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## Study of variations in physico-chemical parameters and plankton diversity during monsoon and post monsoon season in taro reservoir, Kawardha, Chhattisgarh

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### Abstract

A study was carried out to determine variation in physico-chemical parameters of water and plankton diversity in Taro reservoir of Kawardha, Chhattisgarh. The study was conducted in the months of July 2021 to December 2021. Various Physico-chemical characteristics are analyzed such as Temperature, pH, Transparency, Total alkalinity, Total Hardness, Dissolved oxygen and Biological Oxygen Demand (BOD) and results of the parameters were in acceptable range for fish culture. Plankton forms integral components of fresh water environment and contributes significantly to biological productivity of the ecosystem. Various zooplankton and phytoplankton were identified in Taro reservoir, among zooplankton Cladocerans and Copepod were found predominantly higher in number as compared to other zooplankton and Spirulina, *Volvox* and *Chlorella* were dominant phytoplankton. Present study indicates that Taro reservoir is having ideal physico-chemical parameters and plankton diversity which will support good fish production.

**Keywords:** Taro reservoir, physico-chemical parameters, phytoplankton biodiversity, monsoon, post monsoon

### Introduction

The Physicochemical characteristics that define the aquatic environment directly impact the life of aquatic organisms. A little variations in those elements frequently generate an adverse environment with organisms, restricting their growth as well as disrupting to the physiological processes and this decrease their ability to grow and compete in another population from the environment, ultimately changing the natural environment community (Kedar and Patil, 2011)<sup>[1]</sup>. Monitoring and management for the quality of water was a crucial significant phase that can lead towards the conservation of aquatic ecosystems. Ultimately, aquatic ecosystem management aims to conserve habitat while sustaining the physico-chemical quality of water within acceptable limits. Fish production depends directly on both the quality and quantity in natural food available in the environment (Hussain et. al., 2013)<sup>[6]</sup>. Phytoplankton form good source of natural food for aquatic animals especially fish as well as are sensitive to indicators of environmental stress and in maintaining a healthy balance between biotic and abiotic constituent in the water environment. Their availability in the aquatic environment are affected by various factors such as biological, chemical, and physical variables, making them a valuable tool in monitoring programs. The production of plankton is depends on different physico-chemical parameters and every parameter vary seasonally. Hence, in the present study, an effort was made to study the physical and chemical characteristics and plankton diversity of Taro reservoir situated in Taro village of Kabirdham district.

### Objectives

1. To study the physico- chemical parameters of water of Taro reservoir in monsoon and post monsoon season.
2. To study the plankton diversity in Taro reservoir in monsoon and post monsoon season.

### Material and Methods

#### Study Site

Taro reservoir is situated in Taro Village district Kabirdham (Fig. 1.) and it is about 7-8 Km away from College of Fisheries, Kawardha, Chhattisgarh. The reservoir has depth of 16 feet.

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**Fig 1:** Arial view of Taro reservoir

**Sampling**

Fortnight sampling has been carried out from Taro reservoir to analyzed water quality and plankton diversity during Monsoon and Post Monsoon for a duration of six months (July 2021 to December 2021). The samples were taken in the mornings, between 9 a.m. to 11 a.m. The water samples have been collected in sample and DO bottle; the sample bottle were cleaned with distilled water and before collecting the sample and the bottle were once rinsed in sample water and subsequently collected water sample to the sampling site. Plankton samples were taken as well for both qualitative and quantitative estimation. Planktons were collected by using plankton net in which almost fifty liters of water was filtered

through plankton net.

**Physico-chemical analysis of water**

A series of physic-chemical parameters, viz., temperature, transparency, dissolve oxygen (DO), pH, alkalinity, hardness, and biological oxygen demand (BOD) for the water were estimated and recorded fortnightly. Water sample collected for DO analysis were fixed with Winkler’s reagents sampling at the sampling site itself. Temperature using thermometer and transparency using secchi disk were also determined at the site during the sampling and other water quality parameters were analyzed in Aquaculture lab following the procedure given by standard methods (APHA 2005)<sup>[1]</sup>.

**Plankton analysis**

Analysis of plankton was done both qualitative and quantitative estimation. Collected plankton were preserves in 10% formalin and proceed for further analysis. Qualitative estimation of plankton was done by identification of plankton under microscope and quantitative estimation of plankton was done by counting the planktons using Sedgwick rafter cell.

**Results and Discussion**

Mean values for various physicochemical parameters from Taro reservoir during monsoon and post monsoon are given in Table-1.

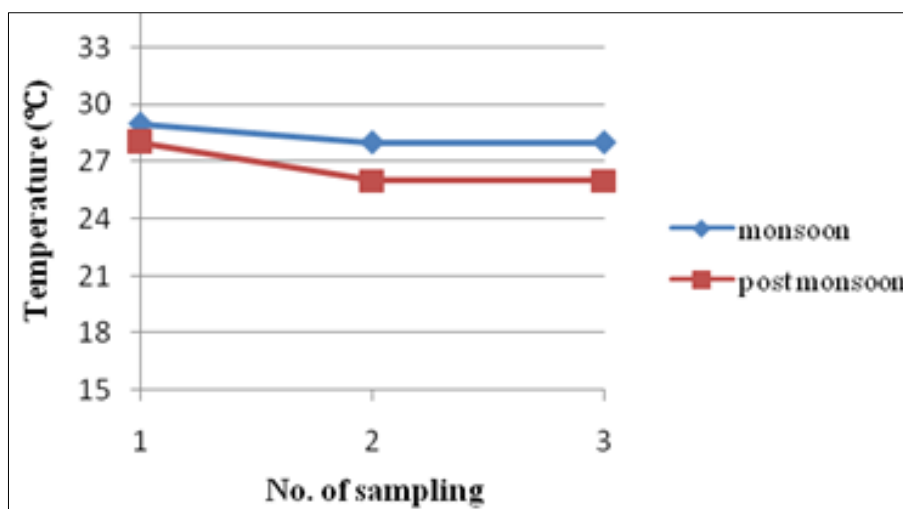
**Table 1:** Physico-chemical parameters of Taro reservoir during two seasons

Parameters	Monsoon	Post monsoon	Aquaculture pond water standards as per Boyd (1998) <sup>[3]</sup>
Temperature (°C)	28.3	26.6	25-32
Do (mg/l)	5.1	5.3	5-15
Ph	7.4	7.06	7-9
Transparency (cm)	23.3	30	35-40
Total hardness(mg/l)	84.1	102.8	50-200
Total alkalinity(mg/l)	155	179.6	50-300
Bod mg/l)	4.98	3.77	0-10

**Water temperature**

Temperature contributes an important role that affects the chemical, biochemical, and biological properties of water bodies. Water temperature directly and also indirectly affects several both abiotic and biotic elements of aquatic ecosystem. It also indicates the metabolism and physical behavior of the

aquatic environment. In the present examine temperature was determined to be in the acceptable range in both the season. During monsoon temperature is in range of 28-29 °C and in post monsoon gives in range 26-28 °C which is favorable temperature for fish culture (Fig. 2). Kennan and Job (1980)<sup>[9]</sup> were also observed similar results as in this present study.

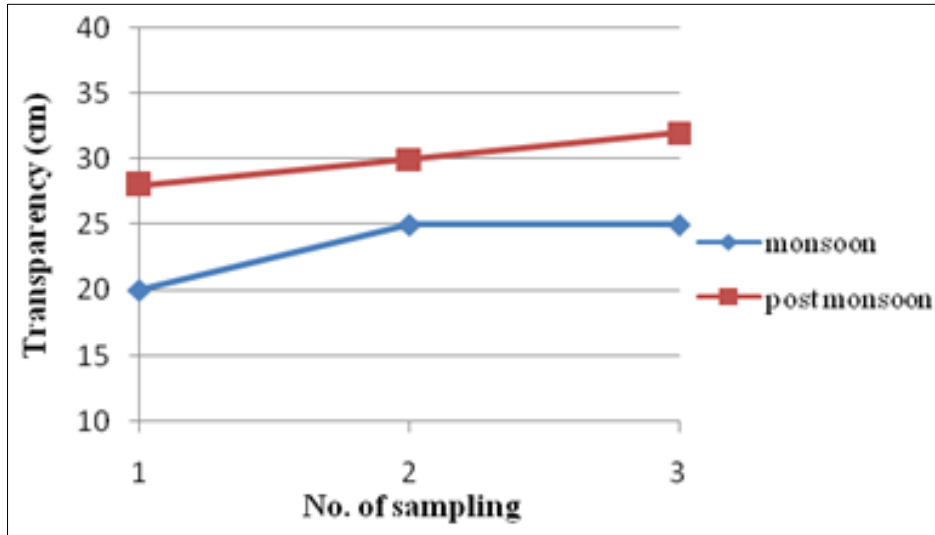


**Fig 2:** Temporal variation of Temperature of two seasons

**Transparency**

The amount of suspended particles present in the water determines water transparency. These particles can be algae and sediment to erosion, the more particles – the less water transparency for example the light cannot pass through as deeply to the water column. In the present investigation transparency for both monsoon as well as post-monsoon season was in the acceptable range. In monsoon

transparency is 23cm and in post monsoon we found 30cm (Fig. 3). After monsoon the water level of the reservoir were rise and all the suspended particles were settle it, due to this reason it gives higher value in transparency. A similar result was reported by Kamal *et al.* (2007) [10]. Transparency plays a significant impact to nutrient transformation as well as indicates the productivity of the water and the availability of the plankton which also impacts the transparency of the water.

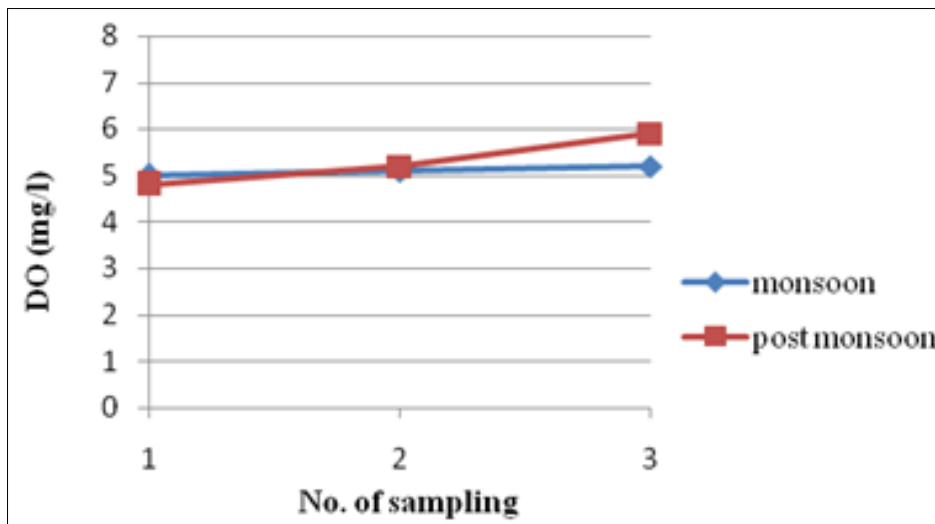


**Fig 3:** Temporal variation of Transparency of two seasons

**Dissolved oxygen**

The level of dissolved oxygen in water body have been accepted as the most significant and widely used estimation of water quality and indicate a water body's ability to support important aquatic life. Jhingran (1982) [8] indicated that the dissolved oxygen content to tropical water could be low considering the high temperature. In the present study

dissolved oxygen values during monsoon was 5.1mg/l and during post monsoon season we found mean of 5.3mg/l (Fig. 4). The amount of oxygen in water is either directly or indirectly dependent on water temperature, relative pressure of air, salinity, etc. Similar findings of low DO were identified by Chaurasia as well as Pandey, (2007) [4] using different pond water samples.



**Fig 4:** Temporal variation of Dissolved oxygen of two seasons

**Total Hardness**

Magnesium and calcium, when mixed with bicarbonate, carbonate, sulphate and various other varieties, contribute to the overall hardness of natural waters. Hardness values less than 20 ppm, according to Bhatnagar and Devi (2013) [2], cause stress in fish, 75-150 mg/l are ideal for fish culture while >300 ppm is harmful to fish life because it affects pH, which affects the mineralization process. The total hardness

of water can be categorized as soft (0-75 mg/l) slightly (75-150 mg/l) hard, hard (150-300 mg/l) and over 300 mg/l as very hard. In the present study, the total hardness in Taro reservoir during monsoon seasons was 84.1 mg/l and Post monsoon was found 102.8 mg/l which is in the acceptable range for fish culture and the water quality of in the pond appears to be moderately hard (Fig.5).

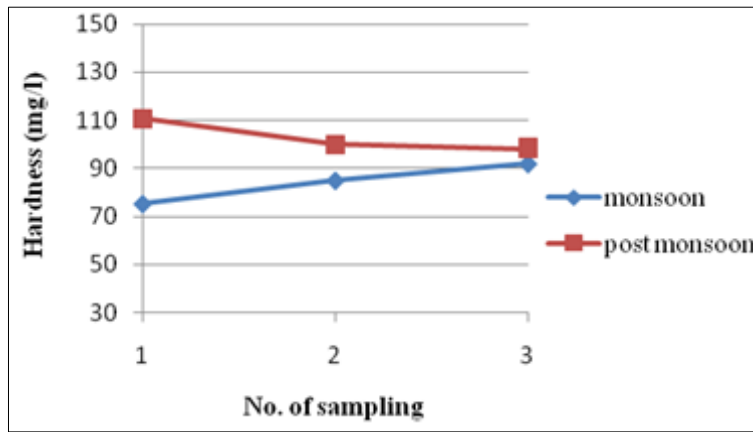


Fig 5: Temporal variation of Hardness of two seasons

**Total Alkalinity**

The carbonate, bicarbonate, and hydroxide contents in the water samples indicate alkalinity. The alkalinity is between 75 - 200 mg/l, according to Wurts and Durborow (1992) [16], though less than 20 mg /l was ideal for a fish farming pond. In

present study total alkalinity during monsoon seasons was observed 155mg/l and during post monsoon it gives around 179.6 mg/l (Fig. 6). Higher value in total alkalinity might be due to contamination of water with agriculture waste and other domestic waste.

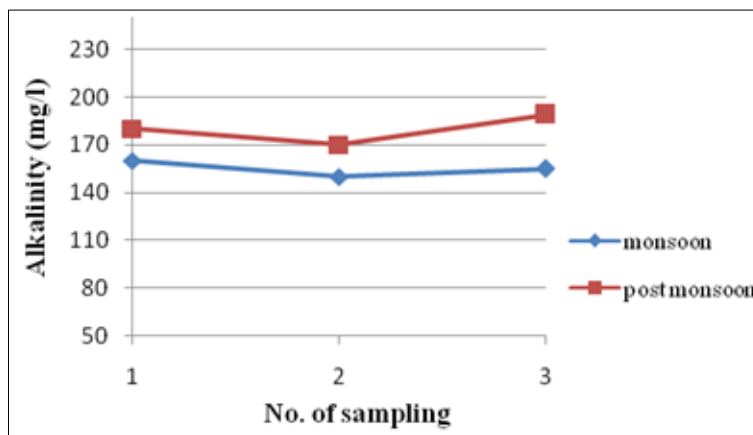


Fig 6: Temporal variation of Alkalinity of two seasons

**pH**

pH refers to the amount of hydrogen ions (H+) present in the water when is a measure of acidity or alkalinity. The pH in water samples of the study area during monsoon as well as post-monsoon season was 7.4 to 7.06 accordingly (Fig 7), which is the optimum range for fish culture. This result is in acceptance by Huet (1972) [7] as well as USDA (1996)

[15] reported that is the ideal water for fish farming in pH is neutral and alkaline in the range of 7-8. According to Jhingran (1982) [8] the pH level of alkaline waters is ideal for the farming of fish. The pH level of the present study was a little alkaline due to domestic uses like cleaning clothes and bathing livestock but overall the pH was the same in both seasons.

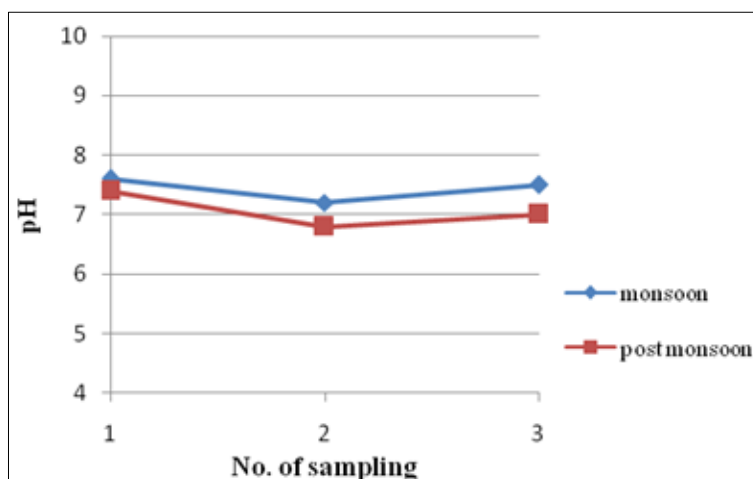


Fig 7: Temporal variation of pH of two seasons

**Biochemical Oxygen Demand (BOD)**

BOD represents a pollution determine that indicates the level of organic load in water bodies that receive organic wastes (Dimele, 2012) [12]. In the present study during monsoon seasons the BOD value 4.98 mg/l whereas during the post-

monsoon season it was found 3.77 mg/l (Fig. 8). In the current investigation, B.O.D. levels of Taro was observed to be higher during the monsoon season which might due to organic load during rainy days. These findings are by Paul and Mukherjee (2006) [14] and Pal (2008) [13].

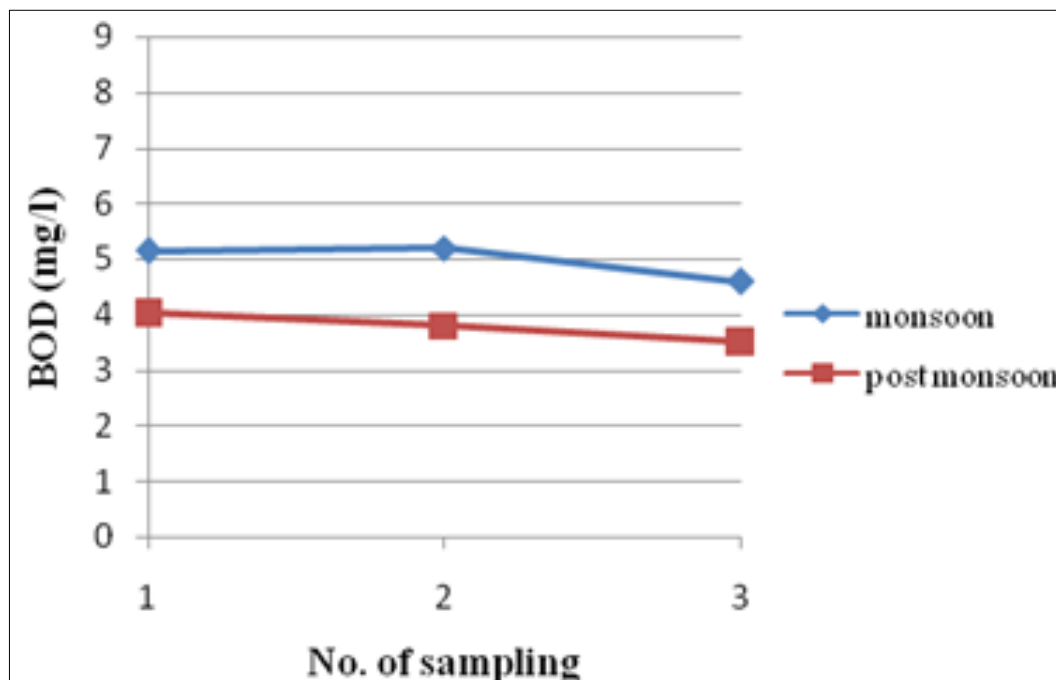


Fig 8: Temporal variation of BOD of two seasons

**Plankton Analysis**

Plankton estimation of both quantitative and qualitative of

two seasons (monsoon and post monsoon) from July to December 2021 is given in Table- 2.

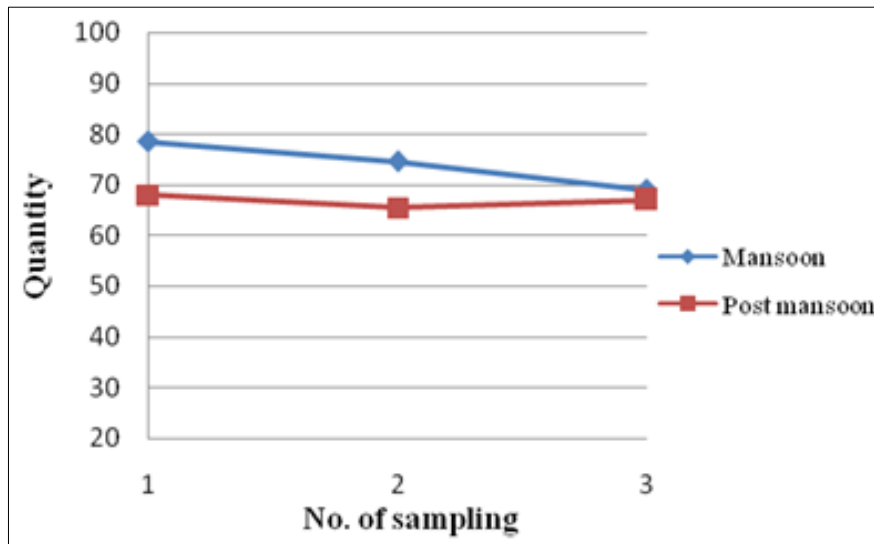
Table 2: Qualitative and Quantitative estimation of plankton in Taro reservoir

Species	Monsoon						Post monsoon					
	Sampling 1 <sup>st</sup> (no./ml)		Sampling 2 <sup>nd</sup> (no./ml)		Sampling 3 <sup>rd</sup> (no./ml)		Sampling 1 <sup>st</sup> (no./ml)		Sampling 2 <sup>nd</sup> (no./ml)		Sampling 3 <sup>rd</sup> (no./ml)	
<b>Zooplankton</b>												
<i>Daphnia</i> sp.	3	5	4	4	3	4	5	4	4	5	6	4
<i>Moina</i> sp.	1	2	1	0	1	3	2	1	2	1	3	4
<i>Cyclops</i> sp.	3	2	3	4	2	5	3	5	5	5	6	5
<i>Gonatozygon</i> sp.	2	3	4	1	3	4	2	3	5	5	4	4
<i>Synedra</i> sp.	3	5	3	4	5	3	4	6	3	5	4	6
<i>Brachionus</i> sp.	4	3	5	6	4	7	6	4	6	5	6	4
<b>Phytoplankton</b>												
<i>Spirogyra</i> sp.	10	8	8	9	7	5	5	6	5	4	6	4
<i>Euglena</i> sp.	8	10	6	7	5	6	6	4	5	4	4	5
<i>Chlorella</i> sp.	10	7	7	6	8	6	5	7	8	5	6	5
<i>Volvox</i> sp.	8	10	8	9	10	7	8	8	5	7	5	7
<i>Anabaena</i> sp.	9	9	8	8	6	6	8	5	6	7	5	7
<i>Nostoc</i> sp.	8	10	10	7	9	7	8	6	6	7	6	5
<i>Navicula</i> sp.	9	7	9	8	7	5	7	8	5	6	6	7
Total	78	81	76	73	70	68	69	67	65	66	67	67
Average	79.5		74.5		69		68		65.5		67	

During the study the biological parameters of the pond was found to be higher in phytoplankton than zooplankton, which indicates that the pond productivity was high which in turn supports good fish production. The mean cell density (no.

/ml) of the plankton was observed to be significantly higher throughout the monsoon season compared to the post-monsoon season (Fig. 9).





**Fig 9:** Temporal variation of quantitative plankton estimation of two seasons

### Statistical analysis

The readings of different variables of physico-chemical investigation were taken in triplicate every fortnight as well and the average was determined based on seasons using Excel.

### Conclusion

From the present study we can conclude that water quality parameters in Taro reservoir were in acceptable range for fish culture. Natural productivity of water which includes phytoplankton and zooplankton production was great importance for production of fish. Present study gives a clear picture of diversity of phytoplankton and zooplankton in Taro reservoir both during monsoon and post monsoon which is indicating good production in term which will supports fish production. Taro reservoir is mainly meant for irrigation purpose and fishery is a secondary aspects. Eventhough department fishery has leased the reserved for fish production and present water quality and plankton diversity study indicate good fish production. Further study on effect of water quality and plankton diversity on fish production is needed to evaluate the correlation between the factors.

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