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An Assessment on Seasonal Physico-Chemical Variations of Charipunia Beel of Morigaon District, Assam, India

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Abstract

The present study was conducted to evaluate the seasonal physicochemical characteristics of Charipunia beel (7.0 ha) in the Morigaon district of Assam over a one-year period from May 2022 to April 2023. The majority of physico-chemical parameters were found to be a favorable range for growth and reproduction within the water temperature of aquatic species ranged from 18.60o C to 29.30o C, water pH from 5.5 to 7.9, dissolved oxygen ranged from 4.5 mg/l to 7.6 mg/l, total alkalinity from 42.3 mg/l to 67.1 mg/l, total hardness from 51.3 mg/l to 70.2 mg/l, free carbon dioxide from 5.5 to 9.3 mg/l, turbidity from 3.1 NTU to 4.6 NTU, and ammonia nitrogen ranged from 0.14 mg/l to 0.32 mg/l. Although the beel conditions were found to be favorable for fish production, there is an urgent need for strict imposition and monitoring of fishery regulations during the banned season. In addition, the identification and protection of feeding and breeding grounds of Indigenous fishes, as well as awareness among fishermen, are very much needed for the sustainable use of the beel.

Keywords: Physico-Chemical, Charipunia Beel, Seasonal Variation, Water Quality

Introduction

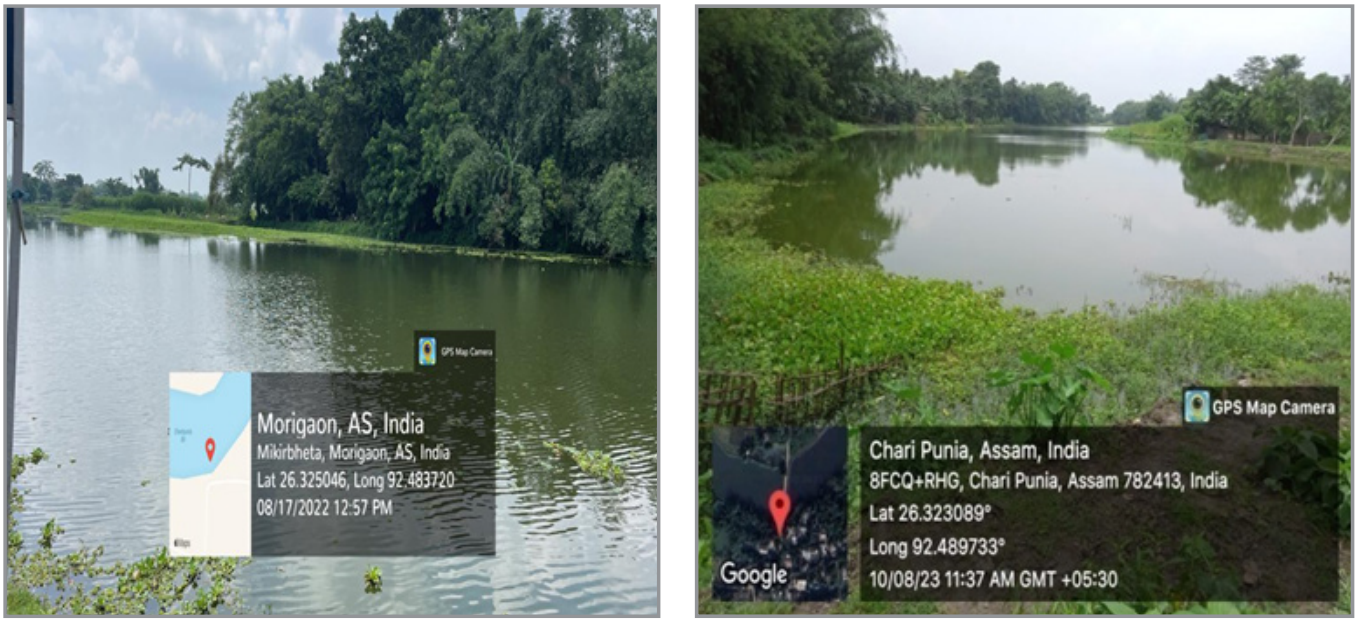
Assam's biologically rich beel on Majuli Island supports a diverse array of aquatic and terrestrial species, including some that are globally threatened. The local communities rely heavily on this beel for their livelihood, engaging in fishing and harvesting other wetland biological resources. Consequently, the water quality of the beel holds significant economic and environmental importance [1]. In Assam, the water quality of beels is closely linked to local environmental conditions, including seasonal variations, agricultural practices, and human activities, such as fishing, wastewater disposal, and the use of chemicals in nearby farm lands. Therefore, continuous monitoring of the physicochemical parameters is crucial for understanding the health of the beel ecosystem and implementing effective conservation and management practices. Furthermore, the physicochemical characteristics of beel waters play a key role in the overall functioning of the aquatic food chain. The functioning of an aquatic ecosystem is largely governed by the interactions between its biotic and abiotic components. Among these, the abiotic or physico-chemical factors of water play a crucial role in determining the system's quality and productivity. These factors include water temperature, transparency, pH levels, dissolved oxygen, free carbon dioxide, alkalinity, chloride, phosphate, and others. Physical parameters significantly influence thermal stratification, as well as daily and seasonal changes, affecting the presence and distribution of microorganisms, plankton, benthic organisms, fish, and even vertebrates like birds. Meanwhile, chemical characteristics also directly impact the ecosystem's physical dynamics and its overall biological productivity [2]. The productivity of a water body is largely influenced by its physicochemical and biological characteristics. The goal of this research was to assess the water quality of the beel, which is essential for understanding the ecological health and sustainability of aquatic ecosystems. These measurements help evaluate the suitability of water for supporting aquatic life and offer insights into the effects of both environmental and human factors on the ecosystem. The pH levels, maintained within a narrow range by factors such as bicarbonate (HCO_3^-), play a crucial role in supporting ecosys-

tem stability and align with established environmental thresholds [3]. Water is essential for all living organisms, as life and development cannot occur in its absence [4].

Methodology and Study Area

The Charipunia beel is a perennially close beel located in Charipunia village in the Morigaon district with latitude 26°15'10.0" N and longitude 92°21'22.8" E. The area of the beel is around 7 hectares (17.297 acres).The minimum depth of this beel is 5 feet and the maximum is 12 feet. Approximately 250 families depend on this beel for their livelihood. The beel is under the lease of Charipunia Goan Unnayan Samiti which was established in the year 1988-89.

Water samples were collected monthly from the surface layer at two locations (stations 1 and 2) for the research. Samples were collected early in the morning, between 4:30 and 6:00 AM, to maintain consistency in measurements. Samples from each station were stored in separate plastic bottles, clearly marked as Station 1 and Station 2. The study analyzed several parameters, including water temperature (°C), pH, dissolved oxygen (mg/l), total alkalinity, total hardness, free carbon dioxide, turbidity, and total ammonia-nitrogen (mg/l). These physicochemical properties were measured according to the standard methods specified in the American Public Health Association guidelines, ensuring reliable and consistent results.



Map 1: GPS Map Locations of Study Sites of Charipunia Beel

Results and Discussion

From May 2022 to April 2023, various water quality parameters of the Charipunia beel, including water temperature, pH, dissolved oxygen, total alkalinity, total hardness, turbidity, free carbon dioxide, and total ammonia-nitrogen, were measured (Table 1). Water quality is defined as the overall relationship between the physical, chemical, and biological properties of a water body. Analyzing water quality is essential for conserving natural ecosystems [5]. Additionally, water quality significantly affects fish growth, maturation, reproduction, and development [6]. Human activities such as agriculture, urban development, domestic sewage disposal, and other factors can alter the physicochemical properties of water, thereby degrading water quality [7]. The wetland holds great biological, environmental, and social significance, and any decline in water quality will negatively impact the entire wetland ecosystem [8]. Observed highest pH during monsoon season and lowest during post monsoon season and recorded a pH range from 7.2 to 8.0 in the Bhara Haripota Wetland of 24- South parganas, West Bengal [9]. Found dissolved oxygen values of 3.7 to 5.6 mg/l in Ghorajan beel, Assam and 5.5 to 8.8 mg/l in Dighali beel, Assam [10]. Kailash Khal wetland exhibits the spatial variations in phytoplankton community structure were sig nificantly correlated with certain environmental variables (pH, temperature, total hardness, TDS and nutrients like nitrate, phosphate and silicate) which were evident from CCA [11]. Water temperature ranged from 17.70ºC to 31.1ºC on the Moridikhow oxbow lake in Sivasagar district, Assam [12]. Dissolved oxygen ranged between 2.29 mg/l to 11.11 mg/l in Barbilla beel and 2.02 mg/l to 10.2 mg/l in Borali beel in Assam [13]. The beel is widely recognized for its rich variety of native fish species, many of which hold significant value both as food and for ornamental purposes. Additionally, it provides an important resting habitat for numerous local and migratory bird species. However, in recent years, the rise in human activities driven by a growing population has posed serious environmental threats to its biodiversity, ultimately affecting the broader ecological balance [14]. Dissolved oxygen varied from 5.13mg/l to 7.33 mg/l in 47 no. Morakolong beel, Morigaon district of Assam [15]. Recorded average turbidity of 56.5 NTU in Dhir beel of Dhubri district of Assam [16].

Table 1: Seasonal Changes in the Physico-Chemical Parameters of Charipunia

Season / Parameters	Pre- monsoon (February 2023, March 2023, April 2023, May 2022)		Monsoon (June 2022, July 2022, August 2022, September 2022)		Post- monsoon (October 2022, November 2022, December 2022, January 2023)	
	Station 1	Station 2	Station 1	Station 2	Station 1	Station 2
Water Temperature(°C)	24.70± 1.58	24.45± 1.65	26.75± 1.35	26.82± 1.49	19.30± 0.35	19.45± 0.17
Water pH	7.37± 0.21	7.55± 0.13	6.40± 0.33	6.27± 0.23	6.70±0.15	6.60± 0.26
Dissolved oxygen (mg/l)	5.90± 0.57	6.17±0.58	5.42± 0.29	5.12± 0.13	5.57±0.20	5.80±0.20
Total alkalinity (mg/l)	46.30± 1.17	44.32± 1.06	48.67± 2.49	46.45± 2.65	57.02± 1.63	59.40± 3.25
Total hardness (mg/l)	60.72± 3.43	61.30±3.43	56.02± 1.94	55.27± 2.01	65.55± 0.93	66.65± 0.91
Free CO2 (mg/l)	6.55± 0.34	6.67± 0.34	6.00± 0.15	5.80± 0.15	8.17± 0.40	8.25± 0.46
Turbidity (NTU)	3.62± 0.20	3.47± 0.14	4.42± 0.08	4.40± 0.10	3.52± 0.15	3.52± 0.04
Total Ammonia-nitrogen (mg/l)	0.22± 0.02	0.23± 0.03	0.18± 0.01	0.17± 0.01	0.15± 0.01	0.16± 0.01

*Data are mean± Standard Error of 3 determination

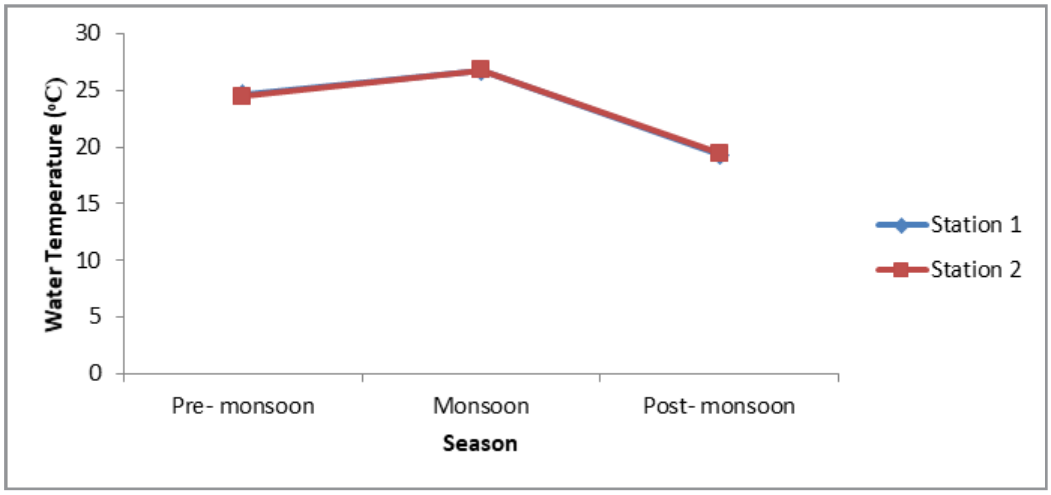


Figure 1: Seasonal Fluctuations in Average Water Temperature (◦C) at Two Selected Stations (S1, S2)

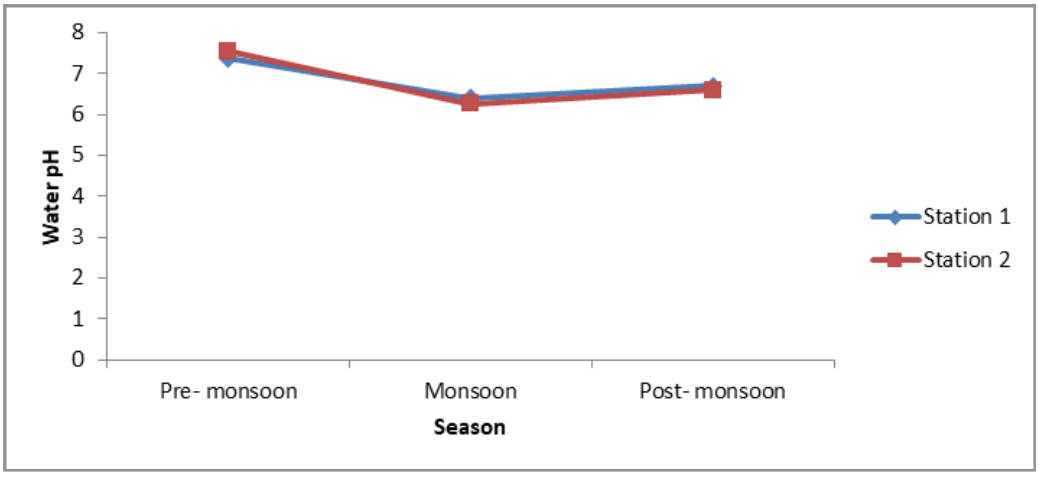


Figure 2: Seasonal Fluctuations in Water pH at Two Selected Stations (S1, S2)

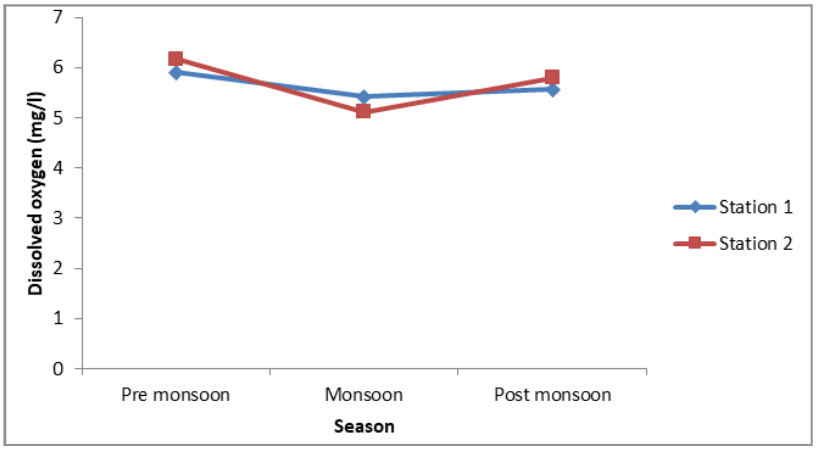


Figure 3: Selected Variation of Dissolved Oxygen in Two Selected Sampling Stations (S1, S2)

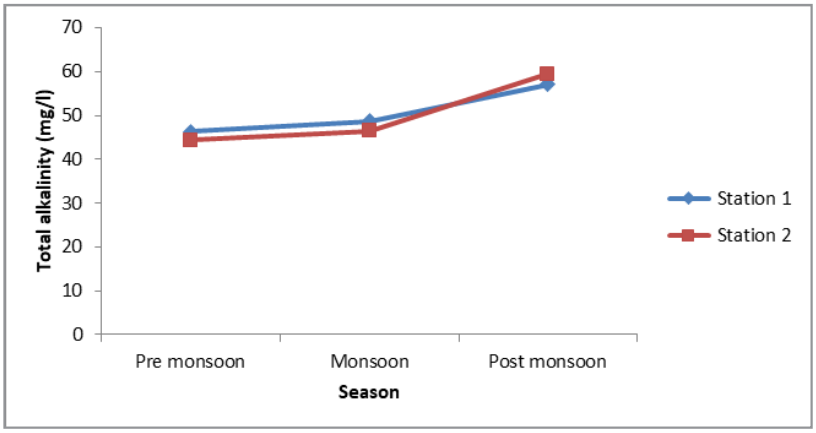


Figure 4: Selected Variation of Total Alkalinity in two Selected Sampling Stations (S1, S2)

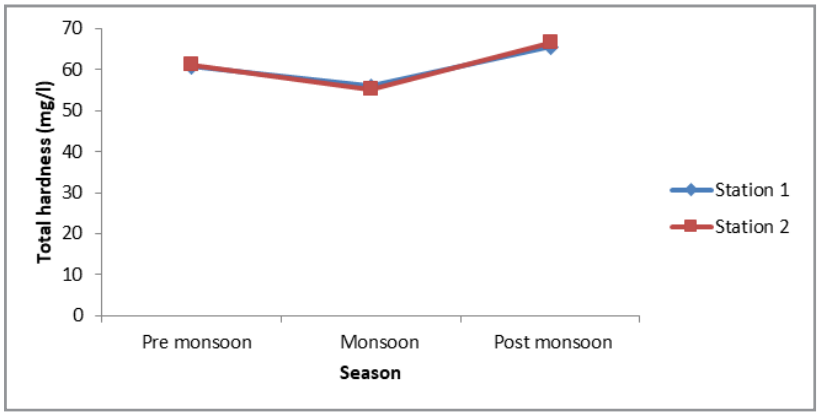


Figure 5: Selected Variation of Hardness in Two Selected Sampling Stations (S1, S2)

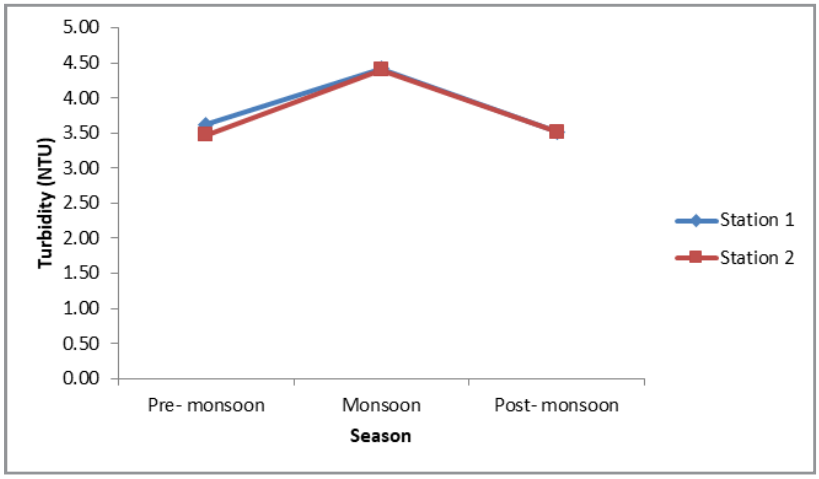


Figure 6: Selected Variation of Turbidity in Two Selected Sampling Stations (S1, S2)

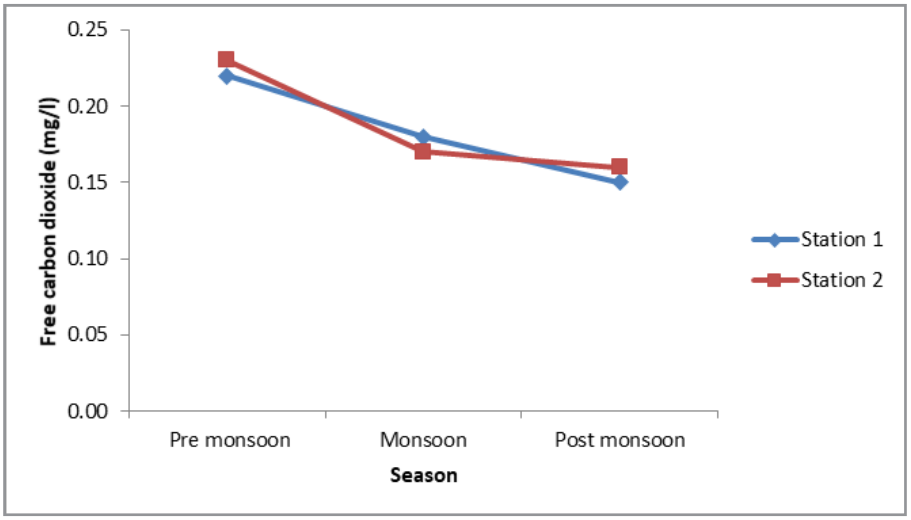


Figure 7: Selected Variation of Free Carbon Dioxide in Two Selected Sampling Stations (S1, S2)

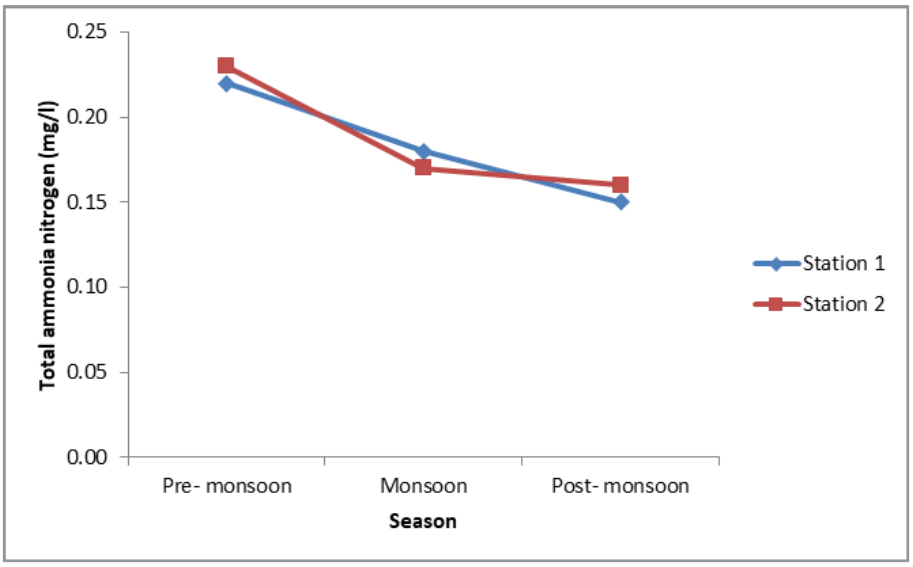


Figure 8: Selected Variation of Total Ammonia- Nitrogen at Two Selected Sampling Stations (S1, S2)

Conclusion

This study assessed the physicochemical characteristics of Charipunia beel in Morigaon district, Assam, India, from May 2022 to April 2023. The research was conducted at two stations across three seasons: pre-monsoon, monsoon, and post-monsoon seasonal variations of physicochemical parameters in Charipunia beel, which can inform future management and conservation. Water temperature ranged from 18.60°C (December) to 29.30°C (July).

Turbidity varied between 3.10 NTU (January) and 4.60 NTU (September).Total ammonia-nitrogen concentrations were highest in May (0.32 mg/l) and lowest in December (0.14 mg/l).Free carbon dioxide levels peaked in November (9.30 mg/l) and were lowest in September (5.50 mg/l).Total hardness ranged from 51.30 mg/l (August) to 70.20 mg/l (February). Total alkalinity was highest in November (67.10 mg/l) and lowest in March (42.30 mg/l). Dissolved oxygen concentrations were highest in February (7.60 mg/l) and lowest in May (4.50 mg/l).Water pH varied from 5.50 (July) to 7.90 (March). The chemical composition of the wetland directly impacts the survival of its biodiversity. It is essential for individuals engaged in activities related to wetland resources to be aware of the consequences of overexploitation and the improper use of these resources for their livelihoods. The study concludes that the water quality of the beel remains generally healthy. However, if anthropogenic activities such as the excessive use of fertilizers near agricultural fields and the use of detergents for washing are not regulated, the water quality may deteriorate further, potentially affecting the composition of aquatic flora and fauna. This research could contribute to the optimal use and sustainable management of the beel [17].

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