# Ecological roles of anammox bacteria

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*Abstract*-Types of bacteria such as anammox bacteria obtain their energy for growth from the anaerobic oxidation of ammonium with nitrite to dinitrogen gas.Because of thisfeaturehas made anammox bacteria very valuable for industry where they are applied for the removal of nitrogen compounds from industrial and domestic wastewaters.Anammox bacteria are also important in nature where they contribute significantly to oceanic nitrogen loss. Further, anammox bacteria have similarities to both Archaea and Eukarya, making them extremely interesting from a cell biological perspective. The anammox cell does not conform to the typical prokaryotic cell plan: single bilayer membranes divide the anammox cell into three distinct cellular compartments that possibly also have distinct cellular functions. The innermost and largest compartment, the anammoxosome, is the location of the energy metabolism. The middle compartment, the riboplasm, contains the nucleoid and ribosomes and thus has a genetic,information processing function. Finally, the outer most compartment, the paryphoplasm, has an as yet unknown function.

*Keywords*-Anammox bacteria; Anaerobic; ammonium oxidation Anammoxosome;Cellcompartmentalization

## I. Introduction

The existence of microbes that were able to perform anaerobic ammonium oxidation (anammox), with nitrate or nitrite, to dinitrogen gas was already proposed many years ago based on theoretical calculations and anomalies in nitrogen balances (Hammand Thompson 1941; Richards 1965; Broda 1977). However, it took until the 1990s before their existence was verified and the bacteria were enriched and identified to belong to the phylum of the Planctomycetes (van de Graaf et al. 1995; Strous et al. 1999).Anammox bacteria form a distinct, deep branchingphylogenetic group within the phylumPlanctomycetes and a separate order, ''CandidatusBrocadiales'', and family, ''CandidatusBrocadiaceae'' (Jetten et al.2010). This family consists exclusively of anammoxbacteria and encompasses all known genera capable of anaerobic ammonium oxidation. To date, five different genera have been described: ''CandidatusBrocadia'' (Strous et al. 1999; Kartal et al. 2008).

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CandidatusKuenenia'' (Schmid et al. 2001), ''CandidatusScalindua'' (Kuypers et al. 2003; Schmidet al.2003; Woebken et al. 2008; van de Vossenberg et al.2008, 2012), ''CandidatusAnammoxoglobus'' (Kartalet al. 2007), and ''CandidatusJettenia'' (Quan et al.2008; Hu et al. 2012b). The divergence between thefive different anammox genera is relatively large andthe sequence identity on 16S rRNA gene level rangesfrom 87 to 99 % (Jetten et al. 2010). Scalindua isusually found in marine environments but has alsobeen shown to occur in estuarine systems and freshwater lakes and rivers (Risgaard-Petersen et al. 2004;Schubert et al. 2006; Zhang et al. 2007; Rich et al.2008). The other genera thrive in man-made ecosystems, such as wastewater treatment facilities, but havealso been detected in soil and natural aquatic systems(Penton et al. 2006; Clark et al. 2008; Hirsch et al.2011; Hu et al. 2011; Li et al. 2011; Yoshinaga et al.2011; Hu et al. 2012a).

The anammox activity in the Ocean's oxygenminimum zones contributes to a large extent to theglobal nitrogen cycle. Studies in different oxygenminimum zones around the world indicated thatanammox bacteria are the key players responsiblefor the nitrogen loss from these systems (Jettenet al.2009; Lam and Kuypers 2011). As such, anammoxbacteria would have a major impact not only on theoceanic nitrogen cycle, but also on the nitrogen cycleon a global scale.

Anammox has alsoemerged as a cost-effectiveand environment-friendly technology to removeammonia and nitrite from both industrial and domesticwastewaters. Wastewater treatment facilities havebeen faced with more stringent emission standardsfor nitrogen and the anammox reaction has emerged asan attractive alternative toconventional nitrogenremoval (through nitrification and denitrification processes) from wastewater (Kartal et al. 2010). The first75 m3anammox wastewater treatment plant has beenoperating in Rotterdam (The Netherlands) since 2002and is used to remove nitrogen from concentratedsludge reject water. Currently there are at least 11 fullscale anammox wastewater treatment plants in TheNetherlands and China treating sewage, food ingredients processing, yeast, tannery, and potato processingwastewater.

Due to their long generation time, 1–2 weeksdepending on the growth conditions (Kartal et al.2011a), anammox bacteria are

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grown in bioreactorswhich contain 74 % [aggregated cells in a sequencingbatch reactor (Strous et al. 1998)] or 95 % [planktoniccells in a membrane bioreactor (van der Star et al.2008)] anammox bacteria.

Anammox bacteria are not only interesting from anecological and applied point of view but also for theirunusual metabolism and cell biology. Anammoxbacteria convert ammonium and nitrite to dinitrogengas with nitric oxide and hydrazine as intermediates.Like all other Planctomycetes (Lindsay et al. 2001),the cells of anammox bacteria are compartmentalizedby individual bilayermembranes and proposed to havean archaeal-like cell wall devoid of both peptidoglycan and a typical outer membrane. In the case ofanammox bacteria, the cells are divided into threecompartments (Fig. 1) by three membranes. Theoutermost membrane encloses the paryphoplasmcompartment which has a yet unknown function.The middle membrane encloses the riboplasm compartment which contains the ribosomes and nucleoid.Finally, the innermost membrane encloses the largestcompartment of the cell, the anammoxosome, which isthe location of the energy metabolism. All threeanammox membranes are single lipid bilayer membranes, which are enriched in lipids that are unique foranammox bacteria. The lipids are called ladderanelipids, owing their name to the ladder-like arrangement of cyclobutane rings in thehydrocarbon tails ofthe lipids that are ester or ether bound to the glycerolunit (Boumann et al. 2006; Rattray et al. 2008). Theladderane lipids contain three or five linearlyconcatenated cyclobutane rings and are unique in nature; sofar they have only been found in anammoxbacteria(SinningheDamste ´ et al. 2002, 2004; Boumann et al.2006). Molecular modeling suggests that the ladderanes confer a low degree of rotational freedom to themembrane and limit its permeability (SinningheDamste ´ et al. 2002; Boumann et al. 2009).

 Thelimitation of passive diffusion of protons, and thus theloss of the proton motive force and subsequent ATPsynthesis, could be very important for anammoxbacteria due to their very slow growth speed. Inaddition, the excessive diffusion of (toxic) intermediates of the anammox reaction, e.g. nitric oxide andhydrazine, would further exacerbate the loss of energyand thus has to be limited as much as possible(van Niftrik et al. 2004).

## II.    Structure of anammox bacteria

### 2.1.The cell wall

The cell wall of anammox bacteria has been proposedto be devoid of both peptidoglycan and an outermembrane (Jetten et al 2003). In this way, thestructural cell wall type of anammox bacteria wouldbe neither Gram-positive nor Gram-negative, as isproposed for all Planctomycetes (Ko ¨nig et al.

1984).However, the cell wall composition of anammoxbacteria still needs to be determined experimentally.

Interestingly, the metagenome of the anammoxbacterium K. stuttgartiensisharbors 19 of the 21 genesneeded for the biosynthesis of peptidoglycan (Strouset al. 2006; Neumann et al. 2013). All essential genesare present, except those encoding the penicillinbinding proteins (PBP) 1a and 1b. These proteins arerequired for the insertion of peptidoglycan precursorsinto polymeric peptidoglycan (Ghuysen 1997). Inaddition, none of the peptidoglycan synthesis genesare detected in the K. stuttgartiensismetaproteomeexcept for the protein D-alanine–D-alanine ligase (Ddl)that produces the peptidoglycan precursor D-alanine-D-alanine (Kartal et al. 2011b). In conclusion, genetically K. stuttgartiensis could produce a glycan-lesspolypeptide to substitute for the canonical peptidoglycan polymer, but so far there are no indications thatthis is indeed the case and needs further investigation.
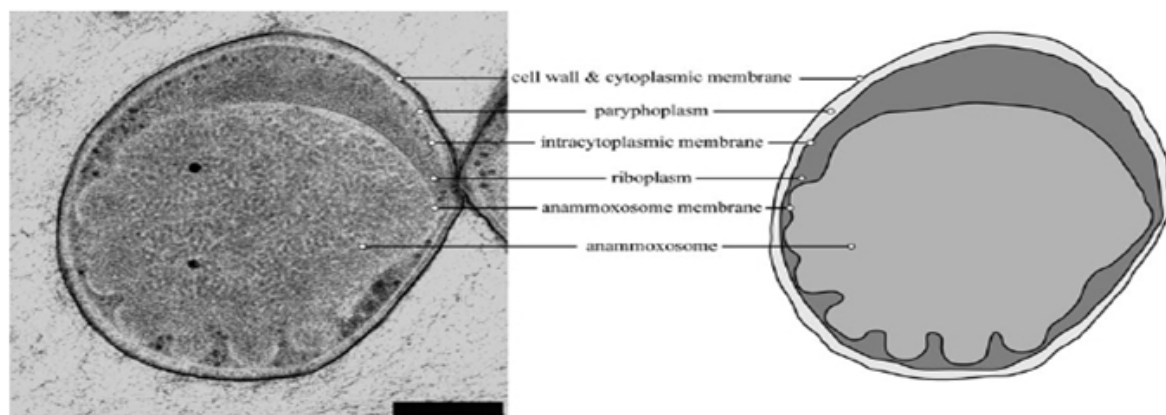
Fig. 1 Transmission electron micrograph and schematic drawing of the cell plan of anammox bacteria. Scale bar 200 nm

Like in all other Planctomycetes, the outermostmembrane of anammox bacteria has been defined asthe cytoplasmic membrane. This is based on theimmunogold localization of RNA inside the paryphoplasm (Lindsay et al. 1997, 2001) indicating that theparyphoplasm is part of the cell; i.e. cytoplasm.However, it is uncertain which type of RNA wasdetected and in view of the relatively small size of theanammoxparyphoplasm compartment and the lengthof the antibody-target complex whether RNA wasdetected in the paryphoplasm or riboplasm. In additionto the RNA localization, the immunogold localizationof an F-type ATPase to the outermost membrane of theanammox cell (van Niftrik et al. 2010) suggests theability of gradients (e.g. proton motive force) to existover this membrane and also supports its identificationas a cytoplasmatic membrane. Nevertheless, themetagenome (Strous et al. 2006)of K. Stuttgartiensisencodes proteins typical of the periplasm and outermembrane of Gram-negative bacteria. Several porinhomologs can be found (van Niftrik et al. 2010), ofwhich a few are also expressed in the metaproteome(Kartal et al. 2011b; Speth et al. 2012). A completeTonB system, including five outer membrane receptors, is encoded (van Niftrik et al. 2010) but notexpressed in the metaproteome (Kartal et al. 2011b).Finally, both the metagenome and the metaproteomeshow the presence of a number of typical Gramnegative multidrug exporters (Kartal et al. 2011b).Immunogold localization of these genes and theirproteins reminiscent of a typical Gram-negative outermembrane could indicate whether these are reallyfunctionally expressed and, if so, where they arelocated. At the moment, the identity of the outermostmembrane of anammox bacteria remains under debateand investigation.

**2.2.TheParyphoplasm**

The paryphoplasm forms the outermost compartmentof the anammox cell, makes up on average 20 %of thetotal cell volume and has an unknown function. Theidentity of the paryphoplasm as either periplasmic orcytoplasmic depends on whichmembrane is defined asthe cytoplasmic membrane. As explained above, theoutermost anammox membrane has been defined asthe cytoplasmic membrane. So at the moment, weconsider the paryphoplasm of anammox bacteria as acytoplasmic compartment. In transmission electronmicrographs of anammox bacteria, the paryphoplasmappears as the most electron-light compartment(Fig. 1), which suggests a relatively low density ofmaterial in this compartment. The paryphoplasm ispresumed to contain some RNA (Lindsay et al. 2001),but ribosomes and DNA are absent. Even though thecontents of the paryphoplasm are unknown, onestructure can be clearly observed in the paryphoplasmof dividing anammox cells: the cell division ring(Fig. 2a). The cell division ring can be seen as anelectron-dense, bracket-shaped structure (van Niftriket al. 2009). Anammox bacteria divide by binaryfission (van Niftrik et al. 2009), unlike other Planctomycetes which divide by budding. The canonical celldivision ring protein FtsZ (Margolin 2005) is notpresent in the metagenome of K.

stuttgartiensis (vanNiftrik et al. 2009). Instead, the cell division ring inanammox bacteria might consist of the proteinencoded by the K. stuttgartiensis gene kustd1438.Immunogold labeling showed that this protein waslocated at the cell division ring in K. stuttgartiensis(van Niftrik et al. 2009) and might thus be the ringitself or a protein associated with it. The furthercomposition of the cell division ring or divisomecomplex in anammox bacteria is unknown, but itseems plausible that more proteins are involved, as isthe case in the FtsZ-based cell division ring. Inconclusion, besides the cell division ring, the contentsand function of the paryphoplasm compartmentremain unknown and await further research.

## 2.3.TheRiboplasm

The riboplasm forms the middle compartment of theanammox cell and takes up on average 20 % of thetotal cell volume. The riboplasm is the site of DNAmetabolism and protein synthesis and contains theribosomes, the DNA and the great majority of RNA(Lindsay et al. 2001).

In anammox bacteria, the building blocks for proteinsynthesis are derived from carbon dioxide via autotrophic carbon fixation. The carbon fixation mayproceed via the acetyl-CoA (Wood–Ljungdahl) pathway as is suggested from the metagenome of K.stuttgartiensis (Strous et al. 2006). The Wood–Ljung-dahl pathway for the reduction of carbondioxidedepends on electrons with a high reducing power (lowredox-potential; i.e. ferredoxins). These could bederived from the oxidation of the high energy-containing compoundhydrazine,which is an intermediate in thecatabolismof the anammox bacteria (Kartal et al. 2013).

Excess assimilated carbon is stored as glycogen,branched poly-glucose, granules (Fig. 2b) inside theriboplasm (van Niftrik et al. 2008a). Glycogen isformed when carbon is present in excess, but anothernutrient, i.e. ammonium, phosphate, sulfur or aminoacids, is depleted. Under stress conditions, glycogen isthen degraded again to supply the cell with carbon andenergy needed for survival (Preiss1984).

Ribosomes are found only in the riboplasm of theanammox cell. Therefore, newly synthesized proteinshave to betransported to the other cell compartments,i.e. theanammoxosome and paryphoplasm. Anammoxbacteria possess both the ubiquitous general secretory(Sec) pathway and the twin arginine translocation(TAT) system (Strous et al. 2006). The prokaryoticsecretion systems type I–V are absent. The TATsystem was predicted in silico to be located exclusively on the anammoxosome membrane (Medemaet al. 2010), the cell compartment associated with theenergy metabolism of the cell. The Sec pathway isthought tofacilitate transport to all cell compartmentsin anammox bacteria. However, how anammoxbacteria are capable of specifically

transporting proteins from the riboplasm to either the paryphoplasm oranammoxosome remains unclear. No specific signalpeptides could be detected for different compartmentsand it is hypothesized that protein sorting might beachieved through both the Sec (both paryphoplasmand anammoxosome) and TAT (anammoxosome)systems with additional chaperones to achieve specificity and facilitate separate translocation routes(Medema et al. 2010).
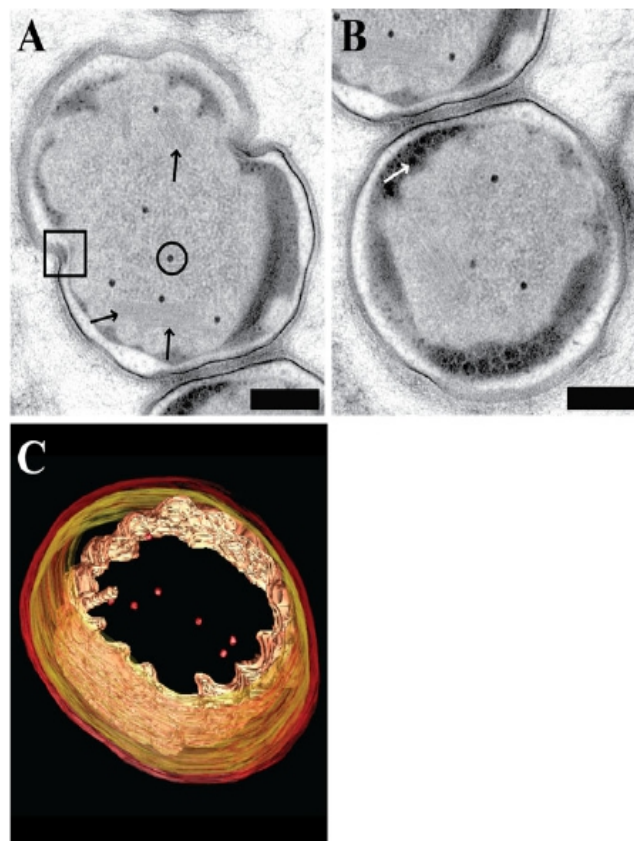


Fig. 2 Transmission electron micrographs of anammox bacteria.a High-pressure frozen, freeze-
substituted and Eponembedded K. stuttgartiensis cell going through cell division.Square the cell division ring, circle iron particle, black arrowstub ule-like structures. b High pressure frozen,freeze-substi-tuted and Epon-embedded K. stuttgartiensis cell showing
storage (white arrow). c Snapshot of K. stuttgartiensiselectron tomographymo del showing the three anammox cellcompartments, the curved anammoxoso me membrane and ironparticles. From out-
to inside cell wall, outermost and middlemembrane (semi-
transparent), curvedanammoxosome membrane and iron particles. Scale bars 200 nm

## 2.4.Theanammoxosome

The anammoxosome is the innermost and largestcompartment of the anammox cell. It takes up onaverage 60 % of the cell volume, has a highly curvedmembrane and contains conspicuous iron particles andtubule-like structures. It is the location where theenergy metabolism of the anammox cell takes placeand probably conserves energy by use of aprotonmotive force across the anammoxosome membrane.
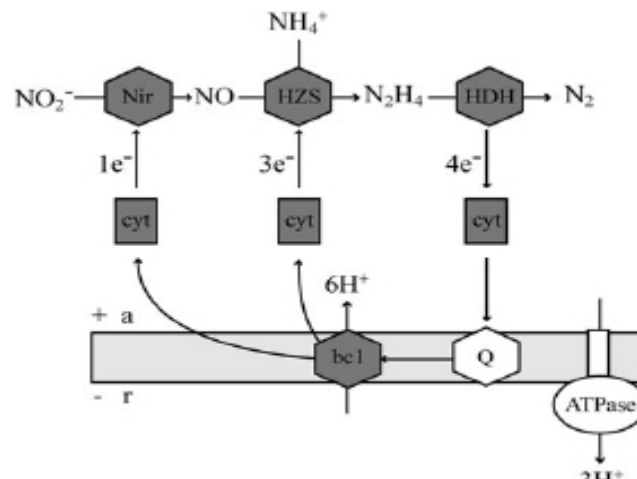
The extensive folding of the anammoxosomemembrane (Figs. 1 and 2) (van Niftrik et al. 2008b)is thought to be connected to the central role theanammoxosome plays in the energy metabolism of thecell. The curvature enlarges the surface area of theanammoxosome membrane available for metabolicenzymes and could thus enhance the metabolic rate ofthe bacteria.

The anammoxosome contains tubule-like structures (Fig. 2a) whose composition and function hasnot yet been elucidated (Fuerst 2005; van Niftriket al.2008b). However, there are several hypotheses. Thetubule-like structures could be cytoskeletal elements,theymight function inmaintaining the curvature of theanammoxosome membrane and/or play a role in thedivision of the anammoxosome. On the other hand, thetubule-like structures could also be a highly abundantmetabolic protein, i.e. a key enzyme of the anammoxreaction, that assembles into a higher order structure.

Next to the tubule-like structures, the anammoxosome contains electron-dense particles 16–25 nm indiameter (Fig. 2a, c). Energy dispersive X-ray analysis has shown that these particles are enriched in ironand could thus bebacterioferritins, i.e. iron-storageparticles (van Niftrik et al. 2008b). The iron particlescould serve as a reservoir for the multitude of heme-containing proteins that participate in the anammoxreaction and are located inside the anammoxosome, orperhaps constitute a pool of alternative electronacceptor for anammox bacteria, which are capable ofiron respiration (Strous et al. 2006).

The anammoxosomeharbors the energy metabolism of the anammox cell and is therefore analogous infunction to the mitochondria of Eukaryotes. It is thefirst and only energy-conserving cell compartment inprokaryotes that has been discovered to date. Anammox bacteria derive the energy for growth from theanaerobic oxidation of ammonium, with nitrite aselectron acceptor, to dinitrogen gas. The conversion ofthe substrates can be split into three separate reactions(Fig. 3): the reduction of nitrite to nitric oxide, thecondensation of nitric oxide and ammonium tohydrazine and the oxidation of hydrazine to dinitrogengas (Kartal et al. 2011b). The oxidation of hydrazinereleases four electrons that are proposed to betransferred to a membrane-bound cytochrome bc1complex (de Almeida et al. 2011; Kartal et al. 2012).Via cytochrome c-

type proteins as intermediate electron carriers, one electron is then shuttled to thereduction of nitrite and three electrons to the synthesisof hydrazine. The electron transport could facilitatethe translocation of protons by the bc1 complex acrossthe anammoxosome membrane resulting in a protonmotive force. This proton motive force could then beused by membrane-bound ATPases to produce ATP.



**Figur 3**Model for anammox energy metabolism. The process of anaerobic ammonium oxidation is coupled to the anammoxo-some membrane resulting in a proton motive force and subsequent ATP synthesis in anammox bacteria. Heme-containing enzymes are shown in grey. Nir nitrite reductase, HZS hydrazine synthase, HDH hydrazine dehydrogenase, cyt cytochrome, bc1 cytochrome bc1 complex, Q co-enzyme Q. a anammoxosome, r riboplasm

Evidence for the role of the anammoxosome in theenergy metabolism of the cell initially came from theimmunogold localization of both HAO-like proteins tothe anammoxosome (Lindsay et al. 2001; Jetten et al.2009) and an F-ATPase to the anammoxosomemembrane (van Niftrik et al. 2010). Furthermore,using cytochrome peroxidase staining, cytochrome ctype proteins were shown to be present exclusively inthe anammoxosome (van Niftrik et al. 2008a).

### III.    Conclusion

Anammox bacteria are intriguing micro-organismsthat have defied many biological concepts. They werediscovered as the missing link in the nitrogen cycle,play a major role in the nitrogen loss from the oceansand are valuable for wastewater treatment. They havea unique metabolism with unusual intermediates, suchas the rocket fuel hydrazine, and perform this reactionand the subsequent energy conservation inside a

socalled prokaryotic organelle, the anammoxosome. Theanammox cell is compartmentalized by three singlelipid bilayer membranes that contain unique, ladderane, membrane lipids. Future research will include thecomposition of the anammox cell wall, the contentsand function of the paryphoplasm, the protein sortingmechanism, cell division, and further in-depth analysis of the energy metabolism of the cell. In addition,the ecological significance and application in wastewater treatment will also remain topics of study. Inconclusion, over the past decade anammox bacteriahave proven to be of a high (micro)biological interest.

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# Evaluation of microalgae biomass, a convenient source of energy

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*Abstract* – A variety of species of green and blue algae from water and soil samples were enriched and isolated. The isolated strains were identified as Chlorella, Nostoc, Chlamydomonas Oscillitoria, Anabaena. Chlorella vulgaris a variant was cultivated under optimal conditions to produce biomass as laboratory as well as the site in both bioreactor and open pond systems. Dried biomass with 10% moisture was tested for calorific value by standard methods and the same were in a range of 3000-3500 kcal per kg. Biomass was subjected to recovery of oils as well as blended with coal and calorific values were 4200 to 5300 KC/KG.

*Keywords*— microalgae; biomass; chlorella; energy; mitigation

## I.    INTRODUCTION

With the increase in shortage of electricity and constant increase in the cost of electricity, we are forced to look for alternative sources of generation of electricity to meet the present demand. Global warming  induced by increase in the concentration of GHG in the atmosphere is a matter of great environmental concern. Annual emissions of $CO_2$ are estimated to be $2 \times 10^{10}$ tones primarily from combustion of fossil fuels, with an increasing population and industrialization. Attempts have been made to reduce atmospheric $CO_2$  using physical and chemical treatments to separate and recover $CO_2$.  Micro-algal photosynthesis has increasingly received attention as a means of reducing the emission of $CO_2$  from atmosphere [1][2][3]. Emissions from power plants, cement-producing factories & other industries can be controlled by growing photosynthetic micro-algae. It is possible to recycle $CO_2$ to produce microalgae.Microalgal biomass generated can be used as a fuel to supplement coal in generation of electricity [4][5].

Biologists have categorized micro-algae into variety of classes, mainly distinguished by their pigmentation, life cycle and basic cellular structure [6]. The main groups are Bacillariophyceae, Chlorophyceae, Cyanophyceae, and Chrysophyceae. Microalgae are primitive organisms with a simple cellular structure and a large surface to volume body ratio which gives them the possibilities of large uptakes of nutrients. They are fast growing and efficient converters of solar energy capable of producing many times the biomass per unit area compared to terrestrial plants. Microalgae are

remarkable and efficient biological factories of converting zero energy in the form of $CO_2$ into a high-density liquid to be used as bio-diesel and heavy biomass [7][8][9][10][11][12].

The studies were aimed at developing mix biomass of micro-algae which can be an alternate to coal used for generating power using wastewater and $CO_2$ generated at the industrial site.

## II.    Material and methods

### 2.1. Enrichment, isolation and identification

Water samples from freshwater bodies, cooling water deposits, soil and sludge were enriched in CHU no-3 medium. Flasks were incubated at ambient temperature for 10 days in chamber with artificial light (white) source. Four serial subcultures were made in the fresh medium and algal biomass developed was cultivated under same conditions. Biomass after serial subculture was isolated on CHU-no-3 solid media plates and incubated for 7 days in chamber with artificial light sources. Selected microalgal species were cultivated in various culture media like Beneck's liquid medium, CHU no 10, Kuhl and Lorenzen medium, Erddekokt and Salze, Pringsheim medium and Czurda medium [13][14]. Strains were identified using up to genus level using microscopic techniques and Stain C-1 was identified using molecular methods using genetic markers by outside laboratory.

### 2.2. Cultivation in bioreactor and analysis of biomass

Chlorella species were grown in flasks containing enrichment culture medium for 7 days and the biomass separated was inoculated in 1 liter and 5 liter capacity rectangular open bioreactor and incubated at ambient temperature in chamber with light sources. Developed biomass was then cultivated in larger volumes in photobioreactor as well as open ponding system at thermocol molding factory using exhaust fume using same conditions.

Biomass was allowed to settle and the sediment collected was centrifuged and dried at 105oC. Dried biomass was analysed for TOC (Dichromate reflux method) Protein (colorimetric method), Lipid contents (Soxhlet extraction) and Calorific value (using Bomb calorimeter) as given in Standard Methods for Water and Waste Water Analysis 1989 [15].

Blending with coal was carried out to prepare mixture with 25 and 50% coal and calorific values were determined. Sample processing for determination of calorific value of Chlorella sp. was done by drying them at 8O 0C for 24 hours

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and recording their dry weight. The dried samples were then ground into a fine powder using a mortar and pastel, and placed in desiccators. The calorific content of dried samples was measured using a Phillipson Microbomb Calorimeter. Small pellets of dried sample (15-30 mg) were placed in the bomb chamber, pressurised to 425 psi with pure oxygen, combusted and amount of heat generated recorded. The calorimeter was calibrated against benzoic acid standards [16]. Dried biomass of Chlorella was subjected to hydrothermal liquefaction to recover oil and the same was analysed for oil contents along with GCMS and FTIR analysis to determine the chemical and physical properties of oil.

## III. Results and discussion

The energy crisis of the 1970s was followed by increased concern for the environment, with particular emphasis on protection of the global ecosystem. The RAPAD established in Japan investigated the development of technologies for biomass conversion and utilization, in particular, the production of ethanol from cellulosic biomass. Various forms of biomass resources exist. Among these, sugar and starch crops are inappropriate for use as energy sources since they are primary food sources, and are unstable from the viewpoints of long-term supply and cost. Cellulosic resources, on the other hand, represent the most abundant global source of biomass, and have been largely unutilized [17].

Development of technologies that efficiently produce biomass and convert it to more convenient forms of energy is therefore very important [18]. Microalgae have been investigated for the production of a number of different biofuels including bio-diesel, bio-oil, bio-syngas, and bio-hydrogen. The production of these bio-fuels can be coupled with flue gas $CO_2$ mitigation, wastewater treatment, and the production of high-value chemicals. Developments in micro-algal cultivation and downstream processing (e.g., harvesting, drying, and thermo-chemical processing) are expected to further enhance the cost-effectiveness of the bio-fuel from micro-algae strategy [19]. Biofuel is a renewable energy source produced from biomass, which can be used as a substitute for petroleum fuels [20]. Biofuels are expected to play an increasingly important role throughout 21st century [21][22]. Algae based biofuels are considered as a viable option as the oil productivity of many algae exceeds that of oil crops.

Table 1.comparison of potential oil yields of algae and other oil seeds[23]

| Crop | Oil yield gallon/acre |
|---|---|
| Corn | 18 |
| Cotton | 35 |
| Soyabean | 48 |
| Mustard seed | 61 |
| Sunflower | 102 |
| Rapeseed/Canola | 127 |
| Jatropha | 202 |
| Oil palm | 635 |
| Algae | |
| 10g/m²/day at 15% Triglycerides | 1,200 |
| 50g/m²/day at 50% Triglycerides | 10,000 |

Table 2. Identification of isolated algal cultures

| Site where the sample was collected | Abbreviation | Taxon identified. |
|---|---|---|
| Puddle at Churchgate | C1 | Chlorella vulgaris |
| Darjeeling soil sample | D2 | Chlorella |
| Toxic effluent from Industry | A1 | Chlamydomonas |
| Sea water isolate | SW1 | Dunaliella |
| Darjeeling tree bark | D4 | Chlorella |
| Gangtok tree bark | U4 | Chlorella |
| Powai lake sample | PL | Oscillatoria |
| Borivali National park water sample | NP | Nostoc |
| United States soil sample | USA 1 | Rivularia |
| Goregaon Soil sample | GS | Spirulina |
| Rain water pool sample | U K | Lyngbya |
| Bandra wall scraping sample | BW | Anabaena |
| Upvan lake sample | UL | Microcystis |
| Darjeeling tree bark sample | D4 | Chlorella |
| Cement factory | Ultra1 | Oscillatoria |
| Cement factory Green deposit | Ultra2 | Spirulina |
| Cement factory | Ultra3 | Spirogyra |
| Cement factory Air condition duct | Ultra4 | Chlorella |
| Cement factory soil sample | Ultra5 | Scendesmus |
| Cement factory effluent sample | Ultra6 | Closterium |
| Thermacol factory-1 | KK1 | Chlorella |
| Thermacol factory-2 | KK2 | Ulothrix |
| Thermacol factory-3 | KK3 | Oscillatoria |

In the present studies microalgae strains were enriched and isolated from various samples using cultivation techniques used for mineral salt enrichment culture. After serial subculture in CHU-3 medium algal strains were isolated on solid media and identified up to genus level. Table 2 shows the results. Most of these were green and blue green algae species. These strains showed excellent growth in mineral salt media supplemented with carbonates as source of carbon. Cooling water deposits showed wide variety of algae species. All the selected media supported heavy growth of both green and blue green algae. The organisms isolated were identified by microscopic methods as species of  Diatoms, Chlorella, Chlamydomonas, Nostoc Oscillitoria and Anabaena. Growth of  Diatoms and  Chlorella  was more as compared to other strains. Both Nostoc and Anabaena showed ability to fix nitrogen and grew in media without nitrogen source. Nitrogen and Phosphorus concentrations influenced the composition of cellular biomass. At the limiting levels of nitrogen the lipid contents increased.

Isolate C-1 was identified using genetic markers and identified using sequence matching with standards as available on website www.scigenom.com. as  Cholrella vulgaris shows significant similarity with Chlorella vulgaris based on nucleotide homology and phylogenetic analysis. Blast reports showed E value to be zero. Zero E value indicated there was no random matching. Blast results indicated 97 % identity with Chlorella vulgaris which means this particular strain C1 may be a mutated strain. This strain showed a significant growth and the growth rate was excellent. This strain along with other was used for different studies.

Microalgal biomass generated can be used as a fuel to supplement coal in generation of electricity [24][25]. Preliminary results have shown that the co-firing of 7 % biomass, on a heat input basis, with crushed, pulverized coal can lower NOx  and CO2. Micro-algae offers have excellent lipid contents and thus are good source for bio-diesel. The use of microalgae as sources of liquid fuels is an attractive proposition from the point of view that microalgae are photosynthetic renewable resources, are of high lipid content, have faster growth rates than plant cells, and are capable of growth in saline waters which are unsuitable for agriculture.

Four strains of Chlorella C-1, D-2, D-4 and U-4 were used for large scale cultivation at the site using Boiler exhaust fume. Growth in photobioreactor as well as open ponding system was excellent and gave promising results. Table 3 shows results of Biomass of Chlorella species.

C-1 grown in the presence of chimney fumes and $CO_2$ in a photobioreactor showed better growth as compared to other strains including chimney fumes. Conditions of cultivation were same for both photobioreactor as well as ponding system. Increase in biomass indicated these cultures could grow in the presence of 9 % $CO_2$, 2.66 kg/d of $SO_2$ and 36.25 mg/nm3of N0x. This was average concentrations of chimney gases at the site. Growth rate was quite good  in the modified medium and with changes in cultivation conditions it improved well. C-1 was with higher growth rate compared to other strains.

Table 4 shows the biomass of C-1 strain produced in open pond and this cultivation was carried out in ponds with 10Kl to 30KL capacity and rate of growth was determined. Similar results were obtained in photobioreactor with 10lit capacity.

Table 3.Biomass of chlorella species

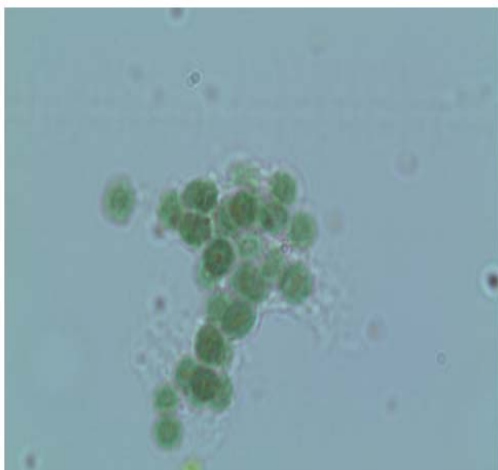| Purging | C1 mg/l | D2 mg/l | D4 mg/l | U4 mg/l |
|---|---|---|---|---|
| CO2 | 1100 | 860 | 950 | 750 |
| Chimney fumes | 1020 | 670 | 780 | 700 |

Fig 1. The photograph shows morphology of C-1 (chlorella vulgaris)strain.

Table 4.Biomass in ponding system

| | Pond 1 | Pond 2 | Pond 3 | Pond 4 | Pond 5 |
|---|---|---|---|---|---|
| Biomass g /250 l | 418 | 426 | 435 | 410 | 425 |
| Biomass g / l | 1.672 | 1.7 | 1.74 | 1.64 | 1.7 |
| Biomass g / l /d | 0.238 | 0.242 | 0.248 | 0.234 | 0.242 |



Fig 2.Photograph of photobioreactor and ponding system.

### 3.1. Biomass analysis

Strains were grown on large scale in bioreactor with 10lit capacity. The biomass was allowed to settle and the collected sediment was centrifuged and dried in oven at 105oC. In a period of 7days the growth yields were in a range of 5-10gm/lit. The Protein content of these strains was in a range of 40-60% TOC 40-55% and lipid contents 12-18%.

### 3.2. Hydrothermal liquefaction

While the lipid content of microalgae, on a dry cellular weight basis varies between 20 and 40 %, lipid contents as high as 85 % have been reported for certain micro-algal strains. Botryococcus braunii, is a unique micro-algal strain, having a long-chain hydrocarbon content of between 30 and 40% (dry weight basis), which is directly extractable to yield crude oil substitutes. Both physical and chemical processes are applicable in the production of liquid fuels from algal strains of high lipid content. These processes include direct lipid extraction in the production of diesel-oil substitutes, trans-esterification in the formation of ester fuels, and hydrogenation in the production of hydrocarbons. Oily substances are also produced via liquefaction of micro-algal biomass through thermo-chemical reactions under conditions of high pressure and temperature.

Algal biomass collected during cultivation of Chlorella in open pond was subjected to hydrothermal liquefaction to get bio oil or bio crude. The hydrothermal liquefaction of Chlorella was performed using a hydrothermal reaction system which consisted of a 1.8 L batch stirred reactor (PARR Instruments Co.USA). HTL was done in stainless steel autoclave with mechanical mixing.   248   M.S.Ghayal and M.T.Pandya / Energy Procedia  32 ( 2013 ) 242-250

The products of liquefaction include gaseous, aqueous and solid phases [26]. Viscous tar-like matter attached to the cooling pipe and the inner wall of the autoclave, and some floated on the aqueous surface. Total amount of bio oil extracted from Chlorella C1 cells after HTL was 11.45 %.

### 3.3. Energy balance of the liquefaction process

Energy recovery (%) = HHV of biocrude X mass of biocrude / HHV of feed X mass of feed. X 100
= (34720 X 1.44/3386 X50) X 100 = 29.531%  (1)

This does not compensate for any processing energy used in the liquefaction reaction (Biller et al 2011) The GCMS results indicated presence of C17,C19 hydrocarbon (alkane and alkenes) alicyclic and aromatics acids, amines and carboxylic acids. The presence of alkanes and alkenes were confirmed by FTIR. FTIR results showed presence of alkane, alkene, carboxylic acids, amino acids, primary and secondary alcohol, aliphatic amine and aromatic compounds. The heating value of oil was higher as compared to the reported [27], when compared with the various properties of algal oil recovered during this study.

3.4. Calorific values of Chlorella strains

Table 5 shows the results of Calorific values of Chlorella strain and the same was quite good comparable with commonly used substrates for energy generation.  As the strains were cultivated on exhaust fumes it showed one method for mitigating  problems due to GHG emission effects Chlorella species were grown in medium with purging CO2 as well as chimney fumes for 7 days. Cell mass of each species was harvested, dried, and then subjected to analysis for Calorific values as given below. The biomass was analysed for its calorific value. The dried biomass with about 10% moisture had calorific values in a range of 3000-3500Kcal/kg. Attempts were made to grow micro-algae on large scale economically. One kilogram of dry algal biomass utilizes up to 1.7 KG CO2

Table 6 shows calorific values of Chlorella biomass mixed with coal in 25 and 50% levels. It can be seen that biomass blending can be one alternative to reduce coal usage as the even at 25% coal blending Calorific values are quite comparable although not as high as coal itself. It can be also blended with other renewable sources of energy.

Table 5.Calorific values of various chlorella strains

| Chlorella strains | Open tray KC/KG | | Photobioreactor KC/KG | |
|---|---|---|---|---|
| | Purging CO2 | Purging chimney fumes | Purging CO2 | Purging chimney fumes |
| C1 | 2540 | 2380 | 3280 | 3105 |
| D2 | 1600 | 1575 | 2300 | 2692 |
| D4 | 1630 | 1600 | 2584 | 1700 |
| U4 | 2500 | 2708 | 3300 | 3832 |
| C1+D2+D4 | 2670 | 2800 | 3400 | 3190 |
| C1+D2+D4+U4 | 3160 | 3008 | 3290 | 3465 |

Table 6.Calorific values of chlorella strains belended with coal

| Biomass +Coal powder | KC/KG | Ash (%) | KJ/KG |
|---|---|---|---|
| C1 | 4205 | 30.5 | 17605 |
| C1 + Coal powder(50+50) | 5300 | 22.3 | 22190 |
| C1+Coal powder(75+25) | 4500 | 32.83 | 18840 |
| Coal | 6200 | 13.38 | 25958 |

IV.    Conclusion

Different green algae, blue green bacteria and diatoms are isolated from various samples Concentration of CO2, which is a major greenhouse gas, can be reduced by generation of biomass for production of electricity. The algal species Diatoms, Chlorella, Chlamydomonas, Nostoc and Anabaena had good calorific values and lipid contents. Extensive studies carried out using C-1 strain which was identified as variant of Chlorella vulgaris showed excellent results and it has added advantage of separation making downstream process very easy. The oil contents were 11.45% with energy recovery of 29.531% with higher heating values as compared to other strains. C-1 could be easily blended with coal as solid fuel since the bled had calorific values comparable. The growth rate of C-1 was quite good in both photobioreactor as well as open ponding system and it could be easily cultivated using chimney fumes from the plant. Using these strains can develop biomass on large scale in photobioreactor as well as open ponding system which can be dried and used as a supplement for coal. Microalgae development can give tailor made solutions for industries with uninterrupted power supply at reasonable cost.

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# Estimating and analysis of canola production function with inputs affect water, land, seed, labor, fertilizers, pesticides and machinery (instance study in selseleh township)

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*Abstract*— The aim of this present research is estimating and analysis of canola production function in selseleh city. In this way, by use of weighing economy analysis Ways , considered and experienced usage effect of factors like fertilizer , poison , seed , water , labor force , land and machinery on canola by way of in one's Presence interview with 150 persons of canola farmers whom they were related to Propagation center and jahad kheshavarzi services of the city in georgic year 2011-2010 and with sampling by the way of classification among of 985 persons . then the evaluated by use of linear production , cupdaglos , Leontief , radical And translog functions . the examinations showed that translog model has the best model among the production functions . According to the to results of the investigation , usage of fertilizer and labor force factors , located in the third region of the production and because attractiveness of usage of these two factors was negative , so proposes with propagational performances and correct instructions of revenuers , attain to optimum level , also another result of this paper is to use of land and water factors has been located in the first region that proposes come together ways of more usage of these two factors because more usage of them is frugal .

*Keywords*—About four key words or phrases in alphabetical order, separated by commas.

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## I. INTRODUCTION

Increase the efficiency of production and farmers' incomes is always attend the policy makers, researchers and agricultural planners, formulation of appropriate policies and programs to increase efficiency, while requiring sufficient knowledge of manufacturing conditions (constraints and production bottlenecks) is the sources in the agricultural sector is and resources in the agricultural sector is belongto decide of farmers and their reaction against the policies[6].

The transitory of the nature unpredictable and natural disasters in agriculture has created certain conditions for the production, that affecred the decision and farmers practice [2]. Every year many farmers affected by drought, chilling, freezing, untimely rains and floods, pests and diseases etc are facing and unrreparable damage to them and their families to enter, In addition to natural disasters often lack the financial backing, the variability of input prices and lack of access to timely and with the adoption of new technologies (Including new varieties) with great risk and uncertainty worsens the situation and create conditions for farmers that as a result of that fear, anxiety, feelings of insecurity and the lack of appropriate action in the face of risk [3].

### Materials and Methods

The econometric express some views on the economy, the accuracy of these methods is important because measurement of the economic theories for the social sciences related to the economy, what is discussed and interpreted, qualitative issues if the quality problems to little problems, the ability to discuss these issues and health data Vsqm defined, This is what it takes Econometrics [3]and has also been used in the study.

This study is done at 2011- 2010 at selseleh one the of eight lowland plains of lorestan state.,According to FAO, this zone has the half-dry climate with cold winters and short,

moderately warm summers and long, and 160 dry days of Therm-Mediterranean (Mediterranean, g); In this study, according to a survey conducted in the cultivation and exploitation, it can be non-overlapping classes that the variance within classes, little and large variance between classes is established; Since the full list of participants and the number of districts to take any of the actions specified in the the sampling way done (stratifed sampling) was [2].

By estimating the amount of production s in fromation and consumption of agricultural inputs by asking a series of 90-1389 in the selseleh city were collected

In order to perform this phase of the research using data obtained from Canola Growers city series to 985 farmers whom they were stratified sample and The sample size was estimated as 150 canola planters for each of the questionnaires were completed in person Analysis of 146 questionnaires were used.

Rhe inputs of the model use include fertilizers, pesticides, seeds, water, labor, land and machinery.in order to achieve production function fits the data collected, different models were estimated.

In this paper,the results of the translog function as the best fit to the data in this study.

## Results and Discussion

The results show that according to various criteria such as the number of significant variables, normality and Translog function model selected as the best fit to the data in this study, in which in this model not only water and labor,but also the second logaritms of these will produce a significant effect on volatility.

Table 1 Results of Translog production function

| SD | Statistics T | Factor | Comment | Variable |
|---|---|---|---|---|
| 0/78 | -1.05 | -0.82 | Interaction between seed and labor | LSL |
| 0.92 | 0.02 | 1.86 | Interaction between seed and machinery | LSM |
| 0.92 | **2.34 | 0.31 | Interaction between seed and water | LSW |
| 0.15 | ***-2.58 | -0.4 | Interaction of fertilizer and pesticide | LFP |
| 0.29 | ***-3.46 | -1.07 | Interaction of fertilizer and labor | LFL |
| 0.36 | ***4.25 | 1.55 | Interaction of fertilizer and machinery | LFM |
| 0.32 | ***2.68 | 0.22 | Interaction of fertilizer and water | LFW |
| 0.21 | -0.64 | -0.13 | Interactions between pesticides and labor | LPL |
| 0.19 | 1.27 | 0.24 | Interactions between pesticides and | LPM |
| 0.23 | 1.51 | 0.34 | Interactions between pesticides and water | LPW |
| 0.6 | -0.67 | -0.4 | The interaction of labor and machinery | LLM |
| 0.54 | ***2.64 | 1.43 | The interaction between labor and water | LLW |
| 0.51 | 0.28 | 0.14 | Interaction machines and water | LMW |
| 1.14 | **2.1 | 2.4 | Square acreage | LAA |
| 0.099 | -0.36 | -0.036 | Square seed | LSS |
| 0.21 | **-3.03 | -0.65 | fertilizer Square | LFF |
| 0.11 | 0.39 | 0.043 | Square poison | LPP |
| 0.42 | ***-6.46 | -2.71 | Square labor | LLLP |
| 1.01 | -0.72 | -0.73 | Square machines | LMM |
| 0.68 | ***-3.2 | -2.2 | Square water | LWW |
| 9.13 | -0.43 | -3.98 | Constant factor | C |
| 0.92 | | $\overline{R}^2$ | ٠/٩٤ | $R^2$ |

Source: Findings  *** The significance level of 1%      **The significance level of 5%      * The significance level of 10%

| SD | Statistics T | Factor | Comment | Variable |
|---|---|---|---|---|
| 4.31 | 0.78 | 3.38 | Log acreage | LA |
| 3.81 | -1.49 | -5.71 | Logarithmic seed | LS |
| 2.3 | 1.05 | 2.42 | Logarithm of fertilizer | LF |
| 1.77 | 1.35 | 2.4 | Poison Log of | LP |
| 2.25 | ***5.48 | 13.1 | Log of labor | LL |
| 2.67 | ***-4.01 | -10.73 | Logarithm machines | LM |
| 2.81 | **-2.32 | -0.64 | Logarithm of water | LW |
| 0.63 | *-2.79 | 1.78 | Interaction acreage and seed | LAS |
| 0.76 | -0.3 | -0.23 | Interaction acreage and fertilizer | LAF |
| 0.44 | 0.7 | 0.31 | Interaction acreage and pesticide | LAP |
| 0.76 | **3.13 | 2.4 | Interaction acreage and labor | LAL |
| 0.95 | **-2.43 | -2.31 | Interaction acreage and machinery | LAM |
| 0.93 | -0.5 | -0.47 | Interaction acreage and water | LAW |
| 0.69 | 0/98 | 0.68 | Interaction between seed and fertilizer | LSF |
| 0.39 | **-2.05 | -0.42 | Interaction between seed and pesticide | LSP |

In the translog function we can seen that in addition to entering the logarithms of the variables, the interaction between inputs and can also be imported.

Check the t-statistics indicate that the variable log of labor, labor Chemical fertilizer - machine interaction variables, Chemical fertilizer - poison Chemical fertilizer - Chemical fertilizer machines - water, power, water and labor are the two variables are significant at 1%

The water in the estimated production function variables and interactions between variables acreage - Labor acreage - Machines, seed- poison Seed - Water and square acreage and Chemical fertilizer variable is significant at 5% level .In this model the interaction -seed acreage is significant at the 10% level.

After estimating production functions in various forms, in order to select the most productive form of As well fit the criteria, the number of significant variables, normality and adaptation to the effects of other variables in the model theory has been used. The dependent variable is identical to the patterns that have been used Box-Cox statistic The results show that the model selected according to various criteria

such as the number of significant variables, normality and the best fit of the translog function model of the study, selected Significant variables in the model so that water and labor, the second logaritms of these variables will produce a significant effect on volatility. The ultimate effect inputs to determine the production rate due to the inclusion of various forms of input, the output elasticity of intermediate inputs used in the level of consumption. This tension is reported in the table below.

Table 2 - stretching inputs in the production function is translog

| Traction in middle level inputs | Input |
|---|---|
| 1.09 | Earth |
| o.73 | SEED |
| -0.109 | Chemical fertilizer |
| 0.72 | poison |
| -0.58 | Labor |
| 0.54 | Machinery |
| 7.31 | Water |

Source: research Findings

As can be seen in the table abone production elasticity is negative for inputs and labor Chemical fertilizer , This shows that the use of these inputs is in the third region of production, ie, the consumption of inputs in the sample is greater than the amount required And an increase in the use of these two inputs is reduced rapeseed production in the study area will be. As well as land and water are the most limiting factors of production in the region So that an increase of one percent increase in the use of these inputs 1.09 and 7.31 percent of the study area is However, for inputs of machinery, pesticides and seed to farmers in the area say that the latter are produced and consumed in reasonable range is Upon conclusion of the review of the seven input into the model, only two cases have shown the behavior of risk aversion,The use of agricultural inputs than the optimal values may indicate that behavior is based on risk aversion.

### Suggestions

Since the elasticity of fertilizer input is negative, and the negative impact this has on the average production of the optimal use of these inputs may canola planters ignorance and failure to comply with the optimal consumption

That this may be one of the factors in the third region of production therefore, it was appropriate promotional measures and proper training of farmers, helping them to make optimal use of these inputs. Also, given that water is a limited resource

available to farmers, Therefore, with the proper extension and properly trained operators, they have to make optimal use of this scarce resource, guidance and assistance  and Of course, modern irrigation methods to replace traditional methods of enforcement mechanisms provided irrigation.

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# Evaluation of Remote Sensing Data for Estimation of Precipitation

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*Abstract*—Precipitation patterns determination for dry periods in space and time is necessary for drought adaptation plans. Precipitation data plays a key role in drought monitoring, however short period of measured data and inappropriate distribution of weather stations, the study of water resources / climate in some regions of the province is carried out with difficulty. Therefore, it is necessary to recognize other reliable climatic data resources. Then to overpass the difficulty, after verification, the data is used to complete or substitute the existing data. Accordingly, in this research for Khorasan Razavi province using data from 10 synoptic stations around the province, the monthly precipitation data of TRMM satellite was evaluated. The evaluation was measured using MBE (Mean Bias Error), $R^2$ (Coefficient of Determination) and relative bias (percentage of relative bias). The results showed that there was a very good consistency between earth and satellite rainfall data. $R^2$ (ratio) average value for stations with less and more than 200m annual rainfall was 0.88 and 0.93, respectively. Based on the results, it can be concluded that the satellite data has the capability use for rainfall source over the province.

*Keywords*—Khorasan Razavi province, rainfall, remote sensing, TRMM, 3B43 product.

## I. INTRODUCTION

Precipitation data have been widely used in many earth science applications ranging from crop yield estimates, tropical infectious diseases, drought and flood monitoring. However, in many tropical regions and parts of the mid-latitudes, rainfall estimates still remain a major challenge due to sparse rain gauges. To better develop applications for these regions, it is necessary to have rainfall data with adequate spatial and temporal resolutions.

Precipitation data plays the key role in drought monitoring. Rain gauges are the mainly measuring methods for precipitation but they are concentrated in developed countries and are spare in developing countries and remote areas in the world [1], [17].

Chiu et al (2008) indicated that remote sensing techniques using space-borne sensors provide an excellent complement to continuous monitoring of rain events both spatially and temporally [5]. Microwave and Visible/Infrared are the main forms of remote sensing technologies; both have varied advantages in terms of imaging accuracy and spatial-temporal resolutions[6]. So, the fine spatial-temporal precipitation products need the coalescence of both. Tropical Precipitation Measuring Mission (TRMM) carrying sensors on precipitation provides the opportunity for fine spatial-temporal precipitation products [8]. Since the launch of TRMM, there were numerous efforts to evaluate TRMM precipitation products [3], [4], [5], [7], [10], [13], [14], [17], [18] and [19]. The accuracy of the version-6 TRMM Multisatellite precipitation analysis (TMPA) is the best among TRMM precipitation products.

BaraniZadeh et al (2011) compared TRMM monthly precipitation data with Asian Precipitation - Highly-Resolved Observational Data Integration Towards Evaluation of Water Resources (APHRODITE) in Iran for period of 2000-2007. Correlation coefficients for winter, spring and autumn precipitations was 0.83, 0.86 and 0.83, respectively; which showed that the satellite data has the capability of precipitation estimation in Iran [2].

Another research, in a region of India, was concluded that there was a very good consistency between TRMM satellite data and Doppler radar (Correlation Coefficient ~0.9) [16].

Vegetation indices with combine visible and infrared bands are also used for drought monitoring. Moreover, using a combination of precipitation radar and microwave in TRMM satellite has brought about possibilities of drought evaluation with the satellite datavia measurement of precipitation.

Li et al (2010) have taken the drought occurred in the winter wheat areas of North China from October 2008 to February 2009 as a monitor case, the TRMM 3B43 precipitation data product was used with the index of precipitation anomaly percentage, finally the spatial evolution process of this meteorological drought was monitored. Due to the better temporal and spatial continuity than the ground-based meteorological observation, TRMM precipitation data

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had good application prospects in the meteorological drought monitoring at a national or regional macro-scale [9].

Zang et al (2010), based on the index of precipitation anomaly percentage, have monitored and analyzed the severe meteorological drought of China in the early 2010 by utilizing the 3B42 and 3B43 precipitation datasets of TRMM Satellite. The monitoring results indicated that the TRMM precipitation data showed good results in meteorological drought monitoring and it can be applied to large-scale meteorological drought monitoring and analysis in China [20].

In another research, during the period from 1998 to 2009, the potential of the version-6 monthly TRMM multi-satellite precipitation analysis (TMPA; 3B43 V.6) was assessed for droughtmonitoring at the 1and 3-monthes scale in a basin with strongheterogeneity of terrain and climate. The assessment was carried out by using standard precipitation index (SPI), at the grid point (0.25°×0.25°) [21].

In addition, TRMM monthly data captured the occurrence and development of two severe droughts happened in 2006 and 2009 in China. Based on these, their analysis showed that TMPA (the version-6 monthly TRMM multi-satellite precipitation analysis) has the potential for drought monitoring in data-sparse regions [21].

In this research for Khorasan Razavi province, the monthly precipitation data of TRMM satellite was evaluated.

## II. MATERIALS AND METHODS

### A. Study area

Khorasan Razavi Province is located in the North East of Iran. The area of province is 118851 km$^2$, the 5$^{th}$ greatest province in Iran,and is located between 56°-61° E and 33°-37° N. There are 13 synoptic stations within the province. Mashhad station has the longest record length (about 60 years) and Fariman station has the shortest record length (about 5 years).

### B. Data and Methodology

The data set used includes monthlyprecipitation depth from both synoptic stations and TRMM data (3B43 V.7, in ASCII format). A fifteen year (1998–2012) period were chosenfor the analysis.The starting year is due to TRMM lunch date, and the last year was sat to 2012 due to inaccessibility of synoptic stations data. Only 10 of synoptic stations had data throughout the 13 years time span.Then, to have enough accordance between satellite and ground data, pixels thatcover theground stationswere determined.Figure 1shows locationof stations and the relevant pixelused. From TRMM monthly precipitation products, those with a 0.25°×0.25° spatial resolution were used [12]. This is the highest resolution found in TRMM.



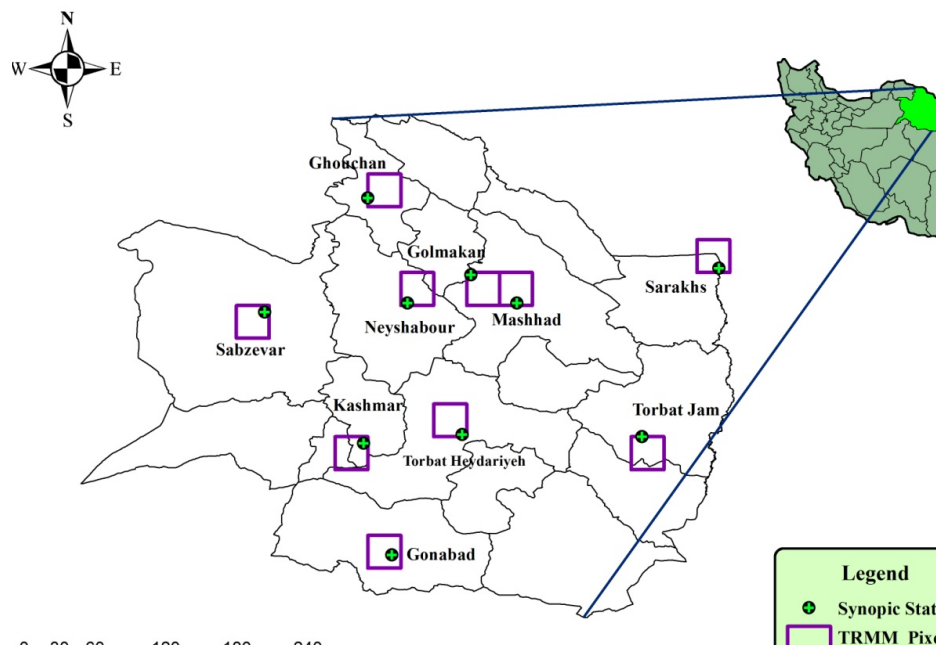Fig. 1.Position of Synopticstationsandthe relevant of TRMM pixelsin Khorasan Razavi province.

TR

MM satellite was launched on 28 November 1997 in collaboration with the space agency's of both the USA and Japan. The Satellite can measure precipitation over land and sea. Especially it is useful for areas that lack data or have inappropriate data. The satellite is located at a height of approximately 350 km from earth surface with an inclination angle of 35 degrees. The satellite covers from -50° to 50° latitude. The data is distributed by NASA GSFC Distributed Active Archive Center [11].

The TRMM satellite carries three rain-measuring instruments. NASA GSFC provided the TRMM Microwave Imager (TMI), the Visible Infrared Scanner (VIRS), and the observatory, and operates the TRMM satellite via the Tracking and Data Relay Satellite System (TDRSS). The Japan Aerospace Exploration Agency (JAXA) provided the Precipitation Radar (PR), the first space-borne precipitation radar, and launched the TRMM observatory. TRMM standard products at three levels are available at the Goddard DAAC.

For data analysis, Data series should mach some basic criteria including randomness, homogeneity, stability and inspection and rejection of outlier data [15]. The accuracy of precipitation data that are used from synoptic stations and TRMM satellite are provided by the source provider.

The evaluation was measured using MBE (Mean Bias Error), $R^2$ (Coefficient of Determination) and relative bias (percentage of relative bias). MBE and relative bias are obtained with (1) and (2):

$$\text{Relative bias} = \frac{\sum_{i=1}^{N}(P_{g(i)} - P_{s(i)})}{\sum_{i=1}^{N} P_{g(i)}} \times 100 \qquad (1)$$

$$\text{MBE} = \frac{\sum_{t=1}^{n}(x_t - \hat{x}_t)}{n} \qquad (2)$$

Pg, xt = amountof precipitationfor the station
Ps, $\hat{x}_t$ = amountof precipitationfor the pixel of satellite

### III. RESULTS AND DISCUSSION

Results ofMBE, relative biasand thecoefficient of determination($R^2$)forTRMMagainst of stationsare shown inTable (1).

Best of values for MBE and relative bias (lowest) obtained for Ghouchan station. The station has maximum annual rainfall over the all stations of province (~313 mm). Neyshabour and Golmakan stations have Maximum value for the $R^2$(0.96). Both of the stations have annual rainfall more than 200 mm.

Maximum errors for the MBE and relative bias (largest) obtained for Gonabad station that has minimum annual rainfall over the all stations of province (~144 mm), although the value of $R^2$for this station is good (0.84). But this value of $R^2$ is lowest over the all stations of province.

Graphs (figure 2, 3) show the simple regression curves for the selected stations, which yield the correlation factor $R^2$to be 0.96 and 0.92 for best matching and 0.93and 0.88 for average matching onstations that have annual rainfall more and less than 200mm,respectively. Average matching means the average of $R^2$ values for TRMM data encircling the selected city's ground gauge point station that could be away from the corners of grid point,whereas best matching value meant that value of $R^2$for grid point of TRMM data that is nearest to ground gauge station value.

Theresults show better accordance between the satellite data with data of stations that have annual rainfall more than 200 mm in comparison to other stations.

Table 1. Results of the evaluation indices

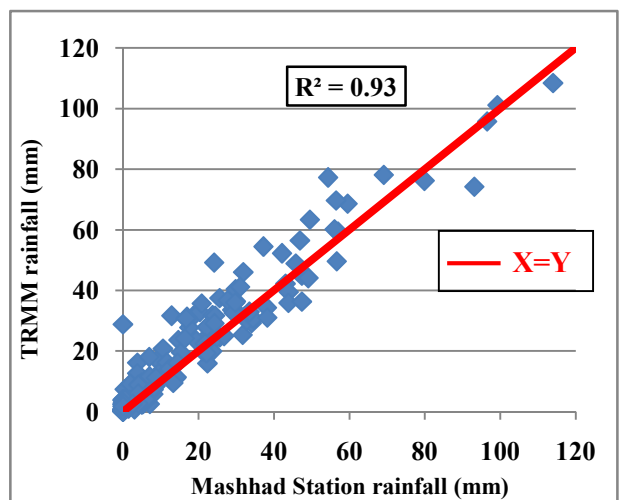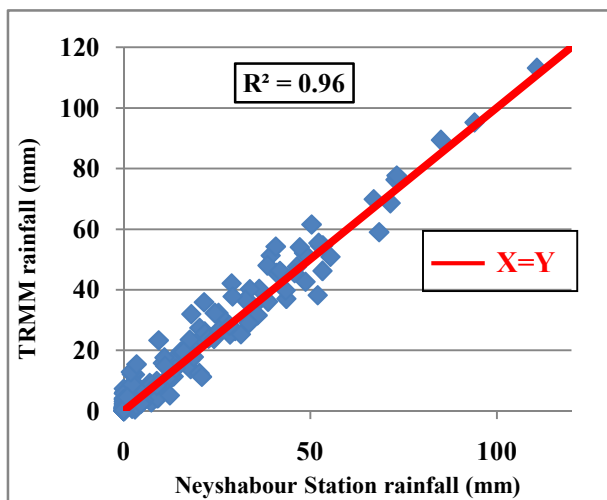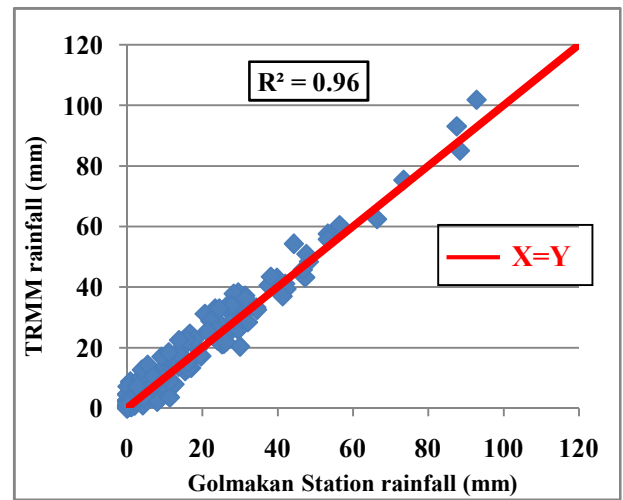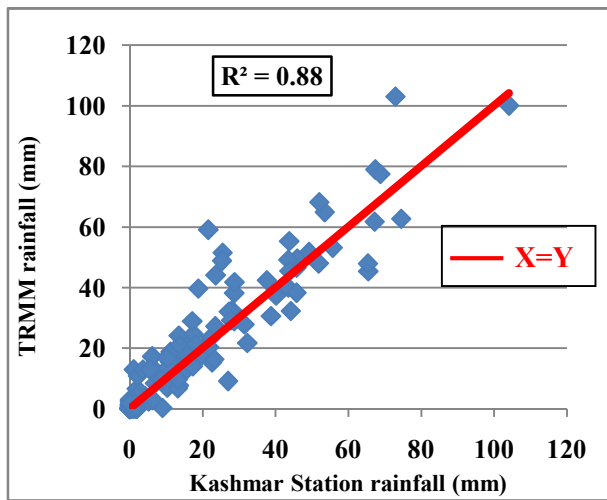| Synoptic Station | Station Coordinates | | Coordinates of relevant pixel | | Station Annual Precipitation (mm) | Station Elevation (m) | rel. bias (%) | MBE | R | $R^2$ |
|---|---|---|---|---|---|---|---|---|---|---|
| | longitude | latitude | longitude | latitude | | | | | | |
| Ghouchan | 58.74 | 37.07 | 58.625 | 37.125 | 313.1 | 1287 | -1.73 | -0.41 | 0.96 | 0.92 |
| Golmakan | 59.28 | 36.48 | 59.375 | 36.375 | 214.5 | 1176 | 8.69 | 1.43 | 0.98 | 0.96 |
| Gonabad | 58.68 | 34.35 | 58.625 | 34.375 | 144.4 | 1056 | 20.4 | 2.40 | 0.92 | 0.84 |
| Mashhad | 59.63 | 36.27 | 59.625 | 36.375 | 255.2 | 999 | 12.5 | 2.40 | 0.96 | 0.93 |
| Neyshabour | 58.80 | 36.27 | 58.875 | 36.375 | 239.8 | 1213 | 7.4 | 1.35 | 0.98 | 0.96 |
| Kashmar | 58.47 | 35.2 | 58.375 | 35.125 | 203.9 | 1110 | 10.1 | 1.50 | 0.94 | 0.88 |
| Sabzevar | 57.72 | 36.2 | 57.625 | 36.125 | 189.6 | 978 | 9.38 | 1.38 | 0.95 | 0.9 |
| Sarakhs | 61.17 | 36.53 | 61.125 | 36.625 | 188.9 | 235 | -4.95 | -0.66 | 0.96 | 0.92 |
| Torbat Heydariyeh | 59.22 | 35.27 | 59.125 | 35.375 | 273.9 | 1451 | 5.78 | 1.09 | 0.94 | 0.89 |
| Torbat Jam | 60.58 | 35.2 | 60.625 | 35.125 | 175.6 | 950 | 12.9 | 1.81 | 0.93 | 0.86 |

Fig. 2. TRMM rainfall data against of stations that have annual rainfall morethan 200 mm
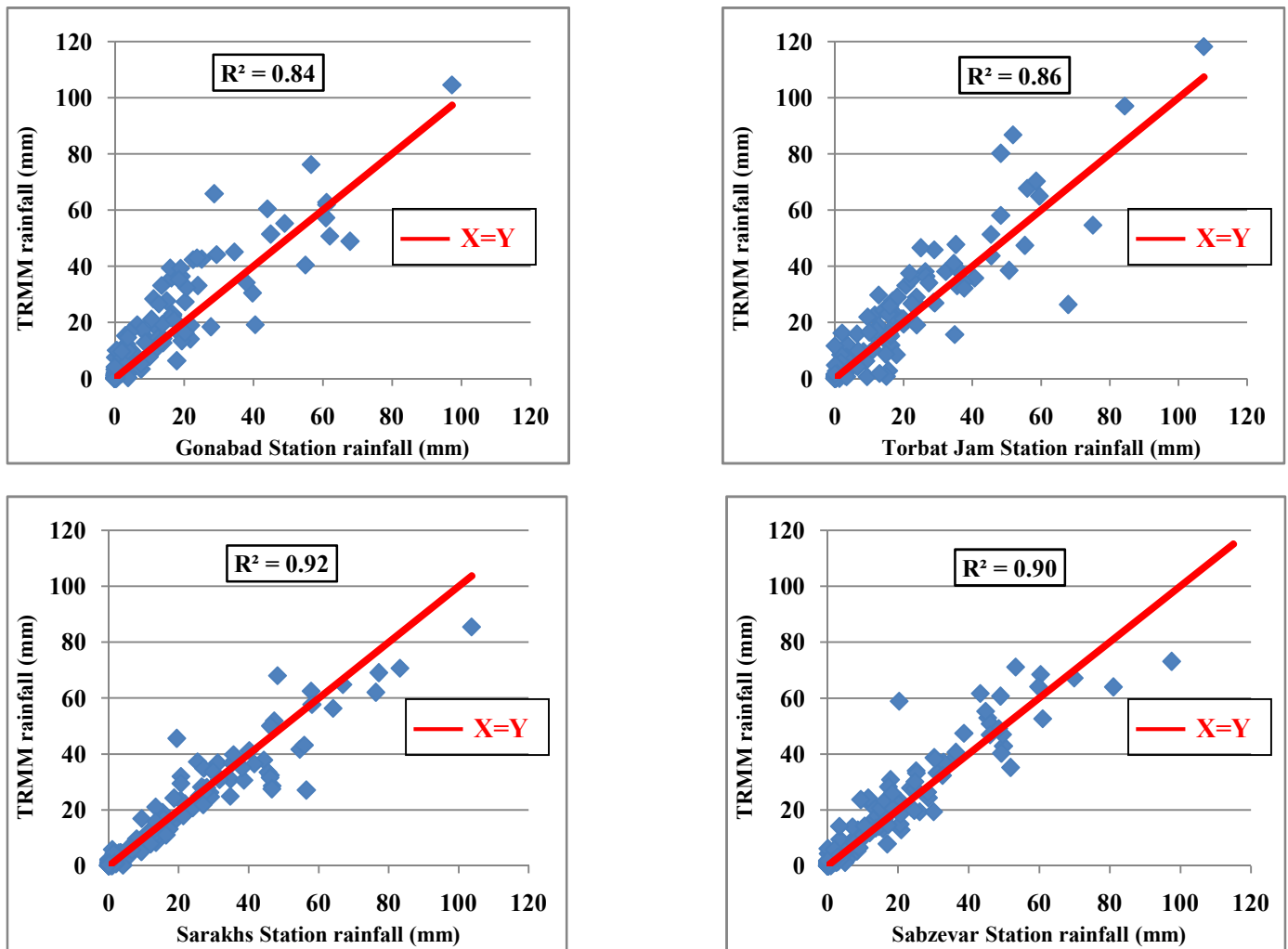
Fig. 3. TRMM rainfall data against of stations that have annual rainfall less than 200 mm

## IV. CONCLUSIONS

In this research, for Khorasan Razavi province, the monthly precipitation data of TRMM satellite (3B43) was evaluated.The evaluation was measured using MBE (Mean Bias Error), $R^2$ (Coefficient of Determination) and relative bias (percentage of relative bias).

$R^2$has smooth behavior, showing validity of TRMM data for the province. This analysis has demonstrated that the TRMM rainfall products show very good agreement with gauge data over the selected cities of Khorasan Razavi province on monthly timescales and 0.25° space scales. The best correspondence is obtained for stations that have annual rainfall more than others.

We consider the resulting estimates to be sufficiently accurate for use rainfall, in support of water resources management, agriculture and fire prevention. Further research is recommended to determine a bias correction may also produce better rainfall estimates in other regions prone to periodic water shortages where short period of measured data and inappropriate distribution of weather stations.

Based on the results, it can be concluded that the satellite data has the capability use for rainfall source over the province.

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# Genealogy of International Environmental Law

Seyed Abbas PoorhashemiPh.D[1], YaldaKhalatbari[2], SaharZarei[3]

*Abstract*—International Law as the international community laws entered a new realm after World War II and the foundation of the United Nations in 1946. Otherwise, indiscriminate and unilateral economicdevelopment and its impacts caused widespread environmental degradation in the world. Scientists Warning and international public pressure forced sates to deal more responsibly towards protecting the global environment. In this regard, development of legally binding and non-binding instruments concerning global environmental protection in international law began in the 1970s. Despite global efforts for the development of legally binding and non-binding rules, there are environmental concerns such as global warming, climate change, desertification, and deforestation etc..... In this regard, this paper focuses on some conditions and situationsinvolved the emergence of international environmental law.

*Keywords*:Environment, International Environmental Law, International Law, Global Environmental Protection.

## INTRODUCTION

Formation of International Environment Law more than anything else, depends on the formulation of legally binding and non-binding instruments. Although some jurists oppose to use of the term "International Environmental Law" and believe that since this branch of International Public Law, doesn't have unique sources and methods to make rules, so it can't be mentioned as an independent division of such Law. However, the majority of legal scholars by pointing to the use of similar words such as: human rights, law of the sea and so on, know the use of international environmental law as a common and legitimate branch of Law[15]. Philips Sands[4] includes in International environmental law: the principles, procedures and rules of international law that their main purpose is to protection of the environment[19]. "In this definition, he refers to two basic elements of international law. The first is that the sources of international environmental law and international law are the same. The Second is that the goal of this branch of international law is environmental protection [9]. From another perspective, one can recognize the International Environmental Law as one of the newest and most widely branch of public international law that regulates relations between actors of international law in the field of environmental protection. In other words, international environmental law is rules and regulations of international law governing the relations between followers and actors of international law both governmental and nongovernmental regardingglobal protection of environment.

## II. Formation of international environmental law

Along with industrial revolution in the western countries and increasing economic growth and industrialization, the global Environment was exposed to degradation and transformation[1]. Development of international environmental law has been accompanied by economic and social developments relatively. From this perspective, the international environmental law has historically been divided into three periods:

Period I: Conclusion of bilateral environmental agreements until the Declaration of the United Nations Conference on the Human Environment in Stockholm (1781- 1972)

This period Started in the second half of the eighteenth century by formulation of bilateral agreements, mainly in the field of fisheries and marine living resources, and by expanding into other areas, including wildlife, plant species, rare and endangered animals, from the early twentieth century, entered a new phase. Based on rules created on marine organisms, on one hand, governments are obliged to protect marine living resources and on the other hand, their right was recognized to freely exploit this resource on the high seas and waters shared between countries. Since the mid-twentieth century, due to environmental experts warn, incidence of new environmental, scientific discoveries of scientists, public reaction through the environmental movements and activation of some of international organizations, especially the UN[5], Conclusion of international multilateral treaties, particularly as part of regional and international, were placed on the agenda of international law actors. In this period, specially fighting against oil, Chemical and nuclear pollution, Protection of the Sea Environment and internationally important wetlands and controlling air pollution, beyond the atmosphere and Protection of the Antarctic environment Expanded, And tried

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to put an end to ineffective and fragmented world Measures and to Make further progress to establishment of international rules. The most important feature of this period is that it was regional and that the contractual obligations of governments were created to protect a region-specific. In this context, one of the first international environmental treaties wasthe International Convention for the Protection of Birds useful to Agriculture, signed in Paris on 19 March 1902. Subsequently,the Treaty relating to Boundary Waters and Questions arising along the Boundary between Canada (British colony at the time), and the United States in 1909 concerning the Great Lakes. Then on 11 January 1909, a treaty was signed on the Protection of the foks(Sea Dogs) , known as the Washington Convention. Also in 1933, a Convention was signed in London Relative to the Preservation of Fauna and Flora in the Natural State, also known as the London Convention of 1933.

In the meantime, environmental disasters like the 1967 incident, the grounding of tori Canyon tanker which caused the tides on the coast of France, England, Belgium and more than 100 thousand tons of crude oil leaked into the sea, More than before revealed the need to develop the necessary rules for fighting oil pollution at sea, And led to the drafting of a new treaty in this field

Including the 1961 Brussels Convention on Civil Liability for damage caused by oil pollution at sea and intervention during disasters related to oil pollution. In the meantime, the 1971 Convention was signed on the Conservation of International Wetlands Known as the Convention of wetlands of international importance, particularly of wetlands that are Habitat for water birds (the Convention of Wetlands), Ramsar in 1971 [13]. In general in the 1960s that is Known as the student movements Decade (the women's movement, Greens movements and post Modernism movements), Put a question mark against the destructive modernity And posed foundational issues including the environment. According to these movements more consumption and thus more produce should not be done at any cost. Followed by that, Environmental experts and scientists declared that if industrial development proceeds with this process, the world will be destroyed. As a result, by the end of this decade and early 70, From 5 to 16 June 1972, Respective governments were forced to hold a conference in Stockholm. Stockholm Conference in 1972, as the first milestone In the development of international environmental law With the recognition of the right to have Healthy Environmental As one of the fundamental human rights considered the close relationship of the environment development And by proposal to establish of international institutions, Gave coherence to the international cooperation on Environment and provided The way for further development of relevant international rules. As noted earlier, the international organizations Recognized issue of new threatening dangers soon.

For example in 1968, Council of Europe Adopted two documents about water and air pollution control. The Organization of African Unity, Adopted a Convention on the Conservation of Nature and Natural Resources. In 1968 following the propose of General Assembly of the United Nations, International Conference held from the date of 5 to June 16, 1972 In Stockholm, Sweden on the protection of the environment. It should be noted that until that date, it was the largest international conference, in which more than 6,000 people as representatives of 113 countries and approximately the same number of representatives of intergovernmental organizations And 700 observers from 400 international nongovernmental organizations(NGO$_{S)}$ were involved [5].

Period II: Between the Stockholm Conference and the Rio Conference on Environment and Development (1972-1992)
Final statement of Stockholm Conference referred to important principles of environmental law and environmental protection that currently exists in many regional and international conventions and bilateral treaties in this regard. The purpose of this meeting was to consider the Global environmental issues, human rights and also recognizes the harmful effects of human activities to the environment.

This document contains an introduction, 26 Article and an action plan About Environmental Policies containing 109 recommendations including propose of the establishment of a United Nations Environment Programme (UNEP) and Global Environmental Facilities(GEF) that have had a major role in the development of international environmental law. The first principle of the Declaration stipulates that: human freedom, equality and adequate conditions of life, in an environment that allowed him to live with dignity and prosperous gives the fundamental right and responsibility to protect and improve the environment for this generation and future generations. Articles 18 and 20 refer to instruments between-International Environmental Policy and Planning and Management by the National Institutes With the use of science, science and technology, exchange of information and the importance of education and information on environment. Article 21 predicts the rights that According to which Responsibility to ensure or control Activities within the territory of the State In a way that Does not damage the environment of other states or territories beyond their is on that government and Emphasizes And develops the scope of this right. In fact, Article 21 is seeks to Countries have their own environmental policies in such a way that don't cause damage to other countries and it seems this principle of customary Gradually Has become one of the international ErgaOmnes in International Environmental Law. As can be seen, the statement that is of non-binding and soft rights and at first is not binding, Sometimes because seeks to Express a legal norm Can be effective in the development of international environmental law. Article 21 of the Stockholm Declaration Which refers to the principle of prohibition of loss

and damage to other countries, Stipulated in other international declarations. Article 22 refers to the principle of compensation that governments should cooperate in further development of international law In relation to Liability or compensation to victims of pollution and other environmental damage caused by activities within their jurisdiction or in areas under their control Or In the areas beyond their territory. They should also support the rules and standards of environmental and predict Guarantee System for the effective implementation of Environmental protection in all countries, especially developing countries. Governments must work together to protect and improve the environment and Follow international organizations and thereby, play a dynamic and coordinate role to improve the environment[6]. Another important outcome of the conference was the establishment of new assisting organ of the United Nations Environment Programme. UNEP is an Environmental Protection program which is affiliate to the United Nations and works as the most important environmental protection organ in the world. One of the important tasks of UNEP is to assessment of global environmental, for this purpose it publishes an annual collection and in which expresses the state of the environment. It also has a duty to manage the global environment with the collaboration of other countries. Under this task, UNEP has no right to intervene, directly in matters relating to the environment of other countries, Rather All actions by UNEP are done with the cooperation of governments At the regional and global level and it's responsible for supporting the Global Environment, Meaning that the United Nations assigns Finance and credits to protect the Countries environment So that Countries take the necessary measures for the conservation and protection of their environment [2]. One of the major events of international environmental law in this historical period Is the adoption of World Charter for Nature[25] By the General Assembly of the United Nations on 28 October 1982, although this is not a binding legal document But has left Fundamental impact on international environmental law, we can see the similar article in public international law, the Declaration of Human Rights December 10, 1948. Although the Universal Declaration of Human Rights It is one of the most important and influential texts in international human rights but is Not binding, However it has a significant influence on the development of human rights, Hence we see that legal principles of the Charter of the natural world entered into Convention for the Protection and Conservation of Natural Resources of Southeast Asia And became binding. , the effect of Universal Declaration of Nature was in this way that Despite its binding, Legal principles Despite its binding in 1985, become through Convention for the Protection and Conservation of Southeast Asia And 10 years later, some of the principles of the Universal Declaration of Nature Mentioned in the statement of the Rio 1992[3]. In terms of structure International Environmental Law was developed in this course. As

previously mentioned, the most important event that happened in this period was Establishment of Organization of the United Nations Environment Programme (UNEP). During the same period, in addition to the establishment of UNEP, Other international organizations, put the Protect of environment on their aims and objectives, in this way, we can refer to International LabourOrganization(ILO), Food and Agriculture Organization (FAO), World Health Organization(WHO) and the International Atomic Energy Agency(IAEA). In addition, many international conventions were formed in this period that we can refer to the convention on International Trade of Species of wild animals and plants in danger of extinction, Washington in 1973[12] and the Convention on the Law of the Sea, Monte Gobies 1982[21] and many other conventions, These conventions usually have an organization and structure for implementing the objectives of the conventions. So in this period International Environmental Law Development was great Both in terms of law and legal rules and principles As well as formation of International organizations for environmental protection. It can be concluded that the most important characteristics of this period was the Preparation of several strategies In the context of protecting the Earth's environment By international agencies Which have been considered by other countries In compiling National strategies and legislating Domestic laws and also used in the preparation of international instruments in the field of international environment. Among these strategies can name the world conservation strategy[4]. During this period Although a number of international organizations Contributed to development of international environmental law But the active participation of international organizations in this process Begins with the establishment of the United Nations And its specialized agencies, International Atomic Energy Agency(IAEA), International Maritime Organization(IMO), the World Health Organization(WHO) and others that In addition to their main activities involved in this issues[7].

Third Period: Rio Conference on Environment and Development 1992

UN General Assembly approved the holding of International Conference on Environment and Development[22] during which the Secretary-General was asked to provide arrangements for the holding of the conference. Accordingly, the Preparatory Committee for the Conference Was established with the active participation of representatives of all Member States and representatives of international organizations and non-governmental and during the fourth meeting, the Issues that should be discussed at the conference were investigated.

Subsequently, the United Nations Conference Began On Environment and Development in Rio de Janeiro, Brazil on June 3, 1992, With over 30 thousand people from 176 countries, including 116 head of state and representatives of

1400 international non-governmental organization Active in the field of environment And the 9000 Reporter And until June 14 Various topics related to the environment and Development and existing problems before humans were discussed and evaluated[16]. Two other important legal documents Such as the United Nations Framework Convention on Climate Change, Newyork ,1992 (UNFCCC)[23], and the Rio de Janeiro Convention on Biological Diversity in 1992[11]. That were created and developed before the Conference to be held, was opened for governments to signature in Rio. Rio Conference Discussed about environmental issues As a global problem And emphasized on the need to Coordinate the development of countries with Environmental Protection and introduced environmental protection as an important international issue For the next century and by proposing the creation of international environmental regulations To achieve sustainable development, created a new evolution in the development of international environmental law. Rio Declaration 1992 Can be investigated from two perspectives: One is that this text reflects Differences between developed and developing countries the other is the Attempt to direct the formulation and development of international environmental law. Thus, the legal principles set forth In the this Declaration, including: the Right to environment (Article 1), the Sovereign right of states to exploit natural resources under their jurisdiction (Article 2); The right to development (Article 3), Eradication of Poverty (Article 5); Considering the circumstances and needs of developing countries (Article 6), The responsibility of developing countries In the environmental protection (Article 7), The need for Technical knowledge (Article 9) Reflects the views of the developing countries. On the other hand, principles such as: Changing production and consumption patterns, Population growth in its adaptation to the environment and sustainable development (Article 8); the Right of people In access to environmental information and the right of access to courts and administrative authorities and to apply penalties and compensation for environmental damage (Article 10); Supporting open international economic system and without discrimination (Article 12), Emphasis on participatory Including the participation of women (Article 20) In the process of sustainable development Reflects the views of the industrialized and developing countries In the field of environmental protection and sustainable development[17]. Second document of the Rio conference is the statement of basic principles of World overall agreement on management of the protection and sustainable development of forests, including an introduction and 15 stuff,

This document is a non-binding document and makes recommendations to governments on how and by what mechanisms to manage national forests and is the first global consensus on forests.

Non binding document of action Plan for the 21st Century Called Agenda 21 was the other Approval of the Rio Conference 1992 that assesses various aspects of the environment and Sustainable Development And identifies existing problems and Suggests Solutions and procedures for each of them. Agenda 21 was prepared in 40 seasons, 115 Topics and 800 pages and was available to governments. In this document on the conservation and management of resources: The air, forests, water, and strengthening the role of public organizations or administrative measures such as fiscal and institutional measures and Encouraging countries national legislative systems are raw materials of this principle.

Among impacts of the Rio Conference on International environmental law can refer to followings:
Governments should always be concern of safety and environmental protection and consider sustainable development as an approach in national development programs on economic development, industrial growth and globalization.
Governments should take into account "The principle of sustainable development" in formulating rules and regular program as well as writing binding multilateral and bilateral documents.
Governments should recognize the role of social groups, institutions, organizations and nongovernmental organizations in national, regional and global environmental protection.

Thus the third period in the development process of international environmental law can be called as the period of realism, holistic reforms and the emergence of disputes between different countries on environmental matters.
In this period, International environmental rules and regulations evolved in the context of sustainable development and corrected and if necessary to be in harmony with the facts of the world and can be implemented in practice and in some cases formed new Rules and regulations[14]. In this period, Agenda 21 as an international action plan was welcomed by the majority of countries and some of its cases entered into internal laws of the countries.
In the course of history a number of international conventions were established On the Environmental Protection which the most important of them were is most important, United Nations Earth Summit +5 1997and the declaration of the World Summit on Sustainable Development in South Africa, Johannesburg 2002[26]. After 5 years of the Rio Conference in 1992, based on decisions of the Conference, with the participation of Heads and representatives from 185 countries with the aim of Investigation and analysis of the achievements of the Rio Conference, Evaluation of the implementation of its agreements and making decisions about necessary measures to prevent the destruction of the environment and achievement to sustainable development, In the form of nineteenth special session of the UN General Assembly from 23 to 27 June 1997 Held at United Nations Headquarters in New York. The meeting Following the

differences between developing countries and industrialized countries in the terms of financial resources and technology transfer to the developing countries and differences in renegotiating of Agenda 21 On the one hand, and the differences between America and Europe union to determine a timetable to reduce greenhouse gas emissions on the other hand, Has ended by issuing an statement as a program for further implementation of Agenda 21 and Without obtaining a result. Mr. Dzaly Ismail, Malaysian Chief of the General Assembly In opening ceremony of the meeting with reference to failure of the international community in performing comprehensive measures for environmental protection stated: "Five years after the Rio Conference we are facing downturns, Not only in the economy, But In spirit and political will for the principal changes. Published statistics show that aspirations in Rio for achieving sustainable development in the world to some extent have been turned into despair and have created difficulties in achieving these goals. Earth environment is destroying and any disregard or delay in protecting the environment makes it impossible to prevent further destruction of the planet Earth. In 2002, the fourth legal nonbinding statement was adopted In Johannesburg, South Africa. Johannesburg Declaration was nothing Else but a rehash of the Rio Declaration and in term of failure to provide legal remedies to preserve the global environment is not considered as a successful statement.

Nonetheless, the international environment has been caught in conflicts between developed countries, that have destroyed the environment and the earth to achieve economic growth and development on a large scale and now claim to protect it, On the one hand, and developing countries that don't have necessary motivations due to costly environmental protection and lack of access to modern technologies, on the other hand. Failure to reach agreement on the Copenhagen Climate Change Conference, 2009 to review and revise the Kyoto Protocol is one of the problems which Facing the contemporary international environment. United Nations Conference on Sustainable Development, Rio+20, 2012 which held in order to assess the state of the global environment, It is not yet resolve Disputes and conflicts between developing and developed countries and put the solution Before paradox of economic growth of environment Protection, Therefore the development and evolution of international environmental law In this course of history thanks to a common understanding of developing and developed Governments on protection of the global environment.

## 3. Conclusion

Unliketraditionalconceptionofinternational relationsand the international communitybased on Conflict of interestAndInternationalconflicts inthe newapproach,the international communityeffortstodevelopinternational cooperationincludinginstitutionalizedand non-institutionalized,

thisapproachismore visibleinsome ofissues includingglobal environmentalprotection. Although the international community is far from institutionalization, this community has no organized centralization of power, hierarchy and constitution; however there is no denying this growing participation of international organizations as the irrefutable fact of the contemporary world. The ruling power toforeign Relationsfollowing therelease ofwill actaccording totheirinterests.Buta newinternational lawhas developedageneralobligationtocooperate withothersinordertoovercome the problemsof the international community, however,despite all theefforts of theworld for growth and developmentof legal normsbinding andnon-binding, theInternational environmentlawis facingalotof legalgaps in the GlobalEnvironment Protection, inthisregard,it is necessary to thinking abouteffective legalstrategiesto deal with it.

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# Performance evaluation of herbal pesticide Palizin® compared to chemical insecticide Mospilan® in reducing eggs and nymphs pistachio psylla, *Agonoscena pistaciae*

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*Abstract*— Common pistachio psylla, the pest of pistachio orchards in Iran which feed on plant sap in the leaves and fruits of pistachio creates irreparable damage, so many farmers use insecticides to control this pest. With the aim of reducing the use of chemical pesticides in pistachio orchards, plant pesticide Palizin® (2000 ppm concentration) compared to chemical insecticide Mospilan® (250 ppm), were tested in the fields of Kashmar region, during 2012. The results showed that pesticide plant Palizin® better performance in reducing the number of eggs and nymphs pistachio psyllid found.

*Keywords*—Palizin, pest control, pistachio psylla, safe product

## I. INTRODUCTION

Common pistachio psylla, *Agonoscena pistaciae* Burckharat & Lauterer (Hem.: Psyllidae), A native pest of pistachio in Iran and neighboring countries. This insect is now a key pest of pistachio orchards in Iran. Common pistachio psylla just after the buds swell and open pistachios in the first days of spring are beginning to work and usually rapid population increases. There high population density of the insect brain concurrent with the closing and then filling in the brain is impaired, resulting in damage to the product of imported pistacia. So pistachio farmers, extreme sensitivity to this pest and pesticide application materials to try to control them [5]. The pest control from 1950 onward was mainly using chemical insecticides and pesticides on the already large number of insecticides have been tested formally. Due to the

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emergence of insecticide resistance, various insecticides one after another lost its effect [4]. The impact study showed that use of insecticide Mospilan® 200 and 250 grams per 1000 liters of water, pistachio psylla control, and while the effects of pesticides on natural enemies among intermediate risk [1]. Concentration of 300 g per 1000 liters of water, insecticides Actara® (Wettabl Powder 25%) is suitable for pistachio psylla pest control and natural enemies have the adverse effect of [2]. Investigate the effect of plant pesticides containing Palizin®, Sirinol® and Tondeksir® with two concentrations of 2 and 2.5 per thousand showed that all these compounds are able to reduce populations of aphids and mites pomegranate, also mentioned compounds and concentrations used were significant differences were observed, based on the information obtained, to reduce aphid damage pomegranate, pomegranate combined Palizin® to reduce his losses, Tondeksir® combination was more effective [6].

In this study effect herbal pesticides Palizin® in reducing the number of pistachio psylla eggs and nymphs compared to chemical insecticides Mospilan® and controls were determined.

## II. MATERIALS AND METHODS

For doing the project, a garden cultivar owhadi in Kashmar (Khorasan razavi, Iran), was selected in 2012. Experiment with 3 treatments, including pesticide plant (Palizin® SL70%) (soap thickened coconut oil 60 to 70 percent with extracts of peppermint and eucalyptus, 2000 ppm concentration), insecticide a chemical commonly used (Mospilan®, SP 20%, 250 ppm) and control (spraying water) and each treatment consisted of two trees (a total of 24 trees) are a randomized complete block design with four replications Palizin® pesticide plant (manufactured by Kimiasabzavar Co) was launched in May jnd were sprayed by the sprayer wheelbarrow for stirrer was done. The percentage reduction in

egg and nymph populations by counting the number of pistachios a day before and 3, 7, 14 and 21 days after spraying, respectively. Statistical analysis was performed using SAS statistical software.

### III. RESULTS

The mean percentage decrease in pistachio psylla eggs after spraying pesticide plant that Palizin Better than chemical pesticides Mospilan® and egg reduction rate in the treated pistachio psylla Palizin®, respectively, including 68/77± 7/48, 85/26 ± 0/37, 46/24 ± 4/96 and 59/35 ± 10 / 95% at 3, 7, 14 and 21 days after spraying and the egg count reduction pistachio psylla treated Mospilan®, respectively, including 68/54 ± 7/30, 91/62 ± 1/65, 67/56 ± 6/06 and 43/31 ± 17/60% at ages 3, 7, 14 and 21 days after spraying, and while the control group at 7 and 14 days after spraying, respectively, 44/47 ± 16/85 , 43/56 ± 14/67% reduction in the population studied (table 1).

| Treatment | 3 |
|---|---|
| Palizin® | 68/77± 7/48 A |
| Mospilan® | 68/54 ± 7/30 A |
| Control | 55/29±4/4/88 A |

Also comparison of pistachio psylla eggs show that after spraying the crowd in all treatments reduced and then increases and have control over the implementation research it has the highest number of eggs (Chart 1).

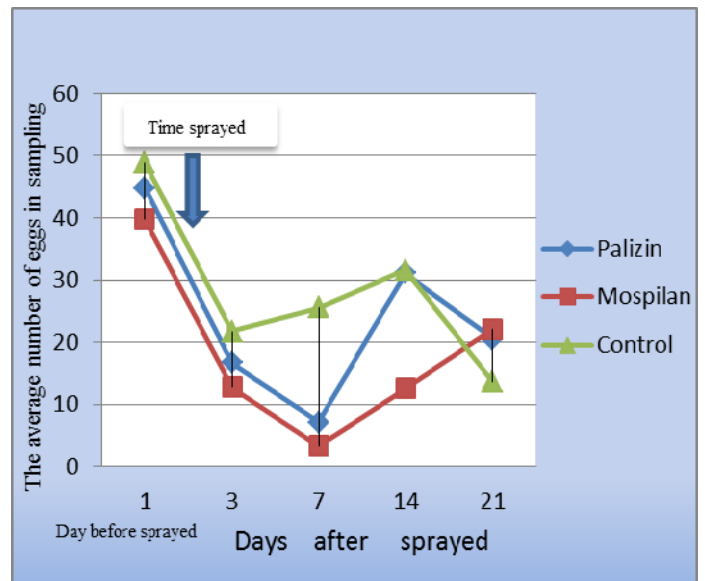| Table 1: Average pistachio psylla egg count reduction test in different treatments | Percent reduction in egg in the days after spraying | | |
|---|---|---|---|
| | 21 | 14 | 7 |
| Palizin | 59/35 ± 10 / 95 A | 46/24 ± 4/96 B | 85/26 ± 0/37 A |
| Mospilan | 43/31 ±17/60 B | 67/56 ±6/06 A | 91/62 ± 1/65 A |
| Control | 72/80±5/57 A | 43/56 ± 14/67 B | 44/47 ± 16/85 B |



Chart 1) changes in the average number of psylla eggs during the research.

The mean percentage reduction in the number of pistachios nymph after spraying pesticide plant that Palizin® better than chemical pesticides Mospilan® and nymph reduction rate in the treated pistachio psylla Palizin®, respectively, including 96/14 ± 1/74, 90/80±2 , 80/41 ± 5/76 and 59/48 ± 8/61% at ages 3, 7, 14 and 21 days after spraying, and despite the fact that the loss nymph pistachio insecticide chemicals

Mospilan®, respectively, including 68 / 53 ± 7/29, 91/62 ± 1/65, 67/56 ± 6/06 and 43/41 ± 17/60% at ages 3, 7, 14 and 21 days after the spraying. The reduced number of control nymph pistachios, respectively, including 29/55 ± 88/4, 44/47 ± 16/85, 43/56 ± 14/67 and 72/80± 5/57% in times of 3, 7, 14 and 21 days after spraying (Table 2).

## IV. DISCUSSION

Also comparison of pistachio psylla nymphs show that after spraying the crowd in all treatments reduced and then increases and have control over the implementation research it has the highest number of nymphs (Chart 2).
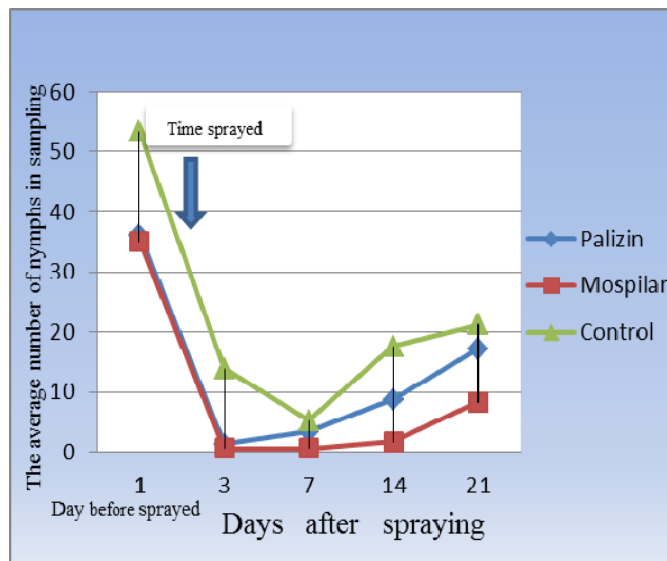


Chart 2) changes in the average number of psylla nymph during the research.

According to the analysis of pistachio psylla variance of the number of eggs in the first 3 days after spraying there was no significant difference in all treatments had the same effect but control of all pesticides in the 7 days after spraying in group B familiarize, Also Palizin® pesticide plant at 21 days after spraying and other treatments percent better performance and significantly reduce the number of eggs were lower. However, the use of conventional insecticides Larvin increases pistachio psylla eggs and therefore not recommended [7].

Based on the analysis of variance nymphs in 3 days after spraying pesticide treatment plant Palizin® highest population decline was observed. The chemical insecticide treatments Mospilan® better performance and lower control mortality were statistically significant. So that insecticide Mospilan® in group B and group C were treated controls.

The analysis of variance showed that the number of nymphs in the seven days after spraying insecticide treatments, Palizin® herbal pesticides and chemical insecticide Mospilan® were in a group, The control group mortality was significantly lower in group B familiarize different. Analysis of variance showed that the percentage reduction in the number of nymphs at 14 days after spraying the treated pesticide plant Palizin® than other treatments, in group A familiarize, and treatments with mortality less statistically significant so that insecticide

| Table 2: Average pistachio psylla nymph count reduction test in different treatments | | Percent reduction in nymph in the days after spraying | | | |
|---|---|---|---|---|---|
| | Treatment | 3 | 7 | 14 | 21 |
| | Palizin® | 96/14 ± 1/74 A | 90/80±2 A | 80/41 ± 5/76 A | 59/48 ± 8/61 A |
| | Mospilan® | 68 / 53 ± 7/29 B | , 91/62 ± 1/65 A | 67/56 ± 6/06 B | 43/41 ± 17/60 A |
| | Control | 29/55 ± 88/4 C | 44/47 ± 16/85 B | 43/56 ± 14/67 C | 72/80±5/57 A |

Mospilan® in Group B in group C and control groups.

Analysis of variance nymphs in the first 21 days after spraying showed that there is no significant difference between treatments. The greatest loss is Palizin® treatment plant pesticides. Evaluation of three pesticide plant Tondeksir®, Palizin® and Sirinol® *Planococus citrus* mealy bug in the lab showed that Palizin®, Tondeksir® plant pesticides and pesticide concentration of 3000 ppm compared to 3500 ppm concentration Sirinol® plant creates more losses [9]. Comparison of citrus leafminer larvae mortality at 96 days after *Phylocnistis citrella* show that treatments with pesticides Tondeksir, Sirinol, Palizin tracer at a concentration of 2 per thousand in 1000 liters of water 0/75 shows that insecticide Tondeksir® Add oil to the greater mortality, but mortality pesticides trocar above the rest [10]. Compare Palizin® herbal pesticides, Sirinol®, and mineral oil on citrus leafminer larvae indicated that insecticides plant Sirinol® and Palizin® had higher mortality rates than the B.T insecticides and mineral oil [8].

## V. Conclusions

According to information obtained by the use of Palizin® found that the performance of pistachio psylla control not only not less, but more efficient than chemical insecticides are Mospilan®. The most important advantage of using herbal pesticides Palizin® compared to conventional chemical pesticides to control pests of pistachio psylla using non-chemical or organic compounds that have a negative impact on the environment, human beings and the natural enemies of the pests absent.

The other advantages of herbal pesticides Palizin® preserve natural enemies. Considering the results obtained, in order to produce healthy, organic, herbal pesticide spraying Palizin® (2000 ppm concentration) for the management of pistachio psylla in pistachio orchards, can be used.

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# Snow water equivalent estimation in the upstream basin of Karun 3 dam using satellite data and SRM model

Soroosh Bordbar, Sam Bordbar

*Abstract*—In this study, using 8 day MODIS snow cover images and data of daily temperature and precipitation, daily runoff flow in upstream basin of Karun 3 Dam is simulated by means of SRM model. In order to calibrate and to evaluate the model, 2002 and 2003 water years are respectively chosen and based on 2002 daily measured discharge data, the parameters of the model are evaluated and calibrated and the coefficient of determination and volume deference percentage are respectively 0.81 and 2.98. The daily measured discharge data of 2003 are used to evaluate the model accuracy and the coefficient of determination and volume deference percentage are respectively 0.71 and -0.38. Results show that SRM model in line with satellite data is efficient to simulate daily runoff in ungagged basins. Besides, sensitivity analysis of the model parameters indicates that the model is most sensitive and least sensitive, respectively to recession coefficient and time lag.

*Keywords*— MODIS, Remote sensing, Snow water equivalent, SRM, Upstream basin of Karun 3 dam.

## I. INTRODUCTION

A small part of the world is mountainous areas. However this small part plays a significant role in the hydrological aspects of basins. And, in most parts of the word, snow cover in mountains is the main source of surface and ground water. The goal of this study is to forecast daily runoff from snowmelt in upstream basin of Karun 3 dam based on ground-based data of daily temperature and precipitation and snow covered data form MODIS images by means of remote sensing technology and SRM snowmelt model [1].

## II. LITERATURE REVIEW

The Snowmelt Runoff Model (SRM) is designed to simulate and forecast daily stream flow in mountainous basins where snowmelt is a major runoff factor. SRM was developed by Martinec (1975) in small European basins. Thanks to the progress of satellite remote sensing of snow cover, SRM has been applied to larger and larger basins up to the area of 917,444 km2 [6]. SRM also successfully underwent tests by the World Meteorological Organization (WMO) with regard to runoff simulations in 1986 [4].

Tajdari and Vazifeh-doost (2011) extracted snow covered data of Navrood basin from MODIS images and had applied SRM to simulate the daily stream flow for 2001 water year. Results show that 12 percent of annual stream flow volume is due to snow melting [3].

Romshoo and Dar (2013), by means of remote sensing and SRM had simulated snow water equivalent for the Lidr basin in Kashmir. They had used meteorological data of daily temperature and precipitation. And, the coefficient of determination and volume deference percentage of this simulation are respectively 0.87 and 1.23 [7].

## III. STUDY AREA

The study area is the upstream basin of Karun 3 dam which is located between 49°33′ & 52°00′E and 30°16′ & 32°40′N and is a sub-basin of big Karun watershed basin and contains Chaharmahal and Bakhtiari province and parts of Fars, Kohgiluyeh boyer ahmad, Isfahan and Khuzestan provinces. This basin has an area of 24407 km$^2$. The highest point of the basin is 4388 m and the lowest point is 666 m above mean sea level. Fig. 1 shows the location of the basin in Iran.

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Fig. 1 Location of the basin in Iran

## IV. DATA

SRM[1] is a conceptual model and is based on degree-day factor. In this model, each day, the water produced from snowmelt and from rainfall is computed, superimposed on the calculated recession flow and transformed into daily discharge from the basin according to Equation (1) [8]:

$$Q_{n+1} = \left[ C_{sn} a_n \left( T_n + \Delta T_n \right) S_n + C_{Rn} P_n \right] \frac{10000}{86400} \left( 1 - K_{n+1} \right) A + Q_n K_{n+1} \quad (1)$$

In Equation (1), Q is the average daily discharge [$m^3 s^{-1}$], Cs is the snowmelt runoff coefficient, Cr is the rain runoff coefficient, a is the degree-day factor [cm $°C^{-1} d^{-1}$], T+ΔT is the temperature at the hypsometric mean elevation [$°C$ d], S is the ratio of the snow covered area to the total area of the basin, P is the precipitation contributing to runoff [cm]. A is the area of the basin or zone [$km^2$], n is the sequence of days during the discharge computation period, k is the recession coefficient indicating the decline of discharge in a period without snowmelt or rainfall, and (10000/86400) is the conversion fraction from cm·$km^2 d^{-1}$ to $m^3 s^{-1}$.

## V. DATA

Data used in this study are categorized into two groups of satellite images and meteorological & hydrometric data.
- ➢ Satellite images are ground digital elevation model and MODIS[2] snow cover images.
- ➢ Meteorological & hydrometric data are data of daily temperature, daily precipitation, daily discharge, and snow density.

Digital model (DEM[3]) which is used in this study is GDEM[4] which is made from ASTER[5] satellite images. The DEM is used to delineate the basin and to determine the elevation zones and zonal mean hypsometric elevations.

Information about amount of snowfall on the basin, area

[1] Snowmelt Runoff Model
[2] Moderate Resolution Imaging Spectroradiometer
[3] Digital Elevation Model
[4] Global Digital Elevation Model
[5] Advanced Spaceborne Thermal Emission and Reflection Radiometer

percentage of each elevation zone which is covered with snow, and snow spatial distribution are the basic required information of every snowmelt model. In this study MOD10A2 (MODIS/TERRA Snow Cover 8Day L3 Global 500m, Grid Version5) is used to extract snow covered area data of the basin.

### A. Area and zonal mean hypsometric elevation

Area and zonal mean hypsometric elevation are the required parameters of SRM. Upstream basin of Karun 3 dam is between 662m to 4388m above mean sea level which is divided into 6 elevation zones. In order to determine zonal mean hypsometric elevations, elevation- cumulative area percentage diagram is plotted. Table I shows characteristics of elevation zones and Fig. 2 shows basin elevation zones.

TABLE I: ZONAL ELEVATION CHARACTERISTICS

| Elevation zone No. | Elevation range (m) | Hypsometric mean ele. (m) | Zone area (km²) | Area percentage |
|---|---|---|---|---|
| 1 | 662-1388 | 1186 | 915 | 3.75 |
| 2 | 1388-1888 | 1718 | 3545 | 14.53 |
| 3 | 1888-2388 | 2189 | 10262 | 42.02 |
| 4 | 2388-2888 | 2564 | 7517 | 30.78 |
| 5 | 2888-3388 | 3047 | 1709 | 7 |
| 6 | 3388-4388 | 3596 | 467 | 1.91 |



**Elevation (m)**
- (1) 662 - 1,388
- (2) 1,388 - 1,888
- (3) 1,888 - 2,388
- (4) 2,388 - 2,888
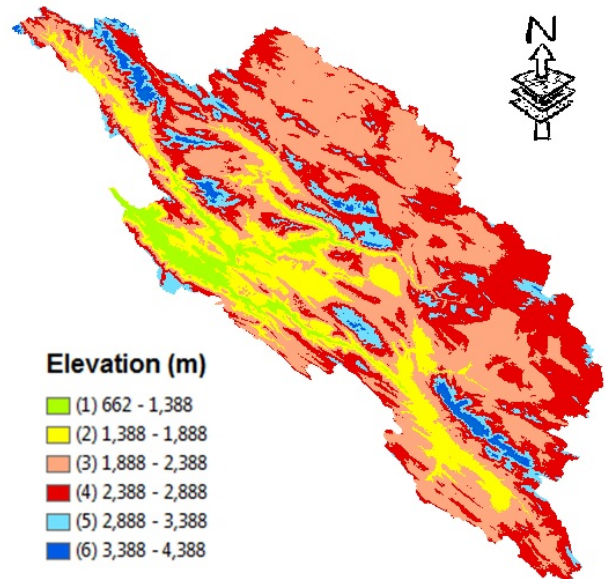- (5) 2,888 - 3,388
- (6) 3,388 - 4,388

Fig. 2 Zonal elevation map

As SRM needs daily mean temperature data at zonal mean hypsometric elevation, data of the following stations are used based on the examination of characteristics and location of all synoptic, climatology and rain-gauge stations in the basin. Table II shows synoptic and climatology stations and Table III shows the name of chosen rain-gauge stations in each elevation zone. And, Fig. 3 shows drainage map of the basin

and the location of stations.

Table II: Thermometer stations characteristics

| Name | Latitude | Longitude | Elevation (m) | Station type | Elevation zone |
|---|---|---|---|---|---|
| Dehdez | 31.72 | 50.27 | 1457 | Synoptic | 1 |
| Malkhalife | 31.28 | 51.25 | 1762 | Climatology | 2 |
| Brojen | 31.95 | 51.30 | 2197 | Synoptic | 3 |
| Avargan | 31.90 | 50.95 | 2410 | Climatology | 4, 5 & 6 |

Table III: Rain-gauge stations

| Elevation zone | Rain-gauge stations Name |
|---|---|
| 1 | Sar-rak & Barez |
| 2 | Yasooj, Pataveh, Kata & Ab-torki |
| 3 | Soolgan, Dastna, Firooz abad yasooj & Hirgan |
| 4 | Sepidar, Mehrgerd, Batari, Dehkade-Shahid & Dezak-Abad |
| 5 | — |
| 6 | — |

### B. Daily discharge

SRM needs data of daily discharge at the outlet of the basin. Thus, data of Pol-shaloo hydrometric station, which is the nearest hydrometric station to the dam location in the upstream basin, is used. Latitude and longitude of this hydrometric station are respectively 31.75 and 50.13.
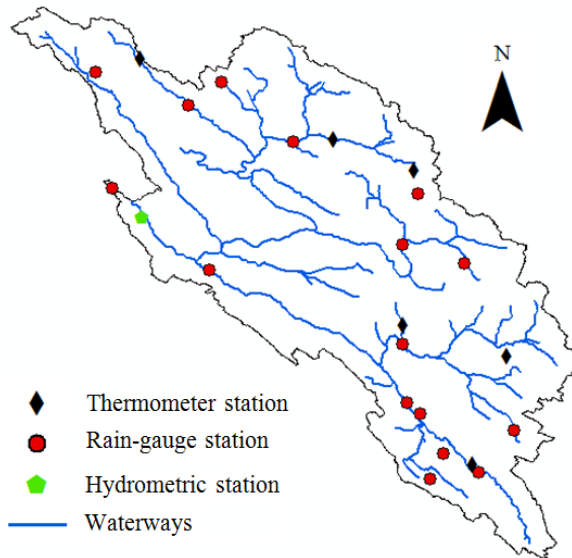


Fig. 3 Drainage map of the basin and the location of stations

### VI. PARAMETERS

Basic and required information to determine model parameters are not available in Iran basins. Therefore, these parameters are chosen based on a primary guess or calculated with experimental equations or extracted from previous studies and are calibrated afterwards.

### A. Runoff coefficient

As required data to calculate rain and snowmelt runoff coefficient are not available in the basin, based on the SRM user's manual information, value of 0.7 is chosen to start calculation and through trial and error in the calibration step, values of 0.242 and 0.320 are respectively chosen for the rain and snowmelt runoff coefficient [2].

### B. Degree-day factor

As required data to calculate degree-day factor are not available in the basin, using snow-gauge stations' data of 2002 and 2003 water year and with experimental equation (2) value of 0.49 is calculated as the primary guess. And, in the calibration step, value of 0.31 is chosen as the degree-day factor [2].
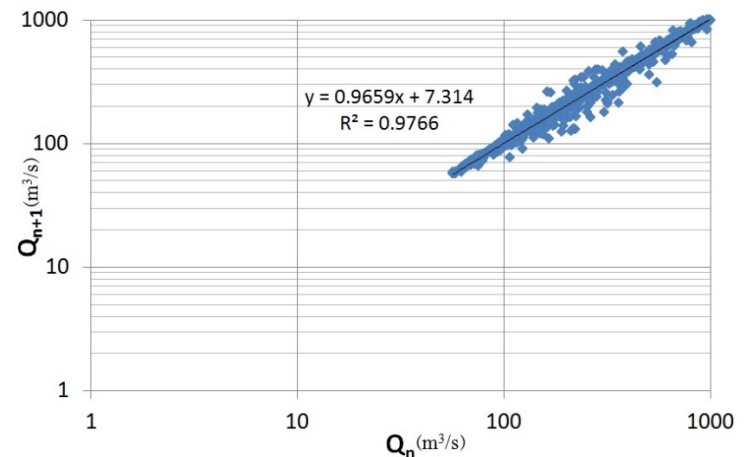
$$a = \frac{1.1\rho_s}{\rho_w} \tag{2}$$

### C. Critical temperature and time lag

As required data to calculate critical temperature and time lag parameters are not available in the basin, the value of 2.4 °C and 18 hours are respectively extracted from previous studies for critical temperature and time lag parameters [5].

### D. Recession coefficient

In this study, in order to calculate recession coefficient parameter, daily discharge data of Pol-shaloo hydrometric station of 35 water years from 1969 to 2004 are examined. Plotting the 35 years hydrograph results in that the recession period of the basin is from April to October. Fig. 4 shows the logarithmic scale of $Q_{n+1}$-$Q_n$ diagram for the period of 35 years. And, values of x and y are respectively 1.232 & 0.038 for the period of October to April and are 1.180 and 0.035 for the period of July to September [2].



Fig. 4 $Q_{n+1}$-$Q_n$ diagram for the recession period

## VII. CALIBRATION

SRM is a conceptual model and its function contains the two steps of calibration and validation. As Pol-shaloo hydrometric station's data are available until 2004 water year. SRM model is run for two 2002 and 2003 water years. And, 2002 water year is chosen for the model calibration. As some measured data are not available in the basin to calculate the values of some parameters, first, these parameters are evaluated based on basin characteristics and primary guesses, and are determined through trial and error in the calibration step. These parameters are rain and snowmelt runoff coefficient, degree-day factor, critical temperature, time lag, and recession coefficient.

Fig. 5 shows simulated discharge - measured discharged diagram in the calibration period.

Comparison between daily simulated discharge and daily measured discharged shows that the coefficient of determination and the volume difference percentage are respectively 0.81 and 2.98 in the calibration step.
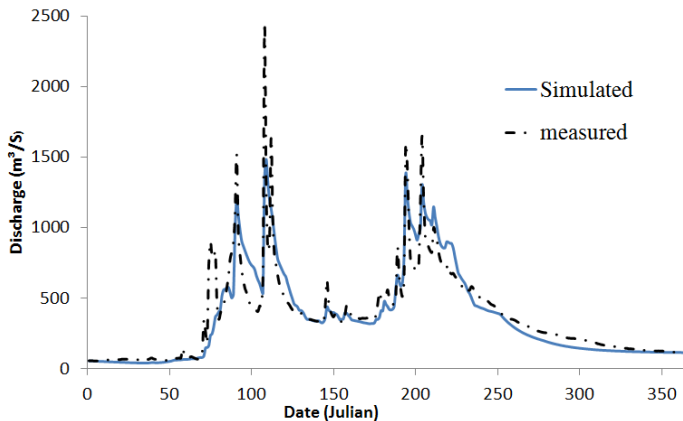


Fig. 5 Simulated discharge - measured discharged diagram, calibration period

## VIII. VALIDATION

In order to evaluate the accuracy of the results and evaluated parameters in the calibration step, the model is validated for the 2003 water year. Fig. 6 shows simulated discharge - measured discharged diagram and Fig. 7 shows the correlation diagram of the simulated discharge - measured discharge in the validation period.

Comparison between daily simulated discharge and daily measured discharged shows that the coefficient of determination and the volume difference percentage are respectively 0.71 and -0.38 in the validation step.
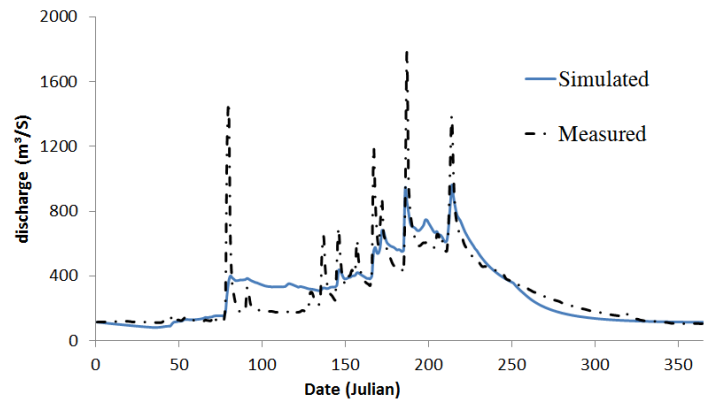


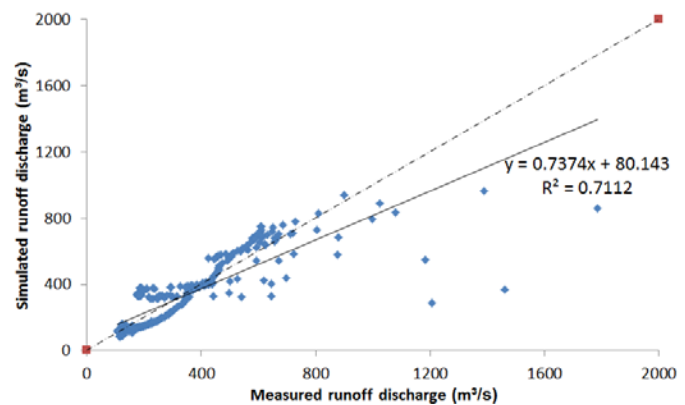Fig. 6 Simulated discharge - measured discharged diagram, validation period



Fig. 7 Correlation diagram of the simulated discharge-measured discharge in the validation period

## IX. SENSITIVITY ANALYSIS OF SRM PARAMETERS

In order to analyze the SRM model sensitivity to its parameters, parameters of degree-day factor, rain and snowmelt runoff coefficient, critical temperature, time lag and x & y values are 5, 10, and 20 percent increased and 5, 10, and 20 percent decreased and the daily runoff discharge of 2002 water year is simulated and the result is that the model is most sensitive and least sensitive, respectively to x and time lag.

## X. CONCLUSION

In order to calibrate and validate the SRM model, two 2002 and 2003 water years are chosen and based on daily measured discharge data of the 2002 water year, model parameters are evaluated and calibrated and the coefficient of determination and the volume difference percentage are respectively 0.81 and 2.98 in the calibration step. And, In order to evaluate the accuracy of results, 2003 water year is chosen and the coefficient of determination and the volume difference percentage are respectively 0.71 and -0.38 in the validation step. And, based on the complex hydrological behavior and vastness of the basin, the results are appropriate and acceptable.

Results show that SRM model in line with satellite data is

efficient to simulate and forecast daily runoff in ungagged basins where snowmelt is a major runoff factor.

Based on the results of this study and previous studies and as this model has lots of parameters and related data are not available in almost all basins of Iran, Thus, it is essential to calibrate the model parameters before applying the model for each basin in Iran.

Sensitivity analysis of the model parameters indicates that the model is most sensitive and least sensitive, respectively to x & y (Recession coefficient) and time lag.

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# Watershed management along with indigenous knowledge to provide nutritional needs (Case study: Shahindezh City)

Abuzar Niknam, Emad Fahim, Hosein Mohsenizadeh, Mohammad Khajeh

*Abstract*—In our country, application of indigenous knowledge has been used by residents of watershed-basins from the distant past, so that the role of these methods in the conservation of soil and water resources is undeniable. In present study we tried to represent the indigenous knowledge development model as a novel approach for management development of watershed-basins, while expressing the importance of indigenous knowledge and its position forreducing disasters'hazards in watershed-basins, and also in participation to organize watershed management projects to protect water and soil resources, which are rich sources to providing human nutritional needs.

*Keywords*— Watershed Management, Sustainable Development, Indigenous Knowledge, Participation, Nutritional Needs.

## I. INTRODUCTION

Indigenous knowledge is the knowledge of human groups in association with various contexts of existence, life and livelihood, which is formed by interaction with natural and social environment and through test and error over time and mostly is unwritten and verbal. Indigenous knowledge is a part of national capital for any nation, which encompasses their local beliefs, values, methods, instruments, and awareness [1]. The experience shows that the indigenous knowledge not only has no conflict and contradiction with formal knowledge, but the different features of indigenous knowledge make it as a good complementary for formal knowledge. Indigenous knowledge is available, understandable, simple, efficient and affordable. Indigenous knowledge views the problems holistically and its translation way is verbal. This kind of knowledge is dynamic and improves over time, and since it has evolved within local natural and social environment, is completely consistent with indigenous and regional conditions. Indigenous knowledge is considerable in third

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world agriculture and often goes unnoticed. Indigenous knowledge can be known as an ordered set of awareness and knowledge that has been obtained by local people. Studying in indigenous knowledge context is a study about human behavior pattern and especially his interaction with the environment. Despite all the modern equipments and new utilities that are available for farmers, they prefer to use tangible and sensible knowledge, the knowledge that belongs to them and they believe that it is appropriate for their specific objectives that they have in their minds [2].

Indigenous knowledge is valuable national source that its increasing influence along with indigenous sustainable development as a respect base for a cultural background of a nation cannot be overlooked. This emphasizes on the necessity of its scientific and practical organizing along with rural sustainable development based on agricultural extension programs. Hence, systematic perception of indigenous knowledge as a milestone for compiling the experimental background of local villagers with the scientific elements of agricultural researchers is conceivable only from the agricultural extension system point of view. Obviously, the key to sustainable success and popularity of the systematic development and progress of the rural environment is known by inspiration from local micro-systems based on indigenous knowledge and its innovative integration with modern knowledge and technologies [3]. The importance of giving attention to indigenous knowledge relates to the nature of conservation technologies. The conservation technologies that are implemented in one watershed-basin due to improving the land management and consequently, reducing the effects of natural disasters, have a goal beyond mere increasing of farm productivity [4].

According to public support of desirable use of natural facilities and attracting their participation in order to implementing programs related to optimum productivity of God-given resources have been discussed as the fundamental objectives of the sustainable development since past. A transient analysis of the results and achievements resulting from implementing the watershed management projects indicates the reality that the much public conscious participation is deep in this issue, the much programs'

objectives accomplish successfully [5]. Therefore, using their knowledge is a long step for sustainable development of natural resources and satisfying nutritional needs of human being.

## II. MATERIALS AND METHODS

Climate conditions of the country has caused to water shortage and led to decrease in production efficiency in the country. Incidents of floods in most watersheds of the country is associated with soil washing and transportation, which in addition to destroying the water, makes the fertile soil out of reach. Physical and financial damages of flood in downstream are one of axioms that disclaim the need for additional explanation. Acquisition information from native people in order to implementing watershed management operation due to control the flood spread, which usually is followed with the aim of preventing flood damage, increasing botanical cover, improving soil quality and increasing groundwater, for few years, it has been favored by executive authorities in the country. The flood dispersion and the artificial feeding are of effective and admirable endeavors that could bring revenue and occupation growth for residents of watersheds.

## III. REGIONAL SITUATION

Shahindezh City is one of 14 cities of West-Azerbaijan Province, which located in southeastern part of the province. The central district of the city is Shahindezh. Shahindezh city is bounded by East-Azerbaijan Province from the north, Kurdistan Province from the south, Bukan City from the southwest, Miandoab City from the northwest, and Takab City from the east. Shahindezh located in a land, which inhabited by various social groups with different traditions, mores, and beliefs, from nomadic tribes, clans and villagers holding ancient costumes and traditions to city-dwellers and religious and ethnic minorities like Zoroastrian, Armenian, Kurd and Turk, each one has its own culture. From the total population of the city, 89.99% is Muslim and others are 0.02% Zoroastrian and 0.08% other religions (Jewish, Christian and so on).

In 1381, the area of Shahindezh city was about 2839 square-kilometers and its portion of province total area was about 6.7%. The population of Shahindezh city according to 1381 census has been estimated about 104814, which is equal to 7.3% of the province population. 31.6% and 68.4% of the population were in urban and rural regions respectively. In the census of 1381, the city consisted of 1 urban region, 2 districts, 7 rural district and 209 villages with residents and 20 vacant villages. Fig. 1 shows the situation of the city.
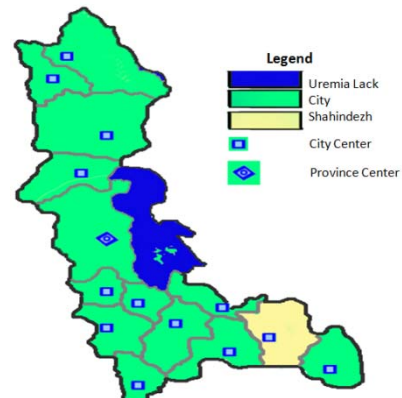


Fig. 1 location of Shahindezh

The study has been conducted using qualitative research methods such as observation and review of articles, documents and library sources related to indigenous knowledge. In a part of the study, in order to collecting information by observation as a field observation, by presence in the watershed basin of Zarinehrud, one of important rivers of the city, consideration and introduction for indigenous operation of soil conservation has been implemented. In addition, a part of the information has been gathered through searching in domestic and foreign articles.

Since the natural resources, pastures and soil resources of the city are very rich (Fig. 2 and 3), in order to keeping it stable and also eliminating the hazards associated with the destruction, we must appeal to pasture-maintaining programs and especially watershed management for help which requires full and experiential information of that territory's people. So, by distributing questionnaires, interview, and making attractive meetings for villagers especially for old persons, very useful information about water and soil resources, also about the magnitudes and size of previous floods can be obtained. In order to achieve the study objective and testing the discussed hypothesis, the study was implemented in the framework of a survey research. The statistical population of the research consisted of all villages in which watershed management activities have been carried out by the relevant agencies from the year 1370 onward. Needed information for achieving the study objectives obtained through applying a questionnaire that was completed by interviewers through personal visiting. A seven-member committee consists of rural sociology, watershed management, and agricultural extension scholars and experts determined the validity of the questionnaire.

Photo by: E. Fahim

Fig. 2 a view of the pastures situated in Shahindezh City



Photo by: E. Fahim

Fig. 3 a view of Zarrinehrud River situated in Shahindezh City

#### IV. RESULTS AND DISCUSSION

Implementing watershed management projects in watershed basin of Zarrinehrud has had very helpful effects, such as social effects, economical effects and so on. We can say that the effects of these projects have caused serious change in the attitude of this region's people about watershed management operations. These operations led to high level of public satisfaction, but unfortunately had no considerable influence to prevent villagers from immigration to cities. According to conducted studies, the participation degree of the rural people of the studied city in watershed management projects and its difficulties presented in tables I and II. Table IIindicates the obstacles of villagers' participation.

TableIhow much do you know the necessity of consulting with local residents before implementing watershed management projects?

| Response | Frequency | Frequency percent | Cumulative percent |
|---|---|---|---|
| Very low | 2 | 3.2 | 2.2 |
| Low | 5 | 5.5 | 7.8 |
| Medium | 11 | 10.5 | 20 |
| High | 25 | 28.2 | 47.8 |
| Very high | 47 | 52.6 | 100 |
| Sum | 90 | 100 | |

Table II the obstacles of peoples' participation in implementing of watershed management projects

| Average obstacles | Average |
|---|---|
| Lack of profiting by credit facilities (loans) | 5.20 |
| Inadequate training classes | 6.8 |
| Having insufficient property (land) | 5.2 |
| Not having financial ability of villagers | 7.25 |
| Unilateral decision making and without taking villagers' opinions about implementing watershed management projects | 4.93 |
| Not having sufficient information about the advantages of watershed management projects | 2.99 |
| Lack of confidence in effectiveness of implemented projects | 5.87 |
| Useless administrative regulations | 3.24 |
| Insufficient broadcasted training-programs from mass media about watershed management and natural resources | 5.36 |

With respect to table I, 89 persons from 90 interviewed people believe that consulting with residents of project site before implementing the operation is necessary, and this will lead the village residents to participate more in maintaining the structures and implemented operation and project success.

The obstacles to public participation in watershed management projects implementation measured in nine items by using of Likert 5-level scale. The obtained results indicate that the most important inhibitor factor is associated with the factor *inadequate training classes* with an average of 5.36. Among the studied inhibitor factors, the factor *Insufficient broadcasted training-programs from mass media about watershed management and natural resources* has had minimum role. Table II indicates the detailed results.

Nowadays, the role of indigenous knowledge in local decision making related to reducing natural hazards for watershed basins is undeniable and it is time that experts and professionals avoid from the mere technical point of view in order to reduce natural hazards and, pay attention to social and cultural aspects associated with reducing natural hazards such as indigenous knowledge.

Obviously, at the present time, the indigenous knowledge provides a strong foundation for problem solving strategies associated with natural hazards and logical exposure to them in watershed basins. Meanwhile, it seems that the beliefs of managers, planners, and experts to profitability of above-mentioned knowledge, and its extension and development scientifically and systematically, and depend upon local populations and watershed-residents participation could be useful.

#### V. CONCLUSION

Regarding the results of applying indigenous knowledge with the aim of reducing natural disasters hazards in watershed

basins, it requires a kind of systematic activity. Accordingly, it is necessary for planners and policy makers to understand the steps of indigenous knowledge development and apply indigenous knowledge based on that. The results indicate that the role of indigenous knowledge in Shahindezh city to establishing and progressing watershed management projects is very negligible. The results show that recognizing indigenous knowledge in order to reducing natural disasters hazards is difficult, because it may be mixed with the technologies and cultural values, or be a part of daily life of watershed basin residents. However, technical and social analysis in order to recognizing indigenous knowledge is necessary. Recognition of indigenous knowledge should be based on the principle of learning from local people, i.e. ranchers, farmers, shepherds, in a word, watershed residents, and at the same time, we must prepare the way for increasing the awareness of local people about the importance of indigenous knowledge. The collectors of indigenous knowledge should be of well-trained persons, acquainted with people's culture, traditions and mores, have adequate skills in collecting indigenous knowledge context. Moreover, they should be good viewers, listeners, and learners, and believe in beneficial functions of indigenous knowledge in reducing hazards.

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# Analysis of recognition informal settlements Case Study: Qom, Iran

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*Abstract*— Informal residence is abnormal phenomenon that is observed in comparison with conventional tissue. This phenomenon is a manifestation of meeting the housing needs of low-income housing that has no place in a formal atmosphere and city planning And in the above legal limits to beyond their capacities are struggling to establish settlements in the border town. The purpose of this paper to address the issues of marginalized and informal settlements and urban fringe areas of knowledge. The study area was the city of Qom and research methodology is descriptive - analytical study which uses the library studies and surveys have been conducted in the study area and data collection methods have been used library with field studies. Findings of research shows that in general there are 16 settlements informal Qom, most of which is adjacent to the highway, railway and high voltage electricity pylons in terms of health risks, and physical break in such high-risk areas. The most deprived neighborhoods in marginal neighborhoods Shadgholy Khan and Ghale Kamkar were known as the mean average of respectively 76.2 and 68.5 percent.

*Keywords*— informal settlement, Qom, marginalized urban development.

## I. STATEMENT OF THE PROBLEM

Today, informal settlements in urban areas are considered as a major problem. Before the Industrial Revolution, and subtle changes in urban communities and consequently the body of a ventricular cities with significant exposure did not change along with changes in the economic, social, cultural and villagers rushed to the big cities urban tissue and its related factors changes dramatically. These changes in city management and economic damage too many cities established. The peripheral areas of research in understanding the characteristics of the economic, social, physical and pays the appropriate suggested strategies to reduce urban fringe areas will have problems.

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## II. THE NEED FOR RESEARCH

Characteristics of informal settlements with poor quality housing and lack of physical infrastructure. With little access to sanitation and drinking water borne diseases are a constant threat to residents (Anklesaria, 2002) of the cities in developing countries with issues like rising unemployment , the informal economy , informal housing , violence , social disorder , delinquency and crime have faced . Recognizing the marginalized areas in major cities and offer solutions to the loss of margin and exposure in major cities with facilities necessary for the proper urbanization as the brought back, this study examines of the settlement of informal pay.

## III. RESEARCH OBJECTIVES AND QUESTIONS

The overall goal of this research is to identify marginal areas and offer solutions for improving the region is the city of Qom.
1. What are the informal settlements in Qom?
2. What physical features fringe areas?
3. Have the features that are marginal in terms of housing and residents of neighborhoods?
4. What strategies to improve informal settlements?

## IV. LITERATURE

Consequences of industrial growth in western countries the incidence of many social problems that marginalization is one of them, so that even today these countries, despite having plenty of development, are not yet capable of resolving this problem and the problem of marginalization still areas around the major cities of the country is seen to be Harlem, New York one of the most famous of these areas (Zahedanian, 1:1369). This phenomenon has issued Western economic programs, as development programs in third world countries were expanded. Poverty in rural areas and uncontrolled population increase, the severity of the problem of unity in Third World countries has doubled. Though analyzing the political economy of expensive, structural causes of population growth in the latter countries, the effect is dependent on the (consequences of the global capitalist system, most emphasis (Gilbert, 1376: 7). Anyway, rural exodus and disability management in the spatial organization

of urban migration, the problem of marginalization has increased a hundredfold. Therefore many researches on this issue, social, and economic affairs has been conducted. Example would be Elias studies (1966), Marshall (1966) and other direct production of George (1989), Panvks, ideas, garden City (Shia, 1375) and the like can be mentioned. these studies are often limited in terms of population growth studies in developing countries since the second half of the twentieth century globally nations, 1998) (United National and the regional (United Nations.2000) continued practical result of this study was to develop strategies and diversification strategies are the most power approach " small towns " by Prakash (1982 ) and Salah Alshkhs (1974 ) , strategy and village - Cities by Friedman ( management and Planning organization, 1363) cited. Nasiri (1382 ) , examining the social harms of addiction and its related businesses , urban studies , he argues , urban areas in terms of geographical distribution of social harms, face of a coordinated their do not show the increasing specialization of jobs in the urban areas of Babylon , the addiction rate decreased with increasing the added amount of primary jobs is ( Nasirikhah , 1382, p 91 ) .

Yazdi sciences , ( 1382 ) , to compare attitudes toward juvenile offenders, juvenile compatible with the Yazd province that concluded Whatever adverse environmental factors and the probability of deviance and deviant intense feeling of frustration can be increased. As a result, the behavior of these individuals is a function of the conditions of their lives, family and social environment (Science Yazdi, 1382, p 155). Salehi Myrzyjrany (1384), a paper entitled "The Pathology of urbanization in Iran" believes that the most vulnerable areas of the root causes of poverty and inequality that their ecological, economic, cultural and unequal distribution of wealth among people is different (Salehi Myrzyjrany, 1384, p 165).

Siddiqui (1378), which examines the problems and residential towns south of Tehran and its effect on attitudes to antisocial behavior is discussed, acknowledged that the tendency of anti-social behavior issues that social and economic development and the formation of a stable away from the stresses and distortions and any possible social planning and social and economic progress makes it a threat.

So the roots of antisocial behaviors with respect to the consequences that such attitudes could be of great importance is the occurrence of such attitudes is not only due to marginalization and poverty, but also can have other causes, but usually expected to underserved areas and poor residents are subjected to pressures that cause them to be better prepared to assume such behavior. (Sodium, 1378).

## V. THEORETICAL FOUNDATIONS

Today, hundreds of millions of people worldwide, especially in developing countries, in settlements illegal and chaotic, poor socio-economic conditions and living environment. England one hundred years ago in England to have their ghettoes and slums notes as a result of the industrial revolution. In 1996, about 25 percent of the world population does not have a home on the dignity of human life (M., 138: 85) Abrams (1946) established the victory of illegal settlements in urban areas providing shelter and housing, and it considered by law defines legal compulsion and coercion. Turner (1969) settlements in such a positive view of the very successful solution to the housing problem in urban areas in developing countries knows (Hadi thirty-one - born, 30 1389). Primarily administrative vacuum has led to the implementation of the management, organization and conduct of the city there is not a specific charge (M Ahmad and others, 1388:14). The valuation models to identify the current status of the residential environment may be useful in understanding the strengths and shortcomings (Rafieian, 1388:4).

-1-6 Informal settlements

The term informal dwellings in informal settlements, illegal and allegedly planned. In informal settlements, residents are exposed to a broad set of environmental and social issues, such as lack of infrastructure, water supply, electricity, sewage and garbage collection, the effects of pathogens in air, food, soil and water on human health, density, and physical hazards such as fires, floods, and earthquakes pointed. In most informal settlements lack access to electricity and gas, from burning coal , wood or other biomass fuels are used to cause damage to the eyes and respiratory ¬ are humans (Benton-Short and Short, 2008:249).

-2-6 Marginalized

The most basic among the most sensitive housing sector in economic and social development plan (Azizi, 1378). Large gaps between family members, competition and conflict for access to live parts due to their scarcity, humiliation, helplessness, Srshkstgy, confusion, lack of identity, inability to swallow their anger and other emotional eating in young people, there are grounds for criminal behavior won. Adventurism, aggression and feelings and desires to accede to instantaneous features of the culture of poverty that focuses on marginalized areas is the ruling (Ahmad, 1384), Or in other words, the concept of marginalized people in the city are said to be ¬residential units in the non- life and are considered among the marginalized (Abedin Drkvsh, 1372: 121).

-3-6 Formation of marginalized and informal settlements

Generally speaking, due 5 can be predisposing factors in the formation of micro Hashynh urbanization and informal settlements include:

1. Lack of clear and effective programs to meet the needs of low-income housing in appropriate geographical distribution.

2. Lack adequate prediction of low-income residential space in the urban fabric designs and standards applied outside of their means.

3. Poor access to formal systems of credit and mortgages for low-income workers especially in the informal sector.

4. The existence of illegitimate power bands and the merchants of the earth parallel to the negligence and failure to supervise and control the construction, especially in urban interstitial space.

5. Lack of institutionalization for low-income and non-plant sources, gathering support and guidance on the administration of self-help housing (Exchange, 7:1381).

4-6 Consequences of informal settlements

1 - Irregularity in the size and composition of components, problems of access and basic services (water, electricity, sewage disposal and surface informal and non-health), very low levels of per capita superstructure services (education, health, etc.), the characteristics is considered. Automotive and non-compliance with any rules and principles of settlement construction makes it virtually organizations face the disturbing physical habitat: take (SHEIKHI, 51 - 36, 1381).

2 - Causing social pathology. Alcoholism , murder , mental disorder , instability, marital status , mortality, juvenile delinquency , schizophrenia , crime , sin and corruption , destruction , Kane still with science, culture , social deviance , assault and robbery , and so is the city .

3 - congestion and overcrowding , shortage of land and lack of needed residents , including educational facilities , cultural services, green spaces and leisure , and a member of the police , failure and imbalance of streets and roads and other infrastructure in the region ,space in urban areas are leading to confusion .

4 - Low-income communities to go along with the city and its suburbs, causing an unhealthy environment which has polluted urban spaces that marginalized the poor and the poor with the rent, the minimum of houses Jayjayy low, and the living provide Daily t do. (F - 141: 1368).

5 - Lack access to clean drinking water, sanitation and sewerage has. Residents are exposed to a broad set of social and environmental issues are such that they can ¬ lack of infrastructure, water supply, electricity, sewage and garbage collection, the effects of pathogens in air, food, soil, water and health human density, and so on

6 - These settlements lack access to electricity and gas, from burning coal, wood or other biomass fuel use causing damage to the eyes and respiratory rate are human. Due to the high population density in slums and informal settlements, permanent physical contact between susceptible and infectious individuals in the population focus and exposure can result in the transmission of communicable diseases.

7 - sub- cultures led to conflict, hostility and longstanding disputes, corporate education, property, honor and dignity is affected and causes of conflicts, including the assassinations of accidental addiction. These factors are clearly visible in marginal areas.

8 - and illegal sale of prohibited goods such as CDs , tapes, vulgar or pornographic material , alcohol , illicit drugs and doping , the use of satellites and the instruments .

## VI. RESEARCHES

Methods: This descriptive - analytic study. First, through literature review , attempts to develop a theoretical framework , processes , materials and methods Askanhay informal settlements have been paid , and then using field research will

be conducted a case study on the city of Qom . To collect data using the field data collection methods and areas of the city library , taking notes from Ktbha , articles, results, seminars, projects , statistics, official letters , doctoral dissertations , master's theses and official institutes and centers so that , linked Askanhay unofficial taken.

## VII. STUDY AREA

The study area selected for this research area is in the city of Qom. Qom city, the province and the city of Qom Province with an area of 631.14 square kilometers and the city center is located. According to statistics, in 1390 the population was about 1,151,672 persons, of which 1,095,871 persons (15/95 percent) in urban areas and 55,798 patients (85/4 per cent) in rural areas and the rest have nomads.

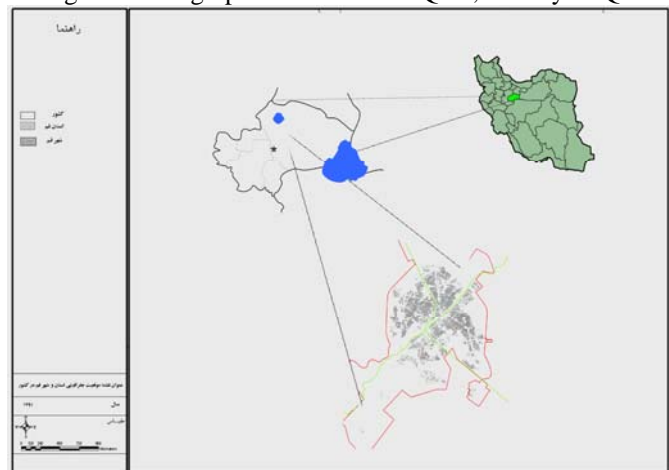Figure 1: Geographical location of Qom, the city of Qom.



Table 1: Population of Qom, and the average annual growth during 1385-1365

| Average annual growth | | Population | Year |
| Percent | Period | | |
|---|---|---|---|
| | 1365-1375 | 616963 | 1365 |
| 3.29 | | 853044 | 1375 |
| | 1375-1385 | 1046737 | 1385 |
| 2.07 | | | |

Source: Statistics Agency of Iran

## VIII. FINDINGS

Guide to the identification of disadvantaged areas and informal settlements in the country, provide for the identification and classification of 12 groups of informal neighborhoods, as has been reflected in the table below.

Table 2: Indicators of exclusion zones and the informal

| Group index | |
|---|---|
| Economic Characteristics of Land and Housing Characteristics of housing rights Quality, densities and housing Texture characteristics of residential | Indicators of land and housing |
| Density Passages features Vicinity of Municipal infrastructure Entitlement Services Location of settlements | Indices and municipal infrastructure |
| Characteristics of residents Economic centers based in settlements | Social and economic indicators |

Source: Development and Improvement, 1385

Type of land ownership and how to make the most of informal land and housing in the neighborhood. 16 districts or zones mainly in the city of Qom, there is no document or a building permit, primarily in West, North West and South East of the city.

**1-9 Recognition of informal housing areas**

As previous studies showed that informal zones are among the most deprived urban zones excluded from the scope of informal areas are more. Area of 315 ha and 4 percent of informal neighborhoods filled tissue area of the city. Fatemieh in town, village and city Jamkaran land dedicated to God there and Shahid seeker, Akbar Abad, Sydmsvm, Shadqly Khan, Town M, Abbas Abad town and lands of the Lord of the parent document are common. Other areas have Qvlnamh is informal. In all these areas, more than 50 percent of the buildings have no license.

Table 3: Characteristics of legal land tenure and informal neighborhoods license Qom

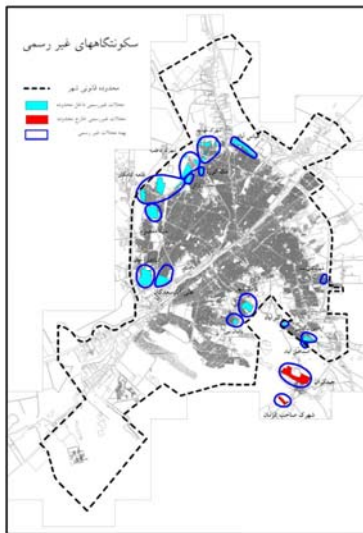| No license | Ownership of land | | | Neighborhood Name | Row |
| | Appropriative | Contract | Joint document | | |
|---|---|---|---|---|---|
| %100 | | | %100 | Shahid jouyande | 1 |
| %50 | | %100 | | Bighdeli | 2 |
| %100 | %40 | %30 | %30 | Akbarabad | 3 |
| %50 | | %100 | | Fatemie | 4 |
| %70 | | %100 | | Chale Kure | 5 |
| %100 | | %100 | | Shelanghiha | 6 |
| %80 | | %10 | %90 | GHale Kamkar | 7 |
| %35 | | %80 | %20 | Seyed Masoom | 8 |
| %100 | | %100 | | Shad Gholi Khan | 9 |
| | | %80 | | Aliabad Sadeghan | 10 |
| %100 | | %60 | %40 | Mahdie | 11 |
| %100 | %100 | | | Abas Abad | 12 |
| %70 | | %100 | | Yazdan shahr | 13 |
| %100 | %90 | %10 | | Esmail Abad | 14 |
| % 95 | | | | Jamkaran | 15 |
| %100 | | | | Shaheba zaman | 16 |

Source: Findings

974

Figure 2: The location of informal settlements in Qom

### 2-9 Recognition of informal community based on characteristics of the physical Characteristics of the major spots identified

As noted earlier, with an area of approximately 305 hectares in area 16, thus mapping an area of 2024 hectares, including passages (service areas) were identified, of which 25 are in the critical spots. The range of 2 to 8 range and 14 spots were identified as the most critical is allocated to informal settlements. Marginaliza all 16 informal settlements within the city limits, built overlooking the far end open and agricultural lands are located. Featuring the belt near the city limits, near the land between the retaining rings and built within the city and tower pressure is strong. This range of selected anatomical studies has been conducted in three levels as follows.

Level

The design of the upper is particularly comprehensive plan in which the properties of the overall physical condition of such piece of ground, buildings, and texture quality, population density, gross and net residential density in urban areas mentioned.

Intermediate level

Gross examination of all informal settlement areas is included. In other words, the informal settlement areas covering critical spots and the immediate environment surrounding the spots are also on. Therefore, integration and segregation and separation factors causing critical spots have been identified and are being allowed to scrutinize and revise. The surface characteristics such as (Action Area) action spots and zones near urban centers and informal structures and normal (high voltage towers, highway, railway, agriculture and barren land) and histological analysis in terms of segmentation, density housing, building density and access to public utilities is studied.

Micro-level

at this level of critical spots are identified and analyzed more

carefully. This re- analysis including texture analysis, based on quality of construction, access to facilities and equipment -welfare , splits , land ownership , Histopathology from the perspective of an urban neighborhood with annoying elements and ultimately enable the development and birth of the tissues analyzed is placed.

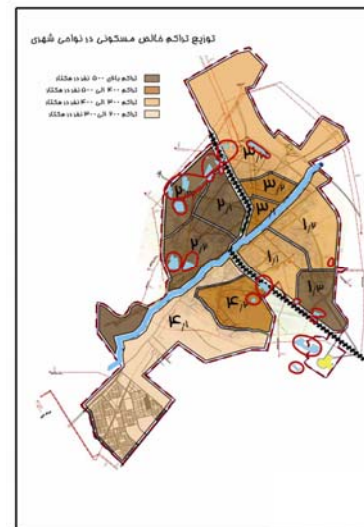### 3-9 examine a range of selection criteria in the comprehensive plan of action

The study area selected under the informal settlement areas is dealt four fold.

• The gross density distribution in urban areas

This status indicates that these zones are located in the modern development and the formation of new, vacant land and not made available within the tissue, and also to adjoining lands, agricultural lands and the limits on the highways Rahahan the features of this is area considered and tower

• Distribution of net residential density in urban areas

Preliminary analysis suggests that this situation is increasing residential users than other urban land uses (lack of services), high density and high family residential units and residential units per hectare piece of property and small pieces of land.
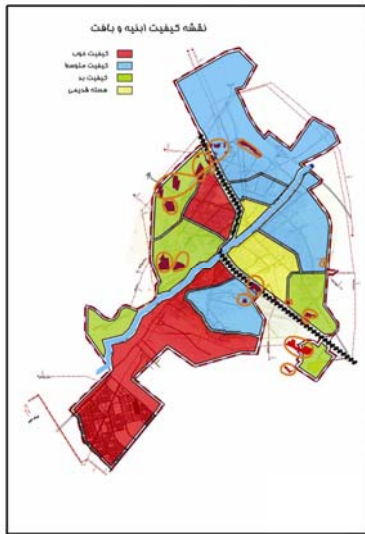


Map 1: Distribution of net residential density in urban areas

• The distribution of residential components

### 4-9 Quality and texture of buildings

The maps indicate that it is the same as the previous investigations concentrated on the area of informal settlement areas is very poor quality buildings. Condition indicates that the construction of rule and control the building without a building permit, separation undesirable and creating uneven texture and poor road network in the area have had a role in the formation of such a situation.

Map 2: Building quality and texture of Qom.

Study of informal settlement areas (intermediate level)

• Evaluation Hmjvaryhay inconsistent (mainly near the high voltage towers, railway and highway)
   • Evaluation of five welfare service delivery (education, health, sports, culture and green space)

• Tissue analysis included (segmentation, density per hectare residential street network analysis)

**5-9 Study Hmjvaryhay incompatible**

The most important problems of informal settlements, settlements with the neighborhood are safe, natural and artificial. Previous studies indicate the locations of railway route include transmission lines, high-risk zone rivers, highways and places of interest are the cheapest housing areas housing low-income classes is. The neighborhood in often endangers the health of residents. So the typology of informal settlements is of particular importance. On the basis of informal neighborhood known within the arteries, high voltage electricity, railways and highways have been investigated are indicated in the table below.

Table 4: Proximity of informal neighborhoods in the city of Qom

| The voltage electricity pylons | Adjacent The Highway | By rail The | Neighborhood Name | Row |
|---|---|---|---|---|
| | • | | Shahid jouyande | 1 |
| | | • | Bighdeli | 2 |
| | | • | Akbarabad | 3 |
| • | | • | Fatemie | 4 |
| • | | • | Chale Kure | 5 |
| • | | | Shelanghiha | 6 |
| • | | | GHale Kamkar | 7 |
| | | | Seyed Masoom | 8 |
| • | | | Shad Gholi Khan | 9 |
| • | | | Aliabad Sadeghan | 10 |
| • | | | Mahdie | 11 |
| • | • | | Abas Abad | 12 |
| | | | Yazdan shahr | 13 |
| | | | Esmail Abad | 14 |
| | | • | Jamkaran | 15 |
| | | | Shaheba zaman | 16 |

Source: Findings

As this table shows, informal neighborhood Qom 7 Drmjavrt high voltage electricity tower and 2 additions to the neighborhood adjacent neighboring rail or highway, there are masts. The areas of risk, health and physical break from the city typologies are risky and difficult.

### 6-9 Recognition based on population characteristics

Generally the more peripheral areas of the city of Qom migrants constitute some communities are composed mainly of Afghan immigrants, while in others, mainly in Iran (left) are. The population of the district is considered one of the criteria by which we can classify neighborhoods populated areas (over 10 thousand) and sparsely populated areas to be separated. An important feature of social dating sites to recognition and analysis is an informal area. Table 5 presents some social features of neighborhoods, older buildings are calculated based on the average life span is shown.

### IX. CONCLUDE

The formation and development of unconventional and spontaneous settlements within and around the city of Qom with unfavorable anatomical features, including social and economic consequences of unbridled urban growth during recent decades. Most of this migration is to achieve better social and economic opportunities of done .the increases are mainly poor and low income people living in areas with low-quality physical environment and a chaotic social isolation , exposure to non- residents of the limits of social and environmental risks and damage frequency data. Migration of rural population to get into traditional livelihoods in urban areas with different structures, often allowing them to reintegrate into the city structure is not possible or require huge spending, the city has suffered from structural duality.

### X. SUGGESTIONS

1. Basis for promoting environmental sustainability and inclusive way to increase the health, safety, hope, faith and dignity in existing informal settlements.

2. Prevent the spread of informal settlement on the future of affordable housing, basic services and infrastructure available at affordable and low-income groups in the informal atmosphere of the town.

3. Areas to benefit from the advantages of urban and cultural enrichment for residents of urban settlements along with their full participation in decision-making and local action.

4. The necessity of providing low-income groups in urban residential areas and their access to basic services transparently focus on urban management.

5. Importance of informal settlements in urban sustainable development and the need to develop a critical role in the development of urban areas in the shadow of urban management.

6. Obtain desirable urban management system of decision-making, participation and involvement of the people.

7. Strengthening local grassroots organizations in developing and maintaining social cohesion and trust in order to identify areas of capacity building, empowerment and development of informal settlements.

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