

SOCIO-ECONOMIC PROBLEMS IN REPLACING EFFLUENT AND WASTEWATER IRRIGATED VEGETABLES AND SUMMER CROPS BY NON- FRUIT BEARING TREES (CASE STUDY : KASHAF RUD, MSHHAD, IRAN)

PROBLEMES SOCIO-ECONOMIQUES DANS REPLACEMENT DE CULTURE D'ETE ET DES LEGUMES UTILISANT LES EAUX USEES ET LES EAUX D'EFFLUENTS PAR LES ARBRES NON FRUITIERS (ETUDE DE CAS : KASHAF RUD, MSHHAD, IRAN)

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ABSTRACT

The problem of Polluted vegetables irrigated with Mashhad wastewater is an issue of social dialog among the people, Mashhad Authorities and newspapers now a days. According to the reports, the non treated wastewater used for irrigation of vegetables is in fact not suitable for irrigation because of the pollution load of biological and chemical matters in such waters. A working group established by the Khorassan government to solve the problem, proposed a project: switching to tree plantation instead of vegetables as an urgent and contemporary solution. Government authorities have guaranteed a loan for farmers who change their plantation using wastewater to produce non-fruit trees instead of vegetables. They are also promised cooperation for further supports as to find market for trees products. Amayesh consulting company (ATSCO) who has performed a social survey on this project, believes that farmers producing vegetables (using wastewater) have a good and immediate market in Mashhad for their products while a market for the sale of wood or other non eatable products is not so easy and no guarantee is given to them for immediate sale of their wood products. So to attract the agreement of farmers to shift growing vegetables irrigated by wastewater to non-fruit bearing trees, a comprehensive

¹ This paper is a summary of results of a study project " replacing non fruit bearing trees (e.g.Poplar tree) instead of vegetables and summer crops irrigated by effluents and untreated wastewater in suburb of north and east of Mashhad"

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social works and socio – economic investigation is needed. Compelling the farmers to change their products by the force and fines and destroying their vegetables farms is not a good and long time solution. ATSCO believes that further propaganda and informative measures accompanied by serious pertinent local supports can provide better results in the near future.

Key words: Wastewater, effluent, vegetables, poplar, non-fruit bearing trees, Mashhad, Kashafrud River.

RESUME ET CONCLUSIONS

La rivière Kashaf rud, une rivière saisonnière qui est sèche la plupart de l'année, est un système de drainage d'une vaste zone dans la partie nord-est de Mashhad en Iran. Kashaf Rud est situé dans la zone de préurbaine de Mashhad. Les eaux usées préurbaines sont rejetées dans la rivière et ses affluents. Il y a 40 villages dans deux côtés de la rivière et ses affluents. Plus de 1,5 millions d'agriculteurs de préurbaines qui vivent dans ces villages propres terres agricoles moins deux côtés de la rivière. Les agriculteurs d'irriguer leurs vergers et des terres agricoles par les flux de l'eau de la rivière et ils envoient habituellement l'eau du débit de la rivière par des pompes. En plus des eaux usées, ils utilisent également l'eau souterraine et des effluents des deux usines de traitement des eaux usées dans la région. En raison de la pénurie d'eau et de sécheresse plus de l'écoulement dans la rivière et ses affluents se compose d'eaux usées non traitées (eaux usées industrielles et résidentielles) qui est entièrement contaminé par des pollutions chimiques et biologiques. La rareté de l'eau pure est tellement élevée que les agriculteurs doivent irriguer leurs terres avec des eaux usées non traitées. Malheureusement, la plupart des terres agricoles, maintenant des jours, sont sous la culture de légumes et de produits de l'homme d'été utilisable qui est vendu à un citoyen de Mashhad.

A partir de 3 ans l'écologiste responsable a informé la pollution au-dessus des eaux usées pour la production de plantes comestibles en particulier pour la culture de légumes. Depuis lors, beaucoup d'efforts ont été faits par les personnes responsables, comme les autorités l'environnement, la santé et de la ville pour arrêter l'irrigation par les eaux usées contaminées. Récemment (2008) groupe de travail gouvernemental composé de représentants de l'agriculture, l'environnement et la santé ainsi que la ville et le gouverneur des sociétés de conseil a approuvé un plan pour encourager les agriculteurs remplacement par des arbres non fruitiers avec des légumes et des produits comestibles qui sont irrigués par les eaux usées maintenant. Deux directives importantes ont été approuvées. Une approche à long était de terminer la ville de Mashhad des eaux usées système de collecte et traitement des eaux usées de transmission aux différentes usines de traitement des eaux usées et l'eau purifiée peut être distribué aux terres agricoles pré-urbain. Parce que ce programme prend du temps et de l'investissement est tellement élevé, en plus de cela, une deuxième approche a été également présentés. La seconde approche, qui était un programme court, a été un projet de laisser les agriculteurs à utiliser les eaux usées que pour l'irrigation des arbres non fruitiers ou autres produits non utilisés pour la consommation humaine et l'élevage. Le titre du projet était: «le remplacement des arbres non-fruits au lieu de cultiver des légumes sur le côté deux Kashaf Rud River irrigation avec des eaux usées". La zone du projet est entre les deux usines de traitement appelé Parkandabad et olkand mesures préliminaires ont

été: ONG coopération et la coordination des agents responsables locaux environnement particulièrement, de la propagande pour optimiser l'utilisation de l'eau, Séances d'information avec les organismes gouvernementaux responsables secondaire et avec les utilisateurs des eaux usées. La principale recommandation a été entière satisfaction des utilisateurs des eaux usées et également un règlement pour l'encouragement ainsi que système de la peine pour contrevenants.

Mots clés: *Eaux usées, effluent, légumes, peuplier, arbres non fruitiers, Mashhad, rivière Kashafrud.*

(Traduction française telle que fournie par les auteurs)

1. INTRODUCTION

Definition in this paper

Effluents: preliminary treated industrial and grey water

Wastewater: Untreated wastewater flowing from city and surrounding of Mashhad including industrial wastewater

Kashaf Rud River, a drainage system of Kashafrud basin, is located in the suburban of Mashhad metropolitan city in the north eastern part of IRAN. Part of untreated wastewater of the north and the east of Mashhad including industrial and grey water flows into this river. From some years ago, farmers living at two sides of the river and its tributaries are growing vegetables, summer crops, and other fast growing plants irrigated by the water of the Kashafrud River, which is mixed with the untreated wastewater. This has brought undesirable and widespread environmental, medical and social effects, which severely threaten health and food security of people in Mashhad. A comprehensive project is in progress now to prevent and minimize the environmental and health risks in this region. Two guidelines were proposed to prevent growing vegetables and summer crops irrigated by untreated wastewater:

1. **Long term guideline :** establishment of a comprehensive network of wastewater collection in the north and the east of Mashhad and its treatment in constructed waste water treatment plants in the study area. This guideline is very beneficial with good results but takes time and is expensive.
2. **Short time guideline :** The short time plan is to force legally the farmers who use untreated waste water to replace their agricultural activities to growing non eatable products for human and animals. Those farmers who accept the proposal will receive support from the government and social institutions .The proposed product, legally permitted to be irrigated by wastewater, was the non- fruit bearing trees such as poplar. The project advise the government agency and executive managers to proceed with the replacement project with the least objection from the people. The farmers who accepted planting trees instead of vegetables, were promised enough wastewater, loan from the banks and other agricultural aids such as pesticides and plant medical cares.



Fig. 1 Irrigating eatable products with untreated wastewater in Kashafруд- Mashhad- IRAN

Main objectives

- Optimal utilization of effluents and treated wastewater in the margin of Kashafруд river
- Replacing non- fruit bearing trees (poplar, etc.), industrial and house plants instead of growing vegetables irrigated with wastewater.
- Creation of a green belt in the flood catchment area of Kashafруд plain and its tributaries
- Carrying out the replacing project with the least objections from the people and without social, political and security challenges
- People's participation in optimum utilization of effluents and treated wastewater by establishment of wastewater users' cooperatives .

Vegetables and summer crops cultivation with irrigation by untreated wastewater from Kashafруд River and its tributaries is a basic issue and is related to all problems of suburban settlement and could not be considered as only a rural cultivation problem.

The study area

The study area includes the agricultural land of Mashhad urban surrounding at the sides of Kashafруд River and its tributaries in the north and the east part of Mashhad. This area covers a distance of 43 km between Parkandabad treatment plant to the Olang treatment plant. Kashafруд tributaries include Kale Pava, Kale Sisabad and Alteymoor, which are located in the service area of Mashhad municipality.

In the study area there are 35 rural and 2 city regions of Alteimoor and Sisabad where the agricultural lands are located at the sides of Kashafруд River. The study subject of this paper is the agricultural lands located in the flood plains of Kashafруд River and at present these lands are irrigated with effluents and wastewater. Figure 2 shows the study area, Kashafруд and the villages that grow vegetables irrigated by untreated wastewater.

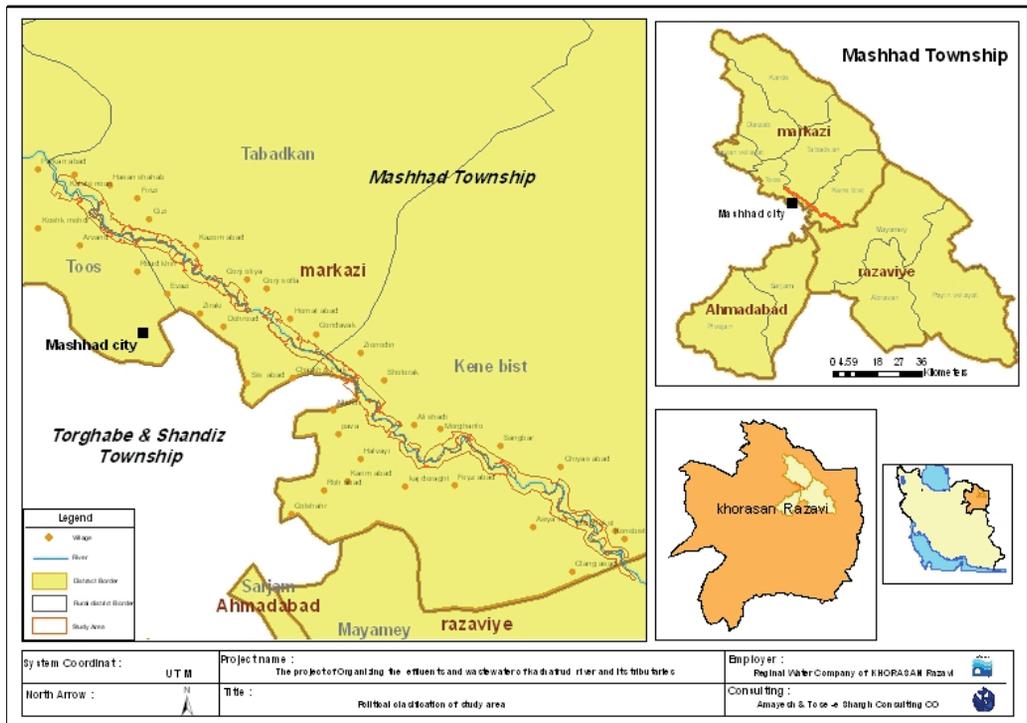


Fig. 2. Controlling effluents and wastewater flows in Kashafrud river and its tributaries : (political classification of study area)

The farmers in study area have three main sources of irrigation :

1. Ground water mixed with effluents or wastewater.
2. Untreated wastewater flow in Kashafrud river and its tributaries.
3. Treated Effluents outflow from treatment plants.

The seasonal amount of over flows of Parkandabad treatment plant is variable and its daily quality varies too. The Olang Asadi treatment plant with an area of 600 Hectares is located in the down part of study area. Olang effluents is utilized for agriculture in lands of Torogh village and Astan ghods sample farms.

The wastewater utilization

Part of Mashhad wastewater flows to Parkandabad treatment plant. The rest flows into Kashafrud tributaries of Sisabad , Abasabad, Alteimoor and Pawa. The wastewater flowing in the river is used for irrigation by farmers in study area. The amounts of wastewater used depends on the far or nearness of the tributaries .The wastewater utilization in villages of the study area is carried out in three main methods:

- Using motor pumps

- Using wastewater by stream flow
- Dig holes and hand wells beside the river

The prevailing cultivated crops

Study shows that the preferred and most cultivated crops in the study area are vegetables and summer crops, which are irrigated with effluents and wastewater. Depending on the wastewater availability, the priority is given to plants such as vegetables, summer crops or beans and peas.

The volume of wastewater and effluent in Kashafrud and its tributaries

Production of effluent and wastewater on peak days is 1134 l/s equivalent to $97 \times 10^3 \text{ m}^3$ in 24 hours and equivalent to 36 million m^3 in a year.

Social condition of wastewater users in Kashafrud area

There are 441 real and legal land owners. These land owners own 1815 ha agricultural lands of which, 1219 ha fall in the 25-year flood plains. The lands besides the Kashaf Rud River which contains the wastewater and effluents are mostly little pieces less than one hectare belonging to different owners. Small ownership and the small pieces of lands are the main problem in project performance. Grouping the land owners shows that most of owners have a piece of land less than 5 hectares.

Table 1. General specification of KashafRud river and its tributaries in study area

Limited area	Number of pieces	Number of owners	Total limited area	Average land area per person (ha)	Area in 25-year flood plain
Kashafrud	438	237	1224	5.2	628
Tributaries	277	204	591	2.9	591
total	715	441	1815	8.1	1219

Table 2. Classification of all land owners in Kashafrud area

Land area (hectares)	Number of owners	% total	Total land area
Less than 0.1	2	0.50	0.15
0.1 – 0.2	8	1.99	1.36
0.2 – 0.5	51	12.66	18.45
0.5 – 1	82	20.35	62.84
1 – 1.5	57	14.14	70.88
1.5 – 2.5	64	15.88	119.84
2.5 – 5	67	16.63	235.79
5 – 7.5	23	5.71	139.19
7.5 – 15	24	5.96	259.64
15 – 30	15	3.72	310.24
30 – 50	6	1.49	226.91
50 – 100	3	0.74	187.64
More than 100	1	0.25	103.95
Total	403	100	1736.88

Project guidelines

- Execution of project through social methods (negotiation, expertise satisfying , understanding with people, contract signing) accompanied with least challenges and police-people confrontation.
- Improvement in economic condition of people.
- Problem resolution one by one, crisis prevention by not entering to various complicated problems such as taking back the river bed or ownership of river limit from the people.
- Protection of poor people.
- If necessary, a confrontation of police and judge with law breakers.

Executive guidelines

Table 4. Long term guidelines

Control and Monitoring institutions	Executive institution	Guidelines
Regional water co. , environment org. , medical science university	Water and wastewater co., Mashhad	Selection, transfer and treatment of Mashhad wastewater based on Scientific standards

Table 5. Mid term guidelines

items	guidelines	The executive and monitoring institutions
1	Prevention from offloading of homes, industrial and medical wastewater into the surface water of Mashhad	Mashhad Municipality , environment .org , university
2	Prevention from offloading the transferring tanks of homes, industrial and medical wastewater in KashafRud river	Environment.org., university , Regional water co., water and wastewater co.of Mashhad
3	Prevention of vegetables and summer crops cultivation irrigated with untreated wastewater and effluents	Jihad Keshavarzi org., environment.org., University of medical sciences
4	Prevention of offloading the homes, industrial and building wastes in KashafRud and its tributaries	Regional water co., environment. org and university
5	Qualitative development of Parkand abad 1 & 2 and Olang Asadi treatment plants to produce purified standard effluents	Water & wastewater co., water co., environment.org, university of medical sciences
6	Prevention from mixing industrial and medical wastewater with homes wastewater	Industrial states, hospital managements , environment.org, university of medical sciences
7	Pre treatment of industrial and medical wastewater based on scientific standards	Industrial states , hospital managements , environment.org, university of medical sciences
8	Arrangement and organizing the jobs and industrial units and their associations and transferring them from city to industrial states and allowed places.	Municipality of Mashhad, industrial states co., environment. org, University of medical sciences

Short term guidelines

Avoidance and prevention of cultivation of vegetables and summer crops irrigated with untreated wastewater and effluents and replacing them with non-fruit bearing plants such as poplar tree.

Practical activities for replacement non-fruit bearing trees instead of eatable agricultural products

The most important activities carried out to begin the project were as follows :

1. Informative and justification sessions

These meetings were conducted in village mosques, public halls and in the farmers' houses. In addition to the farmers, influential local persons in the study area participated in meetings.

Informative subjects presented were :

- Encouragement on optimal water utilization
- Information on the dangerous risk of untreated wastewater use for growing eatable food products and the risks of health and environment pollution
- Information on economic benefit of poplar cultivation instead of polluted vegetables
- Plantation of a green belt in limit of project area through cultivation of non fruit bearing trees and explaining its benefits for farmers
- Encouragement the farmers and getting their agreement without any social challenges or with least social , political and security challenges
- Establishment of wastewater users cooperatives who grow trees and other non eatable products

Establishment of people associations in the form of cooperative companies

To organize and arrange the utilization of wastewater and effluents users through people participation, formation of associations and water users cooperatives (WUCs) was necessary. In this connection three cooperatives named KalatehNoori, Alteimoor and Pawa were established.

Considering the economic and social conditions of people in the region and their economic problems, the most important obstacle of non fruit trees cultivation instead of vegetables is that vegetables and summer crops have immediate products and easy and profitable market for sale but tree plantation has a late product while there is no guarantees for the sale. One of the best encouragements for farmers to plant the trees instead of vegetables is to improve their living through economic development by different methods as mentioned below:

1. Policy actions of encouragement and punishment

The following procedures of encouraging and punishment policy is recommended and is used at present :

Encouragement policies

- Giving free young poplar trees free to volunteer farmers for cultivation.
- Issue the permission for utilizing effluents and wastewater and also motor pump permission to growers of non-fruit bearing trees
- Tree growers will receive motor pump using permission and are introduced to companies of oil products distributors or electric companies to receive easy and cheaper products needed for energy and fuel to irrigate their farm of tree plantation
- Training poplar growers how to irrigate scientifically and grew poplar tree without any harm and effect from wastewater and also cultivate, breeding and taking poplar product
- Providing agricultural needs (pesticides, medical care , etc.,) to members of tree planter cooperatives

- Introduce tree poplar planters to banks for receiving loan
- Providing insurance for poplar planted farms
- Providing valid guarantees for sales of poplar products for farmers
- Official recognition of wastewater users cooperatives by governmental organization and determination of effluent using rights for them and also governmental cooperation with wastewater users cooperatives
- Municipality cooperation in buying the flowers and home plants produced by Wastewater cooperatives in the area of project.

Punishment policies

These policies will be followed in a limited way that the encouragement policies

- Every farmer who plants vegetables or summer crops irrigating with wastewater from the time of project execution, would be sent to judge for punishment
- Based on environmental laws, production of any eatable product by utilization of wastewater would be absolutely forbidden and all production of violators would be removed and destroyed in the farms.
- The water pumps of violators will be removed by the Khorassan water co. and police of the court.



Irrigation by treated wastewater (Mashhad-Kashafруд)

The number of poplar trees planted in the project area :

Considering encouragement and punishment policies performed, the trend of trees plantation instead of vegetables increased from the year of 1387 (2008) and the numbers of non fruit tree planting volunteers are increasing.

Table 6. General conditions of poplar planter at the sides of Kashafrud River and its tributaries

Number of young trees distributed	Number of villages	Area under poplar plantation (hectares)	Cultivation year	Items
266390	15	69	1387-88	1
454040	25	187	1388-89	2
All request for 300 hectares			1389-90	3
720430	-	556	Total	



Poplar trees planted in Kashafrud area (in suburb of Mashhad city in the Khorassan province in IRAN – 2010)

2. SUMMARY AND RECOMMENDATIONS

Kashaf rud River, a seasonal river that is dry most of the year, is a drainage system of a large area in the north eastern part of Mashhad in Iran. Kashafrud is located in the peri-urban area of Mashhad. The urban grey water is discharged into the river and its streams. There are 40 villages at two sides of river and its streams. More than 1.5 million peri-urban farmers who live in these villages own farmlands. The farmers irrigate their orchards and farmlands through water flow of the river and they usually lift water from the river by pumps. In addition of wastewater, they also utilize groundwater and the effluents from the two wastewater treatment plants in the region. Because of water scarcity and drought most of the flow in the river and its streams consists of untreated wastewater (industrial and residential waste water) that is fully contaminated with chemical and biological pollutions. The scarcity of pure water is so high that farmers have to irrigate their land with untreated wastewater. Unfortunately

most of farmlands, now a days, are under the cultivation of vegetables, which is sold to the citizen of Mashhad. Since about last three years, responsible environmentalists have informed the adverse impact of using waste water for irrigating plants, which give eatable products, particularly vegetables. Since then a lot of efforts have been made by responsible persons such as environmentalists, health and city authorities to stop irrigation by contaminated wastewater. Recently (2009) a governmental working group consisting of agricultural, environmental and health representatives as well as the city Governor and some consulting companies has approved a plan to encourage farmers substituting non-fruit bearing trees for vegetables and eatable products that is irrigated by wastewater now. Two important guidelines were approved. A long term approach was to complete Mashhad city sewage collection system and transfer wastewater to different sewage treatment plants and then purified wastewater could be distributed to peri urban farmlands. Because this program takes times and the investment is high, a second approach was presented too. The second approach was a short program, letting farmers to utilize wastewater only for irrigation of non-fruit bearing trees or other products not used for human or animal consumption. The project title was : “Substituting non-fruit bearing trees for vegetable crops grown at the two sides of Kashaf Rud River and irrigated with wastewater”. The project area is between two treatment plants called Parkandabad and Olkand. Preliminary measures were: cooperation and coordination of local responsible agents particularly environmentalists, NGOs, for making propaganda for optimizing water utilization, informative sessions with governmental secondary managers and with wastewater users. The main recommendation was that the short term programme was to be implemented with complete satisfaction of wastewater users and also a regulation for encouragement as well as punishment system for violators.

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