*Indian Journal of Fundamental and Applied Life Sciences ISSN: 2231– 6345 (Online)*
*An Open Access, Online International Journal Available at www.cibtech.org/sp.ed/jls/2014/04/jls.htm*
*2014 Vol. 4 (S4), pp. 2936-2939/Maskooni et al.*
***Research Article***

# EFFECT OF FLOOD SPREADING ON PHYSICAL AND CHEMICAL PROPERTIES OF SOIL (CASE STUDY: AAB BARIK, BAM, IRAN)

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## ABSTRACT
Inappropriate utilization of renewable resources and draughts are among the main causes of increasing desertification. Only through correct and timely utilization of soil and water can desertification be prevented. Flood spreading is a proper solution for containing desertification. To investigate the effect of flood spreading on physical and chemical properties of soil, a series of experiments were conducted in the AabBarik Plain (approx. area: 150 hectares), Kerman Province. The experimental results were then analyzed via the SPSS platform and the mean values compared through a randomized scheme using the Duncan test at the 1% significance level. The overall results showed that, as compared with the control samples (i.e. parts unaffected by flood spreading), flood spreading increased at a significant level the phosphorus, potassium, organic carbon, and total nitrogen content of soil as well as its cation-exchange capacity (CEC).

***Keywords:*** *Soil Properties, Total Nitrogen, Absorbed, Absorbed Potassium and Organic Carbon*

## INTRODUCTION
In the arid and semi-arid regions the limited availability of water in most cases is the major constraint to rained agriculture. Lack of water in this area has affected the rural land ecology. Drying weather, desert situation, lack of vegetation cover, climate change, soil erosion by wind, soil erosion by water after each rainfall that cause flood are some of the characteristics of these regions (Ghazavi *et al.*, 2010). Floodwater spreading may be employed in flood mitigation, inhibition of desertification, artificial groundwater recharge and environmental rehabilitation (De Vries *et al.*, 2002). Moreover, flood spreading represents an optimum approach for rural development by means of flood irrigation (Dahan *et al.*, 2007). Iran is a country in the arid and semi-arid climatic region with little precipitation. The mean annual rainfall in the country is approximately 274 mm, about a fourth of the global average (860 mm). This has turned arid conditions into a climatic reality in Iran. Alizadeh (2001) argues that out of the 130 billion $m^3$ of extractable water in Iran, only 54 billion is actually consumed and the rest is lost. The annual ground water level drop in Iran is estimated as circa 5.5 billion $m^3$. Short-duration rainfalls are another climatic characteristic of arid and semi arid regions, causing frequent flooding even at low precipitation levels. The water from such flooding is often lost and cannot be made available for use; and the floods can sometimes lead to loss of life and property damage to the inhabitants in the area. Flood spreading operations can prepare the ground for containing floods and using the water obtained from them. Due to the influx of high volumes of water during transient floods, different salts and minerals as well as suspended sediments with different origins are deposited onto the flooded area. Moreover, infiltration of fine aggregates into soil can in time introduce certain changes in soil characteristics (Alizadeh, 2001). Flood spreading is the efficient control and distribution of flood water through surface mechanical operations to prevent undue loss of water to the environment. Simpler forms of flood spreading go back several thousand years and used to be performed in different ways based on regional conditions (Javadi and Mahmoudi, 2011). Flood spreading is important in arid and semi-arid regions because the suspended sediments left onto rocky coarse-grained terrains can turn these terrains into fertile agricultural land. Suspended particles in floods can introduce changes in soil texture as well as structure, and increase soil depth and fertility in the flooded areas. Today, flood spreading systems (called “water supply projects”)

are implemented in certain regions in Iran. During the course of these projects, a great volume of flood water containing salts and minerals as well as an abundance of suspended particles with different origins flows over the terrain, depositing new sediments and causing fine-grained materials to penetrate into soil (the surface layer of soil in particular) to change its characteristics. Various studies have so far been conducted on physical and chemical characteristics as well as fertility of soil resulting from flood spreading: Sokouti and Oskoui (2002) studied the effect on physical and chemical characteristics of soil as a result of implementing a flood spreading system at Poldasht Flood Spreading Station. They concluded that electrical conductivity (EC), saturation percentage (SP), organic carbon content, and clay content of soil decreased by 61.1, 9.1, 2.7, 100, respectively. Fakhri *et al.,* (2003) conducted studies at the Bushehr Province Research Station and concluded that clay and silt content of soil increased and its sand particles significantly decreased (1%). Moreover, the SP increased (at a 5% significance level), whereas organic materials, total nitrogen, and pH did not exhibit significant (5% level) changes. Sokouti and Mahdian (2005) demonstrated a significant difference among some soil properties during four years of experiments. Compared with the first year, some soil parameters such as electrical conductivity, organic carbon and clay percentage increased whereas pH, sand and infiltration rate decreased. Sarreshtehdari (2005) studied on desert lands around Kerman province, by investigating impacts of floodwater spreading plan in Abbarik catchment by analyzing depth of sediment yield, reported salinity and electrical conductivity is significantly increased. Soleimani *et al.,* (2007) conducted a similar study at Mousian Plain Flood Spreading Station, Ilam and obtained, upon flood spreading, sand and clay contents of 84.2% and 10.9% respectively (as compared with those of the control sample of 79.7% and 14.6%), which indicated a significant increase/decrease at a significance level of 1%. They also obtained an increase in soil clay content of 22.9% to 24.5% which was not significant. The organic carbon and total nitrogen contents for the soil at this station were greater than those obtained for the control area. However, pH, EC, and available K variations were not significant at the considered level. Javadi and Mahmoudi (2011) examined certain physical and chemical properties of soil in Jajarm, Northh Khorasn Province. They found significant increases in the mean clay, silt, SP, organic carbon, EC, total nitrogen, phosphorous, and absorbed potassium values; and a significant reduction in sand content and acidity of the flood spread areas as compared with the control areas. In this study, an effort was made to evaluate the variations in the chemical characteristics of soil in Aab Barik Flood Spreading Station during flood streaming operations. The following properties were considered: total nitrogen (TN), absorbed phosphorous (P), absorbed potassium (K), organic carbon (OC), and cation-exchange capacity (CEC).

## MATERIALS AND METHODS

### *The Study Area*

The Bam Ab barik plain is located at southeast of Kerman Province in Iran. Geographically, this area is longitudinally located 58˚45’ E and 59˚20’ E and between 28˚30’ N and 28˚50’ N. The climate in this desert area is arid with a mean annual rainfall of 59 mm.

### *Soil Sampling*

Since the samples were to represent all the existing soil properties in the region, three strips were selected in the studied (flood spread) area for sampling. To take soil samples, each strip was first divided into three equal sections and the center of each section was determined. In the next step, a 1-kg soil sample was taken from the center in each section (by digging a 75cm x 75cm profile with a depth of one meter and taking samples from three depth ranges of 0-30, 30-60, and 60-90 centimeters). Next, three other samples were taken at three heads of a triangle inside a radius of 1-2 meters around the same center. Finally, a hybrid sample was selected by combining these four soil samples, and subsequently sent to the laboratory along with the control sample (obtained from the untreated area), where TN, P, K, OC, and CEC were measured for both samples. The variance analysis test in the SPSS platform was used to compare the results obtained for the change in chemical properties of the flood spread area to those obtained for the control sample. The test results were then analyzed through SPSS via the fully randomized Duncan’s test at 1% significance level.

## RESULTS AND DISCUSSION

***Results***

The results of statistical analysis of the three flooded and control samples in the Aab Barik Region are summarized below:

**Table 1: Mean comparison of soil characters in transect number**

| Transect Number | OC | TN % | P | K | CEC |
|---|---|---|---|---|---|
| First | 1.17 a | 0.053 a | 14.27 a | 211.42 a | 9.91 a |
| Second | 1.22 a | 0.054 a | 12.74 a | 218.53 a | 8.12 b |
| Third | 1.12 a | 0.050 a | 15.11 a | 225.45 a | 7.36 c |
| Control | 0.38 b | 0.041 b | 5.23 b | 113.12 b | 4.51 d |

The increase in mean values of K, P, TN, and OC in the flooded soil samples was significant at 1% significance level (Table 1), i.e., flood spreading significantly increased the content of these elements in soil as compared with the control samples. Moreover, this increase was more pronounced in the surface layers which in turn exhibited a significant difference of 1% as compared with greater depths (Tables 2).

**Table 2: Mean comparison of soil characters in soil depth**

| Depth | O.C | T.N | K | P | CEC |
|---|---|---|---|---|---|
| 0-30 | 1.18 a | 0.068 a | 223 a | 15.2 a | 10.11 a |
| 30-60 | 0.81 b | 0.054 b | 205 b | 12.18 b | 8.83 b |
| 60-90 | 0.76 b | 0.047 c | 202 b | 12.1 b | 8.61 b |

The cation-exchange rate also increased in the three strip samples as compared with the control samples. This increase was more pronounced in the first strip sample. The reason is that this strip had absorbed more flood water as compared with the other two samples, leading to fixation of CEC in the soil. The deposited sediments from flood spreading contained a great amount of useful elements which would turn barren land into fertile agricultural land. Overall, flood spreading improved the physical and chemical quality of soil and increased micro-organism activity in soil. This is an important achievement since artificial soil fertilization via chemical fertilizers would bring about environmental hazards. Flood spreading, if it carries the proper sediments, would increase soil fertility and rehabilitate sandy, infertile, or eroded lands. Moreover, the silt and mud accumulated in ponds and networks of the flood spreading system can serve as natural fertilizers to improve soil properties. Overall, flood spreading can significantly increase soil fertility. This was proved in the present study by flood spreading the studied area and obtaining favorable results. Therefore, it is recommended that similar projects be carried out in other properly situated regions as well. For long-term flood spreading operations, appropriate operational schemes and accurate maintenance management must be provided. Flood spreading is particularly effective in infertile areas since it can increase soil fertility and prepare the ground for planting trees and vegetation.

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