinking water. Meanwhile, reshaping of El Mahmoudia cross sections as a second scenario, can improve water level along the canal, which in turn improve effacing of drinking water stations.

Keywords: Water balance, modeling (HEC-RAS), Water demand, water management, El-Mahmoudia canal.

1.Introduction

Water balance in general is the difference between produced water and the authorized consumption which have a returned value. The Egyptian inflow consists of the release of Nile water from Lake Nasser and the effective rainfall in addition to the deep groundwater withdrawal in Egypt.Water resources available in Egypt are the Nile River (55.5 BCM/yr.), rainfall (1.6 BCM/yr.) on the northern strip of the Mediterranean Sea and Sinai, non-renewable deep groundwater (2.4 BCM/yr.) from western desert and Sinai, and shallow groundwater (6.5 BCM/yr.) in Delta and El-Wadi [1]. The total water supply is 66 BCM/yr., while the total water requirement for different sectors is 79.5 BCM/yr [1]. This gap is compensated by recycling of drainage water either officially or unofficially.

According to El-Agha *et al* [2], the total inflow into the Delta is 44 Bm^3, including 42 Bm^3, 1 Bm^3 and 1 Bm^3 from the Nile River, rainfall, and groundwater respectively.Delta balance has not dramatically altered in the past 35 years. Changes include an increase in groundwater abstractionand drainage water reuse.
El Mahmoudia canal is one of the most important canals which are taken from the Nile River Rosetta branch at km 194.2. Figure (1) showed the location of El-Mahmoudia canal [3]. It is

the main source of water for the Alexandria and El Beheira governorates. The total water supply in El Mahmoudia canal is about 14 Mm^3/day (12 Mm^3/day from the head of canal, and 2 Mm^3/day from El Kandaq El Sharqy canal), while the total requirement for different sectors is 15.59 Mm^3/day. The gap between the needs and availability of water is about 1.6 Mm^3/day. Moghazy [4], stated that Mahmoudia canal is suffered from instability and failure of side slopes in some reaches in the studied area, also there was erosion in canal berm and significant difference between the measured and designed cross-sections. He recommended some earthen works to canal cross sections to pass more flow safely. Ouda [5], presented a hydraulic analysis of the Mahmoudia canal at different operation conditions by applying different expected discharges up to the year 2017. The performed analysis included velocities, bed shear stress, and water levels. She investigated the stability of selected cross sections along the canal at five critical reaches were chosen at curved locations, under different operation conditions. Abd El Azim [6], presented different assumptions in supply and demand for the management of water resources, and improvements in the El- Mahmoudia canal. She recommended strategic plans for managing the dynamics in water resources of the canal to meet the projected discharges up to the year 2050. According to Abd El Azim [6], the current status of the drinking water requirements on the Mahmoudia canal was estimated at 3775051 m^3/day while it was estimated at 7210576 m^3/day in year 2050.

The main objective of this paper is to investigate the proposed future plan of El-Seyouf drinking station in Alexandria to meet the increase of water demand bared on El-Mahmoudia canal water. Differentscenarios will be investigateusing HEC-RAS model.

2. Study area

Mahmoudia canal has a length of 77.1 km and it serves a net irrigated area of about 280,000 feddans in El Beheira and Alexandria Governorates. It provides water to 66 branch canals off-taking directly canal. The canal also provides water to municipal and industrial water to the city of Alexandria, and about 90 villages. El Mahmoudia canal receives water from four sources: El Atff pumping station, the tail escape of El Khandaq EL Sharaqi canal, Edko reuse pump station (not working now), and small reuse pumping stations feeding tail ends at some branch canals to cover the shortage of water at peak periods.

3. The drinking water stations along the El Mahmoudia canal

Municipal water requirements express a top priority of El Mahmoudia requirements.There are nine drinking stations along El Mahmoudia canal with a production capacity of 3.4Mm^3/ day [6]. Alexandria requires about 2.8 Mm^3/day through drinking water canal and El Seyouf drinking station. Drinking water canalis located at km 54.859, serves five drinking stations with a production capacity of 1.5 Mm^3/day. El Seyouf drinking stationis located at km 62.5 along El-Mahmoudia canal with a production capacity of 1.3 Mm^3/day. Apart of this value is directed to El-Mamoura water plant with a capacity of 265 thousand m^3/day.

4. Proposed Scenarios

Two scenarios are proposed to study their capability to provide extra drinking water to Alexandria Governorate in the future:

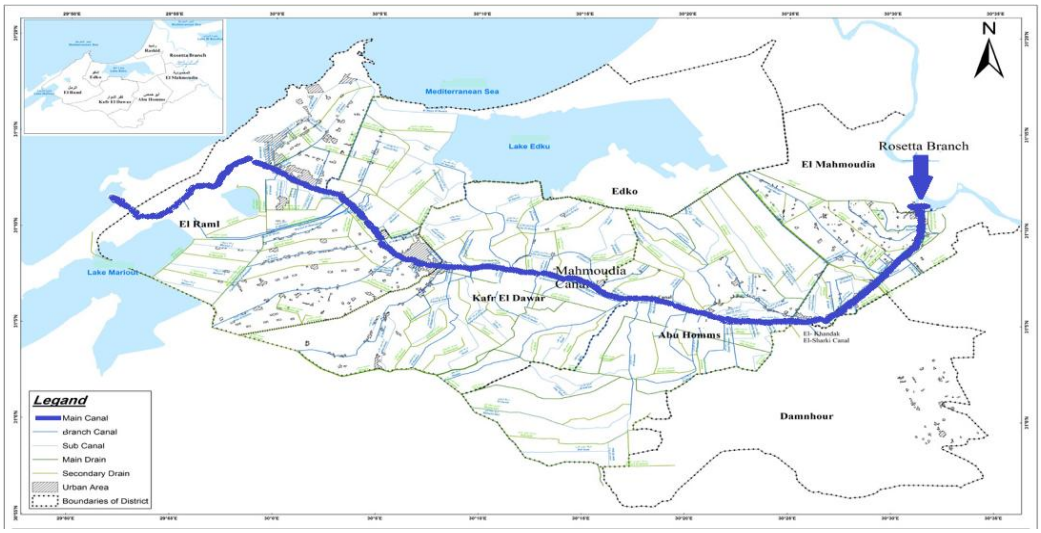

Figure 1:El-Mahmoudia command area,Egypt, [2]

4.1. First Scenario

Alexandria Company for drinking water proposedconstructingnew pipelines from the El Mahmoudia canal before the Kafr Al-Dawar lock, with a capacity of 500 thousand m^3/day to increase the productivity of both drinking water canal and El Seyouf drinking station. About 400 thousand m^3/day will be directed to El-Seyouf plant and but 100 thousand m^3/day will be directed to drinking water canal.

4.2. Second Scenario

Due to continue clearance and dredging of the canal, its cross sections become more winder than the designed sections. Therefore, reshaping cross sections of El-Mahmoudia canal from km 43.1 to km 62.5 is proposed.

4.3. Numerical model

In order to investigate the proposed scenarios, Engineering Center-River Analysis System (HEC-RAS) model had been used [7]. This model is designed by U.S. Army Corps of Engineers to perform one–dimensional (1D); two-dimensional (2D), or combined 1D and 2D hydraulic calculations for a full network of natural and constructed channels. Water surface profiles are computed from one cross section to the next by solving the energy equation with an iterative procedure called the standard step method. HEC-RAS model was useddue to its flexibly to evaluate the hydraulic analysis of the open channels. Shahroknia et al. [8], used a HEC-RAS model to evaluate the performance of Doroodzan irrigation network in Iran. It appears that hydraulic models are appropriate tools, if properly calibrated and validated to understand and diagnose the hydraulic behavior of the irrigation system. Consequently, it can be utilized to improve the operational performance of the irrigation systems. Aly [9], used a HEC-RAS model on the improved irrigation system (Dakalt canal) in the Nile Delta of Egypt. He concludedthat, it can be used successfully for a large and complex irrigation system for evaluation and monitoring of its performance in the absence of observed flow data and improvement of irrigation management plans.

4.4. Model's Calibration

The HEC-RAS model has been calibratedto simulate the flow through a specific period (July). This is considered the peak demand of water along the year, wherethe water levels of El Mahmoudia canal weremeasured at different locations. This include Nekla canal at km 2.05 of El-Mahmoudia canal. The main objective of this calibration is to compare the measured water levels with the calculated water levels. Figure (2) showed result of the HEC-RAS model and good agreementhas been obtained between measured and calculated water levels at Nekla canal.

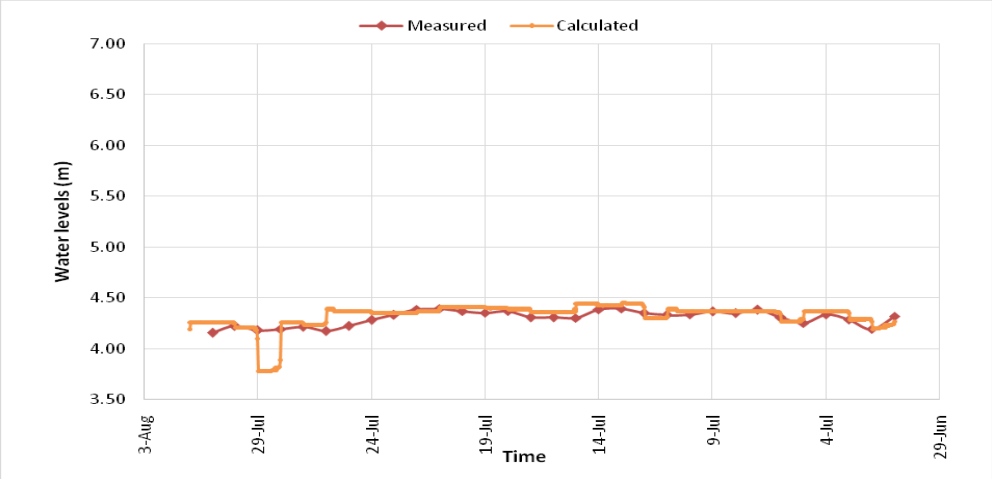

Figure 2: Measured and calculated water levels at Nekla canal

Scenario (1)

Asstated before, for future water requirement sit was proposed to establish new pipelines on the El Mahmoudia canal before the Kafr Al-Dawarlockto transfer additional water to both drinking water canal and El Seyouf drinking water stationwith a capacity of 500,000 m^3/day. Two locations are selected at km 20.5 and km 40.6 before the new pipeline's inlet. The discharge at these locations are calculated by the model for the current situation before applying the new intake. Then, the new intake of the pipeline is simulated to the model and the discharge is calculated. Figures (3) and (4) show comparisons between the measured and calculated values. The discharge at km 20.5 is close to the current situation except in few periods were some differences are noticed. Meanwhile, comparison between calculated and measured discharge at km 40.6 showed some differences between the current situation and the proposed scenario. Figures (5) and (6) show comparisons between the current situation and scenario at km (54.589) and km (62.5) after the new intake of the pipeline. Obviously, the system disorder with the proposed scenario. The discharge in the scenario up to 7th July is close to the current situation while from 7th July until the end of the month there is very low flow.Accordingly, sharp decrease in the canal water levels are noticed as shown in Figures (7) and (8). This drop-in water levels have negative impact on the branch canals intakes and, accordingly, the water flow to the branches. It can conclude from this scenario that constructing new pipeline has severe impact on the discharge of El-Mahmoudia canal irrigation network, especially at its end.

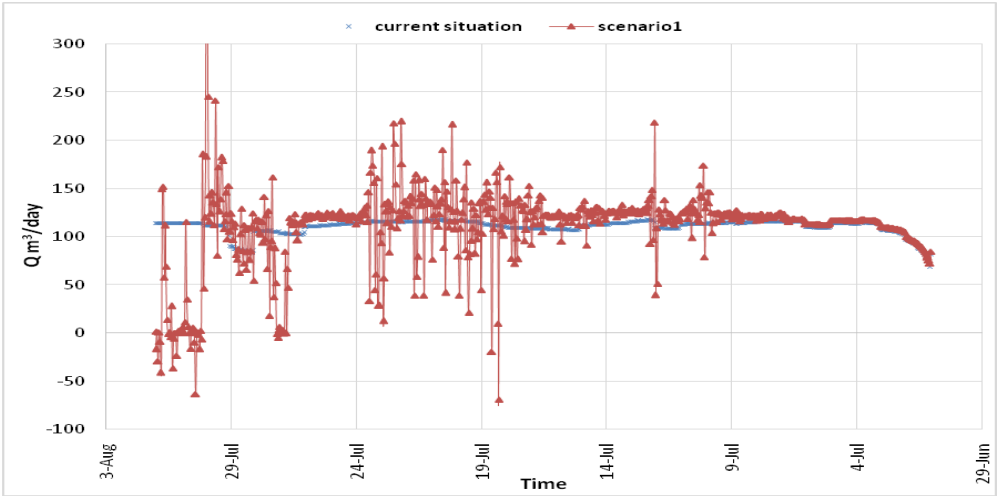

Figure 3: Comparison of discharges of El Mahmoudia canal (km 20.5) before new pipeline inlet

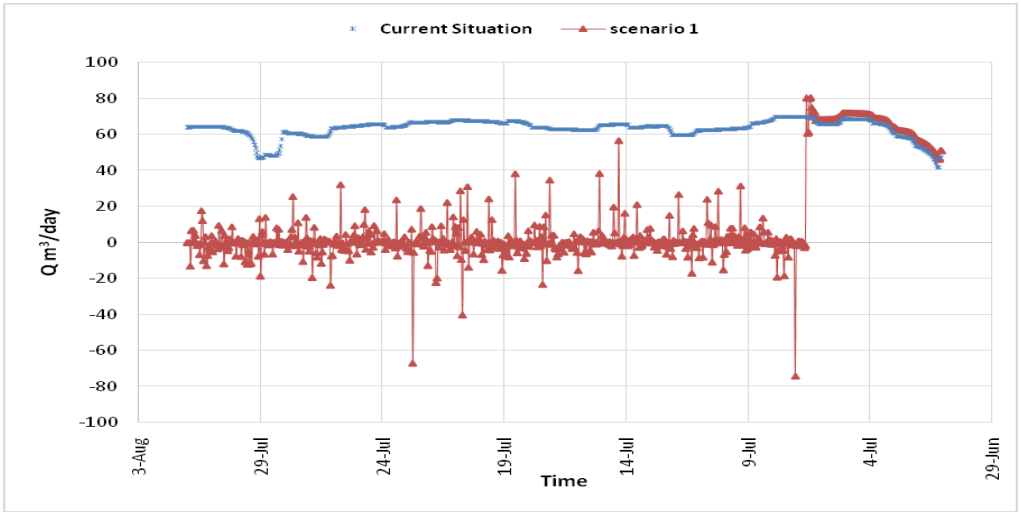

Figure 4: Comparison of discharges of El Mahmoudia canal (km 40.6) before new pipeline inlet

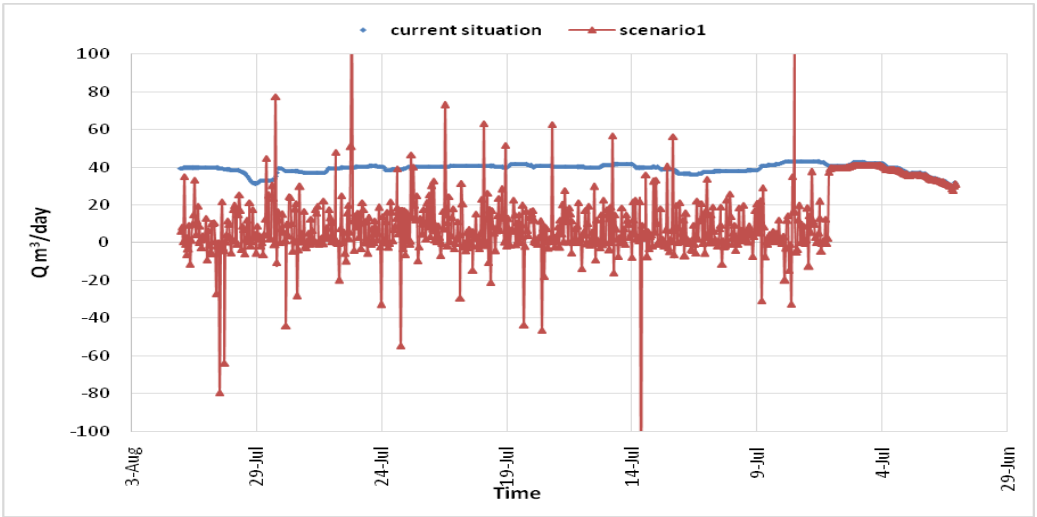

Figure 5: Comparison of discharges at the inlet of drinking canal (km 54.859) after new pipeline inlet

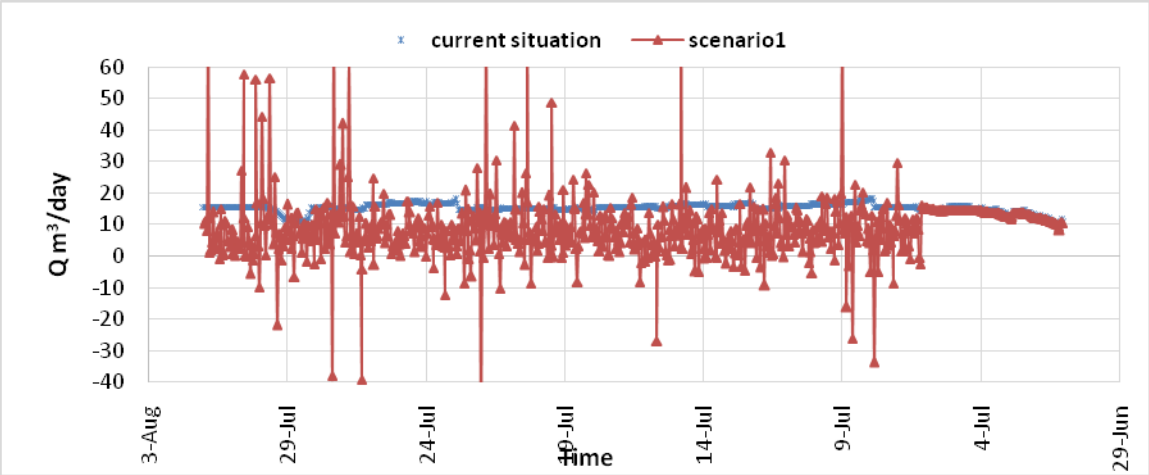

Figure 6: Comparison of discharges at El Seyouf station (km 62.5) after new pipeline inlet

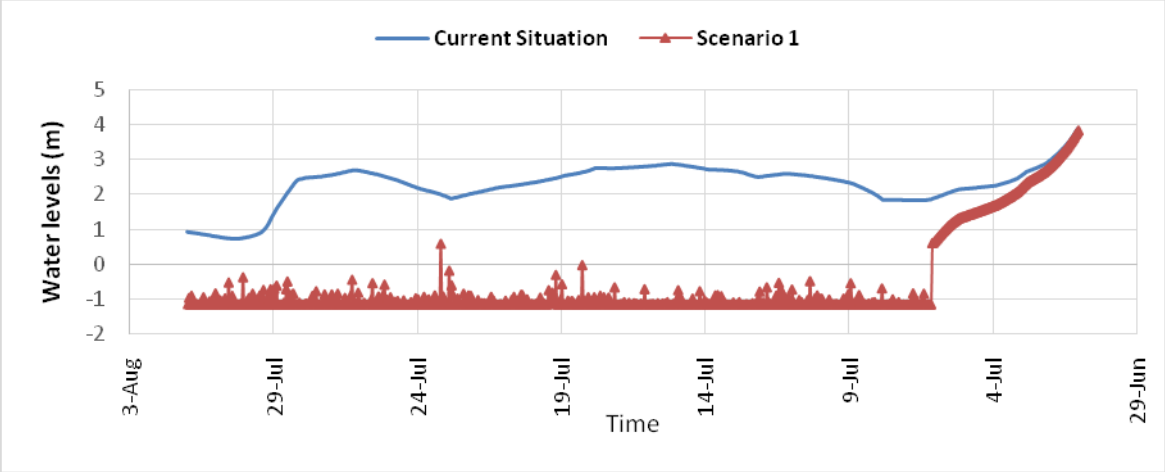

Figure 7: Comparison of water levels at the inlet of drinking canal (km 54.859) after new pipeline inlet

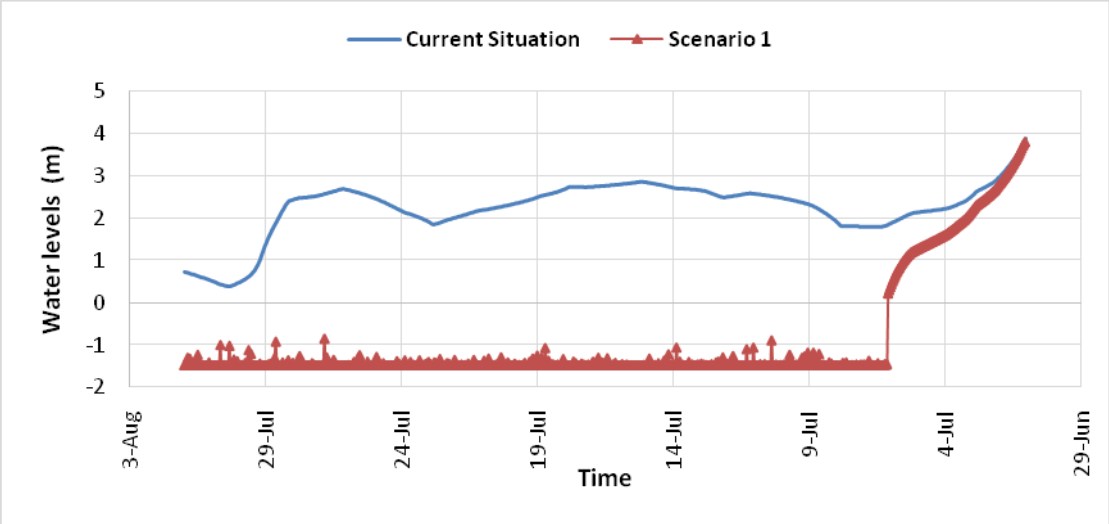

Figure 8: Comparison of water levels at El Seyouf station (km 62.5) after new pipeline inlet Scenario (2)

For the provision water for future requirements, the current cross sections of the El Mahmoudia canal are proposed to reshape them to their hydraulic designs sections from Kafr El Dawar lock at km 43.1 to the El Seyouf drinking station at km 62.5. The discharge in cross sections after reshapeis close to the current situation, as shown in figures (9, 10 and 11). The original canal data for the program has been entered and the corresponding discharge calculation. After that re-enter new sections of the canal from km 43.1 to km 62.5 and the corresponding discharge calculation. In calculating the difference between the discharges per section and the sum its there of, the value of 180,000 m^3/day was obtained. Figure (12) shown the cross section before and after reshape which led to the reduction of the wet environment within the sector, which led to raising the water levels and improving the performance of the canal.

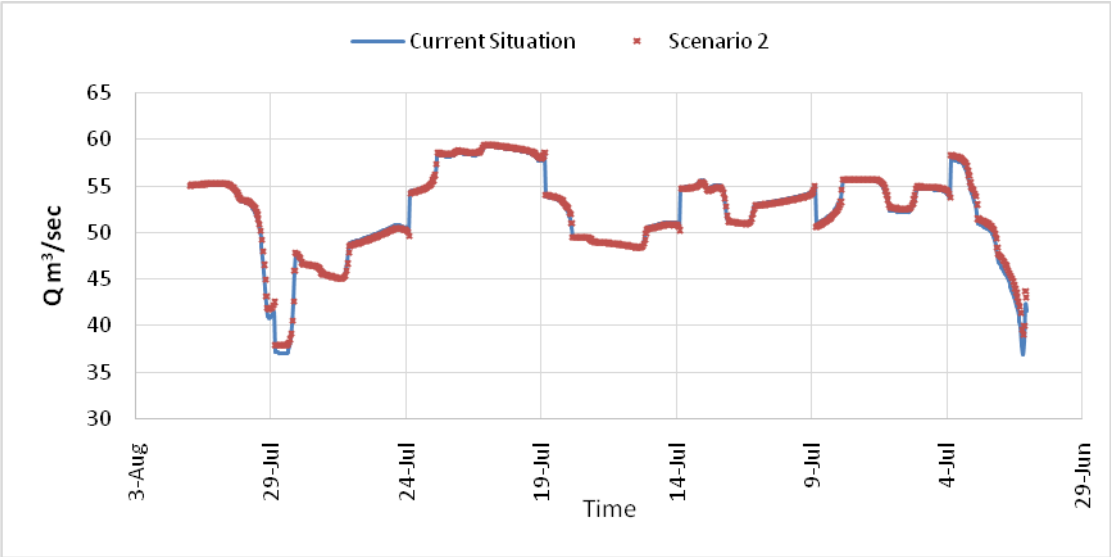

Figure 9: Comparison of discharge of El Mahmoudia canal (km 46.1)

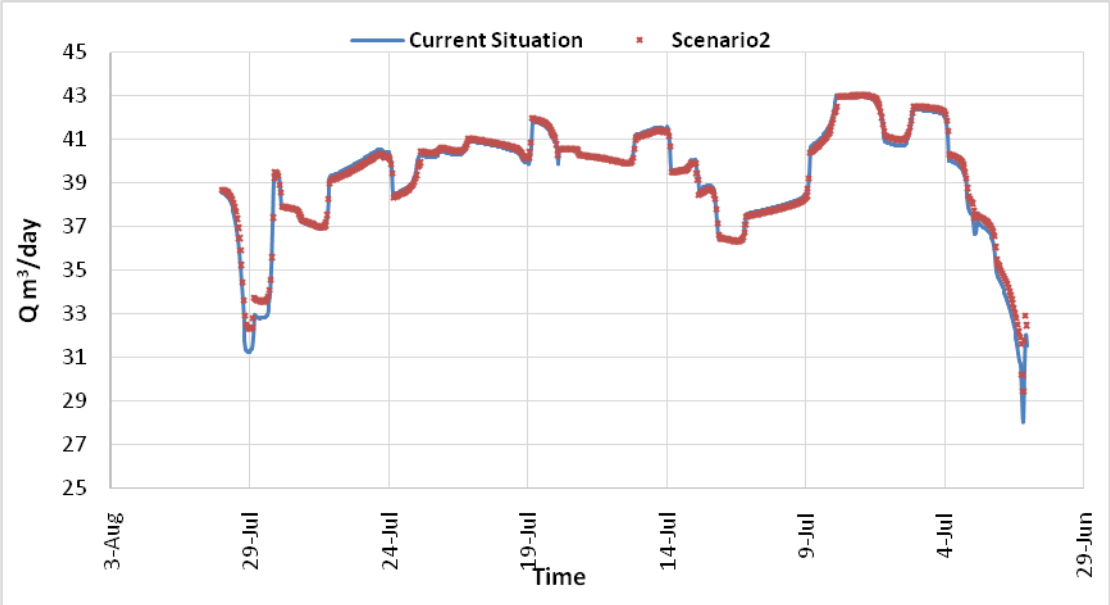

Figure 10: Comparison of discharge at drinking canal (km 54.859)

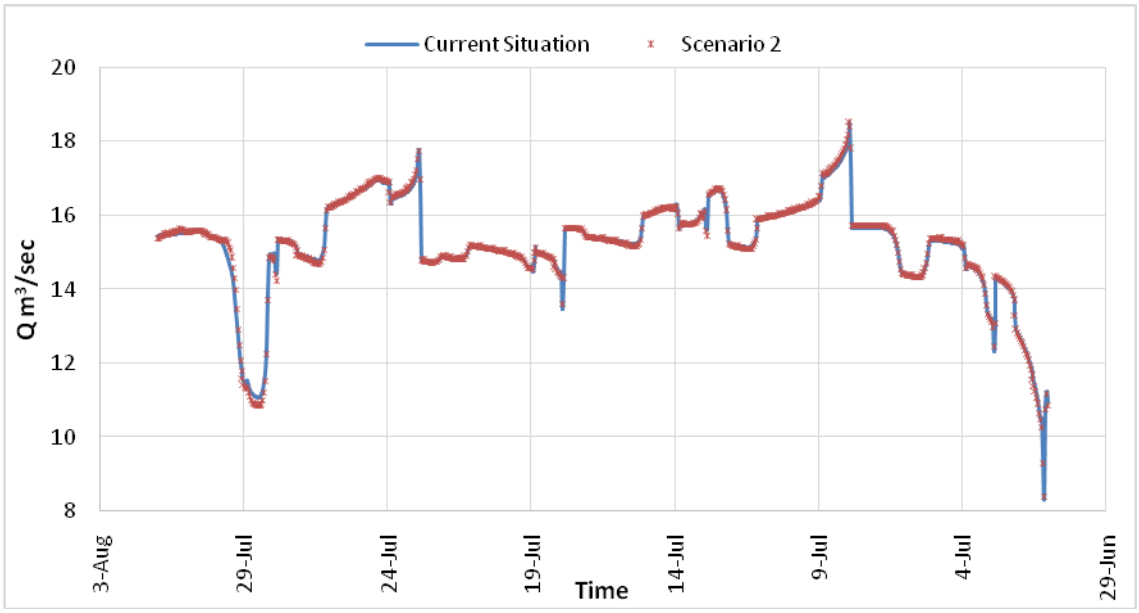

Figure 11: Comparison of discharge of El Mahmoudia canal at El Seyouf station (km 62.5)

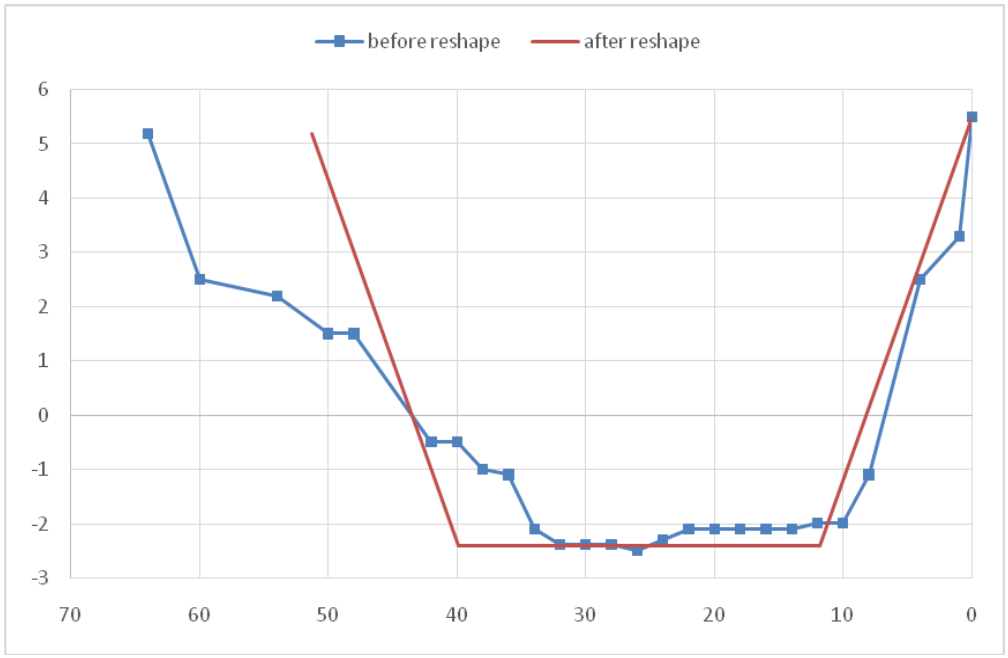

Figure 12: shown the cross section before and after reshape at (km 49)

5. Conclusions and Recommendations

According to the present study the main conclusions can be summarized as follows:

- Reshaping of cross sections of the El-Mahmoudia canal from km 43.1 to km 62.5 can provide extra discharge to Alexandria city.
- Improving the irrigation status in front of the irrigation inlet before El Seyouf station after reshaping the canal

- The proposal of the pipeline line to supply the drinking canal and El Seyouf drinking station with additional operations is not recommended, due to the fixed water resources of the El-Mahmoudia canal and its negative impact on the water levels of El-Mahmoudia canal at branches intakes.

For future studies, the following can be suggested:

- Studying the possibility of re-use of agricultural drainage water with Mahmoudia branches canals to increase their discharges. In addition, water quality models to check the quality are needed of the resulting water after mixing.
- Studying the existing crop pattern on the El Mahmoudia canal and replace it with the crops need less water use.

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Three-Dimensional Investigation of the Metric Properties of Parabolic Double Projection Involving Catadioptric Camera

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Abstract: This paper presents an analytical study for the metric properties of the paraboloidal double projection, i.e. central and orthogonal projections used in the catadioptric camera's system. Metric properties have not sufficiently studied in previous treatments of such system. These properties incorporate the determination of the true lengths of projected lines and areas bounded by projected lines. The advantageous main gain of determining metric elements of the paraboloidal double projection is studying distortion analysis and camera calibration, which is considered an essential tool in testing camera accuracy. Also, this may be considered as a significant utility in studying comparison analysis between different cameras projection systems.

***Keywords*:**Catadioptric Camera, Metric Properties, Paraboloidal Projection, Perspective Projection, True Length.

1) Introduction

The parabolic double projection has been previously studied by many authors both graphically and analytically [1]. Such projection is carried out centrally on the parabolic surface as projection surface from the surface focus as the center of the projection, then orthogonally on the directory plane τ. This double projection may be considered as the most relevant projection system for the catadioptric camera imaging since it provides wide viewing coverage [2,3]. Although the necessity of metric properties determination of the projection for the purposes of camera calibration and accuracy assessment [4], to the authors' opinion, metric properties of such projection has never been focused on previous treatments.This paper originates genuine analytical study for the determination of the metric properties of the parabolic double projection. Such properties include the determination of the true lengths of projected lines and area bounded by projected lines on both the surface and on the directory plane.

2)The Concept of Parabolic Double Projection

Figure.1 exhibits the technique tracked for establishing the perspective double projection of point *A* onto the paraboloid surface and the directory plane τ.In the figure, σ is the focal plane, the plane of the *u*-*v* axes which passes through surface focus *O*. τ is the directory plane which is parallel to σ and the distance between τ and σ

$$U^2 + V^2 = 4f.W + 4f^2 \qquad \text{Eq. (1).}$$

equals *2f*. where, *2 f* is the surface focal length. Point *A* is a space point of coordinates (U_A, V_A, W_A) where the *w*-axis is perpendicular to σ and $A^*$is the orthogonal projection of *A* onto the focal plane σ.Also, in the Figure, θ_A is the angle of inclination of $O_A$to σ and Φ_A is the angle between O_{A^*} and *u*-axis. As the paraboloid surface Equation is:

Then, the double projection technique in Figure.1. may be carried out as follows [1]:

- *A* (U_A, V_A, W_A) is joined to the focus *O*, then the ray *AO* intersects the surface at the perspective $A_1(U_{A_1}, V_{A_1}, W_{A_1})$, where:

$$U_{A_1} = \frac{2f.U_A(W_A \pm \sqrt{W_A^2 + r_A^2})}{r_A^2} \qquad \text{Eq.(2).}$$

$$V_{A_1} = \frac{2f.V_A(W_A \pm \sqrt{W_A^2 + r_A^2})}{r_A^2} \qquad \text{Eq.(3).}$$

$$W_{A_1} = \frac{2f.W_A(W_A \pm \sqrt{W_A^2 + r_A^2})}{r_A^2} \qquad \text{Eq.(4).}$$

where:

$$r_A = \sqrt{U_A^2 + V_A^2}$$ Eq. (5).

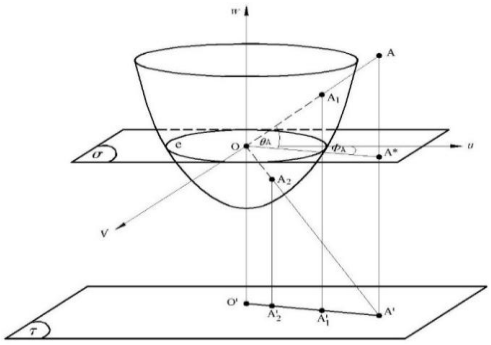

Figure.1. Paraboloid double projection.

i.e., the space points are projected centrally from *O* as the center of projection on the paraboloid as a projection surface.

- *A* is projected orthogonally onto the directory plane τ to obtain the horizontal projection *A'* ($U_{A'}$, $V_{A'}$, $W_{A'}$) of *A*, where:

$$U_{A'} = U_A, V_{A'} = V_A, and\ W_{A'} = -2f$$ Eq. (6).

- $A_1$is projected orthogonally onto the directory plane τ to get the horizontal projection $A'_1$of A_1, where:

$$U_{A'_1} = U_{A_1}, V_{A'_1} = V_{A_1}\ and\ W_{A'_1} = -2f$$ Eq. (7).

- Point *A'* is joined to the focus *O*, then the ray *A'O* intersects the surface at the perspective A_2 of *A'*, where:

$$U_{A_2} = \frac{2f.U_A\ (-2f\ \pm\sqrt{4f^2 + r_A^2})}{r_A^2}$$ Eq. (8).

$$V_{A_2} = \frac{2f.V_A\ (-2f\ \pm\sqrt{4f^2 + r_A^2})}{r_A^2}$$ Eq. (9).

$$W_{A_2} = \frac{-4f^2\ (-2f\ \pm\sqrt{4f^2 + r_A^2})}{r_A^2}$$ Eq. (10).

- A_2 is projected orthogonally onto the directory plane τ to obtain the horizontal projection A'_2 of A_2, where:

$$U_{A'_2} = U_{A_2}, V_{A'_2} = V_{A_2}\ and\ W_{A'_2} = -2f$$ Eq. (11).

As a conclusion, there exists two consequent central projections for any point, the first is the perspective projection of the point on the paraboloid surface, then, the second is the perspective of the orthogonal projection of the point.

2.1) Metric Properties of Parabolic Double Projection

Metric properties of the parabolic double projection are of great importance in the favor of camera calibration and accuracy assessment. Although camera geometric control is considered an essential tool for camera calibration [5], metric properties of the projection never been handled before. Therefore, the analysis concerns determining metric properties of such projection presented in this paper is considered as genuine analysis for imaging concept. This paper originates analytical study for the determination of the metric properties of the parabolic double projection including the determination of the true lengths of projected lines and area bounded by projected lines on both paraboloid surface and on the directory plane.

$$L = \sqrt{(U_A - U_B)^2 + (V_A - V_B)^2 + (W_A - W_B)^2}$$ Eq. (12).

2.1.1) The True Length of perspectively and Orthogonally Projected Lines

In Figure. 2, it is desired to determine the following true lengths:- **true length of space line *L*** joins two given points *A* and *B* which may beexpressed by the equation:

- **true length of the line *L'***, the orthogonal projection of the spaceline*L* on the directory plane. This may be expressed as:

$$L' = \sqrt{(U_{A'} - U_{B'})^2 + (V_{A'} - V_{B'})^2}$$ Eq. (13).

- **true length of the perspective projection of a line on the paraboloid surface.**

Figure. 2 represent a general line in space and its projections. Where, L_1 is the perspective projection of the line

L onto the paraboloid surface. Such a perspective is the curve of intersection between the surface and the plane *α* [*O, L*]. Hence, the planar intersection of paraboloid must be analyzed to classify such intersections.

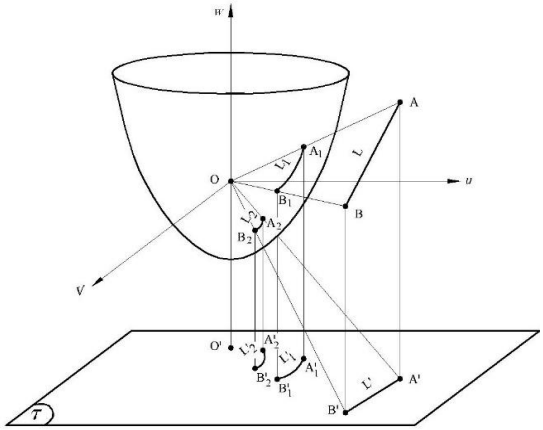

Figure. 2. Projected lines onto paraboloid surface and directory plane.

The desired curves to be studied are the planar curves on the paraboloid surface which are the perspective projection of space lines onto the surface. Such curves may be circles, ellipses or parabolas according to the orientation of plane *α*.

Plane α may be expressed as:

$$\ell.U + m.V + n.W = 0 \qquad \text{Eq. (14).}$$

where *ℓ, m, n*are the components of the normal to the plane and in the directions of *u,v* and *w* axis respectively.

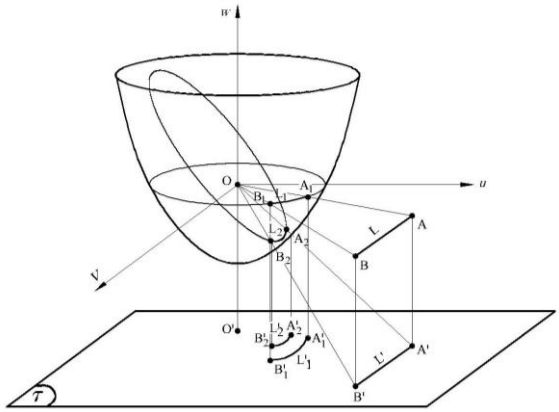

Figure.3. Circle as a perspective of horizontal line.

Figure .3 displays the circular curve of the intersection between the plane *α* [*L*]andthe surface which is resulted when $n = \pm 1$ and both and $m = 0$, i.e., *L* and *α* are horizontal. Hence: $L=L'$ which is given by Eq. (13), and

$$L_1 = L_1' = 2f.\Phi \qquad \text{Eq. (15).}$$

$$= |\Phi_B - \Phi \qquad \text{Eq. (16).}$$

where Φ is the central angle of the arc L_1, as:

$$\Phi = \tan^{-1}\left(\frac{V_A}{U_A}\right) \qquad \text{Eq. (17).}$$

$$\Phi = \tan^{-1}\left(\frac{V_B}{U_B}\right) \qquad \text{Eq. (18).}$$

While, $L_2$is an elliptic arc and L'_2 is a circular arc, their lengths are to be introduced in the following case

The elliptic arc of intersection is generated when

$-1 < n < 1$. Such curve may be extracted by modeling the curve as intersection between the surface and a right circular cylinder whose axis is parallel to *w*-axis and passes through point O_E [1], where, O_E is the Ellipse's center and its coordinates are:

$$U_{O_E} = -2f\frac{\ell}{n} \qquad \text{Eq. (19).}$$

$$V_{O_E} = -2f\frac{m}{n}$$ Eq. (20).

$$W_{O_E} = 2f\frac{\ell^2 + m^2}{n^2}$$ Eq. (21).

And the radiusof the cylinder is the distance $O'_E A'_1$.

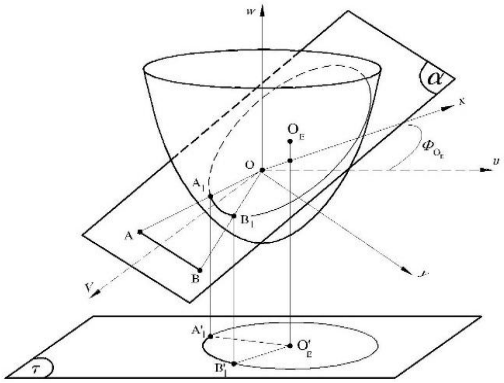

Figure.4. Ellipse of intersection between paraboloid and plane.

Since elliptic arc length is mainly dependent of the major and minor axes lengths, then, such axes may be determined by rotating*u* and *v* axes by the angle Φaround *w*-axis, Figure.4. to direct the *x*-*z* plane in front view and viewing α as a line, i.e., edge view, Figure. 5. Where:

$$\Phi = \tan^{-1}\left(\cdot_1\right)$$ Eq. (22).

According to [6], the resulted rotation matrix is:

$$\begin{bmatrix} X \\ Y \\ Z \end{bmatrix} = \begin{bmatrix} cos\Phi_{O_E} & -sin\Phi_{O_E} & 0 \\ sin\Phi_{O_E} & cos\Phi_{O_E} & 0 \\ 0 & 0 & 1 \end{bmatrix} \begin{bmatrix} U \\ V \\ W \end{bmatrix}$$ Eq. (23).

In Figure.5., the major axis length $2a_E$is the distance between the two endpoints of the edge view I_1 and I_2 where:

$$2a_E = I_1 I_2 = 4f\left(1 + \frac{W_{O_E}^2}{r_{O_E}^2}\right)$$ Eq. (24).

And

$$r_{O_E} = \sqrt{{U_{O_E}}^2 + {V_{O_E}}^2}$$ Eq. (25).

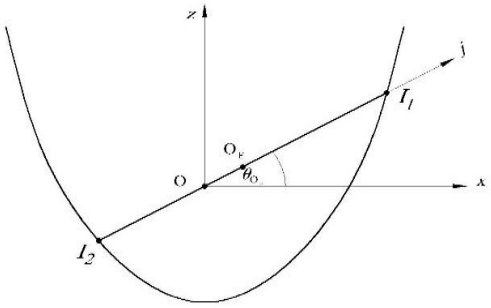

Figure. 5. Ellipse's major axis in the x-z plane.

The minor axismay be determined as the line of intersection between plane $\alpha$and plane α^*, where α^* is passing through O_E and perpendicular to *x*-axis. Hence, α^* is parallel to *y*-*z* plane, i.e., the minor axis is horizontal and

$$\ell^*.U + m^*.V + n^*.W = d^*$$ Eq. (26).

parallel to y-z plane, Figure.6. Plane α^* may be expressed as:

Where $\ell^* = 1, m^* = n^* = 0 \; and \; d^* = X$

Also, p^* is the parabola of intersection between the paraboloid surface and α^*whose focus's coordinates may be expressed as:

$$X_{O*} = X_{O_E}$$ Eq. (27).

$$Y_{O*} = 0$$ Eq. (28).

$$Z_{O*} = \frac{X_{O_E}{}^2 - 4f^{*2}}{4f^*}$$ Eq. (29).

and, $f^* =$

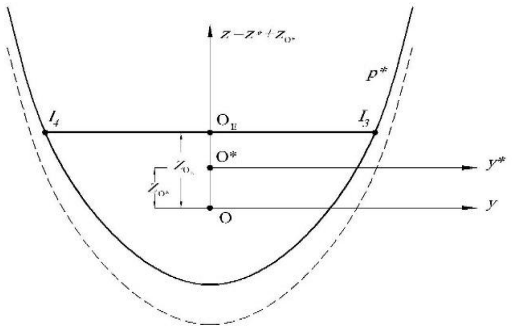

Figure. 6. Vertical plane intersection with the paraboloid surface.

Considering coordinate system $\{O^*, x^*, y^*, z^*\}$, whose origin is point O^* and both x^*, y^* and z^* are parallel to x, y and z respectively. Then, the parabola's equation may be written as follows:

$$Z^* = \frac{Y^{*2}}{4f} - f$$ Eq. (30).

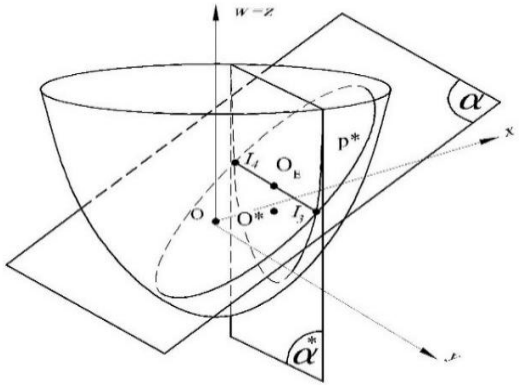

Figure. 7. Minor axis length determination on parabola p*.

According to Figure.7, substituting $Z^*_{O_E}$ in Eq. (33), then, the minor axis length is:

$$2b_E = 2\sqrt{4f\left(Z^*_{O_E} + f\right)}$$ Eq. (31).

$$Z^*_{O_E} = Z_{O_E} - Z_{O*}$$ Eq. (32).

A new local coordinate system (O_E, j, k) is to be originated in the plane α considering point O_E, as the system origin, j-axis is directed towards the ellipse major axis and k-axis direction is perpendicular to j-axis.

To obtain the local coordinates (j, k) which is related to the given space point A (U_A, V_A, W_A), firstly we obtain the perspectiveprojection $A_1$of A then transform its coordinates into the local coordinate system as follows:

$$X_{A_1} = U_{A_1} \cos \Phi_{O_E} - V_{A_1} \sin \Phi_{O_E}$$ Eq. (33).

$$Y_{A_1} = U_{A_1} \sin \Phi_{O_E} + V_{A_1} \cos \Phi_{O_E}$$ Eq. (34).

$$Z_{A_1} = W_{A_1}$$ Eq. (35).

Then, according to Figure.8,

$$J_{A_1} = g_{A_1} + g_{O_E}$$ Eq. (36).

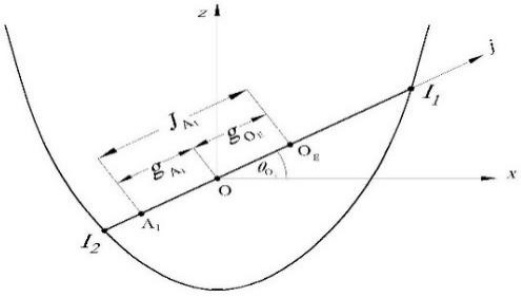

Figure. 8. Local plane coordinates

where:

$$g_{A_1} = \sqrt{X_{A_1}^2 + Z_{A_1}^2} \quad \text{Eq. (37).}$$

$$g_{O_E} = \sqrt{X_{O_E}^2 + Z_{O_E}^2} \quad \text{Eq. (38).}$$

The equation of the ellipse of intersection in the plane α may be written as:

$$\frac{J_{A_1}^2}{a_E^2} + \frac{K_{A_1}^2}{b_E^2} = 1 \quad \text{Eq. (39).}$$

From which:

$$K_{A_1} = b_E \sqrt{1 - \frac{J_{A_1}^2}{a_E^2}} \quad \text{Eq. (40).}$$

The elliptic arc length L_1 equals, [7]

$$L_1 = \left(\frac{\sqrt{(J_{B_1} - J_{A_1})^2 + (K_{B_1} - K_{A_1})^2}}{2 \sin\left(\frac{t_1 - t_2}{2}\right)} \right) (t_1 - t_2) \quad \text{Eq. (41).}$$

where:

$$J_{A_1} = a_E \,.\cos t_1 \quad \text{Eq. (42).}$$

$$K_{A_1} = b_E \,.\sin t_1 \quad \text{Eq. (43).}$$

$$J_{B_1} = a_E \,.\cos t_2 \quad \text{Eq. (44).}$$

$$K_{B_1} = b_E \,.\sin t_2 \quad \text{Eq. (45).}$$

t_1 and $t_2$are two parameters.

Similarly, the true length of L_2, the perspective of the horizontal projection L'on the directory plane is determined using Eq. (41) and the (J, K) coordinates of $A_2$and B_2.

The projected lengthL'_1may be determined using the definite integration as follows:

$$L'_1 = r * \left| sin^{-1}\left(\frac{U - U_{O_E}}{r}\right) \right|_{U_{B'_1}}^{U_{A'_1}} \quad \text{Eq. (46).}$$

Where: r is the radius of the circular arc L'_1.

The true length of L_2 and L'_2, Figure.2., may be determined similarly as the pervious analysis followed in determining L_1 and L'_1.

Finally, as n = 0, then a vertical plane α is resulted. In such case, parabolic curve of intersection $p$is produced as shown in Figure.9.Alike the technique adopted in the preceding case, plane α is rotated by an angle Φ, where Φ is the angle between α and the u-w plane, then the true shape of the parabola could be viewed, Figure.10.Then, coordinates of a points$A_1$and B_1on the curve may be rewritten, according to local coordinate system {O, x, z}, by substituting in Eqs. (33) and (35) with U, V coordinates of A_1,B_1 and Φas the angle of rotation.Hence, the horizontally projected length L'_1between the two points A'_1 and $B'_1$is:

$$L'_1 = |X_{A_1} - X_{B_1}| \quad \text{Eq. (47).}$$

and the true length of the curve L_1along the parabola between $A_1$and B_1 is:

$$L_1 = f\left[sinh^{-1}\left(\frac{X}{2f}\right) + \sqrt{X^2 + 4f^2} \right]_{X_{B_1}}^{X_{A_1}} \quad \text{Eq. (48).}$$

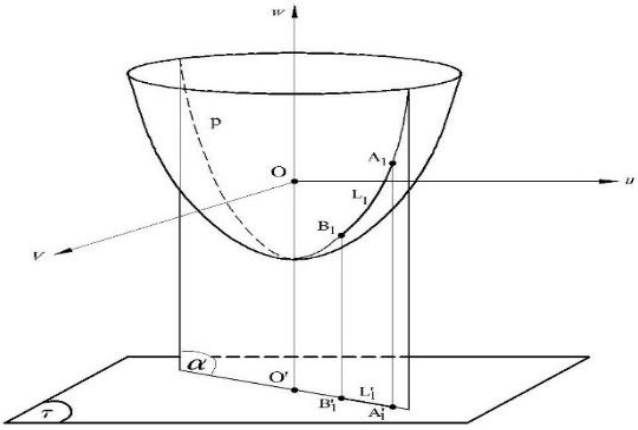

Figure.9. Vertical plane intersection with paraboloid

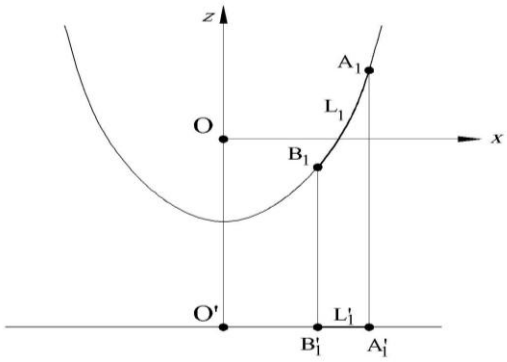

Figure.10. True shape of the curve of intersection

2.1.2) Area Involving Paraboloid Double Projection

Another fundamental aspect characterizes metricproperties of the paraboloid double projection is the areadetermination. Alike true length analysis, area determination incorporates determining area in space, perspectively projected area on the paraboloid surface and orthogonally projected area on the directory plane τare to be manipulated. Two cases involving area determination will be studied herein. Figure.11. exposes a space area *ABCD* where the lines *AB* and *CD* are exhibits circular arcs whose center belongs to the surface axis, and the two lines *AD* and *BC* are vertical. Hence, such area is considered as a portion ofvertical circular cylinder. The surface

$a = (W_A - W_D).\ r_A.\ \lambda$ Eq. (49).

area of *ABCD* is:

where,

$r_A$is given by Eq. (5), and:

$\lambda = \frac{\pi}{180}.(\Phi_A - \Phi$ Eq. (50).

Where,

$\Phi_A = tan^{-1}(\frac{V_A}{U_A})$ Eq. (51).

$\Phi_B = tan^{-1}(\frac{V_B}{U_B})$ Eq. (52).

Eventually, according to Figure.11, the perspective projection of the circular arcs *AB*and *CD* are circular arcs A_1B_1 and C_1D_1[8], and perspective of vertical lines *BC* and *AD* are parabolic arcs B_1C_1 and A_1D_1.Area of the orthogonal projection of the region $A_1B_1C_1D_1$, i.e. the region $A'_1B'_1C'_1D'_1$, is denoted by χ, where:

$\chi = \frac{\pi}{360}.(r_A^2 - r_C^2)(\Phi_A - \Phi_B)$ Eq. (53).

and, $r_C$may be obtained by substituting with *C* coordinates in Eq. (5). Area of the perspective projection of the portion *ABCD*, i., e. area of the paraboloid portion $A_1B_1C_1D_1$, may be obtained employing the finite element technique as follows[6].

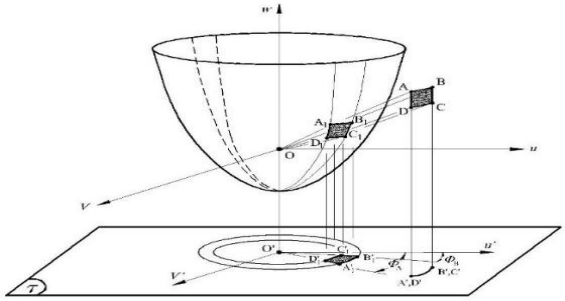

Figure. 11. Area of cylindrical portion.

- The orthogonal projection $A'_1B'_1C'_1D'_1$ is divided into mesh elements as shown in Figure. 12. Each element has dimensions of Δr and $\Delta\Phi$, which are finite increments of radius r and angle Φ respectively, and:

$$\Delta r = \frac{r_A - r_C}{Rows\ Number - 1} \quad \text{Eq. (54).}$$

$$\Delta\Phi = \frac{\Phi_A - \Phi_B}{Columns\ Number} \quad \text{Eq. (55).}$$

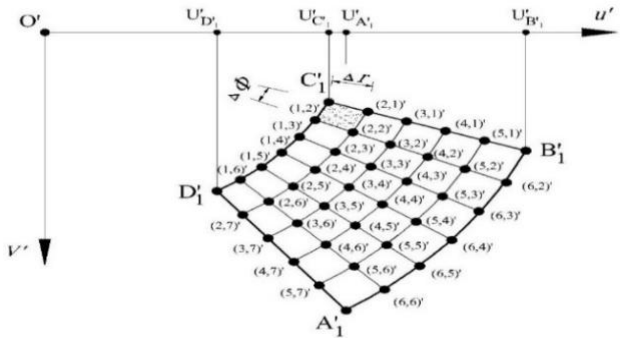

Figure.12. Finite element meshing

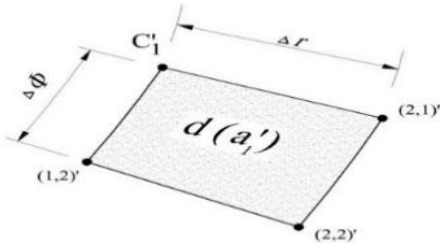

Figure.13. Meshing of unit area

- Each unit area has four nodes, e.g. unit area $d(a'_1)$ of nodes (C'_1), $(1,2)'$, $(2,2)'$ $(2,1)'$ shown in Figure.13., each of which has its counterpart on the surface as the intersection of the surface and the perpendicular line to the plane τ from the node.

-Then, coordinates of the nodes of the mesh unit region on the surface are expressed in polar coordinate form as:

$$U = r_C \cos\Phi \quad \text{Eq. (56).}$$

$$V = r_C \sin\Phi \quad \text{Eq. (57).}$$

and, substituting in the equation of the surface, Eq. (1),

$$W_{C_1} = \frac{1}{4f}(r_C^2 - 4f^2) \quad \text{Eq. (58).}$$

And for the node $(1,2)$

$$U_{(1,2)} = r_C \cos(\Phi_B + \Delta\Phi) \quad \text{Eq. (59).}$$

$$V_{(1,2)} = r_C \sin(\Phi_B + \Delta\Phi) \quad \text{Eq. (60).}$$

$$W_{(1,2)} = \frac{1}{4f}(r_C^2 - 4f^2) \quad \text{Eq. (61).}$$

and so, for the whole nodes of the mesh

- Area of the unit (C_1) $(1,2)$ $(2,2)$ $(2,1)$ on the surface may be expressed as:

$$d(a_1) = \frac{1}{2}\left(\overrightarrow{(2,2)(2,1)} \times \overrightarrow{(2,2)(1,2)} + \overrightarrow{(C_1)(2,1)} \times \overrightarrow{(C_1)(1,2)}\right) \quad \text{Eq. (62).}$$

Where the vectors in the right-hand side of Eq. (64) are:

$$\overrightarrow{(2,2)(2,1)} = (U_{(2,1)} - U_{(2,2)}, V_{(2,1)} - V_{(2,2)}, W_{(2,1)} - W_{(2,2)})$$

$$\overrightarrow{(2,2)(1,2)} = (U_{(1,2)} - U_{(2,2)}, V_{(1,2)} - V_{(2,2)}, W_{(1,2)} - W_{(2,2)})$$

And

$$\overrightarrow{(C_1)(2,1)} = (U_{(2,1)} - U_{(C_1)}, V_{(2,1)} - V_{(C_1)}, W_{(2,1)} - W_{(C_1)})$$

$$\overrightarrow{(C_1)(1,2)} = (U_{(1,2)} - U_{(C_1)}, V_{(1,2)} - V_{(C_1)}, W_{(1,2)} - W_{(C_1)})$$

Finally, the area of the region $A_1B_1C_1D_1$ is the summation of the area of the regions of Eq. (63), as:

$$A_1B_1C_1D_1 = \sum_{a_i}^{a_1} (d(a_1) + d(a_2) + d(a_3) + \cdots + d(a_i)) \quad \text{Eq. (63).}$$

Where i is the total number of the meshes.
Another case study is the determination the area of a vertical rectangle *ABCD* as shown in Figure. 14.
In the Figure, the perspective of the two vertical lines *AD* and *BC* are parts of parabolic curves A_1D_1 and B_1C_1, while those of horizontal sides *AB* and *CD* are parts of either circles or ellipses as previously indicated.
Orthogonal projection $A'_1B'_1C'_1D'_1$ of the perspective
$A_1B_1C_1D_1$ is a region shown in Figure.15., which is bounded by the two lines $A'_1D'_1$and $B'_1C'_1$, and the two circular arcs $A'_1B'_1$and $C'_1D'_1$. The projected area is determined by dividing such area into three regions according to Figure.15., as:

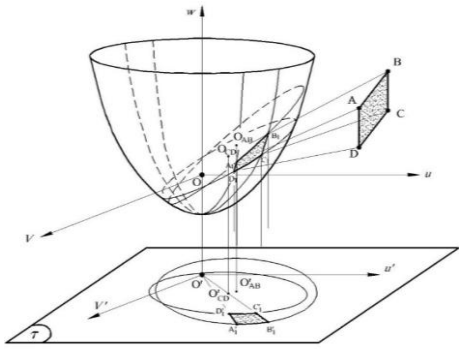

Figure.14. Projection of vertical area

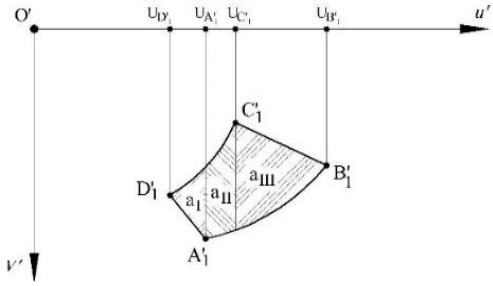

Figure. 15. Orthogonally projected area of the perspective projection of vertical rectangle

- ***Region I*** which is bounded by the circular arc $C'_1D'_1$, vertical line A'_1 $U'_{,}$, and the line $A'_1D'_1$.
- ***Region II*** which is bounded by the two circular arcs $C'_1D'_1$ and $A'_1B'_1$, and two vertical lines A'_1 $U'_{,}$ and C'_1 $U'_{,}$.
- ***Region III*** which is bounded by the circular arc $A'_1B'_1$, vertical line C'_1 $U'_{,}$, and the line $C'_1B'_1$.

For *Region I*, equation of the line $A'_1D'_1$ is:

$$U + s^*.V = 0 \qquad \text{Eq. (64).}$$

Where: $s^* = \frac{-U_{,}}{V_A}$

and the circular arc $C'_1D'_1$equation is:

$$(U - U_{O_{CD}})^2 + (V - V_{O_{CD}})^2 = R_{CD}^2 \qquad \text{Eq. (65).}$$

where R_{CD} is the radius of the circular arc$C'_1D'_1$, Eq. (5), U_O and V_O are *u, v* – coordinates of the circular arc center, Eqs. (19) and (20). Then, the area $a_I$of the portion *I* may be expressed as:

$$a_I = \int_{U_{D'_1}}^{U_{A'_1}} -\left(s^*.V\left(\sqrt{R_{CD}^2 - (V - V_{O_{CD}})^2} + U_{O_{CD}}\right)\right) dV \qquad \text{Eq. (66).}$$

For the *Region II*, equation of the arc $A'_1B'_1$ is:

$$(U - U_{O_{AB}})^2 + (V - V_{O_{AB}})^2 = R_{AB}^2 \qquad \text{Eq. (67).}$$

where R_{AB} is the radius of the circular arc $A'_1B'_1$, Eq. (5), U_O and V_O are *u, v* – coordinates of the circular arc center, Eqs. (19) and (20).
Then, the area $a_{II}$of portion *II* may be expressed as:

$$a_{II} = \int_{U_{A'_1}}^{U_{C'_1}} \left(-\left(\left(\sqrt{R_{AB}^2 - (V - V_{O_{AB}})^2} + U_{O_{AB}}\right) - \left(\sqrt{R_{CD}^2 - (V - V_{O_{CD}})^2} + U_{O_{CD}}\right)\right)\right) dV \qquad \text{Eq. (68).}$$

For the third *RegionIII*, the equation of the line $B'_1C'_1$is:

$$U + s^{**}.V = 0 \qquad \text{Eq. (69).}$$

where: $s^{**} = \frac{-U_{,}}{V_B}$

Then, the area a_{III} of the portion *III* may be expressed as:

$$a_{III} = \int_{U_{D'_1}}^{U_{A'_1}} \left(\left(\sqrt{R_{AB}^2 - \left(V - V_{O_{AB}}\right)^2} + U_{O_{AB}} \right) + S^{**}.V \right) dV \qquad \text{Eq. (70).}$$

Hence, $a_{I,II,III}$, the orthogonally projected region area $A'_1B'_1C'_1D'_1$ is:

$$a_{I,II,III} = a_I + a_{II} + a_{III} \qquad \text{Eq. (71).}$$

Alike the presented first example, the finite element technique is traced to determine the perspectively projected area $A_1B_1C_1D_1$ on the paraboloid surface.

In favor of generating the mesh Figure. 15. shows that the two circular arcs $A'_1B'_1$ and $C'_1D'_1$ in the directory plane τ are not concentric.

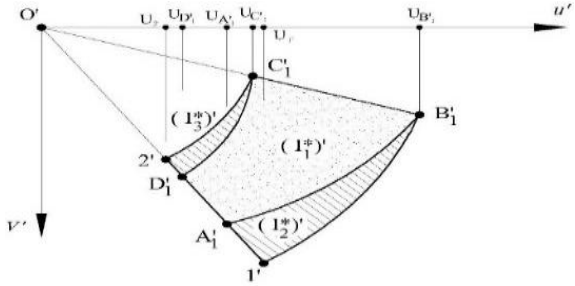

Figure.16. Projected area components

So, the mesh would be easily generated by dividing the whole region into three portions *I*, *I*, and *I*, then the desired area is the subtraction of the areas and from the total area.

The whole areaa_{Total}, the area of region $1B_1C_12$, on the paraboloid surface matches the area $A_1B_1C_1D_1$in Figure. 11. whose mesh generation pattern is indicated in Figure. 12., and its value is given by Eq. (63).

Area and on the paraboloid surface may be determined by constructing a mesh for their corresponding projected area on the directory plane τ, i.e. *I*, and *I*.The finite element net for the region *I*is constructed by dividing the central angle B'_1, O'_{AB}, A'_1 into finite angles to get the net shown in Figure. 17., then, the area of each net division could be easily obtained using the technique tracked in Eq. (62). and Eq. (63). to achieve the area on the paraboloid surface.The same analysis is tracked to obtain the area of the region on the surface, whose corresponding projected area on the directory plane τ is the region $2'C'_1D'_1$. Hence, the desired area of the perspective projection of the vertical rectangle *ABCD* is:

$$a_{I_1^*} = a_{Total} - \left(a_{I_2^*} + a_{I_3^*}\right) \qquad \text{Eq. (72).}$$

Area of the perspective of the projected area may be determined in similar way as previously analyzed.

As a conclusion, the finite element technique may be handled to obtain the area of the perspective projection of any plane figure whose sides are straight lines, whether it is in general position or in particular, as horizontal for example, as well as its orthogonal projection area on the directory plane τ.

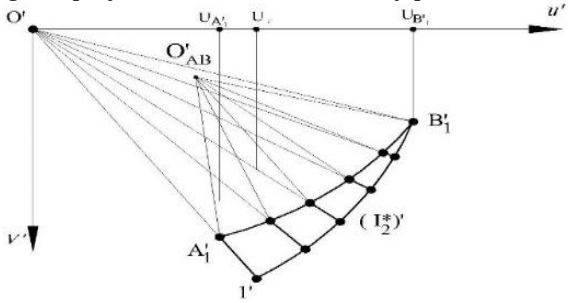

Figure.17. *I* division

3) Conclusion

Parabolic double projection may be considered as the most relevant projection system for the catadioptric camera imaging in the favor of wide viewing coverage.Analytical analysis of such projection involves orthographic and perspective projections onto the directory plane and on the surface respectively employing the analytical analysis for determining the projection metric properties. Such presented analysis is genuine and is considered as an essential tool for camera calibration.Metric properties analyzed herein are the determination of the space and both orthographically and perspectively projected true lengths and areas.Perspective projection of lines on paraboloid surface may be circles, ellipses or parabolas according to their plane orientation, hence their true

length is determined analytically in direct manner. Three different lines are presented for line true length determination.Since areas, either those projected on the surface or on the directory plane, are bounded by conic lines. Hence, such areas may be determine using the finite element technique. Different plane and one cylindrical area were analyzed utilizing such technique.

4) Reftences

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Clean technology transfer in Tunisia: critical analysis

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Abstract: "Give a man a fish, you feed him for a day. Teach him to fish, and you feed him for lifetime." This Chinese wisdom shows the exact issues of our society especially if we talk about technology transfer. We assist now to era of the new and inventive technical solution to technical problems. Although, we didn't solve the problem of climate change, the problem that can wrap up human being! In fact, the technical progress is "frozen" in developed countries which transfer to developing one's products and bury the transfer of research and the "know how". However, climate changes can't be mitigated without planetary solidarity.

Studying the Tunisian example shows that we are still far away from the concept of "solidarity". We notice that economy guide the clean technology transfer which promotes a new business of Intellectual Property Rights (IPR). Stronger IPR protection in developed countries may enforce legal right, make invention tradable but from the other side it makes the knowledge and the technology transfer very expensive. Tunisia, a country that tried to attend the clean energetic transition is curbed with financial obstacles. We notice, in the era of clean technology inventions, that multinationals investors launch polluted projects, knowing that they are the holders of clean technologic inventions. The interpretation of the new free trade agreement proposed by the European Union to Tunisia evince the none- consideration of the necessity of clean technology transfer by developed countries; it's the business affection in reality!

As a conclusion we can say that scientists are the last faith of this planet face to climate changes. Therefore, they should defend the idea of "knowledge and the know how" are "public goods" that contribute to "public good".

Full analysis

Clean technology is a term used to define a set of technologies that either reduces or optimizes the use of natural resources, whilst at the same time reducing the negative effect that technology has on the planet and its ecosystems. The transfer of technology in general is requested by developing countries that have not reached the technological progress of developed countries. Many international conventions have dedicated the necessity of this transfer, especially those related to environment protection[1] . We can notice nowadays that the degree of transfer has not yet reached the expectations of the international community and it's due to different reasons. In fact, international environmental law constitutes part of the contemporary law-making process, especially with generation of new normative process: "Soft law". These norms are non-binding in character but still have legal relevance, it took forms of plans of action or codes of conduct. Part of doctrine finds these new norms the best solution to protect the environment because international acceptance for ambitious norms (ambitious for the benefit of environment) is easier to obtain in soft law processes than in

[1] KYOTO protocol, The United Nations Convention on Climate Change…

negotiations of binding rules. The point of transfer of clean technology issued from different texts in relation with the protection of the environment and climate change represents a limit for the effectiveness of these soft standards. Moreover, there is an explainable commitment of the developed countries. In fact these flexible standards are faced with hard norms that are those for protection of intellectual property.

Intellectual property right is a right that is had by a person or by a company to have exclusive rights to use its own plans, ideas, or other intangible assets without the worry of competition, at least for a specific period of time. These rights can include copyrights, patents, trademarks, and trade secrets. These rights may be enforced by a court via a lawsuit. The reasoning for intellectual property is to encourage innovation without the fear that a competitor will steal the idea and / or take the credit for it[2] . Intellectual property rights(IPR) are crucial for innovation that's why we see high performance of North countries in technologic invention including clean ones. We can say that economy plays a major role here. Indeed, the North is experiencing an excess of production, of which new consumers must be found. It is reported here that we are in a situation of product transfer more than a transfer of technology. Let's take as an example the textile industry and exactly that of jean in the city of Monastir[3] . More than 200 exporting companies (mostly European) are installed there using a non-clean production technology which has destroyed the marine ecosystem of the city. The analyzes carried out in March 2011 by the Regional Analysis LaboratoryBacteriological Water located in Monastir has demonstrated that the oxygen level in the water reached 12.005%. This lack of oxygen threatens the regional ecosystem and causes the deathof thousands of fish and crustaceans by asphyxiation. For example, water collected at Ksibet at the seaside revealed 16.67 grams of miscellaneous components per liter versus 35.44 grams per liter when water was drawn at 7 meters depth. This reflects the direct and obvious effects of industrial activity on marine biodiversity and its impact on the entire food chain.

Figure 1. photos that shows the state of the bay and the population

Jean's industry plays a big role here because the industrialists don't purify the water and discharge it directly into the usual sewage collection lines. It is noted here that the industrialists sometimes have water purification stations required by law but they don't use it to reduce the production costs and increase the profit.The sanctions are not important and even if the law gives the possibility to close the company, in practice we dont do it and even we will propose to go to th transaction. The amount of the transaction is small when compared with the degree of damage caused to the environment.This polluted method is no longer used

[2]Business Dictionary.
[3]Tunisiancoastaltown

in Europe and has been replaced by the use of clean technology that, we, developing countries are not yet allowed too because IPR and patents make it expensive.

Another flagrant example that will challenge IPR , the transfer of clean technology and the know-how is the new free trade agreement that Tunisia is negotiating with the European Union.. In fact the most glaring conflict between developed and developing countries over intellectual property comes from the misappropriation of "traditional knowledge" such as ancient herbal remedies that find their way into high-priced western pharmaceuticals without the consent and the compensation of indigenous people who have used them for generations.At present we haven't made a normative protection for our local know-how which must be governed by the same protection of intellectual property.We note that if the European Union offered us such an agreement with such a threat, that we are still far from the concept of global solidarity because our strength lies in the protection of our local know-how. The most competitive products of tunisie on the international scale, their production is done without the intervention of high technology: we are talking here about olive oil and dates (The olive oil export revenue recorded in 2018 until March 31 is equal to 1128 million dinars and the export earnings of dates until August 2018 reached 722 million dinars). So what technology transfer do we want?

In fact , Tunisia is very affected by climate change seeks ,today, the transfer of not only clean technology but the "clean -renowbale –technolgy".We can notice that the public policies in Tunisia concentrate more than before on the installation of renewable technologies:

Table 1. Recent developments in the field of Energy Efficiency in Tunisia

Horizon of immediate action	Intermediate horizon	Final horizon (one generation)
2020	**2030**	**2050**
characterized by the launch of renewable energy projects and the regulation of the energy sector	marked by the development of clean energies, the impulse of exploration and production of hydrocarbons and the upgrading of energy infrastructures	is distinguished by possible social and technological disruptions and by a possible convergence towards a model of clean energy respecting the environment

In 2017, the energy deficit reached 4.7 million tons of oil equivalents, more than 49% of national primary energy consumption, compared to only 548 ktep in 2001. Furthermore, the contribution of energy in the deficit of the trade balance reached in 2017 nearly 26% is more than 4 billion dinars against only 395 million dinars in 2001 (9.5%). These statistics shows that we need to improve the transfer of clean and renewable energy in Tunisia. What is interesting to note here that important legislative texts encourage the industrialists to opt for a production based on renewable energy, examples: Law No. 2015-12 of May 11, 2015 on the production of electricity from renewable energies, Government Decree No. 2016-1123 of 24 August 2016 laying down the conditions andterms of realization of the projects of production and sale of electricity from renewable energies. Industrialists have shown that they are interested in the adoption of renewable energy production methods (such as solar energy).Unfortunately, a new ministerial text ruined this advancement it's the regulation of

Contract for the sale, transport of electrical energy produced from renewable energy connected to the high network average voltage and purchase of the surplus. This type of contract puts industrials in a situation of energical insecurity if we will link this with the cost and the profit.Incompatibility of the texts hinders the application of adoption strategies of the clean renewable technology; it is explained by the heavy interventionism of the State in the energetic affairs.This influences the protection of the environment which is an emergency and the action is measured by the second!

Bureacracy also explains the disengagement in favor of the transfer of clean technology in Tunisia. This buraucracy even touches the scientific research and the innovation. Innovation is not only in the invention of new technologies but especially "ideas" of how to rethink our vision for the future. Scientists have done a lot to fight climate change whether it's internal or international.Internally, scientific research is not advanced enough due to lack of funding and not human capacity that’s why the transfer of technology from north to south must begin with the improvement of research in these countries.We need scientists to guide the economy and public policy and not the inverse.

Methods

My article was made on the basis of current public opinion in Tunisia.

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Monitoring land cover changedue to urban expansionin in Kafr El-sheikh Center,Egypt

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Abstract: Egypt, is one of the most vulnerable African countries toclimate change impacts. As a developing country, urban areas expand with high growth rates andmostly in an unplanned manner, which causesa significant reduction inagricultural area. The decrease in vegetated areas causesnegative impacts on urban environment.

Land use/land cover changes have effects on the flux of mass and energy. As climate change would affect land cover patterns and land cover change in turn alters, these fluxes Climate change affects both the environment and human, in spite of that limited research was conducted to investigate the relationship between land cover change and urban expansionin Egypt.

This study aims to monitor the land cover change due to urban expansion in Kafr El-sheikh Center-Egypt, by using modern techniques of remote sensing and GIS. This study used Landsat images to monitor the land use / land cover change for the study area for four decades starting from 1987 till 2018.This is done in order to identify the change patterns and study how to mitigate the negative impacts of that change.

Study results show that the agricultural area in Kafr El-sheikh center decreased by 21.8% from 1987 to 2018, while the urban area increased by 71.7%. This urban expansion causes loss of productive agricultural lands. Further studies in this area will be useful for the decision maker to investigate and monitoring illegal use of agricultural land in the Nile Delta region

***Keywords*:**Urban expansion, land cover change, Urban environment, Kafr El-sheikh.

1. Introduction

Growth is the key characteristic of all urbanization processes. As a consequence of growth, land is developed, erosion is accelerated, traffic increases, more waste is produced, and the amount of domestic wastewater increases drastically. One of the main problems, which started in the beginning of the 80's and has negative impacts on water resources quantity, and agriculture, is the expansion of urbanization in the old Nile delta area in Egypt. The loss in old lands in the valley and delta is progressing and is estimated to be approximately 26,000 feddans/year (109 km^2/year). This means that the loss in the old agricultural land during the last 20 years from 1990 to 2010 is more than 2023 km^2 [1]. Agricultural production in Egypt is negatively affected by the encroachment of urban settlements onto previously cultivated lands. The growth around thousands of small villages poses the largest risk to the loss of agricultural productivity as well as the degradation of water quality [2]. At the same time, The Earth's climate has changed in the past due to nature reasons (eg. solar activity and tectonic movements) and human activities. land-cover change is one of the human activites that causes climate change, for example, the expnasion in construction area is followed and rerlated

carbon dioxide emissions [3,4,5]. De Sherbiniin [6] studied the Mobility, urban sprawl and environmental risks in Brazilia. In his studyGISwas used to create spatial indices, such as urban density and a spatial dissimilarity index. The results showed that uncontrolled expansion of urban land use affect social, economic and environmental resources.

Furthermore, historical studies [7, 8] present the impacts of land use/ land cover change on the microclimate at local scale, its effect on the physical behavior of heat and mass momentum between surface and atmosphere. The lossof vegetation cover can led to changes in micro-climatesurface, which increase the possibility of developing Urban Heat Islands (UHIs) and strengths heat waves. It was found that monitoring unplanned urban expansion, UHI and heat waves are useful techniques to assess and estimate the increase heat stress of the city. These three factors are classified as driving forces. Additionally, Land use mapping is used for illustrating the growth of urban areas by using remotely sensing data for different period of time, beside predicting the growth's trend. That makes mapping land use/land cover a major index in studying climate change in both global and local scale (micro-climate)[3].

In Egypt, urbanization trend is expected to grow in the landscape areas with potential expansion in the croplands westward and northward of the north part for western desert.The growth rate will reach the highest level in residential centers. Losing green areas or water bodies' mean losing cooling and breath areas of cities and that will raise the possibilities of developing UHIs and heat waves [9]. Kamh et al., [10] suggested that land use mapping is helpful for monitoring changes in urban environment.Spatial and temporal dynamics of urbanization developing were measured in Hurghada area- Egypt during 1987, 2000 and 2005, accordinglythey identified spot areas of urban expansion and its trend.Their results offered helpful information for improving infrastructures for Hurghada city and proved the importance of mapping land use change for the urban planner in development projects. At the same time, Hassan*et al.*,[11] explained the importance of measuring land use/ land cover change as an indicator for measuring sustainable development. They studied the change in land use in the Eastern Nile delta region, Egypt for five temporal datasets in 1984, 1990, 1998, 2006 and 2015. While, Hassan and Omran [12] explored the relationship between land-use/land cover change and its affects by climate change in the southern region of Port Said governorate, Egypt. Their paper presented the most vulnerable areas to sea level rise and mapping land use helped decision makers in adapting strategies to mitigate impacts of climate change.

2.Materials and Methods

2.1. Location of the studyarea

Kafr El-sheikh Center is located at the South part of Kafr El-sheikh governorate, which is the largest administrative centers of Kafr El-sheikh with a total area about 32.14km^2. [13] (Figure 1)

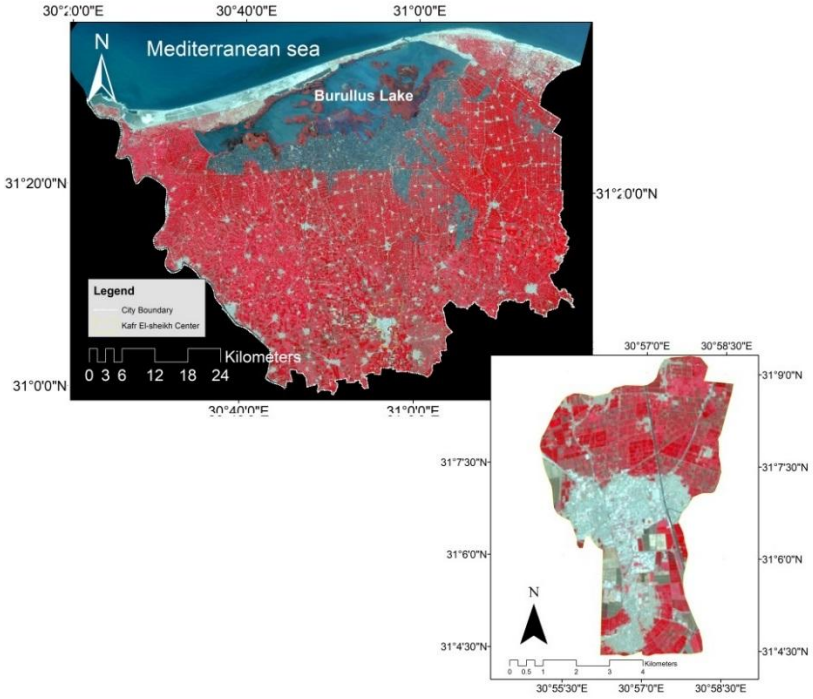

Figure 1: The study area Kafr El-Shikh center

2.2. Digital image processing

The approach was applied using Landsat images (path 177, row 38, covering Kafr El-Sheikh City) acquired on July month for the years : 1987, 1997, 2007 and 2018. The image was chosen at the same seasonal time to get a clear image with zero clouds and in order to avoid any overlapping that could happen from the bare soil of some areas in case the images are not in the same season.

Kafr El-sheikh Center area has been clipped by four Landsat satellite images for the fouryears (1987, 1997, 2007 and 2018) by using a polygon from CAPMAS that bordered the administration borders for the study area(figure 2). Then, three different indices for the major three land cover feature classes in the study area were developed. These indices were Normalized Difference Built-up Index (NDBI), Modified Normalized Difference Water Index (MNDWI), and Soil Adjusted Vegetation Index (SAVI). They cover the essential land-use bands of the urban ecosystem (urban, vegetation and water)[14] .

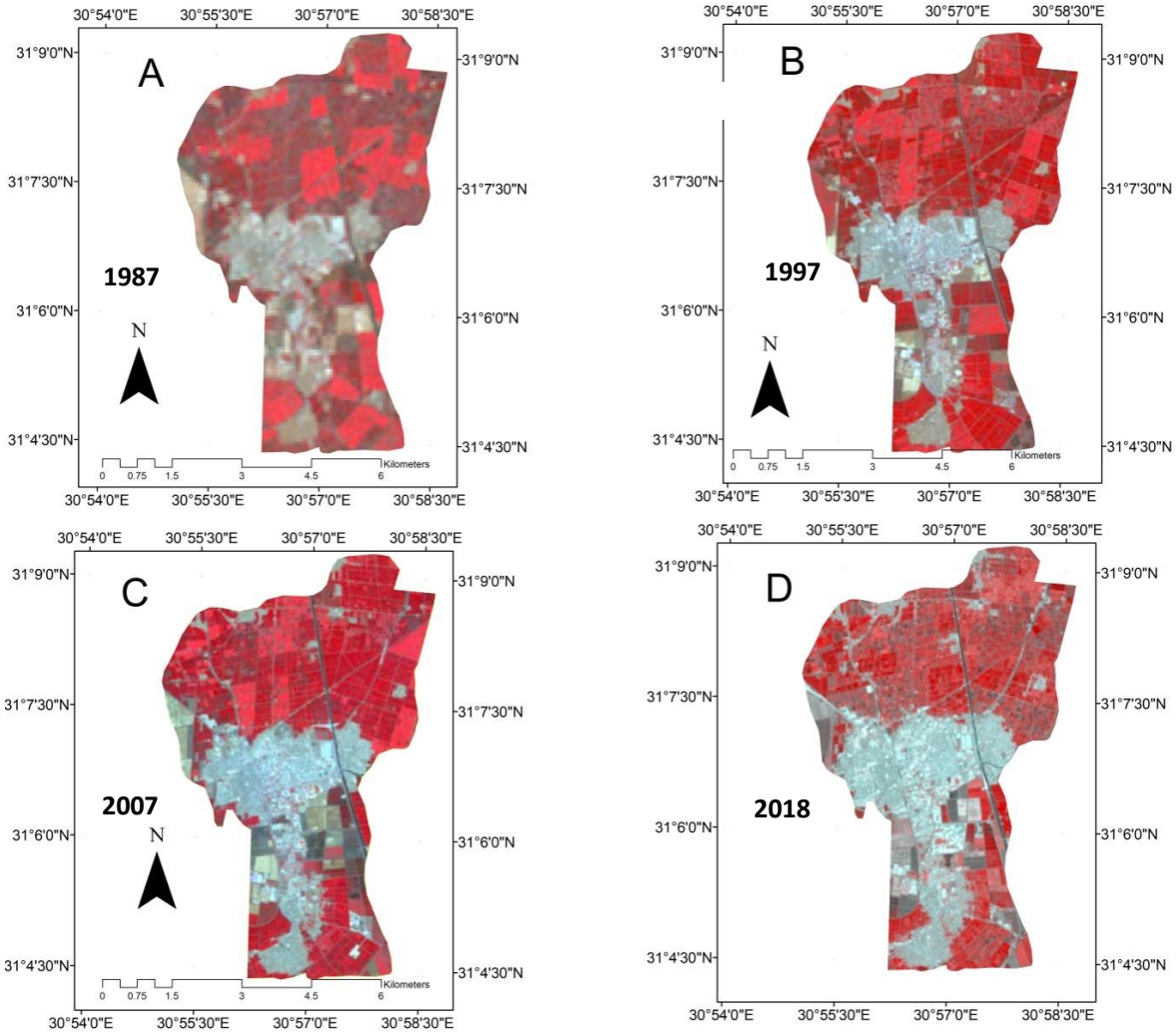

Figure 2 : clipped landsat images for the four years

(a) LANDSAT 5, (b) Landsat 5 Thematic Mapper (TM (c) Landsat 4-5 Thematic Mapper (TM) and (d) LANDSAT_8

After that, three indices (NDVI, NDBI, and MNDWI were used in producing a composite image for each year and this image was used for getting a land cover map for the four different years.To check the accuracy of the land cover classification with ground truth data from the False colorsimages (LANDSAT images). The results of the accuracy assessments were used to identify the different classification techniques used in this study. A total of 50 random sampling points were applied for collecting the ground truth data for accuracy assessment. The accuracy of the four images was more than 85 percentage, which is acceptable the purpose of the research needs.Finally four classified images were developed for three classes (urban, vegetation, and water) covering Kafr El-Sheikh Center city for the years (1987, 1997, 2007 and 2018).as presented in (Figure 3).

3) .***Results and discussion***

Figure 3and 4 present the changes inof vegetation and urban land cover from 1987 to 2018. It can be noticed that, the area of urban growsignificantlyover time due to population growth and expansion in building construction causing a decrease in the vegetation cover..

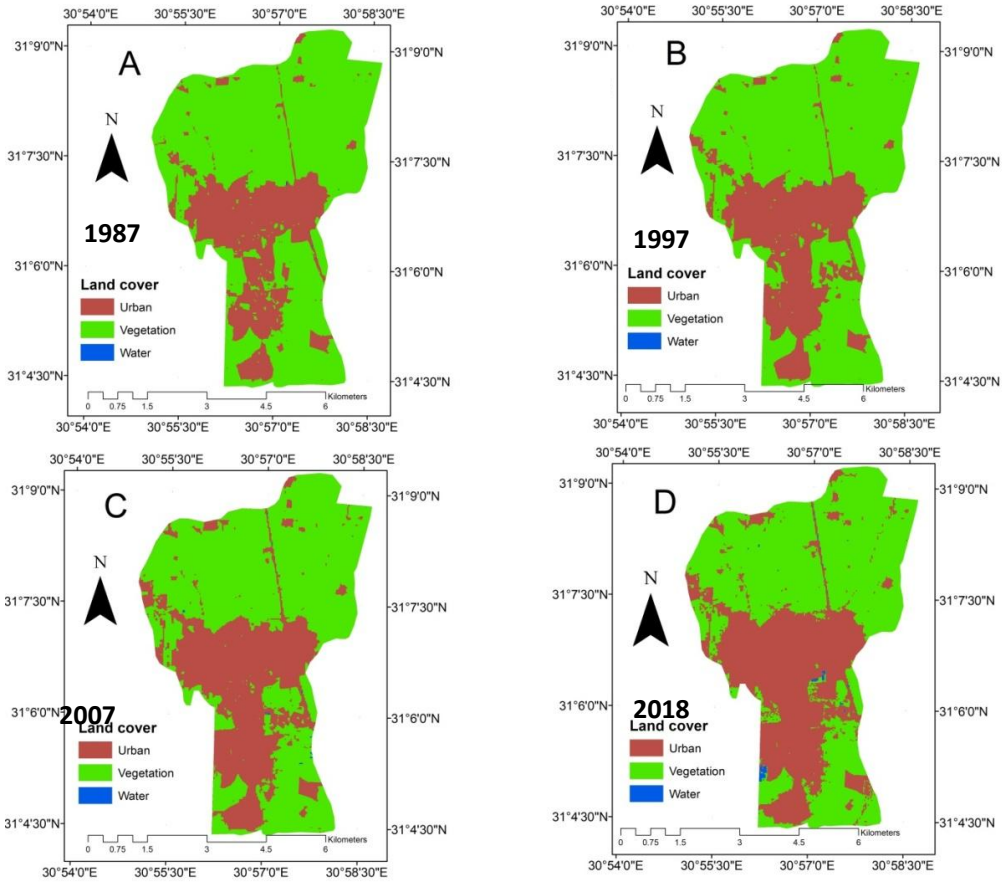

Figure 3: Classified images for the four years
(a) 1987, (b) 1997 (c) 2007 and (d) 2018

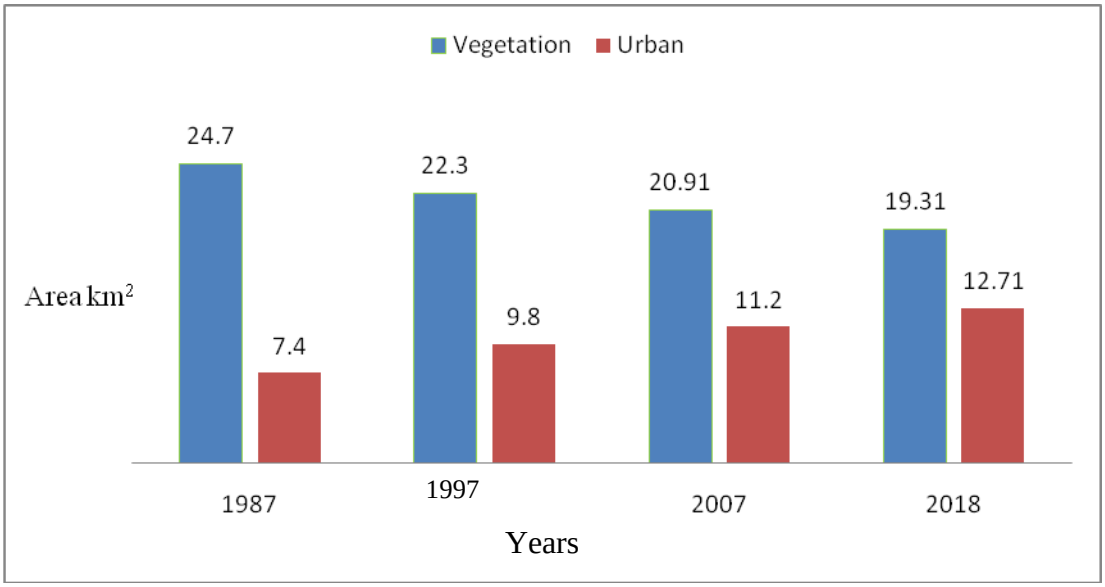

Figure 4: Change in land cover from 1987 to 2018

Initially, in 1987, the urban area was about 7.4 km^2, which represents 23% of the total area of Kafr El-Shikh center (Figure 4). After 10 years the urban area increased to 9.8 km^2, 30.5% of the total area of Kafr El-Shikh center, a 32% increase in urban area compared to 1987`s total urban area. In 2007, the expansion in urban area reached 34.5% of the study area. As for 2018, urban sprawl reached 39.5%. This raising expansion was due to population growth and related expansion of construction areas.

On the other hand, in the year 1987, vegetation area covered 76% of the total study area and this percentage continued to decrease with a rate of 8% per decade.It reached asignificant change in 1997 with recoding loss about 10% of total vegetation cover in this year followed by the same loss rate in 2007. In (2018), the total loss of vegetation area from 1987 to 2018 is5.4 km^2, which represents 22% ofthe total area of Kafr El-Shikh center.

It was found that mapping, measuring and predicting changes in land cover is very efficient for natural resources management planning and sustainable developing projects. Additionally, few studies addressed the connection between landcover and climate change. It is recommended more studies in this area and assesses the change of land cover in Nile Delta.

4) Conclusion

By studying the land cover/land use changes in urban area in Kafr El-Shikh center, during the years 1987, 1997, 2007 and 2018. A significant change in land cover was found, this represented 5.31 Km^2 (16.5% of total area transformed from vegetation to urban areas. This percentage illustrates a huge change in urban environment.

The change in the cover of the area and the loss of the vegetation cover, which is the cooling and breathing source of any city, will have environmental impacts that should be considered with extensively in other researches, besides losing the most fertilize lands in Nile Delta will also have an economic and food security impacts,

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