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Facies and sedimentary environment of cretaceous units at north west of Dihuk – Tabas region(Shotori mountain range)

Ghodratollah Mohammadi, Alireza Ashofteh

***Abstract*—**An investigation was made on the facies and sedimentary environment of upper cretaceous rocks at north west of Shotori mountain range at Dihuk – Tabas region. This study has also covered carving lime sediments mainly being micritic and sparits with fossil(bioclast) markings, such as: Echinoderm, alga, lamelibransch, brachiopodo and berizoa. Field and microscopic studies led to recognition and separation of 10 carbonate and carving facies as follow: Group of open marine facies that include 1- Bioclastic mudstone, 2- Bioclastic wackstone, 3- Bioclastic packstone; Group of barrier facies that include 4- Bioclastic grainstone, 5- Grainstone packstone; Group of lagoon facies that include 6- Bioclastic packstone, 7- Peloid wackstone; Group of continental facies that include 8- Litharenite, 9- Sub-litharenite and 10- Gerywacki. By interpretation and analysis of these microfacies and their related environment we shall be able to recognize the old geographical(palaeobiogeographic) condition in this region which has proven to have been a ramp type carbonate platform with a nearly uniform slope(homodinal ramp).

***Keywords*—**Sedimentology, Mount Shotori, Dihuk - Tabas, Lithology, Facies, Sedimentary environment.

I. Introduction

During the albian, pre-albian and cenomanaian epochs, the existed shallow marine at the central part of Iran has considerably expanded its territory(Seyyed Imami, 1971 and 1997). The stratum at different northern blocks of Tabas prove the occurrence of biogenesis of animals during this era[1], and indicate that this region is situated at central part of Iran and at north - west of Dihuk - Tabas area where existed such formations as Jamal(Shotori mountain range), Sardar, Shishtou, etc. The outcrops observed at the region under study are approximately 250m high and are attributed with following geographical coordinates:

Geographical Length: N07/332811

Geographical Width: E21/572418

The strata protract north - southward with 60degrees gradients and due to tectonic activities they are weak and occasionally get steeper or milder. Connecting paths to this region are:

First Path: Imamzadeh Ali road from Dihuk where the west sector lays.

Second Path: Imamzadeh Ali road from Boshruyeh where the east sector is in view. The weather of the region is sub-mountainously mild, largely similar to Dihuk weather condition. Samples were collected at about constant transversal distances vertical to the strata. The specimens which were made into thin cut pieces underwent precise lithological studies thereby their different elements were distinguished and separated. By synthesizing the Folk(1973) and Dunham(1962) approaches, the facies were given titles. This paper is a part of a research on lithological attributes, sedimentary facies and environmental aspects of the formation of cretaceous sediments and rocks at the region under investigation[2].

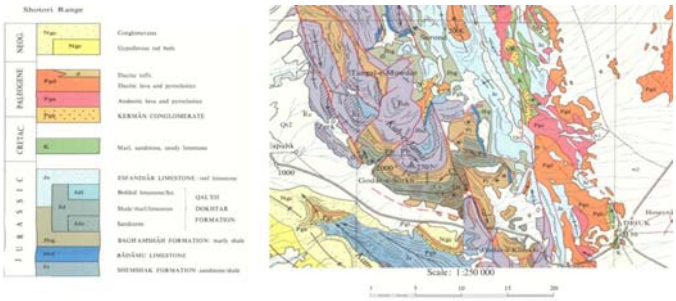

Fig. 1: Geological map of the region under study; south of Shotori range(Boshruyeh geological map with 1:250000 scale; geological survey organization of Iran)

II. Stratigraphy

At the concerned region the limestone sedimentations mainly included micritic and sparit limes containing some traits of fossils(bioclast markings) such as berizoa, spicule sponge, echinoderm and brachiopodo in formations of 250m thickness. The strata protract in north - south direction at 60degrees ramp being weak and occasionally steeper or milder due to tectonic activities.

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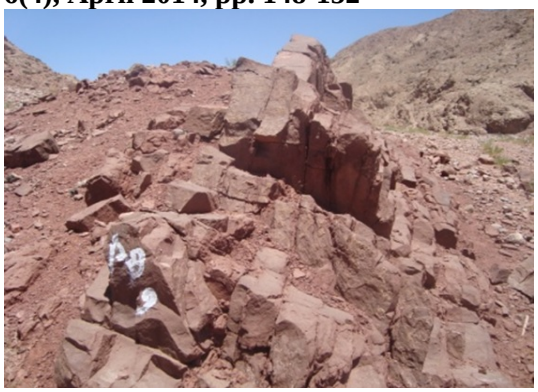

Fig. 2 Showing how strata are piled at the region under study

III. Procedure

Field Studies:
After investigating and collecting data, site visits were made in the region and the most appropriate stratigraphy zone for measurement and sampling were chosen. Samples and specimens were gathered using hammers, measuring tape and compass at every 1meter distance and/or at lesser or larger distances where facies and textural variations were seen.
Laboratory Studies:
Selected samples taken from the ground surface were put to analysis, interpretation and rendering of sedimentary environment and for identifying the sedimentary facies and developing a laboratory model of the carbonate and clast facies. Subsequently, a stratigraphy pillar was plotted.

IV. Microscopic Facies Description

According to microscopic studies on thin cut sections, 7 carbonate facies and 3 carving facies were identified. By review and comparison of these types of facies with facies presented by Flugel(1982) and Wilson(1975) it was clarified that a carbonate ramp environment with a nearly uniform slope are formed. This environment is categorized into 4 groups, namely: open marine, barrier environment, lagoon environment and continental environment each of these having their own sets of characteristics. By taking into consideration the allochems, orthochems, it can be asserted that each group's sedimentary characteristics include facies that we shall be dealing with the most significant ones[3]. The facies related to average to comparatively great depths of the open marine include the mudstone, wackstone and packstone facies.

A- Bioclastic mudstone:

This facie contains little allochems(less than 1%) that include crenoid, spicule sponge, bivalves, scallops of molluscs and plagic microfossils in various sizes and within micritic background. In some microscopic samples some cracks clogged with sparit cretaceous is observed. Plagic microfossils and micritic in the facie indicate the existence of sedimentation in a calm and open marine.

Fig. 3 Biocalstic mudstone containing plagic microfossils under 40x polarized lighting

B- Bioclastic wackstone:

This facie is formed from bioclastic(skeletal) fine grains in micritic background. Such bioclastic fine grains include crinoid thorns and small amount of spicule sponge. In some sectors related to this facie, spicule sponges are dispersed in longitudinal and transversal frames with 0.5 to 1mm sizes inside a micritic matrix substance.

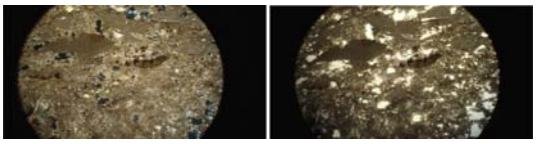

Fig. 4&5 Bioclastic wackstone containing crinoid thorns and small amount of spicule sponge inside a micritic substance. The image on the right is under normal lighting and the one on the left is under 40x polarized lighting

A- Bioclastic packstone:

The elemcnts in this facie include allochems such as alga, bioclastic fine grains(such as: briozova and molluscs in a micritic and sparit background). In this facie allochems are deposited in a calm area.

Fig. 6&7 Bioclastic packstone containing alga, bioclastic(skeletal) fine grains and berizoa within a background consisting of micritic and sparit. Left image is under 40x polarized lighting and the right image is under normal lighting

V. Interpretation of Open Marine Facies Group

Through a vast field and laboratory survey it is found that the above facies are remains in the open marine and shall be dealt with below since these facies are related to the open marine:

1- Facies containing plagic mircofossils are deposits in a calm environment at deep sections of the ramp(Pedley .1998).

2- Bioclastic allochem contents such as spicule sponge, radiolaria and echinoderm in a facies indicate that such a facie

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was formed in open marine(Simo .1993).

3- Mudstone texture with the absence of cement and other facies of high micritic content and low cement allude to environments with low to moderate(open marine) energy levels.

VI. Interpretation of Open Marine Facies Group

Bioclastic grainstone:

Ooids contain concentric laminates deposited around a central core. Older ooids also show the concentric laminates and isodose. Also, the radial and concentric structure in them is well formed. Their core is formed of quartz and carbonate micritic granules. Image below shows various ooid and it can be seen that some contain small cores and thick envelope and others have large cores. This rock also has a large amount of granules(microfossils and fine grained microfossil, intraclasts, ooid and sundry elements) and sparit cement. In the background of this facie, carbonate mud(micrite) is not present. Thus, this facie can have a biogenetical or carving origin and in some cases chemically produced. Fossil pieces contain mollusks and berizoa. Intraclasts and ooids content allude to a high energy level environment. Absence of micrite in the spaces between granules yet being filled with sparit cement alludes to an environment with high energy level[3].

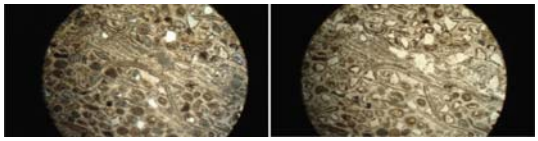

Fig. 8&9 Bioclastic grainstone containing ooids, brachiopodo and quartz granules. Left image is under 40x polarized lighting and the right image is under normal lighting

Grainstone packstone:

This rock contains high amount of granules and micritic cement with concentration of granules in little amount of depositions and the allochems are a mixture of ooids, intraclasts, fine lime particles, quartz and calcite granules. In this rock, neo-morphism of the micrites has taken place.

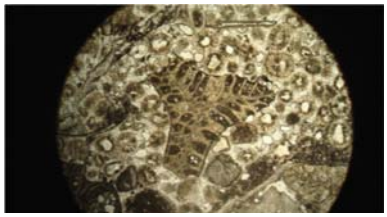

Fig. 10 Grainstone packstone containing a berizoa microfossil, mollusks and ooid in a sparit background with 40x polarized lighting

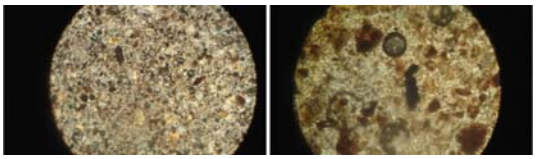

Fig. 11 Grainstone packstone containing bits of intraclasts, ooid, fine lime particles, quartz and calcite granules. Left image is under 40x polarized lighting and the right image is under normal lighting

VII. Interpretation of Barrier Facies Group

A vast field and laboratory survey shows the formation of facies in a barrier environment and below the reasons for their association of these facies with the barrier is given:

1- Absence of micrites and high sparit content with sparit cement filling within the granule spaces indicate high energy level and a barrier environment(Tucker, 1991).

2- Laminate and superficial ooid and some bentic microfossils allude to a barrier environment(Tucker, 1991).

VIII. Interpretation of Lagoon Facies Group

A vast field and laboratory survey shows the formation of facies in a barrier environment and below the reasons for their association of these facies with the barrier is given:

1- Bioclastic pakstone:

This facie contains high amount of allochem in a micritic background. Bits and pieces of fine grained fossils and spicule sponges seen in longitudinal and cross - sections are contained in this facie.

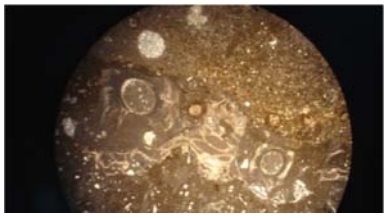

Fig. 12 Bioclastic packstone containing fine grained fossil pieces and elements, bivalve and laga. The image is under 10x polarized lighting

2. Ploid wackstone:

This facie mainly contains micrites and pellets and excremental ploids including first - order allochems. The fine grained fossil and bivalve pieces are sub-allochems that are observable in this facie. Pellets and ploids seen, are 0.1 to 0.3mm. Due to the presence of microfossils related to a lagoon environment, the facie has a lagoon environment.

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Fig. 13 Ploid wackstone including ploids, grapestone, interaclast, fine grained fossil and bivalve pieces under 10x polarized lighting

IX. Interpretation of Lagoon Environment Facies Group

Vast field and laboratory surveys show that the defined facies remain at lagoon regions.

1- Ploid and interaclast related to lagoon environment imply the existence of such an environment.

2- Clacitic y and micriting of the chamber walls of some of the microfossils and micriting inside the chambers could signify the existence of lagoon environment.

X. Description of Carving Facies

Litharenites are in fact sandstones with less than 75%quartz and having rubbles less than that in the feldespat. The image below shows sandstones containing quarts, chert and pieces inoculated with iron - oxide with lime concrete content. At the center of the image quartz granules and mica sheets are seen. In figures 15 and 16, an arnite barrier can be seen which contains carbonate rubbles. These sediments are also single quartz crystals and plates of echinoderms. Echinoderms are granules with patchy spots and similar interacting colors. In this sample, the echinoderms are a disjoint piece of an old limestone rock and thus are not categorized as fine grained fossil that had lived during the last stage of deposition of these sediments. Thus, they are to be considered as sedimentary rubbles and not fine grained fossil.

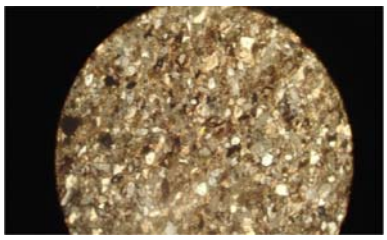

Fig. 14 Litharenite with mica sheets at the centre and quartz granules and pieces inoculated with iron - oxide. The image is under 10x polarized lighting

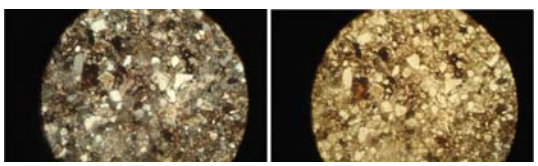

Fig. 15&16 Litharenite containing quartz granules and echinoderms plates. The image is under 10x polarized lighting

1- Sub-litharenites:

This is a kind of grit(sandstone) with 75 to 95 percent of its first - order granules made of quartz and has higher rubble content than feldespat. In images 17 and 18, the quartz granules, chert and a little rubble with micritic matrix substance is shown.

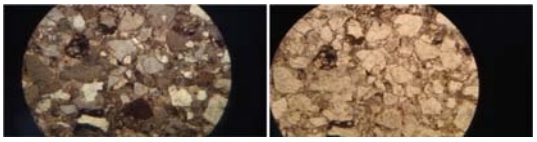

Fig. 17&18 Sub-litharenites with quartz granules, chert and a little rubble with micrite. The image is under 10 x polarized lighting.

2- Gerywacki:

Sandstones with over 15%fine granule matrix. The image below shows a gerywacki with weak sortation and containing high fine granule matrix. Some pieces in these sections are mainly made of single and multiple quartz granules with a small percentage of rubbles.

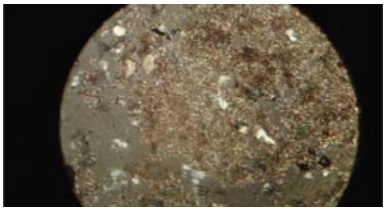

Fig. 19 Gerywacki containing quartz granules and rubbles, under 10x polarized lighting

XI. Sedimentary Environment of Cretaceous Units at North - West Mount Shotori at Dihuk - Tabas Region

According to analysis of acquired results from field surveys and the thin microscopic sections which were also compared with results from standard microfacies distribution models in differnet environments carried out by Wilson(1975), Flugel(1982) and Carozzi(1989), the sedimentary model of cretaceous regions of central Iran zone is produced. In presenting this sedimentation pattern, the Walter Law which in principle holds that strata should lay on each other, is observed throughout. Considering that, the sequence here is to the upper decreasing depth, and with reference to Walter Law, the facies that sequentially pile on top of each other were laid beside each other during formation, conditioned that, there had not been any depositional discontinuity. According to the facies genesis as already described, the region under investigation was in open marine, barrier, lagoon and continental environment which indicates that the carbonate platform is a type of ramp with a more or less uniform slope(homoclinal ramp)[6].

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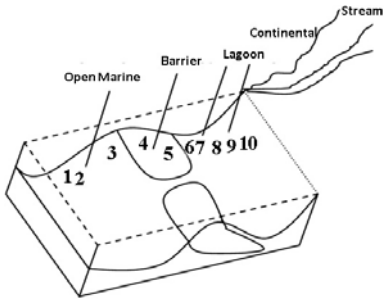

1- BIOCLASTIC MUDSTONE
2- BIOCLASTIC WACKSTONE
3- BIOCLASTIC PACKSTONE
4- BIOCLASTIC GRAINSTONE
5- GRAINSTONE PAKSTONE
6- BIOCLASTIC PACKSTONE
7- PLOID WACKSTONE
8- LITHARENITE
9- SUB-LITHARENITE
10- GERYWACKI

Fig. 20 Sketch of sedimentation model of outcropped cretaceous units at north - west of Dihuk - Tabas

XII. CONCLUSION

The most important results achieved from the study on deposits of cretaceous units of mount Shotori at north - west of Dihuk - Tabas are as follow:

1- Deposits of cretaceous(limestone) at this zone are about 250meters thick. By identifying and grouping 10 facies into 4 facie groups, it is concluded that these deposits belong to environments such as open marine, barrier environment, lagoon environment and continental environment.

2- The group of related facies has emerged in a carbonate platform of ramp type with nearly a uniform slope(homoclinal ramp).

3- The open marine region includes facies 1, 2 and 3; the barrier region includes facies 4 and 5, lagoon region includes facies 6 and 7 and continental environment including litharenite, sub-litharenite and gerywacki.

4- The concluding result of the research and studies can bespeak of the Palaeobiogeographic status of the region during sedimentation of cretaceous units at the region under study. After full reviews on stratigraphy pillar and carbonate microfacies and their related environment whilst also making incidental comparison of the results with each other and full review of the constituting elements of rock facies and with due consideration of the formation of limestone containing bentic microfossils that are related to lagoon environment with micritic and sparit texture and the subsequent emergence of open marine facies, it is made evident that the marine has make headway(progression) at the start of caretaceous epoch. Therefore, the advancement of the cretaceous marine can be clarified due to the expansion of bioclastic facies of the open marine along with microfossils such as spicule sponge, bivalve, berizoa together with large amount of micirte in the region under investigation(during cretaceous era). In the region under investigation, there has occurred conversion of a shallow sedimentary sea into a deep sedimentary sea having a micritic texture containing spicule sponge and bivalves. The formation of limestone with micritic texture and presence of intraclast show instability in the sedimentary condition and environment and fluctuations in the bed of the sedimentary sea.

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REFERENCES

[1] Aghanabati, S. E., 1383 (2004), Geology of Iran, Geological Survey Organization of Iran, pp. 285 – 295.
[2] Tucker, M., 1991, Sediment Petrology, Translator: Haramy, and R. Mahboobi, I., 1383 (2004), Jahad Daneshgahi Publications, City of Mashihad, pp. 90 – 101.
[3] Mohammadi, Gh., 1377 (1998), Review of Sedimentary Environments at Cretaceous Units in Central Iran using Sedimentology and Geochemical Evaluation of Organic Substances (Khor Biyabanak and Golpayigan regions), Islamic Azad University Science and Research Dept., PhD thesis, pp. 130 – 190.
[4] Adams A. E., Mackenzie W. S., Guilford Longman C., 1984. Atlas of Sedimentary Rocks Under the Microscope, pp. 50-55.
[5] Carozzi, A., 1989, Carbonate Rock Depositional Models: A Micro-Facies Approach, pp. 56.
[6] Chen, X., Wang, C., Kunht, W., Holbourn, A. Hunag, Y., and Ma, C., 2011, Lithofacies, Microfacies and Depositional Environments of Upper Creataceous Oceanic Red Beds (Chungde Formation) in Southern Tibet, Sed. Geol., V. 235, pp. 100-110.
[7] Khakimov., F. K., 1998. Zonation of Upper Cretaceous Ammonite of Eastern Central Asia Stratigraphy and Geological Correlation 6. (1998). Pp . 27-41.
[8] Kennedy et al., 2001. Bulletin of the American Museum of Natural History, 267 (2001), pp. 1-148.

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The effect of postharvest treatments and storage methods on leafy vegetable decay

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Abstract— Vegetables are living parts of plant and contain 65 to 95 percent water. Horticultural crops have high level of postharvest decay and loss due to lack of proper packaging methods and storage condition. This study was carried out to evaluate the effect of postharvest treatments and storage conditions. Five leafy vegetables including garden cress, parsley, coriander, peppermint and chives were used. Healthy and free from defect vegetables treated with washing or un-washing treatments and stored as covered and uncovered with polyethylene (PE) at 4 ^{o} C. The results showed that the weight loss and decay were different in 5 species and cress and Mint had highest and lowest decay respectively. Treatments affected weight loss and deceased yellowing and decay percent. Combination of washing and covered Treatments caused less weight loss and is recommended as easy and straight methods in developing country.

***Keywords*—**Postharvest decay, vegetable packaging,

I. INTRODUCTION

FRESH vegetables and fruits are the important part of human diet and now well established that these materials have a high nutritional value and their consumption is effective in human health [1]. Also as reported vegetables are important sources of vitamins, minerals, dietary fiber, and antioxidants [2]. However because of low postharvest life of fresh vegetables, marketing and transportation problems, high cost of storage and pathogen attack their proportion in people diet is restricted. These limitations mainly rise because of vegetable delicate tissues and infection to fungi, bacterial and other microorganism. Therefore fresh and unprocessed vegetables are suitable carrier of at least a bacteria, fungi or virus to human [3], [4].

Several researches had been reported that crud vegetables are carrier of the pathogenic agents [4], [5]. However pathogens cause vegetable tissues injured and decreased postharvest life before infect human. Since fruit and vegetables are alive after harvest and have delicate and perishable tissues provide a suitable medium to spread pathogens [6], [7]. These factors limited postharvest life of vegetables and also average consumption in developing country.

Iran has four season climate and produce huge amount of vegetables [8] but postharvest loss in higher than 30%. The current study was carried out to apply easy and applicable methods and to evaluate their effectiveness in postharvest decay.

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II. MATERIALS AND METHODS

A. Plant material

The current was conducted at the laboratory of physiology, department of horticultural science, University of Kurdistan.

Five common fresh vegetables that are sensitive to environmental condition were used. Materials provided from farmer included: garden cress (*Lepidium sativum* L), Parsley Leaf (*Petroselinum crispum*), Peppermint (*Mentha piperata* L), chives (*Alium ampeloprasum* ssp. persicum), and coriander (*Coriandrum sativum* L) and immediately transferred to laboratory.

B. Treatments

In all species similar, healthy and free from any defect sample were separated and divided to two lots. The first lot washed with tap water for 5 min and second assumed as without washing. Each lot was divided to two sections and transferred to special vegetable tray. The first lots of either washed or unwashed sample were covered with polyethylene (PE) film and second were left uncovered.

All sample were weighted and stored at 4 ^{o} C. Sampling was carried out during 10 days. Parameters such as weight loss, percent of yellow leaves and percent of lesions were monitored during experiment.

C. Statistical analysis

Data were analyzed statistically using analysis of variance (ANOVA) and differences among the means were determined for significance at $P< 0.05$ using Duncan multiple range test by MSTATC software.

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III. RESULTS AND DISCUSSION

The results showed that weight loss percent were different among treatments. In overall T3 and T1 had lowest levels of weight loss (32.05 and 42.55 percent respectively). Garden cress weight loss and decay was significantly higher than other species and coriander, Parsley and mint respectively ranked after that.

Several factors are involved in maintain vegetables moisture and thus decreasing weigh loss that include: leaf water content at harvest time, thickness of cuticle layer, the number of stomata in leaf area and the ratio of leaf surface to vegetable volume[9]. All of mention factors are individual species dependent. Monocot vegetables like chives (*Alliaceae* family) not only have thick cuticle layer but also fewer stomata number [10] thus loss less water and the result of current study confirmed this hypothesis.

Table 1. Effects of vegetable treatments on weight loss percent

	vegetable				
treatment	chives	garden cress	parsley	coriander	peppermint
T1	38.01	48.73	46.37	49.83	29.80
T2	68.81	73.37	71.27	76.40	74.02
T3	32.31	46.42	23.23	35.07	23.23
T4	65.43	71.64	68.30	75.10	73.43
LSD	**3.52**	**2.70**	**2.57**	**3.03**	**4.12**

T1: Without washing + PE, T2: Without washing – PE, T3: Washing + PE and T4: Washing - PE

One of the key factors in vegetable water loss is leaf area index (LAI) [11]. Vegetables with high LAI has high transpiration rate, loss more water and thus have high decay percent. In current study cress with high LAI showed rapid decrease of fresh weight. The results of wash and unwashed treatments showed washing treatment had positive effect and reduced weight loss ratio and decay percent in all five species. Washing treatments maintain leaf moisture and reduce weight loss. Covering vegetables package with PE in addition to washing treatment had lowest weight loss, yellowing and decay percent (Fig. 1, 3 and 5). In all species lack of advanced transport system and delivery methods in markets is main reason of high postharvest loss in vegetables [12].

Consumers purchase fresh produce based on appearance and textural quality [2]. Application of novel packaging system such as modified atmosphere packaging and increasing relative humidity in shelf of vegetable in market is suitable and is more useful to enhance crop quality and reach to consumer demand but at this time straight and easy methods is more practical in developing country.

Raw vegetables are usually contaminated by a variety of microorganisms. The rate of infection in commodity differs and depends to environmental and handling condition. Dipping or rinsing of vegetables in bleach solution is a common practice employed by the retailers and catering companies in order to minimize the initial bacterial load on the surface of vegetables. In current study dipping in water was used and results showed that dipping in water had no significant effects on vegetable weight loss. PE covering was very effective in weight loss decrease and combination of PE and washing significantly reduced weight loss (Fig. 2 and 4).

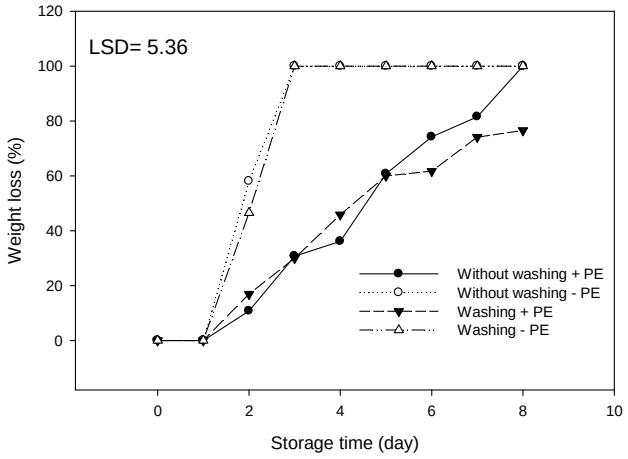

Fig. 1 Weight loss percent in garden cress vegetables during storage at 4 ^{o} C. samples treated with either washing or without washing and packed either with PE cover or without cover.

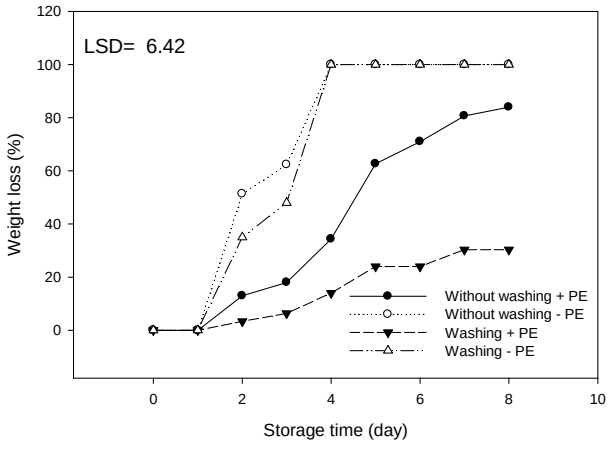

Fig. 2 Weight loss percent in parsley vegetables during storage at 4 ^{o} C. samples treated with either washing or without washing and packed either with PE cover or without cover.

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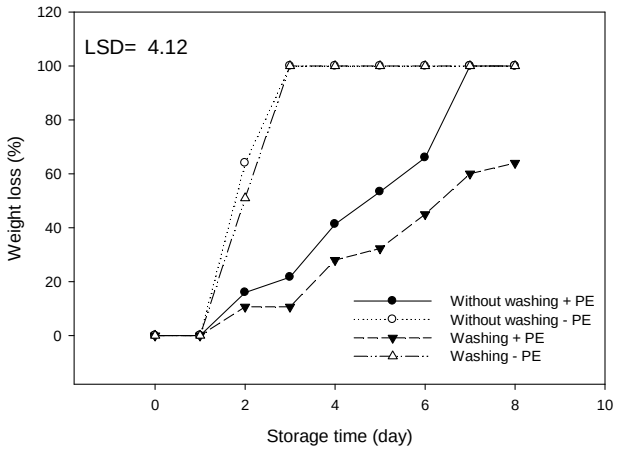

Fig. 3 Weight loss percent in coriander vegetables during storage at 4 ^{o} C. samples treated with either washing or without washing and packed either with PE cover or without cover.

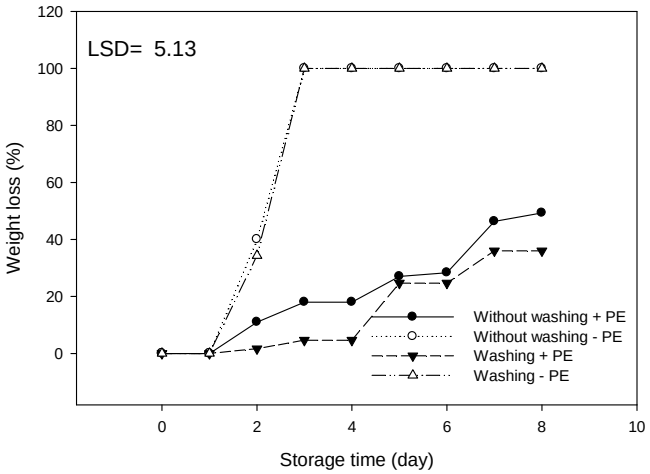

Fig. 4 Weight loss percent in peppermint vegetables during storage at 4 ^{o} C. samples treated with either washing or without washing and packed either with PE cover or without cover.

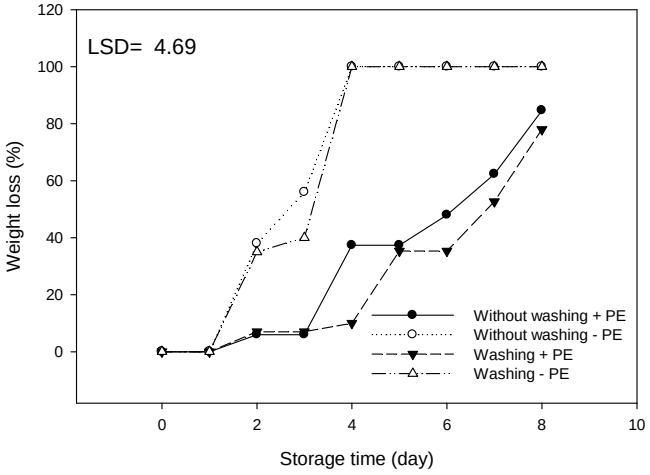

Fig. 5 Weight loss percent in chives vegetables during storage at 4 ^{o} C. samples treated with either washing or without washing and packed either with PE cover or without cover.

IV. Conclusion

Fresh vegetables continue to lose water during shelf life and water lose causes shrinkage and weight loss. Based on current study immediate washing of vegetables and covering with PE is recommended as easy method to decrease decay and enhance the quality of crop delivered to consumers. More research is needed to study other quality factors and microbial infection.

Appendix

Polyethylene film (PE), Leaf area index (LAI)

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References

[1] M. Abadias, J. Usall, M. Anguera, C. Solsona, and I. Viñas, "Microbiological quality of fresh, minimally-processed fruit and vegetables, and sprouts from retail establishments.," *Int. J. Food Microbiol.*, vol. 123, no. 1–2, pp. 121–9, Mar. 2008.

[2] A. A. Kader, "Flavor quality of fruits and vegetables," *J. Sci. Food Agric.*, vol. 88, no. 11, pp. 1863–1868, Aug. 2008.

[3] A. Alexopoulos, S. Plessas, S. Ceciu, V. Lazar, I. Mantzourani, C. Voidarou, E. Stavropoulou, and E. Bezirtzoglou, "Evaluation of ozone efficacy on the reduction of microbial population of fresh cut lettuce (Lactuca sativa) and green bell pepper (Capsicum annuum)," *Food Control*, vol. 30, no. 2, pp. 491–496, Apr. 2013.

[4] L. R. Beuchat, "Pathogenic Microorganisms Associated with Fresh Produce," *J. Food Prot.*, vol. 59, pp. 204–216, 1996.

[5] C. Nguyen-the and F. Carlin, "The microbiology of minimally processed fresh fruits and vegetables.," *Crit. Rev. Food Sci. Nutr.*, vol. 34, no. 4, pp. 371–401, Jan. 1994.

[6] C. Goodburn and C. A. Wallace, "The microbiological efficacy of decontamination methodologies for fresh produce: A review," *Food Control*, vol. 32, no. 2, pp. 418–427, Aug. 2013.

[7] M. Lehto, R. Kuisma, J. Määttä, H.-R. Kymäläinen, and M. Mäki, "Hygienic level and surface contamination in fresh-cut vegetable production plants," *Food Control*, vol. 22, no. 3–4, pp. 469–475, Mar. 2011.

[8] "Food and Agriculture Organization of the United Nations." [Online]. Available: http://www.fao.org/home/en/. [Accessed: 02-Mar-2014].

ISSN (Online): 2305-0225
Issue 6(4), April 2014, pp. 153-156

[9] N. P. Singh, *Fruit and vegetable preservation*. Oxford Book Company,, 2007, p. 360.

[10] H. C. Wien, *The physiology of vegetable crops*. CAB International, 1997, p. 662.

[11] M. Rajasekar, T. Arumugam, and S. R. Kumar, “Influence of weather and growing environment on vegetable growth and yield,” *J. Hortic. For.*, vol. 5, no. 10, pp. 160–167, Nov. 2013.

[12] A. A. Kader, “Quality assurance of harvested horticultural perishable,” *Acta Hortic.*, vol. 553, pp. 51–55, 2001.

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The effect of fructose on regeneration and proliferation of grape cultivars

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Abstract—Carbohydrates are an essential part of *in vitro* medium culture and have effects on grape shoot regeneration and shoot formation. In current study two explants (node and shoot tip) of two grape cultivars ('Khoshnave' and 'Farkhi') in medium contains different fructose concentration (15, 20, 30 and 40 gL^{-1}) was study. Some parameters such as main shoot length, leave numbers of adventitious shoot were evaluated. The highest and lowest shoot lengths were observed in 30 and 15 gL^{-1} of fructose respectively. Although the highest leaf number was observed in 40 gL^{-1} of fructose but this concentration induced high levels sample verification. Shoot tip explants produced longer shoot than node explants but the number of adventitious shoot was higher in node explants.

Keywords: Fructose, regeneration, grape, proliferation

I. Introduction

Concentration and type of carbohydrates and hormones are among the most important factors that affects shoot and root production rate. Ruzic and Cerovic (2008) reported that glucose, sorbitol and fructose had been effective than sucrose in shoot proliferation of sweet cherry and pear rootstocks. Rugini E et al (1985) speculated that 45% of fructose decreased the rate of vitrification in almond and olive. In other side Harada and Murai (1996) showed that among different carbohydrate source (fructose, glucose maltose and sucrose) glucose indeed highest level of shoot proliferation in *Prunus mume*. Somatic embryogenesis of grape in medium contains sucrose and glucose was better than fructose Perez et al (2000). The purpose of current study was to evaluate the response of two grape cultivars to different fructose concentration.

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II. Materiel and methods

The explants of shoot tip and node from grapevines (cultivars: 'Khoshnave' and 'Farkhi') that grown in vineyard of faculty of agriculture, University of Kurdistan, Sannadaj, Iran were collected. MS medium was used after 15 min autoclaved at 121 ^{o} C (2.1 atm). pH of medium was adjusted to 5.8.

Two type of explants (shoot tip and node) and four fructose concentration (15, 20, 30 and 40 gL^{-1}) were used in a factorial experiment based on completely randomized design with 4 replications. During 45 days some parameters such as main shoot length, number of leaves per main shoots, number at adventitious shoot and number of leaves per adventitious shoots were measured. The data was subjected to analysis of variance (ANOVA) with SAS statistical software and Duncan's multiple range test ($p<0.05$) was used to mean comparison.

III. Results and Discussion

Mean comparison of the results revolved signification difference of main shoot length in

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both explants and all fructose concentrations. 30 gL^{-1} of fructose concentration had highest main shoot length. The interaction effects of culture and fructose showed that mean shoot length of 'Koshnave' was higher than 'Farkhi' cultivar (Table 1). The current study result was in agreement with Yu and Reed (1993) that reported glucose as carbohydrate source improved shoot proliferation of hazelnut, also 3% of fructose or glucose induces more shoot length than source.

Table1: The interaction effect of explants, cultivar and fructose concentration on main shoot length.

Fructose concentrations (gL^{-1})	shoot tip		Node	
	'Farkhi'	'Khoshnav'	'Farkhi'	'Khoshnav'
15	1.55 ± 0.08 fg	1.75 ± 0.1 fg	0.67 ± 0.1h	1.42±0.11g
20	3.65 ± 0.3 bc	4.07±0.03b	1.95±0.15fg	2.87±0.14de
30	3.97 ± 0.39 b	5.22 ± 0.1a	3.50±0.17bcd	4.07±0.08b
40	2.80 ± 0.12 e	3.32±0.11cde	1.75 ± 0.17fg	2.12±0.12f

Different letter showed significant difference of Duncan multiple range test ($p<0.05$)

The results showed significant difference of number of leaf per main shoot in nod explants and 15 and 40 gL^{-1} fructose. In shoot tip explants of 'Farkhi' 15 and 20 gL^{-1} had significant effect (Table 2). Chong and Pua (1985) evaluated 10, 30, 50 and 70 gl^{-1} of fructose and 30gl^{-1} had been caused the high level of left to shoot ratio production.

Table2: the interaction effect of explants, cultivar and fructose concentration on number of leave per main shoot

Fructose concentrations (gL^{-1})	shoot Tip		Node	
	'Farkhi'	'Khoshnav'	'Farkhi'	'Khoshnav'
15	4.70 ± 0.44ef	4.82 ± 0.3 ef	4.05± 0.87f	6.37±0.25bc
20	6.25 ± 0.1 bcd	5.10±0.12cdef	4.92±0.52def	5.27±0.11cdef
30	5.87±0.31bcde	5.15±0.22cdef	5.92±0.14bcde	5.80±0.21bcde
40	6.10±0.23bcde	4.97±0.06cdef	8.55 ± 0.60 a	6.82±0.36b

Different letter showed significant difference of Duncan multiple range test ($p<0.05$)

The result showed that number of leave per adventitious shoot was increased with higher fructose concentration and 'Farkhi' had higher number of leave per adventitious shoot than 'Khoshnave'. number of leave per adventitious shoot in node explants was higher than shoot tip explants and vitrification of seedling elevated in high carbohydrate concentration(Table 3). Similarly Gruselle et al (1995) reported the best result was obtained by 3% fructose in Persian walnut but vitrification had been accrued in low carbohydrate concentrations.

Table3: The interaction effect of explant, cultivar and fructose concentrations on number of leave per adventitious shoot

Fructose concentration (gL^{-1})	Shoot Tip		Node	
	'Farkhi'	'Khoshnav'	'Farkhi'	'Khoshnav'
15	3.25±0.1 hi	2.87±0.075 ij	2.30±0.46 j	2.70±0.24ij

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20	5.17±0.12bcd	4.32±0.11defg	3.47±0.48ghi	3.90±0.14fgh
30	5.70±0.12 ab	4.27±0.21defg	5.32±0.19 b	4.22±0.29efg
40	5.25± 0.21bc	4.40±0.16cdef	6.57±0.23a	5 ±0.08 bcde

Different letter showed significant difference of Duncan multiple range test ($p<0.05$)

The highest adventitious shoot number was observed in 30 and 40 gL^{-1} fructose concentration while the lowest was observed at 15 and 20 gL^{-1} of fructose. The highest levels of shoots proliferation were observed in 30 and 40 gL^{-1} of 'Farkhi' and 'Khoshnave' cultivars respectively (table 4).

The study of different fructose concentration, node and shoot tip explants in two cultivars showed that the lowest number of adventitious shoot were observed at 15 and 20 gL^{-1} of fructose in 'khoshnav' cultivar (table, 4 & 5). Similar result had been speculated by Chong and Pua (1985) that reported high level of adventitious shoot in 30 gL^{-1} of fructose.

Table4: the interaction effect of cultivar and fructose concentrations on adventitious shoot number in the explant node

Fructose concentration (gL^{1})	Node	
	'Farkhi'	'Khoshnav'
15	1.50±0.34bc	1.05±0.19cd
20	1.25±0.10cd	0.77±0.04 d
30	2.12±0.14a	1.55±0.08bc
40	2.5±0.23a	1.97±0.10ab

Different letter showed significant difference of Duncan multiple range test ($p<0.05$)

Table5:the interaction effect of cultivar and fructose concentrations on adventitious shoot number in the explant Shoot Tip

Fructose concentration (gL^{-1})	Shoot tip	
	'Farkhi'	'Khoshnav'
15	1.15±0.13bc	0.62±0.04 d
20	1.37±0.17ab	0.75±0.05cd
30	1.30±0.07ab	1.07±0.075bcd
40	1.65±0.26a	1.15 ± 0.2 bc

Different letter showed significant difference of Duncan multiple range test ($p<0.05$)

IIII. Conclusion

Sugars types have different effects on regeneration and organogenesis of different grape cultivars. Fructose concentration had different effect on leaf number, shoot number and shoot high in grape cultivar.

References

[1.] Chong, C. and Pua, E.C. 1985. Carbon nutrition of Ottawa 3 apple rootstock during stage of in vitro propagation. Bull RechAgronGembloux 30: 1-2.

[2.] Gruselle, R.,Nicaise, C. and Boxus, P. 1995. Regulation of in vitro shoot multiplication in persian walnut by different carbon sources and by ammonium phosphate. Bull RechAgronGembloux. 30: 47-55.

[3.] Perez, f., Pablo, M., Maritza, B. and Manuel, P.2000. Effect of carbon source and sucrose concentration on growth and

ISSN (Online): 2305-0225
Issue 6(4), April 2014, pp. 157-160

hexose accumulation of grape berries cultured in vitro.plantcell,tissue and organ culture.61:37-40.

[4.] Yu, X. and Reed, B.M. 1993. Improved shoot multiplication of mature hazelnut (Corylus avellana L.) in vitro using glucose as acarbon sources. plantcell rep. 12:256-259.

[5.] Ruzic D , Lazic T and Cerovic R 2008 Micropropagation of some prunus and pyrus genotypes *in vitro* as affected by different carbon sources. Acta Hortic. 795:413–418

[6.] Rugini E et al .1985. Control of shoot vitrification of almond and olive grown in vitro. Symposium on in vitro problemsrelated to mass propagation of horticultural plants. September16–20 Belgium ISHS Acta Hort

[7.] Harada H and Murai Y .1996. Micropropagation of Prunus mume. Plant Cell, Tissue Organ Cult. 46(3):265–267

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A survey on how to planning Risk Control Cost (RCC) for Civil Projects construction

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Abstract: This paper presents an alternative to established methods of cost control. Using the methodology presented project managers will be able to anticipate the potential cost concerns, the projected costs to completion and proactively prevent the cost differences. It is done with qualitative risk assessments, simulation, and earned value techniques. This new methodology is applied from the planning phase through the implementation phase until a project is completed. The emphasis is on identifying risks, assessing the acceptability, monitoring, policy analysis and control.

Key-Words: Project Management; Civil Construction; Risk Control; project cost

1. INTRODUCTION

The main objective of this paper is to present a methodology to help project managers and engineers cost for cost control during the construction of a complex structure. Cost control during the construction process is essential to the success of a project. The construction of a complex structure is a major undertaking and usually has people specifically responsible for controlling costs. Most complex projects share the common theme that they are fraught with risks and uncertainties that could cause an escalation of costs. For example, Laufer and Howell found that about 80% of all projects to start the building process with a high level of uncertainty [8]. project manager of construction and engineering costs are difficult to build a complex project is on budget.

Construction and engineering professionals costs have long recognized the need for improvements in cost control [6]. Cost management includes assessment, planning, accumulation and analysis of cost data, and finally the implementation of measures to address cost problem. There are several cost control techniques that are used by the construction industry to varying degrees. They are: exception reporting, trend analysis, earned value, estimating range, and the unit cost forecast. Except perhaps for the value gained, these techniques for controlling costs tend to focus on the deviations of the items online once the cost overrun was discovered. What is needed is a method of cost control that proactively seeks potential cost problems and provides project managers with the warning that as many as possible before they occur.

2. RISK ANALYSIS

Risk analysis is identified as an important sub-sector project management [14]. However, its application appears limited in the field of management of construction projects. It is limited in its widespread use [2], sometimes it is used only schedules in development [11], or estimates of costs [5]. The reasons for this limited use are difficult to identify and quantify. McKim suggested that risk analysis is considered by the engineers of the construction cost as an object of bullying [10]. Blair states that the data required to apply risk analysis is often expressed in linguistic terms and is difficult to apply in a conventional quantitative risk

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analysis [4]. An application of fuzzy logic and set theory can be used as a solution to the reason later [4] and [13]. Al-Bahar and Crandall also noted that construction professionals tend to use basic rules, based on intuition, or experience when it comes to risks [2]. What is needed is an application of risk analysis to assist in cost control of project managers is relatively simple to apply, can be used throughout the lifecycle of a construction project represents the trend of building professionals to apply risk in terms of language and apply their experience.

3. Risk Definition

The literature abounds with definitions of risk. The risk may be an ambiguous term somewhat less than its definition and convention are clearly stated. The notion of risk is used to identify and assess the uncertainties associated with an event. Risk can be measured as a pair of probability of occurrence (probability) of an event and the consequences (outcomes) associated with the occurrence of the event. This association is not a mathematical operation, a vector or scalar, but a correspondent in the event of probability one with the desired result.

Risk is sometimes considered the potential for harm. In the context of project management and as defined in this document is considered the risk involved or the potential gain and potential negative consequences. This broader definition of risk is known as engineering risk [15].

There is a consensus within the technical community that a comprehensive risk analysis consists of risk assessment, risk management and risk communication [12]. Risk assessment is the process of identifying and evaluating risk areas. Risk management is the act or practice of treating or controlling the risk. Risks can be managed on the basis of information provided by risk assessment to determine the acceptability of risk and use of decision analysis to make informed decisions and mitigate risk control purposes. Risk communication is the process of documentation and exchange information on results of risk assessments to various stakeholders.

4. Risk assessment

Risk assessment is a process by which scientific and technical risk of a given situation for a system are modeled and quantified. The risk assessment provides quantitative and qualitative data to decision makers for future use in risk management. Risk assessment for construction projects can be done by comparing the resource requirements needed for the construction of industrial projects at existing capacity and performing simulations of the construction process. These techniques highlight the critical areas and cost savings opportunities. When the data does not exist or is not available, a risk assessment of construction may be made in qualitative terms. When data are available or can be obtained, the risk assessment is quantitative. The risk assessment then examines the deviations from these construction scenarios that can lead to positive or adverse. The consequences can be described in terms of positive or adverse effects in project cost, schedule, security or technical performance.

Qualitative risk analysis uses expert opinion to assess the probability and consequences of an event occurred. Security review / audit checklist, what-if, hazard and operability study (HAZOP), Preliminary Hazard Analysis (CHRP), the matrix of risk assessment tables, hierarchical analysis (AHP), evaluation of cause and effect diagrams result, the expected monetary value (EMV) using the Delphi technique, and influence diagrams are usually considered qualitative techniques. The quantitative analysis is based on statistical methods and data bases that determine the likelihood and consequences of an event. Simulation, failure mode and effects analysis (FMEA), Fault Tree Analysis (FTA), Event Tree Analysis (ETA), a tree of success, accident progression and frequency analysis, scenarios common cause sensitivity factors, fuzzy applications stochastic risk premium, and EMV expected net present value (NPV), the risk adjusted rate of return, and stochastic dominance are generally regarded as quantitative techniques for risk assessment.

4.1. Risk Management

Risk management is the process by which network managers, project managers, and owners to make decisions, changes, and choose different system configurations based on data generated in the risk assessment. Risk management is dynamic as new information about events becomes available risk managers must adapt accordingly.

To make decisions based on risk, a level of acceptable risk must be determined. A diagram of risk profile is shown in Figure 1, the emission lines of constant risk that the risk increases the likelihood and / or the consequence of a risk event increases. Figure 1 also shows that when considering the acceptance of risk curves that show a higher result with a very low probability and vice versa, can be used to demonstrate an acceptable risk. Management should determine the acceptance of risk through a systematic process that may be specific projects, based on general government or corporate guidelines. The acceptance of risk can also be determined by the cost-effectiveness of reducing risk or

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opportunity gained. This profitability is calculated as follows:
(Equation 2)
D where the cost is the monetary amount necessary to reduce risk and risk is the level of risk reduction.
An integral part of risk management is the use of decision analysis. Project management and engineering are professions that require decisions to be taken to manage cost, schedule technical and security risks. Most of the techniques of decision analysis have the following steps or phases: 1) identify the problem and objectives, 2) develop alternatives, 3) evaluate alternatives, and 4) implement the best solution [3]. In a decision based on risk analysis of these measures should include the uncertainties associated with data or alternatives. Four possible methods for decision analysis that can be used in a base of decision analysis methodology of risk are:

1) decision trees, 2) the trees end, 3) Analytic Hierarchy Process (AHP), and 4) risk-based net present value (NPV).

5. BASIS OF COST CONTROL RISK

A technique for cost control that anticipates potential cost problems using risk analysis and simulation techniques to highlight potential areas tend to cost increases is presented. This risk analysis is also used to identify areas where cost savings or competitive advantage can be gained. The risk analysis techniques used are a dynamic, constantly updated as new information becomes available. Information Risk analysis and tools costing combined to anticipate problems of project cost and completion costs.
The methodology presented is applied in the planning and execution of a project as shown in Figure 2. methods may be used to help establish cost targets and timetable for the planning phase. Project costs are a function of time and integration cost and schedule is an important element of the methodology. In the implementation phase of the risk methods are applied to help control project managers in order to deliver on budget and on schedule.
The risk analysis presented is a combination of both quantitative and qualitative risk. The generic structure of this risk analysis for cost control is illustrated in Figure 3. In the assessment phase of risk probability and consequences of the risks and opportunities are quantified using a risk assessment matrix table a risk determination is made. Table 1 is an example of a risk assessment matrix table. Once an expression for the probability and consequences of an event is developed a risk assessment can be determined. For example, if the probability of a strike is likely and the consequences of this event is essential, the risk score from Table 1 for a strike is "high".Risk assessments are then compared to levels of risk acceptance and process of decision analysis is used to facilitate administration. Activities in the boxes represent the risk assessments and activities in the arrow represents a change in risk management functions. The basic structure in Figure 3 is applied in all phases of planning and executing a project, except in the execution phase earned value techniques and continuous monitoring are performed.

6. PLANNING PHASE

A method to account for the uncertainty of cost estimates and timetable applies the results of a method for qualitative assessment of risks to the simulation during the planning (feasibility or preliminary design) phase of a project to provide a risk assessment quantitative and qualitative. The qualitative method of risk assessment is carried out using a two-step process. First approach of the checklist is used to identify potential risks, then a matrix of risk assessment technique is applied to an expert to quantify the risk. Using two methods of assessing risk areas of potential risk that affect the cost and schedule are taken into account. Risk assessment and timing of costs are then developed a quantitative analysis using simulation.

6.1. Cost of planning and risk assessment schedule

project costs and construction schedules are usually estimated by developing a single value or "point estimate". A point estimate does not include the effects of uncertainty and is simply based on the sum of a number of point estimates of items of work.
A methodology for risk assessment using the simulation is presented because simulation techniques are easily adaptable to the construction industry. This is because the construction projects and interrelated variety of different activities that can be easily modeled. Once a point estimate is developed, the uncertainty can be expressed probabilistically using probability density functions. Finally, the simulation can be easily performed on the current state of the art desktop computers.
One difficulty in using simulation to develop and schedule risk cost is to determine what factors, parameters, or range of values should be applied to probability distributions used to represent the uncertainty and costs timelines. The simulation model can then use information from risk assessment to

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develop appropriate cost ranges modeled by probability distributions.
The process of preparing the calendar data risk and the cost is shown in Figure 4. The first step in establishing a cost estimate breakdown of the project is using a work breakdown structure (WBS). Once it makes a point estimate can be established for each batch of homework. Replacing a point estimate for a package to work with a probability density to better approximate the cost of each module of work taking into account uncertainty. Care will be necessary to use the appropriate density and related parameters. The selection of the probability density function is more suitable for certain construction operations has been demonstrated by AbouRizk and Halpin [1] and Law and Kelton [9] recommend several alternative distributions. The estimated cost and schedule targets of a project is presented in the last block of Figure 4 and was quantified to reflect the uncertainty and potential risks. This process also highlights the risks or opportunities that can be mitigated or taken advantage of during the planning process.

6.2. Cost of planning and risk acceptability Schedule

Once potential risks are highlighted in the matrix of risk assessment of a method of risk acceptability is needed. The project team should propose to the management level of acceptable risk. The method of determining the acceptable risk must be based on criteria and guidelines established for a particular business or organization. These criteria should be fairly generic so they can be applied to typical projects for the organization.
The risks that have the potential to cause significant effects on costs should be targeted for reduction or control. A two-step process is used to determine the acceptability of risk: 1) all risks above a certain quality threshold should be targeted for reduction or occasionally 2) all other risks must be evaluated by cost-effectiveness of risk reduction.
Management should define the thresholds for risk levels and profitability. risk events in a cost-effectiveness is deemed acceptable and mitigation efforts or opportunities are acceptable . risks negatives that are considered unacceptable and will probably unprofitable project unviable.

6.3. Planning *and* Co *Annex* Decision Analysis Method

There are three major decisions to make in the planning process. The first answers the question "What are the risks must be mitigated or opportunities carried out in the planning phase?" The area of the second decision can set up the simulation for the development and timing of cost targets. Third, a decision is necessary to determine whether a project should be continued favored in the implementation phase.
As shown in Figure 5, the output of the base cost risk and schedule also includes identified risks or opportunities. negative high risks and opportunities should be done during the planning phase. This should reduce the cost and schedule, and therefore the initial estimate must be redone. Finally the cost and schedule objectives are developed that include the effects of attenuation at high risk negative and seize opportunities.
Also shown in Figure 5 are the results of the risk assessment of the risk matrix are applied to the schedule or cost estimate using a simulation method. The risk assessment provides information for determining the appropriate range for use in the probabilistic representation of different costs or activities. The range is a measure of the dispersion of a distribution to a value moyenne.Par example, if a construction is represented by a triangular distribution of the range of values can be chosen arbitrarily by 90% to 110% of average. Although the results of the risk assessment of this range may better represent the risk and is increased or decreased accordingly. For example, a high-risk negative could use a range between 90% and 150% to take into account the possibility of a negative consequence.
The decision to go further with the project will be made once the risks have been highlighted and the final target costs and schedules are known. In general, the issues most important risk is the cost and schedule, the industry's ability to perform the work, and risks.
A methodology for using a risk-based net present value (NPV) is used to determine whether the project should be continued. This method was chosen because it is relatively simple to apply, gives a monetary value that includes the time value of money, and can account for uncertainty in a project [15].

7. EXECUTION PHASE

The execution phase of a project starts once the contracting authority or a government agency gave the green light for the project. Construction work begins in this phase and a methodology for cost control is necessary to ensure that costs remain within budget. This section presents a methodology for cost control that combines risk and obtained analytical techniques of value to the control of project costs.
New information available in the execution phase of a project may not require the original risk assessment to

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be expanded or updated to reflect any change in uncertainty, the evaluation of consequences and likelihood, new risks or events. Risk assessment in this phase is now preformed alongside an analysis of the value gained. The acceptability of risk and decision analysis is preformed in the implementation phase as a means of controlling project costs.

The combined process of risk assessment and earned value analysis is illustrated in Figure 5. This combined process is shown as being composed of the establishment and updating of both risk assessment and earned value processes. Reference values for the risks and costs are established as soon as possible in the implementation phase. Every month more new project information and achieved value data becomes available these tests are updated.

7.1. Running up the Risk Assessment and Earned Value

The 'list of consequences and likelihood of risk assessments of the planning phase are reviewed and updated to provide a risk assessment during the implementation phase. This assessment should begin by examining the existing documentation, such as plans, specifications, contracts, and actual site conditions. dimensions of risk assessment are found using the matrix of risk assessment tables. To combine risk assessment and earned value analysis means for performing all these activities.

Earned Value analysis has two distinct phases. It is the establishment of reference and measuring actual performance against this database. As soon as possible in the implementation phase of the project budget should be established and charted as cumulative cost over time. The base budget or the expected value of work earned value terminology is better organized and analyzed using spreadsheet software. These spreadsheets can be easily updated and graphically show the trends.

The risk assessment provides an overview of the different levels of risk. These elements must be broken or reduced to manageable levels in the analysis of the value gained. This allows managers to identify possible sources of discrepancies. Cost problems sooner or opportunities are identified the better. This allows project managers sufficient time to correct a problem or seize an advantage to affect the outcome of a project.

7.2. Phase of execution risk acceptability

The acceptability of risk is necessary at the beginning of the execution of a project life cycle in order to fully benefit from the mitigation of any damage or capitalizing on opportunities. Once potential risks are identified a process of decision analysis is used to decide a best course of action.

The acceptability of risk is presented as a decision block in the upper right of Figure 5. If an identified risk is acceptable, it should be monitored during the construction process. An event that identified risk is unacceptable or a great opportunity to be sufficiently mitigated or the possibility to consider. A process of decision analysis is used to identify the best solution. Once these events have been implemented, they must be monitored for the life of the project.

7.3. Implementation phase update of the Risk Assessment and Earned Value

This process of risk assessment must be dynamic and constantly evaluate the risk to the life of the project. Once the project progresses, managers need a risk assessment of dynamic process that will not be too long and should be scheduled at regular intervals. The ongoing risk assessment includes the updating of risk profiles and should coincide with the updating of earned value tables.

In Figure 5 presents the updated information is shown in the bottom right of the figure. Earned Value data and risk assessment data are collected monthly. The type of data collected for analysis of earned value is the actual cost of implementing the activities to date and the physical value of the activities accomplished to date (earned value). In addition, a review and reassessment of risk profiles identified must be updated with data from the acquired value.

As shown in the bottom center of Figure 5, once earned value and risk assessment data is updated a difference can be observed. If a discrepancy occurs the reasons why it should be understood and measures taken to correct the situation. If there is a gap does not occur when the monthly update is made risk profiles and earned value data continues to be followed by monthly updates.

8. Discussion and Conclusion

A technical decision is also required as shown in the lower left of Figure 5. This decision process is used to decide how a particular risk is best mitigated or taken advantage of.

For those risks that must or should be mitigated or taken advantage of a goal or decision tree analysis is used to determine the appropriate strategy. A technical objective of trees could be used in this part of the implementation phase for several reasons: 1) time is of the essence, 2) the availability of accurate data, and 3) systematic and simple.

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Time is of the essence in the execution phase, because a decision must be made early enough to influence the outcome of the project. This window of opportunity is greatest at the beginning of a project and decreases in proportion to the remaining time on a project. The typical construction of complex projects will be unique or significantly different from past projects, therefore, accurate data on past projects may not be available to carry out an analysis similar decision that needs probabilistic data. Goal trees are a systematic process that outlines several management options to consider. To help you make quick decisions, they are quickly and simply constructed.

The advantage of trees goal is speed and simplicity. Unfortunately trees lens does not provide a monetary value expected (EMV) or a probability of success. This may be acceptable because of the short window of opportunity and lack of accurate data in the implementation phase. If time allows and accurate decision trees are available should be used to help decision makers choose between solutions.

At this stage of the project management life cycle has taken steps to correct a gap. Once a decision has been taken and the measures taken, results should be monitored for their effectiveness. This process continues until a project is completed.

REFERENCES

[1] AbouRizk, S.M., and Halpin D. (1992). "Statistical Properties of Construction Duration Data." *Journal of Construction Engineering and Management*, ASCE 118(3).

[2] Al-Bahar, J.F. and Crandall, K. C. (1990). "Systematic Risk Management Approach for Construction Projects." *Journal of Construction Engineering and Management*, ASCE 116(3).

[3] Ayyub, B. M. and McCuen, R.H. (1997). *Probability, Statistics and Reliability for Engineers*, CRC Press, Boca Raton, FL.

[4] Blair, A.N. (1999). "Risk Analysis of Cost and Schedule of Complex Engineering Systems." PhD thesis, University of Maryland, College Park, MD.

[5] Hulett, D.T. (1995). "Project Schedule Risk Assessment." *Project Management Journal*, March 1995, Project Management Institute, Upper Darby, PA.

[6] Humphreys, K.K. (1991). *Jelen's Cost and Optimization Engineering* 3rd edition, McGraw-Hill, New York, NY

[7] Kumamoto, H., and Henley, E.J. (1996). *Probabilistic Risk Assessment and Management for Engineers and Scientists*, 2nd *Edition*, IEEE Press, New York, NY.

[8] Laufer, A., and Howell, G.A. (1993). "Construction Planning: Revising the Paradigm." *Project Management Journal*, June 1993, Project Management Institute, Upper Darby, PA.

[9] Law, A. and Kelton, W. D. (1991). *Simulation Modeling and Analysis* 2nd edition, McGraw-Hill, Inc, New York, NY.

[10] McKim, R.A. (1992). "Risk Management Back to Basics." *Cost Engineering,* 34(12), Association for the Advancement of Cost Engineering, Morgantown, WV.

[11] Mullholland, B. and Christian, J. (1999). "Risk Assessment in Construction Schedules." *Journal of Construction Engineering and Management*, ASCE 125(1).

[12] National Research Council. (1983). *Risk Assessment in the Federal Government: Managing the Process*, National Academy Press, Washington, DC.

[13] Ock, J.H. (1996). "Activity Duration Quantification Under Uncertainty: Fuzzy Set Theory Application." *Cost Engineering* Vol. 38/ No. 1. Association for the Advancement of Cost Engineering, Morgantown, WV.

[14] PMI Project Management Institute. (1996). *A Guide to the Project Management Body of Knowledge*, Project Management Institute, Upper Darby, PA.

[15] Wang, J.X. and Roush, M.L. (2000). *What Every Engineer Should Know About Risk Engineering and Risk Management*, Marcel Dekker, New York, NY.

Appendix : Figures and Tables

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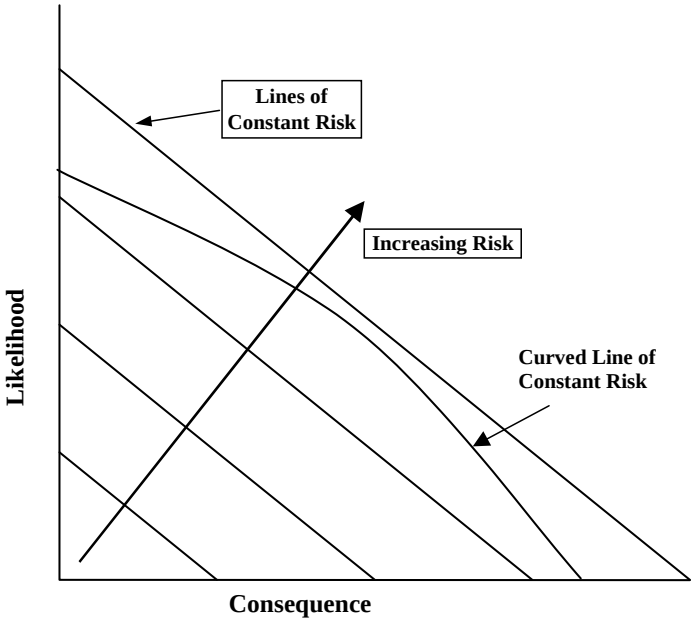

FIG. 1 Risk Profile and Levels of Risk

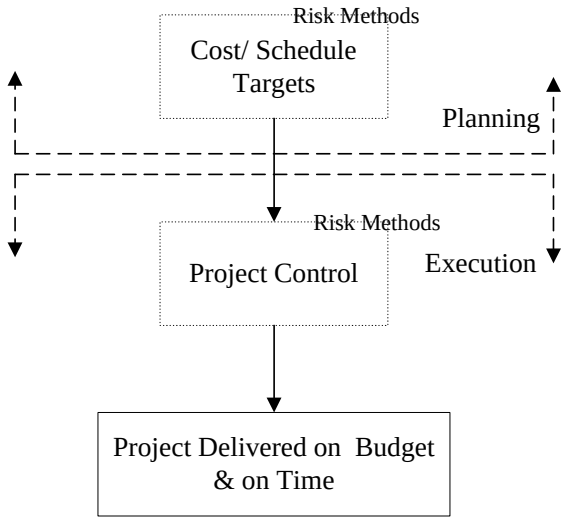

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FIG. 2. Risk-based Methodology Applied to both the Planing and Execution Phase

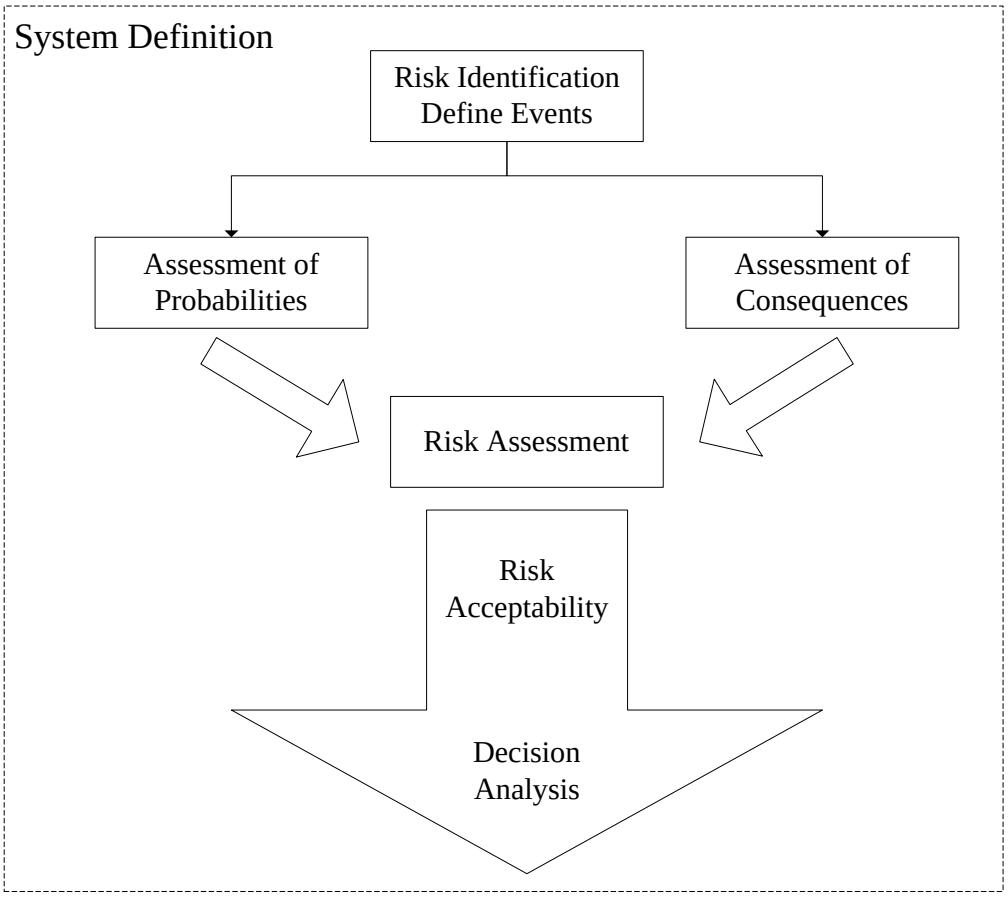

FIG. 3. Generic System Definition of Risk-based Cost Control

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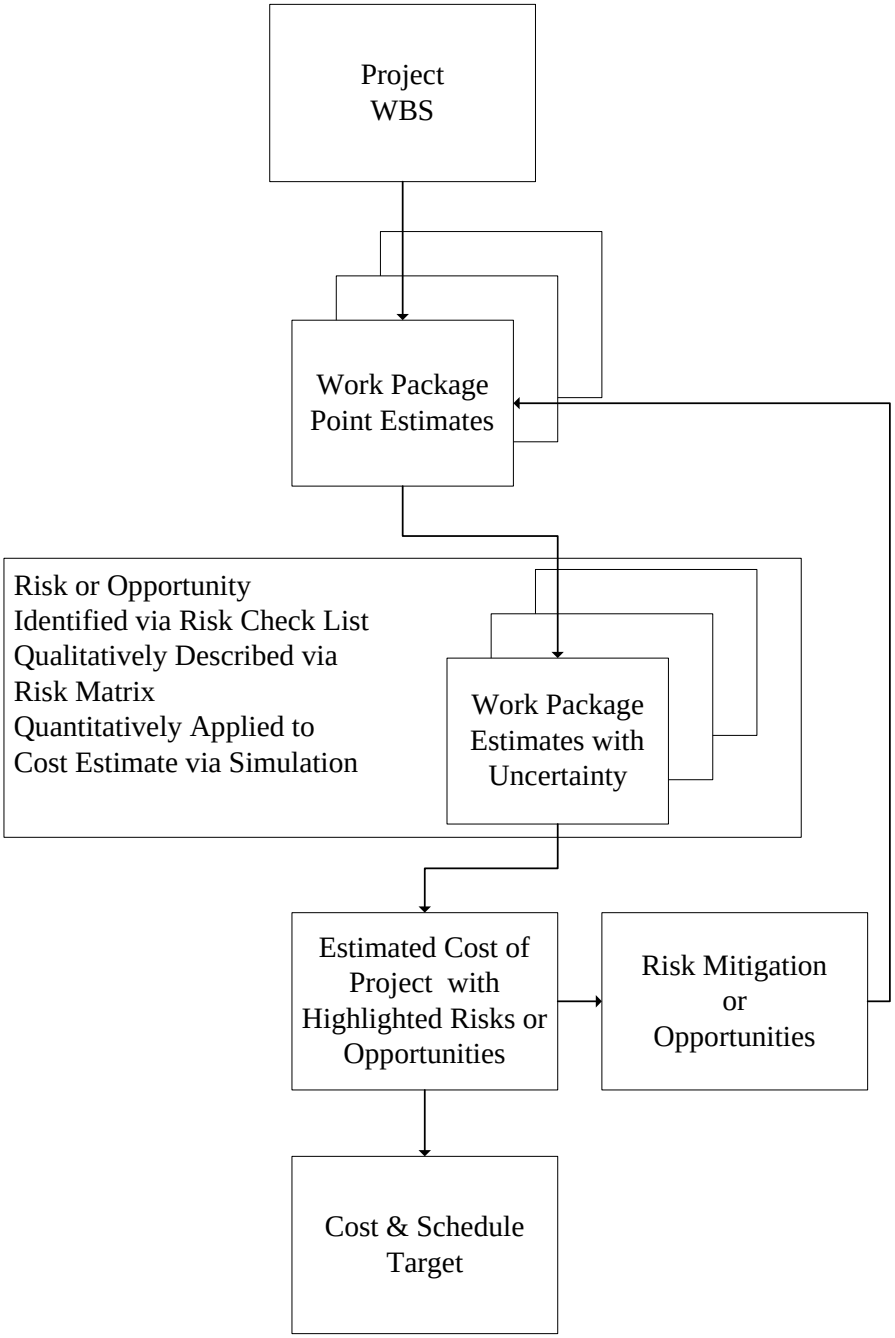

FIG 4. Cost and Schedule Risk Data and Process

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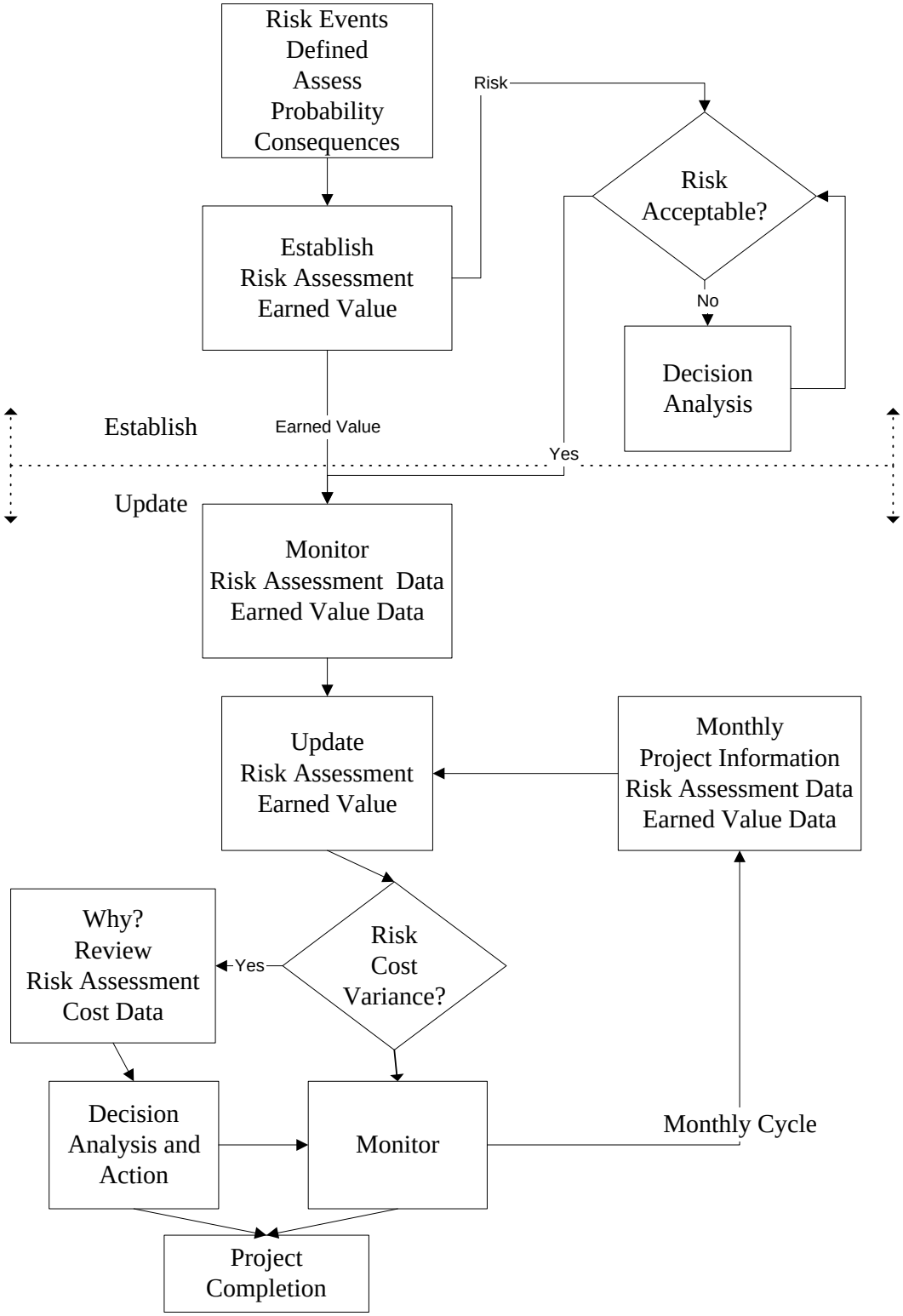

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FIG 5. Combined Risk Assessment and Earned Value Analysis

Table 1. Negative Risk Assessment Matrix Table

Likelihood level (1)	Consequence Assessment				
	I Negligible (2)	II Acceptable (3)	III Marginal (4)	IV Critical (5)	V Catastrophic (6)
A. Implausible	N	L	L	L	M
B. Unlikely	L	L	L	M	H
C. Likely	L	L	M	H	H
D. Highly Possible	L	L	M	H	H
E. Certainty	L	L	M	H	H
Risk Assessment Guide					
N = Essentially no risk, can assume risk will not occur.					
L = Low risk, minor project cost escalation.					
M = Medium risk, average project cost escalation					
H = High risk, certain or if occurs will result in significant cost escalation.					

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Optimizing the fuzzy model for land suitability evaluation by GA approach and choosing the kind of membership function

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Abstract— The land suitability analysis can be the first prerequisite in sustainable agriculture. A model was designed to determine the soil index based on fuzzy approach. The study area was parts of Abyek and Nazarabad towns in Qazvin and Alborz province of Iran, respectively. The used fuzzy inference system was Mamdani type. In this fuzzy model, the eight number of soil characteristics were selected to assess the land suitability for winter wheat production. The output of the model was the soil index as a number between zero and 100. Fuzzy rules were written using knowledge of some experts. GA approach was used as a complementation of fuzzy approach to optimize fuzzy rules of the model. The results showed that the value of determination coefficient for model after optimization was 0.952 and significant at the 1% level. The results showed the accuracy of fuzzy-GA model and the power of fuzzy method in the modeling. In the other hand, choosing the kind of membership function had a significant effect on result. So to find the best combination of membership function, a total of 24 different combinations of membership functions were tested for fuzzy sets of inputs. The best combination of membership function was triangular for the medial fuzzy sets and trapezoidal shape for the side fuzzy sets, respectively. Classification maps for soil units well prepared in the fuzzy-GA method.

Keywords— Fuzzy, GA, membership function, Soil index.

I. Introduction

Correct identification of land capabilities and assign them to the best and the most useful operating systems can be important in retaining the structure of the environment system [1]. So the crop which is the best fit for planted area should be selected for production. Land suitability analysis provides a variety of purposes in advanced agriculture. In this context, the precision farming and sustainable agriculture are considerable [2]. To reach the goals of sustainable agriculture, the crop must be produced in the region where is the best fit for it. So, the land suitability analysis can be the first prerequisite in this way [3]. Parametric method of the land evaluation expresses the land features limitations according to a numerical scale from zero to 100 as a numerical ranking [4]. Qualitative and quantitative land evaluation using limitation and parametric methods has been done by some researchers [1]-[4]-[5]-[6]. These methods are based on classical logic (zero and one).

But the effective factors on soil fertility have a continuous impact on the crop yield and use of the classical logic, leads to vague and non-reality results while the fuzzy approach can be a useful technique in this context [7]. Ref. [8] stated that the fuzzy technique is proper in applications where small and precision differences in soil quality, have a great interest such as the land suitability. In issues with uniform relative importance of characteristics in the study area, the application of fuzzy rule-based inference systems will have a specific importance [8]. Fuzzy rule-based inference system converts the complex decision-making problems to the smaller criteria and makes easier the multicriteria evaluation process. So we decided to use fuzzy approach to modeling the soil Index. Fuzzy inference process is defined by fuzzy if - then rules. The antecedent part is composed of one or more variables that are combined by "AND" and "OR" operators. The subsequent part may be composed of one or more variables [9].

Ref. [3] used the fuzzy (partial) membership classification to adapt the uncertainty in assigning the suitability classes to the pixel. The land evaluation based on fuzzy set and interpolation was done by [8] for corn and coefficient of determination got as 0.87. Two fuzzy rule base models were used to model intensive grazing based on Mamdani and

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Sugeno inference systems [10]. The results of models confirmed that these models are suitable for modeling of grazing cattle. Ref. [11] used the fuzzy logic with Boolean models for digital soil evaluation. The produced maps by fuzzy and Boolean models were similar. In a case study on seed- potatoes, the quantitative prediction errors of the original Boolean suitability map were decreased greatly by the fuzzification. Economic and environmental indicators were applied in the bio economic modeling system. Min-Max inference was used in that fuzzy system [12]. A low level implementation of Mamdani inference system was presented for massive GIS data sets [13]. Generic methodology was applied for developing fuzzy decision models by Ref. [14]. They used T - norm to calculate the membership degree and T – conorm to determine the combined degree of each rule fulfillment.

The main disadvantage of fuzzy systems is their inability to learn. So, the optimization of fuzzy systems is most important steps in designing it. Genetic algorithm (GA) is one of the best methods of optimization [15]. GA approach is a random search method in the vast and large spaces. This process based on the principles of heredity, evolution and structure of genes and chromosomes are converging towards an optimal solution [15]-[16]. Few researches have been done using GA approach in land suitability. A model based on computational intelligence (CI) was presented for land suitability evaluation [17]. This model was a fuzzy neural network (FNN) by integrating fuzzy logic and artificial neural network (ANN). Then, GA approach was employed as the learning algorithm to train the network. This model was a self-learning and self-adaptive system with a rule set revised by training. Ref. [18] evaluated the prediction ability and sensitivity of artificial intelligence-based habitat preference models for predicting spatial distribution of Japanese medaka. In other research, the effect of model formulation on the optimization of a genetic Takagi–Sugeno fuzzy system was assessed for fish habitat suitability evaluation [19].

In this paper, a fuzzy model is built based on Mamdani inference system for land suitability assessment and GA approach is used to optimize the fuzzy rules. The model can gain from full advantage of given knowledge. It can learn from samples and correct original incomplete rules. Also, different combinations of membership functions were tested for fuzzy sets to select the best combination and the highest accuracy.

II. MATERIALS AND METHODS

The study area was parts of Abyek and Nazarabad in Qazvin and Alborz province of Iran, respectively. Before conducting field studies, required data and tools prepared as follow and relevant information were used and interpreted. Aerial photographs (1:40000), geological map of the study area (1:100000 to 1:250000), digital topographic maps (1:25000) and regional (1:50000), meteorological statistics of the region and ASTER satellite images. Digital elevation model (DEM) was created from ASTER satellite images. In this study, to identify and evaluate the spectral relationships between pixels and phenomena on the ground and also between each pixel, at first the unsupervised classification was performed on the images. For identification and segregation of photomorphic units, visual interpretation of satellite images was used. Finally, using the results of unsupervised classification, features such as tone, texture, color, shape and other signs were used to establish the relationship between the pixel and the terrains of ground and photomorphic units were identified on the image. In addition, by a field survey, the geographical coordinates of points within each of the separate units was determined by manual GPS devices for preparation of real land map. The final map was used to assess the classification accuracy. The maximum likelihood method was used for this and the accuracy of the classification results was evaluated through parameters of error matrix, overall accuracy, kappa coefficient, user accuracy and precision of producer.

After supervised classification of satellite imagery and initial segmentation of land units, in order to control the boundary of units, a number of drill and profiles was excavated based on its size, type of physiographic, percentage and direction of slope and parent material within each land cover units. In this research, the numbers of 32 profiles among the surveyed points were selected for more detailed studies. In order to obtain valid soil data, the available soil survey reports were investigated. In the next step, after the field description of each profile, approximately two kilograms of disturbed soil with a number of undisturbed samples were collected from each profile and transferred to the laboratory for the physical and chemical experiments. Coordinates of the profiles and test results were entered to ArcMap ver. 10 software. Figure 1 shows the area map, the location of profiles and soil units. Notice that the order of soil profiles is differ from soil units.

A. Wheat yield and its requirements

Much land is allocated to the wheat production in Iran, so there is a more need for the assessment of productive capacity and achievement to high performance. To find out the yield of irrigated winter wheat in the study area, needed information were collected from questionnaires and interviews with farmers. In this region, some characteristics such as slope, flooding, soil depth, pH and gypsum had the little or almost constant variation. So the eight soil features include drainage, soil texture, coarse fragment percentage, calcium carbonate (lime), cation exchange capacity (CEC), organic carbon (OC), electrical conductivity (EC) and exchangeable sodium percentage (ESP) were selected for study. These characteristics considered to land suitability evaluation for

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wheat and to creation fuzzy model for soil index determination.

Soil profile explanation of sampling after recalculating by depth weighting factors (in anywhere that was necessary) according to Ref. [20] are shown in Table I for soil units (from 1 to 35). In this table, the drainage was classified to good, moderate, poor and very poor. Also, soil texture classes were set according to USDA textural class. The rest of soil characteristics were shown numerical.

B. Description of fuzzy model

Fuzzy toolbox of MATLAB software ver. 7.8.0 [21] was used to design fuzzy model. Fuzzy inference system (FIS) used in this study was Mamdani type that is based on if-then rules. Mamdani fuzzy inference method [22] is the most widely used method. Inference process of Mamdani is composed of several steps [23]: 1) Degree of membership to the proper fuzzy set is determined for each input in the fuzzification step. 2) In more than one part antecedent, the MIN (in this study) operator was applied to get one fuzzy number from the fuzzified input variables. 3) To determine the result of each rule, the consequent is reshaped with regard to the antecedent using an implication function. 4) The results of individual rules aggregated in some way (MAX operator in this study) and the result was one fuzzy set. 5) In the defuzzification stage, the center of gravity method was used to get one numerical output.

For a FIS with three inputs and each of them have five membership functions, the model will have 53 or 125 rules. If the model has more inputs, rules will rise proportionally and writing fuzzy rules using expert knowledge will be difficult and tedious. Fuzzy sets and rules were adjusted based on knowledge according to landscape and soil requirements for wheat [20]. Values of the characteristics that were very good, good, medium, bad and very bad for wheat were signed as VG, G, M, B and VB, respectively. The membership functions of Z and S shape were used for VB or VG values. At first, the membership function of the triangular shape was used for the values between them. The membership functions for output of FIS were selected triangular shape. The output of FIS makes the input values to the crisp values. It has a value between zero and 100. The output (the suitability) could be classified (S1, S2, S3, N1 and N2) or numeric (zero to 100) in the written program. For a better explanation, fuzzy sets for input and output of drainage feature are shown in Figure 2. The input of this characteristic had five fuzzy sets. The designed fuzzy model is composed of three layers. In the first layer, eight FISs were developed. Fuzzy sets had 50% overlap in all designed FIS. Eight soil characteristics were considered separately as input of each FIS in the first layer.

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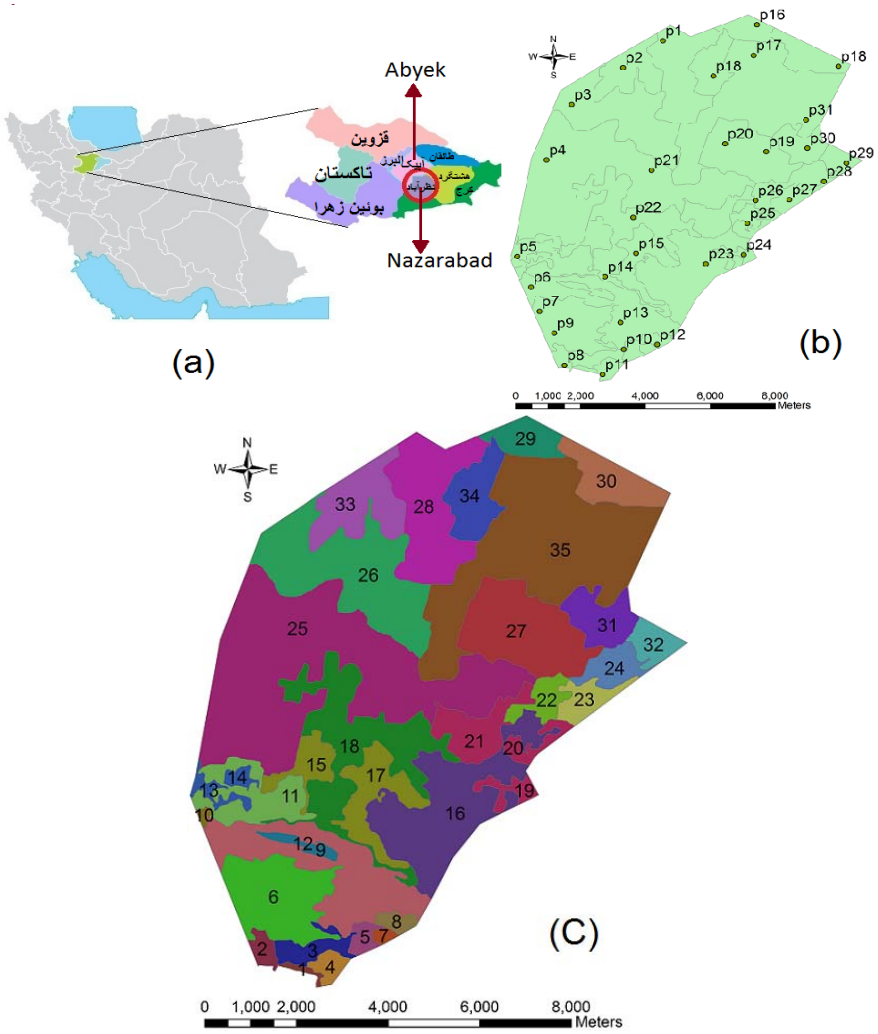

Fig. 1 The area map (a), location of profiles (b) and soil units (c)

Table I – Analytical characteristics of representative soil units for land units of the study area

unit	drainage	Texture class	Coarse fragment (%)	CaCo3 (%)	CEC (meq/100g)	OC (%)	ECe (dS/m)	ESP (%)
1	moderate	SiC	0	14.72	31.37	1.27	13.19	22.09
2	good	L	0	13.48	30.51	1.26	5.64	4.39
3	good	CL	0	15.50	30	0.67	63.83	71.79
4	moderate	SiC	0	14.72	31.37	1.27	13.19	22.09
5	good	SL	3.57	34.08	27.33	2.47	2.42	11.49
6	moderate	SCL	0	13.31	25.68	0.59	36.79	50.06
7	moderate	Si	0	15.51	24.33	0.88	13.85	25.74
8	moderate	SL	0	16.29	17.3	0.48	14.52	29.39
9	moderate	L	0.91	15.32	27.25	0.96	26.80	31.72
10	moderate	SCL	0	17.64	24.50	1.47	25	30.84
11	moderate	SL	0	21.29	19.7	1.92	27.10	28.15

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12	moderate	SiC	0	14.72	31.37	1.27	13.19	22.09
13	moderate	SL	0	21.29	19.7	1.92	27.10	28.15
14	moderate	SL	0	21.29	19.7	1.92	27.10	28.15
15	moderate	SL	0	24.98	14.73	2.02	14.31	25.04
16	poor	SL	0	38.48	27.56	0.84	7.40	43.49
17	moderate	SL	0	24.98	14.73	2.02	14.31	25.04
18	moderate	SL	0	29.83	21.89	1.15	11.39	30.71
19	good	SL	0	30.93	15.99	1.43	5.32	21.56
20	good	SL	5.36	37.62	25.39	3.15	2.95	15.94
21	good	SCL	0	41.16	30.13	2.40	2.83	14.37
22	good	CL	0	39.88	32.94	2.77	3.44	17.08
23	Very poor	C	0	50.58	34.37	1.16	3.26	30.31
24	moderate	C	0	55.33	29.05	3.71	4.27	26.14
25	good	SL	0	22.45	25.65	1.85	1.45	5.19
26	good	SCL	26.9	13.69	23.94	1.82	1.76	4.54
27	moderate	SCL	0	22.16	30.52	1.64	1.97	7.52
28	good	CL	0	26.88	23.79	0.99	1.61	3.83
29	good	L	42.61	14.12	10.42	1.89	1.11	2.55
30	good	L	20.24	18.66	16.79	1.51	1.90	5.77
31	good	CL	0	26.99	31.22	1.09	1.38	2.59
32	good	CL	10.71	19.91	21.74	2.6	1.62	5.75
33	good	SL	24.56	14.18	24.61	0.95	2.42	2.95
34	good	SL	0	30.93	15.99	1.43	5.32	21.56
35	good	Si	8.53	21.09	27.71	1.69	2.37	5.62

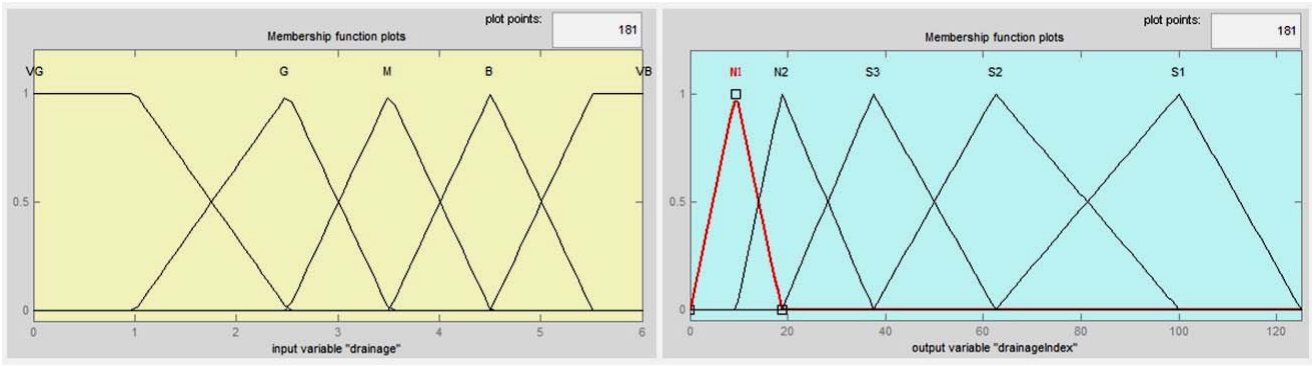

Fig. 2 Input (left) and output (right) fuzzy sets for drainage feature with 50 % overlap

To uniform the values, the output of each FIS was a number between zero and 100 after Mamdani type inference (Figure 3). So the deferent kinds of inputs were graded in the own concept in first layer.

Since every land characteristic has unique impact on production, relative impacts can be stated as weighted factors.

The outputs of first layer were not comparable because they were different. Weighted coefficient of importance for each characteristic must multiply to it to compare them to each

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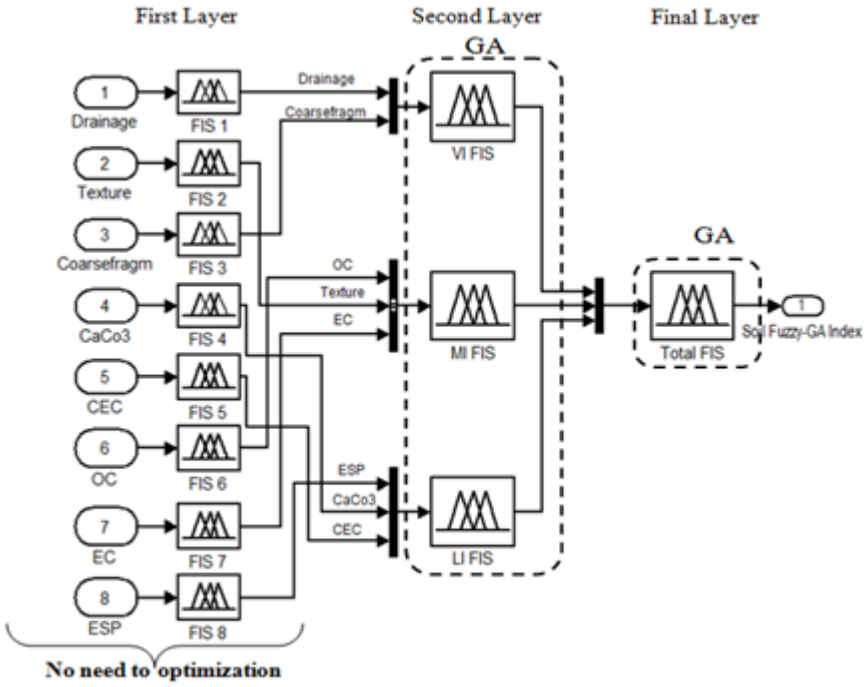

other, but these coefficients are unknown. Another way is that the characteristics are compared with each other based on fuzzy rules according to the expert's knowledge. Then an index is imputed to the soil through the compared characteristics. But this procedure is possible when the importance of soil characteristics is similar or near together. So this procedure was performed in the second layer. In second layer, the weights of soil characteristics were calculated using analytic hierarchy process (AHP) [24] and the intensity of their importance ranked from one to eight. Paired comparisons matrix of land characteristics and final weights are shown in Table II. Consistency index (CI) of paired comparisons was calculated and consistency ratio was got smaller than one (CR=0.0738). It was found that there was acceptable and reasonable consistency between the paired comparisons.

Table II - Paired comparisons Matrix for eight soil characteristics and final weights of them

Characteristics	Drainage	Texture	Coarse fragment	CaCo3	CEC	OC	EC	ESP	W
Drainage	1	4	3	6	7	4	4.5	6	0.337
Texture	0.25	1	0.5	6	7	0.333	2	4	0.129
Coarse fragment	0.333	2	1	5	7	3	3	4	0.195
CaCo3	0.1666	0.1666	0.2	1	3	0.25	0.25	0.333	0.035
CEC	0.143	0.143	0.143	0.333	1	0.1666	0.2	0.24	0.021
OC	0.25	3	0.333	4	6	1	2	3	0.139
EC	0.222	0.5	0.333	4	5	0.5	1	2	0.084
ESP	0.1666	0.25	0.25	3	4	0.333	0.5	1	0.056

CEC: cation exchange capacity, OC: organic carbon, EC: electrical conductivity, ESP: exchangeable sodium percent.

Soil characteristics were grouped into 3 categories of very important (VI), moderately important (MI), and less important (LI). One FIS was designed for each category. The fuzzy rules were adjusted based on the landscape and soil requirements for wheat according to Ref. [20]. Two characteristics of the drainage and coarse fragments with maximum final weights were considered as inputs of VI FIS. Three characteristics of organic carbon, texture and EC with fewer weights than before were identified as inputs of MI FIS. Finally, ESP, CaCo3 and CEC which had the lowest final weights were considered as inputs LI FIS (Figure 3).

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The output of these FISs will also be a number between zero and 100. The outputs of second layer that are the outputs of VI, MI, and LI FISs were considered as inputs of final FIS. So the final layer was composed of one FIS. The output of this FIS formed the soil index as a number between zero and 100. The result was little poor and need to optimize the fuzzy rules.

A. Optimization of fuzzy rules using GA

GA approach was used as a complementation of fuzzy model to optimize fuzzy rules. The rules of FISs in first layer did not need to optimize. But the rules of FISs (VI FIS, MI FIS, LI FIS and Total FIS) in second and third layers were optimized (Figure 3).These FISs are shown with dash drawn around them. The method of Pittsburgh was used to optimize the fuzzy rules for all FISs. In this method, one gene uses for every rule and the gene value finds out the rule. The FIS with two inputs (VI FIS and Total FIS) and five fuzzy sets have 25 rules, so the chromosome of GA was composed of 25 genes. Similarly, the chromosome of GA for the FISs with three inputs (MI FIS, LI FIS and Total FIS) and five fuzzy sets with 125 rules was composed of 125 genes.

The error was used as the fitness value. Some options of optimization tool in MATLAB software (9.2) were adjusted such as population size, creation function, fitness scaling function, selection function, mutation function and crossover function. Chromosomes were arranged based on the fitness function as descending order. Two criteria to stop optimization were 1: the convergence of algorithm or no change in the best chromosome for predefined generation numbers and 2: completion of predefined generation numbers. As mentioned, the final output of model is soil index that shows the suitability of soil. The index of 75 – 100, 50- 75, 25- 50, 12.5- 25 and 0- 12.5 indicates a very suitable (S_1), suitable (S_2), moderate (S_3), unsuitable in current conditions (N_1) and unsuitable in the foreseeable future (N_2) soil according to FAO.

B. The effect of fuzzy membership function on model result

The kind of membership function will have a great impact on result. The kinds of membership function involve triangular, trapezoidal, generalized bell, Gaussian, Gaussian combination, Sigmoidal, product of two sigmoidal, difference between two sigmoidal, Π, Z and S shapes. A program was written in MATLAB software to get the best combination of membership functions for achieving the best result. This program tested the 24 kinds of combined membership functions for medial and side fuzzy sets of input variables. The best result is when the obtained index and yield has the highest value of the correlation coefficient (R^2), minimum value of mean square error (MSE) and mean absolute error (MAE). So the fuzzy-GA model gives the soil index that its fuzzy rules have been optimized and the best combination of membership functions has been selected.

III. RESULTS AND DISCUSSION

Good results were got from optimization of fuzzy rules. Table III shows some statistical parameters calculated for the relationship between soil index and wheat yield in fuzzy- GA method.

Table III - Statistical parameters got after optimization

Statistical parameters	MSE	MAE	R^2	p
VI FIS	434.00	16.81	0.25	$1.21e^{-19}$
MI FIS	89.70	6.92	0.856	$1.65e^{-15}$
LI FIS	94.73	8.10	0.850	$3.77e^{-15}$
Total FIS	30.50	4.38	0.952	$7.28e^{-23}$

In Table 3, the value of R^2 for VI FIS was got 0.25 and the p value showed the significant at the 1% level. The reason of low R^2 in VI FIS can be explained that those characteristics (drainage and coarse fragment) had great importance for crop yield from an expert vision, but their changes were almost constant and there was no clear relationship with observed yield in the region. The value of R^2 for MI FIS and LI FIS were 0.86 and 0.85, respectively. The R^2 values of MI and LI FISs has risen. The reason is that these characteristics (OC, texture, EC, ESP, CaCo3 and CEC) had less importance for crop yield from an expert vision, but they had changes having a significant impact on yield. So their relationship with yield had higher R^2. The R^2 for Total FIS was got 0.952 which was significant at the 1% level.

Figure 4 shows the error of fitness function decreases with rising generation numbers for Total FIS until the best answer obtained. Figure 5 shows the relationship between soil index and yield of irrigated wheat in the region. In this chart, the R^2 value for fuzzy-GA model is 0.952. It can be concluded that the accuracy of optimized fuzzy model by GA is considerable.

After optimization of fuzzy rules, a total of 24 different combinations of membership functions were tested for the inputs fuzzy sets to get the best combination. The lowest R^2 for relationship between got index and yield was belonging to sigmf- dsigmf combination of membership functions for medial and side fuzzy sets, respectively. The lowest MSE (31.3) and the highest R^2 (0.952) belongs to a FIS with membership functions of triangular and trapezoidal shape (trimf-trapmf) for the medial and side fuzzy sets, respectively.

Figure 6 shows the classified map of soil units in fuzzy- GA model after optimization of fuzzy rules and amounts of observed yield in terms of ton per hectare in classified units. In this Figure, in soil units having lower classes and so low yields, EC and ESP were limiting factors. However, in units with appropriate range of EC, ESP and others, the high value of $CaCo_3$ was limiting factor. Finally, the soil units have been classified to S1, S2, S3, N1 and N2 categories indicated the soil as suitable, rather suitable, moderate, unsuitable in current conditions and unsuitable in the foreseeable future, respectively. The accuracy of relationship between soil index

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and wheat yield was considerable in fuzzy- GA model with optimized fuzzy rules. Application of GA approach as the learning algorithm to train the model is so useful whereas it made training the model efficient according to Ref. [17] results. In fuzzy- GA model assigned classes to soil units had more matching with crop yield. According to classification maps, the aim of proper model is not to raise suitable and to less inappropriate soil unit numbers; but the goal is to create a realistic model to make capital not be wasted.

IV. CONCLUSIONS

With regard to correct identification importance for land capabilities in sustainable agriculture, a fuzzy model was developed to land suitability assessment in the study area.

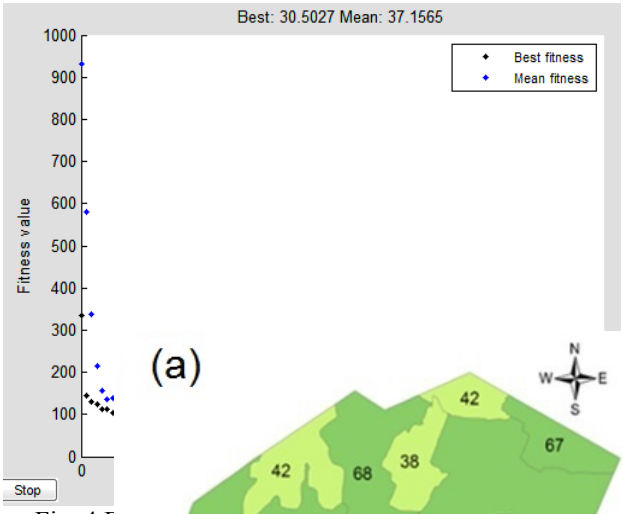

Fig. 4 F

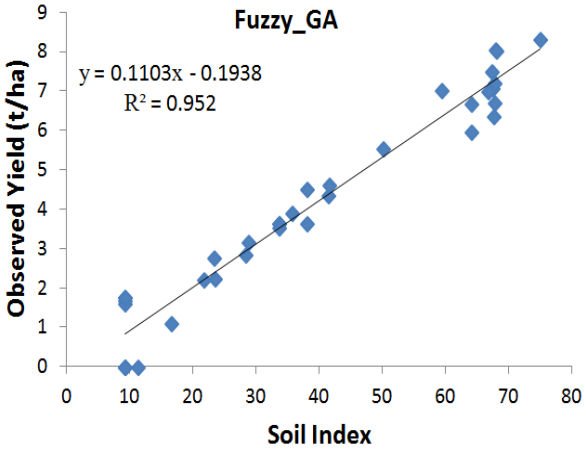

Fig. 5 Relationship between soil index and yield in the fuzzy - GA model

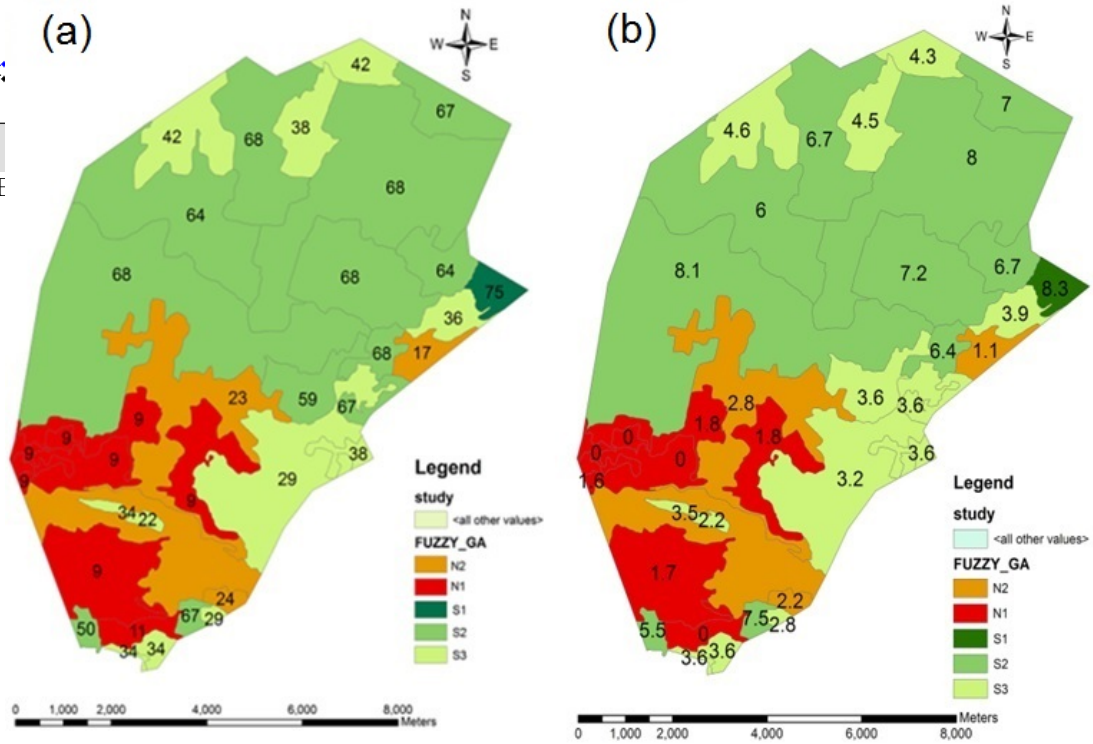

Fig. 6 The classified map of soil units based on soil index in Fuzzy-GA method with best fuzzy rules (a) and observed yield (ton ha^{-1}) in classified units (b)

The fuzzy rules of model were optimized by GA approach to correct written rules and improve the accuracy of model. The accuracy of the relationship between soil index and yield of after optimization of fuzzy rules showed the strength of fuzzy logic and proved the usefulness of this method in modeling of such issues. In other hand, application of GA was

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improved the results. The kind of membership function had a great impact on result. The best combination of membership functions was found. Finally, soil units were classified to five classes based on soil index obtained from optimized model. Application of GA approach as the learning algorithm to train the model was so useful whereas it made training the model efficient.

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REFERENCES

[1] H. Rahimi Lake, R. Taghizadeh Mehrjardi, A. Akbarzadeh, and H. Ramezanpour, "Qualitative and quantitive alnd suitability for Olive (Olea europaea L.) production in Roodbar region, Iran," *Medwell*, vol. 4(2), pp. 52-62, 2009.

[2] T. N. Prakash, "Land suitability analysis for agricultural crops: a fuzzy multicriteria decision making approach," *International Institute for Geo-information Science and Earth Observation,* India, 2003.

[3] T. R. Nisar Ahamed, K. R. Gopal, and J. S. Murthy, "GIS-based fuzzy membership model for crop- land suitability analysis," *Agricultural Systems*, vol. 63, pp. 75-95, 2000.

[4] A. A. Jafarzadeh, P. Alamdari, M. R. Neyshabouri, and S. Saedi, "Land suitability evaluation of Bilverdy research station for wheat, barley, alfalfa and safflower," *Soil and Water Research*, vol. 3, pp. S81-S88, 2008.

[5] M. Behzad, M. Albaji, P. Papan, and S. B. Nasab, "Evan region qualitative soil evaluation for wheat, barley, alfalfa and maize," *Journal of Food Agriculture and Environment*, vol. 7(2), pp. 843-851, 2009.

[6] A. A. Naseri, M. Albaji, S. B. Nasab, A. Landi, P. Papan, and A. Bavi, "Land suitability evaluation for principal crops in the Abbas Plain, Southwest Iran," *Joural of Food Agriculture and Environment*, vol. 7(1), pp. 208-213, 2009.

[7] O. Kremenov, "Fuzzy Modeling of Soil Maps," *Helsinki University of Technology, Department of Surveying*. Pp. 81, 2004.

[8] A. K. Braimoh, P. L. Vlek, and A. Stein, "Land evaluation for maize based in fuzzy set and interpolation," *Environmental Management* , vol. 33(2), pp. 226-238, 2004.

[9] T. V. Reshmidevi, T. I. Eldho, and R. Jana, "A GIS-integration fuzzy rule-based inference system for land suitability evaluation in agricultural watersheds," *Agricultural Systems*, vol. 101, pp. 101-109, 2009.

[10] A. Salski, and B. Holsten, "A fuzzy and neuro-fuzzy approach to modelling cattle grazing on pastures with low stocking rates in Central Europe," *Ecological Informatics*, vol. 1, pp. 269 – 276, 2006.

[11] J. J. d. Gruijter, D. J. J. Walvoort, and G. Bragato, "Application of fuzzy logic to Boolean models for digital soil assessment," *Geoderma*, vol. 166,pp. 15–33, 2011.

[12] C. Sattler, U. J. Nagel, A. Werner, and P. Zander, "Integrated assessment of agricultural production practices to enhance sustainable development in agricultural landscapes," *Ecological Indicators,* vol. 10, pp. 49–61, 2010.

[13] J. Jasiewicz, "A new GRASS GIS fuzzy inference system for massive data analysis," *Computers and Geosciences*, vol. 37, pp. 1525–1531, 2011.

[14] R. Bosma, J. D. V. Berg, U. Kaymak, H. Udo, and J. Verreth, "A generic methodology for developing fuzzy decision models," *Expert Systems with Applications*, vol. 39, pp. 1200–1210, 2012.

[15] O. Cordon, F. Herrera, F. Hoffmann, and L. Magdalena, "Genetic Fuzzy Systems: Evolutionary Tuning and Learning of Fuzzy Knowledge Base," *Advances in Fuzzy System-Applications and Theory*, vol. 19, pp. 89-93, 97, 179-183, 2002.

[16] D. Goldberg, "Genetic Algorithms in Search, Optimization, and Machine Learning," *Addison-Wesley*, 1989.

[17] L. Jiao, and Y. Liu, "Model of land suitability evaluation based on computational intelligence," *Geo-spatial Information Science*, vol. 10(2), pp. 151-156, 2007.

[18] S. Fukuda, and K. Hiramatsu, "Prediction ability and sensitivity of artificial intelligence-based habitat preference models for predicting spatial distribution of Japanese medaka (Oryzias latipes)," *Ecological Modelling, vol.* 215(4), pp. 301-313, 2008.

[19] S. Fukuda, B. De Baets, A. M. Mouton, W. Waegeman, J. Nakajima, T. Mukai, K. Hiramatsu, and N. Onikura, "Effect of model formulation on the optimization of a genetic Takagie-Sugeno fuzzy system for fish habitat suitability evaluation," *Ecological Modelling*, vol. 222(8), pp. 1401-1413, 2011.

[20] C. Sys, "Land evaluation, part I,II, III. ITC," *University of Ghent*, Belgium, pp. 343, 1985.

[21] MATLAB, "The Mathworks Inc, Fuzzy TOOLBOX," MATLAB Software, 2009.

[22] E. H. Mamdani, and S. Assilian, "An experiment in linguistic synthesis with a fuzzy logic controller," *International Journal of Man-Machine Studies*, vol. 7, pp. 1–13, 1975.

[23] M. H. Vahidnia, A. A. Alesheikh, A. Alimohammadi, and F. Hosseinali, "A GIS-based neuro-fuzzy procedure for integrating knowledge and data in landslide susceptibility mapping," *Computers and Geosciences*, vol. 36, pp. 1101–1114, 2010.

[24] T. L. Saaty, "The Analytic Hierarchy Process," *McGraw-Hill International*, New York,1980.

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"Tillage depth and forward speed effects on draft of three primary tillage implements in clay loam soil," *Journal of Food, Agriculture & Environment*, vol. 7(3&4), pp. 382- 385, 2009.

"Application of ANFIS to predict crop yield based on different energy inputs," *Measurement*, vol. 45, pp. 1406–1413, 2012.

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