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Investigating and identifying the effects of rural wastewater in Dena protected area and presenting an environmental management pattern

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Abstract: The purpose of this study was to identify the effects of discharge of wastewater from rural communities on biodiversity in the Dena Protected Area in the Central Zagros. This research is an applied grandson that has been done by library and field method. GIS tools and Landsat satellite have been used to extract and draw maps. In order to develop a comprehensive management plan and determine objectives and operational plans, the approach (SMART+P) and factor analysis method were used. For this purpose, the general principles of water resources management related to rural areas were extracted from global guidelines. In the next step, through library studies and questionnaires, the key stakeholders of water resources management in the study area were identified and the factor burden of each was determined: the highest factor weight belongs to the Ministry of Energy and rural water and sewage companies (16.50), followed by the General Department of Environmental Protection (15.30) and finally, local and rural communities have the lowest weight (10.43). Most of the rural wastewater in Dena protected area belongs to agricultural wastewater (53%), followed by domestic wastewater (28%) and finally, industrial wastewater (11%). The results of the good fit evaluation of the model show that GFI is equal to 0.977 and considering that it is more than 0.9, so it is acceptable in the region. Finally, the proposed model was designed to prepare a plan to assess the effects of rural wastewater on biodiversity in the region in 5 steps, which were: Investigation of wastewater management background; Study of biodiversity indicators; Investigating the characteristics of wastewater in rural communities; Determining the effects and consequences of lack of proper wastewater management in rural communities; Providing appropriate, applicable and scientific methods for wastewater management in rural communities
Keywords: Sewage, rural communities, environmental management, Dena protected area

1. Introduction

The Zagros Mountains is one of the most valuable regions of Iran, which due to its special geographical location, geology-climate, soil, vegetation and animal wildlife, has unique biodiversity values such as the presence of more than 2400 plant and animal species (CIB, 2011). This region has long been the cradle of historical civilization and ethnic diversity of Iran and has accommodated more than ten percent of the country's population, which is mostly rural and nomadic (Dabiri, 2012). Nature-dependent exploitation in the Zagros and land use change over the years, has led to the destruction of natural resources, unprincipled development and unsustainable use of biological and natural resources of the Zagros Mountains. In some cases, the natural and ecological conditions of the habitats in the region are so affected by unstable factors that it is irreversible to equilibrium conditions (Jafari, 2014). Among these factors is the lack of proper management of water resources as well as wastewater treatment. Sustainable and proper management of wastewater is a priority in rural communities of Zagros, because it leads to the preservation of environmental factors and the principles of public health (Abdoli, 2010). The use of simple, low-cost, decentralized systems or small and centralized wastewater treatment systems are the main principles of effective wastewater management, and in some cases, the reuse of wastewater is possible for the benefit of rural communities (Peter et al., 2011).

Rural areas are a major part of the population and natural areas of the country and rural society plays an essential role in the economic and social life of the country (Graham, 2010). Today, various programs for the development of rural areas are formulated and implemented by the government. Laws, regulations, policies, economic, social and physical plans together constitute the system of rural management and development, each of which seeks to achieve the organization and development of rural areas in proportion to the necessities and needs of rural life (Hashemi et al., 2011). In the meantime, paying attention to the rural environment in the rural development planning process is essential for the rural management system. Iran has been promoted and supported in international programs due to its climatic diversity, ecosystem and richness (Ministry of Energy, 2009). Among these, the Central Zagros region due to the unique biodiversity due to the geographical location of the Zagros Mountains, geology, macro and micro diversity of land, climate and soil, vegetation and wildlife are among the areas that have special conservation value (Fahiminia et al., 2011). Considering the unique biodiversity in the Zagros region and the environmental threats caused by the lack of rural wastewater management in this region, the need to provide practical guidelines in the field of wastewater management with a biodiversity protection approach is considered (Hashemi et al., 2011).

Environmental protection and prevention of pollution include the use of processes, working methods, materials or products that avoid, reduce or control pollution, which can include recycling, treatment, process modification, control mechanisms, optimal use of pollution. Sources and replacement of materials, The entry of sanitary, agricultural, etc. effluents into the receiving natural environments not only upsets the ecological balance, but also leads to a decrease in the population of various species such as aquatic animals (Abdoli, 2010). Environmental pollution capability and its components such as water, soil, vegetation, wildlife, etc (USEPA, 2001), by wastewater produced in this area, due to the unique biodiversity available, the need to provide practical guidelines in the field of wastewater management with conservation approach Biodiversity is becoming more apparent (Rezvani & Karimi, 2012). Therefore, assessment of the human pressures on rivers is particularly important to find areas where water resources are threatened and subjected to rapidly increasing anthropogenic effects (Jalili, 2020).

On the other hand, treated wastewater can be used in a variety of ways (Monzavi, 2010). The use of wastewater in agriculture, as a rich source of nutrients, is widely accepted in areas where fresh water scarcity is present (Seyed Mousavi & Saeb, 2019).

The aim of this study was to identify the effects of rural wastewater on the environment of Zagros region (specifically Dena protected area). Also, an attempt has been made to provide a practical model for rural wastewater management and methods to attract people's participation in the protection of the rural environment in the study area. Undoubtedly, upgrading the knowledge and capabilities of relevant organizations and indigenous communities in the field of rural environment will greatly help in improving environmental protection.

Materials and Methods

Study area

The study area is Dena management watershed in the north of Kohkilooyeh and Boyer-Ahmad provinces, which occupies about 6.7% of the area of the Central Zagros region. Approximately 83.3% of the area is mountainous and the rest is plain (Jafari, 2014). The average height of the area is 1979 meters and the average slope is 27.5% (Figure 1). The climate of the region is located in the cold semi-humid floor. Studies show the development of drought in this region. The average total number of annual frost days for the region is about 85 days. In the north and northwest the edibility is relatively high and in the south and east the edibility is low to moderate. In this area, about 36 hectares of wetlands, about 63 semi-deep wells and 256 springs are being exploited (Abdoli, 2011).

There is unique flora and fauna in this area and suitable climatic conditions have increased the density of rangeland vegetation. There are about 167,000 hectares of forest in the Dena region. In other words, 81% of the area is forest. About 37% of the forest area is more than 25% dense. The rest of the forests are less than 25% dense. Therefore, these ecosystems do not have good performance against water erosion. More than 95% of the trees in the forests of the region are Persian oak, and coriander and almonds are in the next ranks. In the rangelands of the region, about 1200 plant species have been identified. This region has about 30,000 hectares of pastures, 30% of which are dense pastures. Indicative species of the region can be mentioned as follows: Brown bear, leopard, lynx, wild cat, wolf, ram, boar, otter, and golden eagle. Figures 2 to 7 show the environmental importance and ecological sensitivities of the study area.

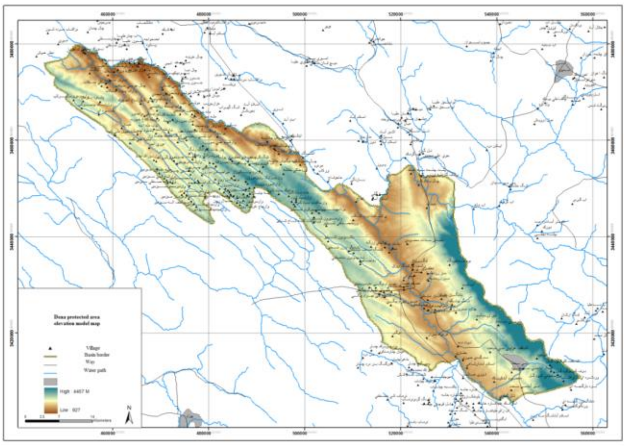

Fig. 1- Altitude map of the study area

Fig. 2- One of the major threats in the Zagros region is the destruction of the environment and natural resources.

Fig. 3- Development of agricultural lands in Zagros region

Fig. 4- Use of water resources for horticultural development

Fig. 5- Existence of numerous water resources in Zagros region

Fig. 6- Persian squirrel is one of the valuable species of oak forests

Fig. 7- Beautiful view of Tang Sayad Biosphere Reserve in Central Zagros

Table 1 shows the area and type of plant in the study area.

Table 1- Area and plant type in the study area

Plant type	Area - hectares	%
Astragalus sp.- Cousinia cylindracea	4873.497	2.361190407
Pistacia atlantica-Amygdalus scoparia	9728.5362	4.713438081
Acer monspessulanum _ Lonicera nummularifolia	12445.973	6.030025678
Acer monspessulanum _Pistacia atlantica	1089.1923	0.527709448
Acer monspessulanum _Quercus brantii	46.6962	0.022624128
Astragalus adsendense- Daphnae mucronata	527.3849	0.25551594
Astragalus sp. – Euphorbia spp	11785.2244	5.709895543
Astragalus sp. – Peganum harmala	15424.4363	7.473079603
Gundelia tournefortii – Cousnia cylindracea	28141.7742	13.63458052
Quercus brantii_ Amygdalus sp.	122337.2855	59.27194065
Total	206400	100

The population of the area is about 60,635 people and includes 4.3% of the total population living in the Central Zagros Mountains. In this area, there are 333 rural settlements and 3 urban settlements. The main financial resources of the residents of the region are in the groups of livestock, horticulture and agriculture. 44 villages out of 199 villages have permanent residents, which is equivalent to 22.1% of the area. Migration, lack of employment, population growth and the number of households are the most important demographic problems in the region. The percentage of agricultural land in the whole region is 6.1%. The main agricultural products of the region are grapes, apples, pears, peaches, plums, tomatoes, figs, wheat, barley and rice. The amount of agricultural production in this region was about 38418 tons and livestock and poultry production was 15655 tons. This area has 99 km of main roads, 77 km of side roads, and 21 km of highways. This area has many tourist sites.

Methodology

This research is of applied type which has been done by mixed method (quantitative and qualitative). In the library studies section, written sources and available reports were used. Also, in the field studies section, visits, field surveys, and a researcher-made questionnaire were used. The statistical population of the study consisted of experts and managers of water resources in Kohkilooyeh and Boyer-Ahmad provinces. The statistical sample of the study (available sample) was 33 people. The face and content validity of the questionnaire was determined by the professors and its reliability was calculated by Cronbach's alpha of 96%. For data analysis, software SPSS, 19 and statistical analysis method were used. In the sampling section, after identifying the centers of contamination, a sample was prepared. The experiments were performed in a trusted laboratory and 2 replications were considered for each. Pollution centers are:

- Rural settlements
- Agricultural lands
- Fish breeding sites
- Paddy fields
- Rural waste disposal sites

GIS tools were used to overlay layers and draw maps. In this study, data obtained from images obtained from Landsat 7 satellite ETM + sensor; Google Earth and IRS (2018) images were used. In order to speed up the process of preparing and correcting the boundaries of land uses, a hybrid technique (digital and visual) has been used in preparing the land use map. To identify the area of each land use, first based on spectral similarities, homogeneous areas on the composition of different bands are identified and then based on the type of land use; the appropriate identification code in the GIS environment is assigned to it. The map has been simplified to a scale of 1:25000 and the extra details that make the map too crowded have been avoided. Also, the 1:25000 topographic maps of the surveying organization and finally the ground control are used to prepare the land use map. In order to develop a comprehensive management plan and determine objectives and operational plans, the approach (SMART + P) and factor analysis method were used.

In this method, the following items are observed in targeting:

Specific= to be stated precisely and precisely to avoid various interpretations.

Measurable= Measurable for quantitative evaluation.

Appropriate= be selected and compiled according to the resources, bottlenecks and facilities.

Realistic= Predict realistically and achievably.

Time bound= Predict in a specific time range. Place bound = Specify within a specific location.

For this purpose, while in-depth study, the general principles of water resources management related to rural areas were extracted from global guidelines.

3. Results:

In the first step, the land use in the study area was identified and determined (Table 2).

Table 2- Area of different land uses in the study area

Land use	Area - hectares	%
Man-made lands	222.0086	0.107562306
Garden	397.2828	0.192481977
Range land	1948.6572	0.94411686
Forests with an average density of 40 to 70%	35383.748	17.14328891
Dense forest	26843.448	13.00554656
Dense forest with a density of more than 70%	5642.5246	2.733781298
Ruined forest	20624.715	9.992594622
Rocky outcrop	141.6569	0.068632219
Mixture of rain fed lands with other uses	5341.7646	2.588064244
Medium rangeland mix with other uses	13146.899	6.36962156
Mixed irrigated and rain fed agriculture	3009.0384	1.457867442
Pasture with good density	8646.7292	4.189306783

Poorly grazed pasture	1468.6363	0.711548595
Medium density pasture	19736.283	9.562152519
Pasture with good cracking	529.1138	0.256353585
Water transfer route	113.3911	0.054937548
water sources	35.819	0.017354167
The protected areas	58036.634	28.11852427
Agriculture	1856.342	0.899390504
Aquaculture	3275.308	1.586874031
Total	206400	100

In the second step, the catchment and water resources of the study area were identified. The study area has several permanent and seasonal rivers. Including Khersan River, this is a tributary of Karoon River. The water resources map of the study area is shown in Figure 8.

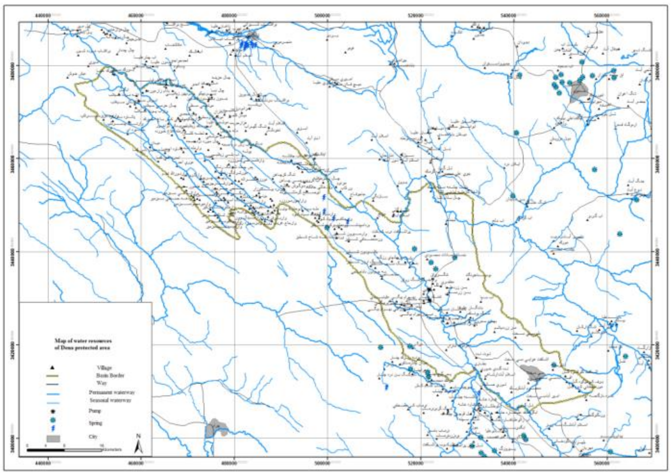

Fig. 8- Map of water resources in the study area

In the next step, by superimposing information layers such as: Settlements, location of water resources (surface and underground), pollutant uses and habitats sensitive to biodiversity, a risk map was prepared. Based on this, areas that are exposed to severe pollution due to the release and release of rural wastewater were identified. The logic used to overlay the layers was Boolean logic. Figure 9 shows the location of sensitive and vulnerable areas that need protection and improvement.

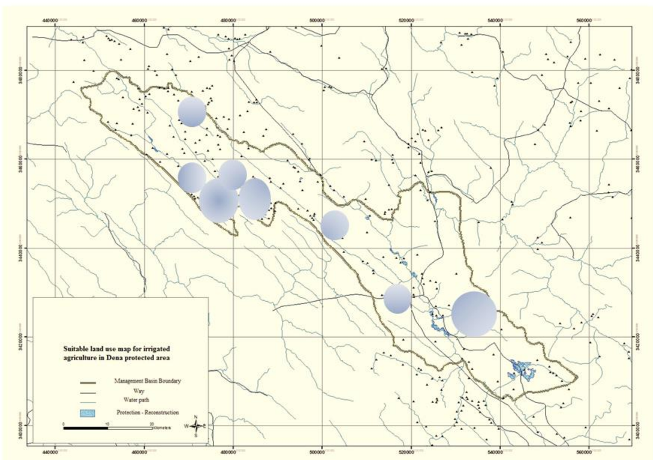

Fig.9- Risk map due to the release of rural wastewater in Dena area

In the next step, through library studies and questionnaires, key stakeholders in water resources management in the study area were identified and the factor burden of each was determined (Table 3). As it has been determined, the highest factor weight belongs to the Ministry of Energy and rural water and sewage companies (16.50), followed by the General Department of Environmental Protection (15.30) and finally, local and rural communities have the lowest weight (10.43).

Table 3- The importance of key stakeholders in the management of water resources in the Dena Protected Area based on library studies and questionnaires

Component	Average	Factor load	T index	p	Significance
Ministry of Energy and Rural Water and Sewerage Companies	16.50	0.77	7.31	0.001	1
Department of Environmental Protection of the province	15.30	0.73	5.56	0.001	2
Department of Health, Treatment and Medical Education of the province	14.70	0.68	7.49	0.001	3
Ministry of Agriculture	13.20	0.66	6.71	0.001	4
Islamic councils of the province	12.55	0.57	6.45	0.001	5
Local and rural communities	10.43	0.49	5.12	0.001	6

Then, the current situation of wastewater management in the study area was reviewed. Most of the land uses in the study area include agriculture and animal husbandry, forests, pastures and water areas and most of the economic activities of the people in the area are livestock and agriculture, which aquaculture is done in the form of these activities. Due to the fact that the distribution of rural areas and agricultural lands is almost in the same area, so the main production wastewater in rural communities of this area is domestic and agricultural and industrial wastewater except in limited cases related to industrial centers located in the study area, which will not be discussed at this time. Therefore, the types of rural wastewater can be classified into three groups according to Table (4):

Table 4- Types of rural wastewater in the Central Zagros region

Row	Wastewater type	Describe
1	Domestic	• Sewage from toilets, laundries, bathrooms, kitchens, sewage from livestock and agricultural activities inside houses, etc. • Sewerage of public places, including sewage of religious, educational, health and psychological, medical and commercial places
2	Agricultural	• Drainage from agricultural land or surface water from rainfall around or downstream of agricultural land containing significant amounts of fertilizer residues, pesticides and agricultural pesticides and minerals such as sand and gravel • Sewage from livestock and aquaculture ponds
3	Industrial	• Industrial effluents from Industrial sites and effluents of factories located in the village or projected, the properties of which depend entirely on the type of factory products.

Figure 10 shows the percentage of each component. As can be seen, most of the rural wastewater in the Dena Protected Area belongs to agricultural wastewater (53%), followed by domestic wastewater (28%) and finally, industrial wastewater (11%).

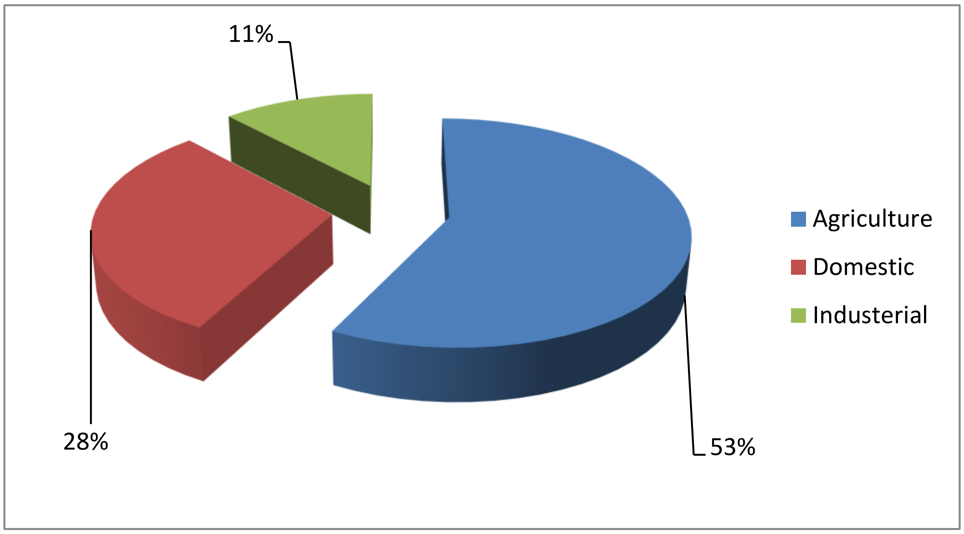

Fig. 10- Percentage and components of rural wastewater in Dena area

The type of wastewater produced in the rural communities of the Dena Protected Area, as well as information obtained from the provincial rural water and wastewater companies on how to manage wastewater in the provinces studied are presented in Table (5).

Table 5- Situation of wastewater and its disposal in rural communities of Dena protected area

Current management mode	Wastewater type	State
Mainly the use of absorption wells and discharge to the river or nature	Sewage of domestic, agricultural, aquaculture type	Kohgilooyeh and Boyerahmad

Next, the destructive factors due to lack of wastewater management in rural communities in the Dena protected area were investigated. The results showed that in recent years, as a result of changes in population, economic and social systems, and the reduction of traditional land management and use methods, etc., the biodiversity of this part of the Zagros has been declining and is now under serious threat. The main destructive and threatening factors of biodiversity due to lack of wastewater management in rural areas are presented (Table 6). The results presented in this table are based on field surveys, previous reports as well as questionnaires.

Table 6- The most important factors threatening the biodiversity of Dena protected area due to lack of wastewater management based on library studies and questionnaires

Type	The most important threats to biodiversity due to lack of wastewater management
Human	Discharge of wastewater into surface water or absorption wells and the environment around human habitation, which reduces the level of public health and the spread of water and wastewater-related diseases.
mammals	1. Domestic and agricultural sewage Includes sewage and domestic runoff and residential areas that contain nutrients, chemicals, toxins or sediments. 2. Industrial wastewater Contains pollutants from industrial and workshop sources, mining, energy production, and other sources of extraction that may contain nutrients, chemicals, toxins, or sediments. 3. Agriculture and forestry Runoff containing pollutants from agricultural, forestry and aquaculture systems, excess fertilizer, soil erosion, sedimentation, herbicides and pesticides
Aquatic species	1-Agriculture Cultivation of crops such as rice in the riverbeds of the Central Zagros region by importing uncounted amounts of fertilizers, nutrients and toxins 2- Development of fish breeding workshops - Intake of sewage from salmon farming workshop in areas of Central Zagros that contain chemical and organic pollutants - The location of these workshops at a short distance from each other reduces the self-

	purification power of the river in reducing pollutants. 3- Livestock The movement of livestock in the bed or in the vicinity of rivers not only causes the entry of animal waste and pathogens into the water, but also erodes the banks of the river by causing turbidity and turbulence in the ecosystem. 4- Domestic and agricultural sewage Direct entry of domestic wastewater or use of depleted wastewater collection and disposal systems such as absorption wells are the most important cases of contamination of surface and groundwater resources in the Central Zagros region and as a result the inhabitants of these ecosystems.
Birds	Disposal of domestic, agricultural and industrial wastewater Water pollution, lead poisoning, use of organ chlorine toxins and heavy metals (agricultural wastewater), use of pesticides, rodent repellents or other chemicals, significant changes in the cover of floating plants and stems in water due to increased nutrients, including phosphorus and nutrients Nitrogen and depletion of food sources
Other species (reptiles, amphibians and butterflies ...)	Disposal of domestic, agricultural and industrial wastewater - Use of various chemical pesticides to destroy pests, weeds and fungi in agricultural fields and their residues into the soil through agricultural drains - Direct disposal of domestic wastewater into natural environments has greatly reduced the diversity of these habitats around farms and in many cases completely destroyed.
plants	Disposal of domestic, agricultural and industrial wastewater - Chemicals in domestic and agricultural wastewater cause many problems in the flora of the region. - Increase in nutrients that cause excessive growth of some species. - Biological accumulation of some chemical elements in plant tissue causes damage to the flora of the region. - The interference of crop species in the natural ecosystem of native species and sometimes their disturbance as alien species has a severe adverse effect on the ecosystem balance.
Aquatic and terrestrial ecosystems	- Domestic and agricultural sewage Direct discharge of agricultural wastewater and runoff and surface runoff contaminated with water bodies or direct discharge of wastewater into nature and open environments is a serious threat to the structure of ecosystems and habitats in the region, some of the most important of which include the following. - The introduction of unaccounted amounts of fertilizers, nutrients and toxins is a serious threat to aquatic ecosystems and their habitats, for example, causing the phenomenon of overeating in lakes. - The inflow of rainwater from rainbow trout farms in some areas of the studied watersheds, which is discharged directly into rivers without treatment and contains chemical and organic pollutants, can be a threat to the biodiversity of the fish as well. The health of humans living downstream. The location of fish farms a short distance apart reduces the river's self-purifying power in reducing pollutants. - Direct entry of domestic wastewater or the use of depleted systems for collection and disposal of wastewater such as absorption wells are the most important cases of contamination of surface and groundwater resources in the Central Zagros region. Unfortunately, according to reports provided by experts from rural water and sewage companies, most villages in the study area do not have a proper sewage disposal system, which is a serious threat to the surrounding ecosystems. Among other things, the use of absorption wells can lead to the leakage of sewage sludge into groundwater sources and their pollution.

With the release of a significant portion of wastewater into the natural environment, and even the range of human life, especially in rural communities, effects on the fauna and flora of the region, habitats, and human health. Table 7 lists the most important of these effects.

Table 7- The most important effects on biodiversity of Dena protected area due to lack of wastewater management based on library studies and questionnaires

Species	The most important effects on biodiversity due to lack of wastewater management
Human	- Decreased level of public health and the prevalence of water and wastewater related diseases such as cholera, typhoid, diarrhea, skin and eye infections, schistosomiasis and pneumonia, malaria, giardiasis, worm diseases such as ascaris and ...
Mammals	- Infection of mammalian bodies with microbial, chemical and toxic agents in domestic, agricultural or industrial wastewater that has entered surface or groundwater sources or contaminated sediments (whether through oral intake or other means of exposure to the substance). These pollutants may directly cause the death of an organism or contaminate its environment, resulting in severe population decline and mortality in later generations. - Some types of chemical and biological pollutants have cumulative properties and biological magnification, which leads to accelerated extinction of species. The prevalence of common diseases between humans and mammals is another effect.
Aquatic species	- Release of a large part of wastewater to surface and groundwater sources and cultivation of crops such as rice in the riverbeds of the Central Zagros region by importing unaccounted amounts of fertilizers, nutrients and toxins, development of fish farms in recent years and the entry of wastewater into these workshops. Water resources have caused the death of many aquatic animals in the Central Zagros region and a significant reduction in their population. - The location of these workshops a short distance from each other reduces the self-purification power of the river and some toxins and chemicals used for aquaculture with cumulative properties, enter the body of aquatic animals that not only the recipient species, but also other species of higher levels Has contaminated the food chain.
Birds	- Discharge of domestic, agricultural and in some industrial cases sewage causes water and soil pollution and as a result poisoning of birds due to the entry of elements such as lead, organ chlorine and phosphorus toxins and some trace elements and heavy metals due to the use of chemical fertilizers, pesticides_, Toxins, etc._As a result, it has led to the death and extinction of many native and migratory birds, especially waterfowl and shorebirds. - Destruction or deterioration of bird habitats due to wastewater discharge has led to death or serious damage to bird species in the Central Zagros region.
Other species (reptiles, amphibians and butterflies ...)	- Reducing the diversity and population of these animals, especially around farms and sewage entry points, which in many cases have been completely destroyed?
plants	- Chemicals in domestic and agricultural wastewater cause many problems in the flora of the region. - Increased nutrients that cause overgrowth of some species and threaten the ecological balance of habitats. - Biological accumulation of some chemical elements in plant tissue causes damage to the flora of the region. Interference of crop species in the natural ecosystem of native species and sometimes their disturbance as alien species has a severe adverse effect on the ecosystem balance. - Provides a significant change in the cover of floating plants and stems in water due to increased nutrients including phosphorus and nitrogen and reduced food sources all with unimaginable speed causes death, reduced fertility and extinction of native and migratory birds in the Central Zagros. Makes.
Aquatic and terrestrial ecosystems	- Direct entry of domestic, agricultural and industrial wastewater or the use of depleted wastewater collection and disposal systems such as absorption wells are the most important cases of contamination of surface and groundwater resources in the Central Zagros region. - Physical changes such as heat pollution, increasing water turbidity and reducing the

	depth of light penetration, chemical changes such as the entry of toxins and pesticides and nutrients or biological changes such as pathogenic microorganisms or eggs of disease-carrying insects and parasite eggs are the most important negative effects of sewage entry into Echo. They are in the central Zagros region. - The introduction of unaccounted amounts of fertilizers, nutrients and toxins through sewage and agricultural effluents increases the likelihood of malnutrition in lakes and closed water sources. - The entry of wastewater from fish farms in some areas of the studied watersheds, directly and without treatment into the rivers, reduces the self-purification power of the river. - This wastewater threatens the biodiversity of fish, aquatic habitats, as well as the health of humans living downstream. The use of absorption wells for wastewater disposal can lead to leakage of sewage sludge into groundwater sources and their pollution.

4. Discussion

Monitoring of surface waters for different uses is an imperative and necessary task in order to provide consumers with a suitable quality of water for different uses (Davoodi et al., 2019). Due to the fact that rural communities in the Central Zagros region have a weak wastewater management system and do not benefit from new and suitable wastewater disposal facilities to maintain public health and the environment, so in this study the following recommendations as a guide to create conditions Optimal control of wastewater entering nature is presented. The proposed model for preparing a plan to assess the effects of rural wastewater on biodiversity in the region is as shown in Figure 11. This template has 5 steps.

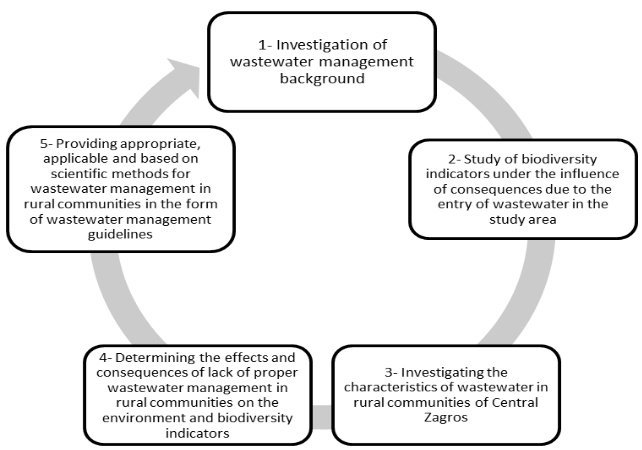

Fig. 11- Flowchart of Evaluation of Rural Wastewater Impact Assessment on Biodiversity in Dena Protected Area

To determine whether to approve or reject the proposed pattern, pattern fit criteria have been used. To evaluate the goodness of model fit, indicators such as: fit index (GFI), mean squared residual index (RMR), Tucker-Lewis fit index (TLI), adaptive fit index (CFI), incremental fit index (IFI), index The ratio of chi-square to degree of freedom (CMIN / DF) and error-based index (RMSEA) were used. The results of the good fit evaluation of the model show that the GFI is equal to 0.977 and considering that it is more than 0.9, so it is acceptable in the area. The RMR is 0.018 and since it is less than 0.08, it is acceptable in the area. TLI is 0.973, CFI is 0.991 and IFI is 0.989, and since they are greater than 0.9, they are in the acceptable range. CMIN / DF are equal to 2,043, and since it is between 1 and 5, it is acceptable in the area. RMSEA is equal to 0.017 and is less than 0.08, so it is in the acceptable range. Therefore, considering that at least three indicators had values in the acceptable range, it can be claimed that the pattern fit is good and acceptable. The proposed pattern is as follows:

1. Knowledge of quantitative and qualitative characteristics of rural wastewater;
2. Avoid releasing sewage into the environment;
3. Selecting the appropriate method of rural wastewater treatment;
4. Wastewater collection and transfer;
5. Wastewater treatment;
6. Recycling and reuse of wastewater;
7. Review and monitoring.

5. Conclusion

Choosing any type of wastewater management program in the villages of the Central Zagros requires considering the costs and benefits of centralized and decentralized methods compared to each other. In areas with low rural housing densities, the use of decentralized methods seems more appropriate, while more concentrated methods are more effective in areas with high densities. In rural areas of the country, it is better to collect rural wastewater by a separate network and use the atmosphere and canals in rural areas to collect surface runoff. In some villages, there is no need to build a sewage collection network, and the wastewater produced at the production site is treated and disposed of in this way, which is called "wastewater treatment and disposal on site." Such as the use of absorption wells, which is a method of on-site disposal? Concentrated systems are systems that are envisaged as a central site including a central treatment plant, equipment for the collection, disposal or transfer of wastewater for an entire area. In villages where the houses are close to each other and in some cases surrounded by agricultural lands, especially in places where the amount of surface runoff is high and there is not enough space to install a sewer system on site, the use of centralized systems is more appropriate. These systems include wastewater collection network, treatment system, recovery system and wastewater disposal system. If the recovery system is equipped with filtration and disinfection, the output water can be used to irrigate the agricultural lands of the same village. In the centralized system, all wastewater is collected by a collection network and transferred to a point outside the village. Unconventional networks, which include pressurized wastewater collection network methods, vacuum wastewater collection network, small diameter gravity network and simplified conventional network, the latter two, small and conventional diameter gravity systems, are more commonly used. The use of any of the above methods depends on the factors mentioned above and the opinion of regional experts contributes to the success of this. Decentralized systems mean that the health system is installed and managed in one place. Of course, these systems can also be used to control the sewage of a group of rural houses that are close to each other. Wastewater is collected by several independent networks and transferred to several points outside the village. Of course, in the rural areas studied in the Central Zagros, it is better to collect rural wastewater by a separate network, on the other hand, it can be used to collect surface runoff from the atmosphere and canals in the village. In the implementation of rural wastewater management programs, socio-cultural factors should be considered and villagers should be aware of the new state of wastewater management. Any wastewater management program actually requires public participation. Therefore, local communities play an important role in developing and advancing the goals of the wastewater management process. Creating a culture to institutionalize the reform of water consumption and wastewater production patterns by the villagers of this region and their participation in management programs is a national task that is possible through the implementation of educational programs. The location of health systems should be chosen according to cultural elements, for example, away from religious, historical centers or cemeteries. The most important cases of reuse and disposal of treated wastewater are:

- Irrigation of agricultural products, afforestation
- Aquaculture
- Irrigation of green space around and inside the village
- Artificial feeding of groundwater
- Discharge in surface waters or channels, etc.
- Sludge can also be used as fertilizer in agricultural fields. Of course, in all cases of reuse of sewage and sludge, it is necessary to comply with the relevant standards.

6. Conflict of interest

The authors declare that they have no conflict of interest.

7. Additional Information And Declarations

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Competing Interests

The author declare there is no competing interests, regarding the publication of this manuscript

Author Contributions

Mohammad Reza Sadegh-Ali: Prposed the plan, conceived the experiments, Field study.

Ali Zare: Analyzed the data, authored or revised drafts of the paper.

Mansour Pournouri: Approved the final draft.

Ethics Statement

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