ENVIRONMENTAL IMPACT ASSESSMENT OF SUSTAINABLE DEVELOPMENT, USING DEGRADATION MODEL A CASE STUDY OF HORAMAN ZONE, WEST IRAN

M. Mehdi Fazelbeygi [a], Gholamreza Yavari [b]
[a] Department of Rural Development, , Science & Research branch, Tehran, Iran
[b] Department of Agriculture Economic, Payame nor, University, Tehran, Iran
Corresponding author: fazel_mehdi@ yahoo.com

 ISSN 1923-6654 (print)
ISSN 1923-6662 (online). Available at http://www.ssrn.com/link/OIDA-Intl-Journal-Sustainable-Dev.html

***Abstract*:** Degradation model is one of the mathematics models that investigates and predicts data for assessing the impact of development. Degradation model consist Degradation coefficient per ecology unit, Total severity of degradation factor of per ecology unit, physiological density (Population in the ratio of arable land) and ecological Vulnerability. In this survey, for studying environmental impact assessment, the first, domain of Horaman zone was divided into 140 networks, (2×2 cm^2 on a topography map 1: 250000) which that per one network was 2500 hectare. Ecological vulnerability was calculated and classified by slope, height, hemisphere, herbaceous cover and settlement maps. In the next step, 24 factors of degradation in Horaman zone were identified and severity all of them calculated by topography map, field researches, advice of experts and participates of native people. Physiological density was estimated via dividing population of networks by splitting population of networks to arable land per network. Finally, regarding to table of degradation and Excel software, degradation coefficient was calculated and analyzed in each network. Degradation coefficient for all networks categorized into 6 classes and 3 sets based on fuzzy set theory. Therefore, all networks were compared together in respect of severity and measure of degradation and whole of the zone was spitted to three areas: A) capability of further development B) need to rebuild and restore and C) need to conservation. Accordingly, 47.1% of study areas prone to further development, 50.6% were need to restore and rebuild and 2.1% of studied areas need to conservation operation.

***Keywords*:** Degradation Model, Ecological Vulnerability, Degradation Factor, Horaman Zone.

I. INTRODUCTION

This survey of thematic background about fundamental plans and projects in Iran indicated that in many of programming, importance of ecosystems was ignored and most of decisions were made irrespective of environmental considerations. Consequence of this mismanagement has leaded various pollutions and drastic degradations of natural resources in Iran. As things stand, because of ecosystems reached a crisis, human should be more aware about himself mistake as for development conceptions.

Kosto (1992) believed that experience of economic development in the past and consequence of inattention to environment; pave the way for identifying and understanding of environmental limitations in the recent decades. Strictly speaking, although human interferences in the nature are inevitable, sustainability of ecosystems not to be neglected [1]. Therefore it is necessary determinant persons and experts that related to development, have well aware from indicators of sustainable development and strategies for environment sustainability. In this regard, on of the illustrated viewpoint is estimating of ecological vulnerability. It seems that by estimating and identifying of environment sustainability factors can be prevent from extension of human operating which that destroyed the natural ecosystems [2].

In this research, supposed that to reach sustainable development in national or regional level, the first, process of sustainable development should be preformed in low level such as country and village. When these small geographical parts take together other, process of sustainable development can be appearing. Principal aim of this research was survey of interferences and collateral effects of de-

velopment on environment and ecosystem in Horman zone. Finally, how did these interferences and collateral effects coordinate with sustainability of ecosystem of Horaman zone? Also, is Horaman zone capable to development potential or not?

A. The Introduce on Case Study

Horaman or Oramanat is a mountain area in Kermanshah province in west of Iran and placed on between plateau Iran and Mesopotamia plain. A height average at altitude 1280 meter, longitude 48º.28´ and latitude 32º.48´. Horaman zone is divided to Paveh, Salas-e-babajani, Ravansar and Javanrood town that and Nusood, Shahoo, Kolashi and Bayangan township. Climate of Horaman zone can be separate into eastern and western area. Eastern district is a chilly and mountainous region and has long and cold winter Western district of Horaman (NW specially) have not height spots and because of vicinity with deserts of Iraq have warm weather.

Horaman has high mountains that Shahoo is the highest mountain in Horaman with 3245 meter height. Whatever closed to border of Iraq, these mountains are neared each other and then arable land is scarce. In some part of Ravansar, Javanrood and Salas-e-babajani areas, there are a few hills that capable to agriculture.

Horaman zone is covered with wild Oak, Almond and Pistachio trees. Zagros mountain range is placed in the region (from NW to SE) along with deep valleys and several rivers and whatever we near the border of Iraq, these mountains are closed together and then arable lands are reduced. Geographically, Horaman zone is enclosed by four large plains. Horaman zone have unique cultural and geographical situations, like Horamy language that only speaks in this part of the world and behalf of United Nations Organization have been got in the list of extinction languages [3].Horaman zone is incomparable animals and herbaceous shelter in plateau Iran. This region has unique resources of genetic diversity because Horaman is an outlying and inaccessible area also has suitable weather to grow different species. It seems that, in several decades ago, human activities and processes development were accomplished in Horaman zone, uninterested to environmental index and it make misgiving about future of ecosystem, diversity, cultural aspects and environmental sustainability in this region. The present study is the first report about environmental impact assessment of development sustainability in Horaman zone.

TABLE I
FEATURE OF HORAMAN ZONE (2008)

County	Area (Km^2)	Forest hectare	Pasture hectare	Arable Land hectare	Village	City
Paveh	805	46875.2	28837.8	966	94	4
Salas-e-babajani	1670	64055.6	85995.5	32297	267	2
Javanrood	765	47925.2	12664.8	16662	136	1
Ravansar	1202	18225.4	54923.7	66746	170	2

II. DEGRADATION MODEL

A. Review of degradation model

Degradation model was invented by Makhdoum in 1994. In fact, the purpose of using degradation model is, avoid of theoretical observes about degradation phenomenal, degradation factors, degradation severity and rate of vulnerability ecosystems. According to this, in future, it will be prevented occurrence of degradation and the new ways for preventing repeated degradation in short time period will be determinate [4].Therefore, it seems that, this research and other research have been done based on classifying of degradation model that shown in the below table [5].These researches provided a suitable and reliable method to compare the measuring of sustainable environment indicators during the time and in different regions.

Noori (1997) [6], Eslami (2001) [7] and Chamani (2005) [8] used similar models in their researches in relation to environmental impact assessment of development.

TABLE II
CLASSIFYING OF DEGRADATION COEFFICIENT BASE ON FUZZY SET MODEL

Decision making for development	Range of Degradation Coefficient	Class
Prone to further development	1.33 – 4.99	1
need to rebuild and restore	5 – 14.99	2
	15 – 19.99	3
	20.56 – 29.98	4
need to conserve	30 - 47	5
	47.21 – 73.49	6

References: Makhdoum, 2002

B. How Calculate the Degradation model

A formula degradation is:

$H= (\sum I + Dp) / V\circ$

H= Degradation coefficient per unit of ecosystem

$\sum I$= Total severity of degradation model per unit of ecosystem

Dp= Physiological density

$V\circ$ = Ecological vulnerability

C. Calculating of Ecological Vulnerability ($V\circ$)

Ecological vulnerability, physiological density, degradation factors and severity of them are the characteristics of degradation model. Ecological vulnerability is calculated by slope, height, hemisphere maps, sensitivity of bed stone to erosion, soil vulnerability, herbaceous cover, settlement and safekeeping ecological land maps.

Firstly, political borders of Horaman were designed using (1: 250000) maps and then whole of the zone divided into networks (2×2 cm^2) based on a co- ordinate system (UTM: Transverse Mercator) and a bench mark as index.

According to this, when environment indices come closed to threshold limit, sensitivity of the ecosystems components was increased.

Finally, in this stage 140 unit networks were obtained that each of them was 4 cm2 (2500 Hectare), also these networks were arranged and nominated based on rank of numbers and alphabetically. In each stages network maps overlapped with other maps and limitation codes were extracted. Codification of environmental indices was performed using threshold contents in ecology science. For estimating rate of vulnerability, total of networks with regarded to ecosystem indicators and range of vulnerability codes, placed in four classes (Table 3).

$E= \sum (a-b) /4$

E= Rate of vulnerability per class, $\sum a$: Maximum range of vulnerability, $\sum b$: Minimum range of vulnerability,

$\sum (a-b)$: Difference of total maximum and minimum range of vulnerability, 4: It is a code of vulnerability (four classes) [9].

TABLE III
Taxonomy of ecosystem vulnerability

Rate of Vulnerability	Code of Vulnerability	Range of Vulnerability
Resistance	4	9 – 16/5
Mid Sensitive	3	16/5 – 24
Sensitive	2	24 – 31/5
Very Sensitive	1	31/5 – 39

Reference: Chamani, 2005

D. Compute of Physiological Density (Dp)

Physiological density is obtained from dividing population by arable land per unit of networks [10].For determining of population in the networks, the first thing, distribution of all villages and towns in Horaman zone was determinate and then measure of population was computed in total of networks, based on statistical information obtained from Statistics Center of Iran in 2006[11]. For estimating rate of extent arable land in Horaman zone, arable land maps of Kermanshah province (1: 250000) and agriculture statistics were used, at last, arable land extent was computed in whole of networks as hectares. After these processes, population of per network was divided by arable land of that network and finally physiological density was computed. Maximum of physiological density was 0/6 and related to G7 network and minimum of it was zero.

E. Determine Degradation Factors and Severity of Them ($\sum I$)

In this part of degradation model, main factors that destroyed environment and ecosystem along with severity of them in estimating of degradation coefficient of ecosystem were used. Twenty four degradation factors in Horaman zone identified and severity of them was determined (Table 4). Degradation severity levels are: code (1) low degradation, code (2) mid degradation, code (3) high degradation and code (4) very high degradation. Degradation factors and severity of them was determined by field work, advice of experts and native people, also extant data and maps (picture 1 than 9). Finally, degradation coefficient was calculated for each network using degradation table that analyzed by EXCEL software

TABLE IV
LIST OF DEGRADATION FACTORS IN HORAMAN ZONE

Degradation Factors	Sign
Conversion of forests to arable lands	RA
Conversion of forests to pastures	RJ
Illegal cultivation on natural resource lands	IG
Soil erosion	DO
Destroy of ecosystems	DS
Poor management	WM
Littering	L
Burning the rest of agriculture fields	BR
Soil pollution	SP
Water pollution	WP
Air pollution	YP
Sewerage flow in the rivers	DR
Plowing along slope of hillside	PS
Unsuitable depth of plowing	UP
Inefficient use of rivers for agriculture	IR
Extra use of mineral resources	IM
Illegal hunting	IH
Irregular grazing	IG
Abuse of forest trees for fuel	UF
Nourishment of seeds and sapling by livestock's	WS
Low education environmental of stakeholders	UE
Low participation stakeholders in conservation of ecosystems	LP
War (1980- 1988)	W
Roadwork's without any plan	RP

III. RESEARCH FINDING

After calculating of degradation coefficients, there were classified based on Fuzzy set logic (Table 5).

TABLE V
RANGE OF DEGRADATION, FINAL CODE DEGRADATION, NUMBER OF NETWORKS, AREA PERCENT AND DECISION MAKING FOR DEVELOPMENT IN HORAMAN ZONE

Range of degradation	1.33-4.99	5- 14.99	15- 19.99	20.56-29.98	30-47	47.21-73.49
Final code development	1	2	3	4	5	6
Number of networks	66	57	8	6	2	1
Area Percent	47.1	40.7	5.7	4.2	1.4	0.7
Decision making for development	Prone to further development	Need to rebuild and restore			Need to conserve	

Thus, 66 networks with final code (1) for degradation identified that contained 47/1 % of total area of Horaman zone and have different abilities for developing. Priorities of development have done according to degradation coefficient per networks, quantity of natural and water resources. Therefore, the rate of degradation networks in this group, illustrated in (Table 6).

TABLE VI
PRIORITY OF DEVELOPMENT BASE ON DEGRADATION COEFFICIENT PER NETWORKS

Decision making for development	Number of networks	Priority		
Prone to development	4	First priority of development		
	12	Second priority of development		
	4	Third priority of development		
	46	Four priority of development (Unsuitable for developing)	Number of networks	Type of zone
			3	Conserved ecosystem
			3	Lack of water resources
			18	High soil erosion
			16	Natural resources land
			6	Arid area

Range of degradation	Priority of development
0- 1.33	First Priority of development
1.33- 3	Second Priority of development
3- 4.99	Third Priority of development

Above table was as base for determining of priority of development and then by overlapping of networks map and distribution natural resources map with topography map, decision has made about priority of development. It seems that quality and quantity of natural resources (water resources specially) influenced on priority of development. So that, existence of them increased the priority of development and conversely.

TABLE VII
RESULT PRIORITY OF DEVELOPMENT IN HORAMAN ZONE

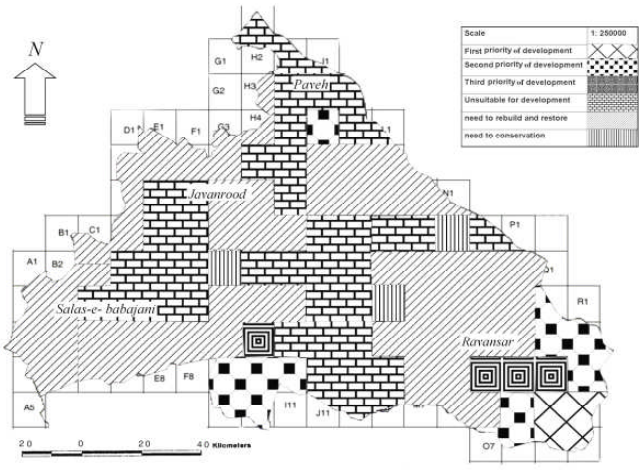


Fig. 1 Decision making map for Horaman zone

IV. FINDING ANALYSIS

With considering (Table 7), 46 networks of total 66 networks prone to development in Horaman zone, was unable to develop or last priority of development due to several reasons. Three networks were belonging to ecosystem conservation organizations. This areas have a great value in respect of animals and herbaceous diversity and conserved ecosystems, then in this areas should be prevent from developing process and in marginal regions, development process should be occur with cautions. At 66 networks that prone to develop in Horaman zone, 8 population networks have degradation coefficient and physiological density equaled to zero. In totally 140 networks, 57 networks have placed on the second code of degradation vulnerability and categorized as sensitive zones, ie, 54 networks need to rebuild and restore and 3 networks need to conserve operations. Networks I7, J2, P4 are included Javanrood, Paveh and Ravansar cities that needs to restore and conserve due to: centralization of population, extension of cities and reduction of marginal arable lands. These issues demonstrated the role of humans in degradation ecosystems Through regions prone to development in Horaman zone, 3 networks faced to lack of water resources and 6 networks had arid lands. These regions are unsustainable to develop, so that, 18 networks faced to high soil erosion and 16 networks taken in natural resources lands.

Decision making and topography maps revealed that ecosystem of Horaman was influenced by expeditious growing of population, abuse of natural resources and increase of accession to ecosystem and develop of economical and natural activities like development of agriculture and extension of towns. Also, it seems that degradation of ecosystem due to negative effect of war between Iran and Iraq (1980- 1988) on environment sustainability to be still continued. Hence, it appears that development pathway in Horaman zone has been occurred without consideration to ecosystem sustainability and rate degradation of areas.

It seems that, in conserved regions of Bozin and Markhiil in northwest of Paveh county, was unable to development completely. In addition, most of lands and areas in Paveh and Javanrood county need to conserve and restore because many district of these counties are forest and natural resources lands, Also large parts of these townships have high soil erosion because of intensive slope. According to analysis of the result, besides degradation factor of war in Paveh and Javanrood counties, another factor like: plowing in hillside slope, unstable depth of plowing, burning rest of fields and pastures, abuse of forest for fuel or production of charcoal as a household financial resource, agriculture in forest and conversion of forest to arable lands and pastures, were main factors that lead to degradation of ecosystems.

Regarding sustainable development in Paveh and Javanrood regions it suggested that, since frangibility and vulnerability of Horaman ecosystem, establishing some factories like gypsum and cement factories, also gravel and ornamental stone mines should be prevent. It seems that attractive and suitable natures and diversity of cultural aspects in Paveh and Javanrood zone, development path should be shift to establishing tourism industry. Creation and extension of ecotourism in these regions lead to employment reduce of poverty, investment and finally help to develop these areas. One of the strategies of sustainable development in these regions is creation and extension of small and medium enterprises (SME). It seems that, development of handicraft SME with regard to long duration of it in these areas and accessibility of elementary materials, are appropriate strategies for sustainable development. Due to, most people in these regions employed in agriculture section, it suggest that strategies of sustainable agriculture are transferred to farmers and native people. Thus it can be help to environment sustainability increasing of financial resources of farmers and eventually help to develop of these regions. Although, it seems that revival and extension of indigenous knowledge in these areas (for example agroforestry, mixed culture and use of natural fertilizer and organic pesticide) maybe useful for environment sustainable development in these regions.

Based on topography and decision making maps (Fig 1), the part of northwest Ravansar County surrounded by natural resources and mountainous lands. Therefore proposal of advice for this part of Ravansar County is not going to develop of process to this side. Generally east and south of Ravansar County have more suitable condition for development and then proposal option for this part of Ravansar county is going development process to this side. Based on finding result, main degradation ecosystem factors in Ravansar County were: drastic soil erosion due plowing of hillside, burn rest of farms and pastures, reduction of jungle and nature resources for arable lands.

In toward sustainable development in Ravansar region, appropriate backgrounds in this area like rich water resources, fertilized arable lands, vicinity with metropolitan of Kermanshah and suitable condition for transportation, it suggested that in this part of Horaman zone are established industrial factories and conservation manufactories. Also, consolidation of

arable lands can be help to establish of mechanized agriculture unit in the near of industries park.

The regions north of Salas-e-babajani taking in slopes and mountain lands are unsuitable for developing. Other regions in middle and south of Salas-e-babajani county to cause taking in mountains and hills, also pastures and natural resources lands need to be rebuild and restore. Based on finding result, main degradation factors in Salas-e-babajani County were: overgrazing by livestock and drastic erosion of pastures, reduction of jungle and nature resources to arable lands, abuse of jungle for fuel and production of charcoal for sales.

Existing of fertilized plains in the south of Salas-e-babajani made good situation for developing agriculture section but regarding lack of inadequate water resources, it suggest that drip irrigation networks and water transferring canals were setup.

APPENDIX

Picture1: Illegal agriculture in natural resources land (Horaman, Photo by Fazelbeygi)

Picture 2: Plowing and agriculture in hillside slope (Horaman, Photo by Fazelbeygi)

Picture 3: Degradation Mountains for mineral resources (Horaman, Photo by Fazelbeygi)

Picture 4: Illegal hunting (Horaman, Photo by Fazelbeygi)

Picture 5: Illegal hunting (Horaman, Photo by Fazelbeygi)

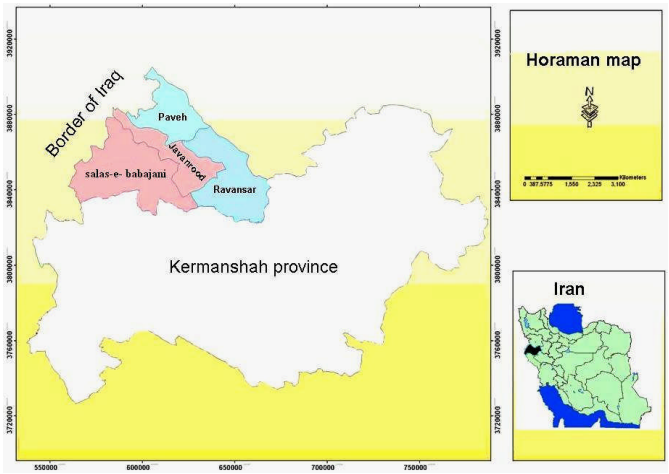
Picture 6: Reduction of jungle for arable lands (Horaman, Photo by Fazelbeygi)

Picture 7: Littering (Horaman, Photo by Fazelbeygi)

Picture 8: Air pollution (Horaman, Photo by Fazelbeygi)

Picture 9: Littering (Horaman, Photo by Fazelbeygi)

Fig 2: Horaman map



REFERENCES

[1] Habitat. A, Methodological Frame Work of EIA for Urban Development, UN center for human settlement. 1992: pp.11-18.

[2] Jaberian, B., Introduce of Objective Method for Determinate of Vulnerability Ecological. Journal of Environmental Studies. 1999. 21 (1). pp 57-68.

[3] Stephen A. Wurm – Cartographer, Atlas of the World's Languages in Danger of Disappearing , New revised edition .UNESCO, Memory of Peoples series. 2001. p90

[4] Makhdoum, M.F., East Azerbaijan and Environment. Proceeding Conference of East Azerbaijan and Development. Tabriz. Iran. 1994.

[5] Makhdoum, M.F., Degradation model: A Quantitative EIA Instrument, acting as a Decision Support System (DSS) for Environmental Management. Environ. Manage. 30(1). 2002. pp151-156.

[6] Noori, A,. The Survey of Environmental Impact Assessment of Development, Using Degradation Model**,** at Kermanshah province. Thesis submitted for the degree of master, Tehran University 1997.

[7] Eslami, L., Environmental Impact Assessment of Development, Using Degradation Model**,** at Oroomiee Lake. Thesis submitted for the degree of master, Tehran University. 2001.

[8] Chamani, A., Environmental Impact Assessment of Development, Using Degradation Model**,** in Hamadan province. Journal of Environmental Studies. 37 (1). 2005. pp.36-37.

[9] Makhdoum, M.F and Mansoori, M., Environmental impact assessment of Hormozgan Province (S. Iran) by degradation model. Journal of Environmental Studies. 23 (1). 2000. pp 51-53.

[10] Miller J.T. Jr. , Living in the environment – Principles, connections and solutions, 11th edition, Brooks/ Cole Publishing Company, California, USA.1999.

[11] Statistics Center of Iran, Statistic of Population and Rural Areas in Kermanshah province. Statistics Center of Iran Press, Iran. 2006.

ABOUT THE AUTHOR:

F. A. Author, Msc, is with the IAU, Science & Research branch, Tehran, Iran. He is now with the Department of Rural Development (corresponding author to provide phone: +989188394458; e-mail :(fazel_mehdi@yahoo.com).

S. B. Author, Dr., is with Payame noor University, Tehran, Iran. He is now with the Department of Agriculture Economic, (e-mail: gh_yavari@pnu.ac.ir).