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Review Article

Aquaculture of Plankton and Fish by Supply of Fertilizer is Best Way to Protect Global Warming

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Abstract

The earth is warmed by scare of nitrogen and phosphorous. Paris agreement ask us CO_2 emission and CO_2 fix become same with prosperity by 2050. We can do by decrease of CO_2 emission or by increase of CO_2 fix. Increase of CO_2 fix is possible by increase of plankton CO_2 assimilation.

I am presenting plan to increase CO_2 fix by increasing the concentration of N and P by stopping NOx, NP elimination. Increase of plankton CO_2 assimilation is possible by increase of N, P. Increase of NP is possible by stopping of NOx, NP elimination. But official of developed countries do not agree to stop NOx, NP elimination. We can consider more positive method. The method is aquaculture of plankton, weed and fish by the addiction of fertilizer, N and P to sea, lake or river. Sea, lake and river are wide enough and can get enough sun energy. Plankton grow infinitely if enough fertilizers are supplied. We can fix as much CO_2 as we wish. We can get as much fish. We must consider sea and lake as firm to grow fish and to fix CO_2. If we supply fertilizer like urea, TPP, ammonium phosphate or Calcium superphosphate to sea and lake, we can activate CO_2 assimilation. We can get precious fish. We can fix more CO_2 emitted and we can lower GWPR than 1 and elevate GDP increase rate.

Keywords: Fish Production; NP Elimination; CO2 Assimilation; NOx; CO2 ; Aquaculture; Fertilizer

Introduction

Global warming is caused by the lack of nutrient nitrogen and phosphorous

The earth is warmed. CO_2 concentrations increasing 20 ppm every year. About 51 billion tone CO_2 is released in the world. 36 billion tone CO_2 is fixed by CO_2 assimilation. But 15 billion tone CO_2 is remaining. Because 7 developed countries eliminated NOx and NP in waste water by the reason NP is pollution substance. We must provide enough NP to fix 15 billion tone CO_2. I am proposing to fix 15 billion tone CO_2 by stopping NOx, NP elimination [1-47]. But this is not enough.

People are looking for reaction to reduce CO_2. CO_2 assimilation is a reaction of CO_2 with water by absorbing sun energy to produce carbohydrate and oxygen. Quantum yield of this reaction is 100%. This reaction proceed in plant infinitively if sufficient materials are supplied. This reaction produce useful products like fish and grain and fruit. This reaction proceed at any temperature. All CO_2 on earth is fixed by this reaction. No other reaction cannot exceed this reaction:

$$CO2 + H2O + 114\ kCal \xrightarrow[Sun]{CO2\ assimilation} 1/6\ C6H12O6 + O2$$

Carbohydrate

The plant makes amino acid, chlorophyll and nucleic acid. It takes CO_2, nitrogen, and phosphorous with the same composition

(C:N:P = 25:1:0.06) as plant itself. Plankton takes C, N and P by the Redfield ratio [48-51] 6.6:1:0.06. or 106:16:1. About 51 billion tone CO_2 is emitted. About 70 % of CO_2 is fixed at sea by plankton. About 30 % is fixed by plant at land. Therefore 51x 0.7 = 35.7 billion tone CO_2 must be used for the plankton CO_2 assimilation. And 35.7 x 16/106 = 5.39 billion tone N is necessary for the plankton assimilation. And 35.7x 1/106 = 0.337 billion tone P is necessary. NP obtained by stopping of NOx NP elimination is not enough to fix 15 billion tone CO_2. Many developed countries are not yet agree to stop NOx, NP elimination. Official of developed countries do not like to return to the state which they have done at around 1980. Therefore global warming is now progressing.

We can consider more positive method. The method is aquaculture of plankton, weed and fish by the addiction of fertilizer, N and P to sea, lake or river. Sea, lake and river are wide enough and can get enough sun energy. Plankton grow infinitively if sufficient fertilizer like NP are supplied. We must consider sea and lake as firm to grow fish and to fix CO_2. If we supply TPP or ammonium phosphate or Calcium superphosphate to sea and lake. We can activate CO_2 assimilation. We can increase fish production to 20 million tone. 20 million tone fish eat 20 times plankton of his weight. Plankton eat same weight CO_2 of his weight.

Plankton grow infinitely if enough fertilizer are supplied. Fish and sea weed can grow infinitely. We can fix as much CO_2 as we wish. We can get as much fish.

We can choose sea or lake which decreased fish production remarkably. I am proposing the plan 1. Plan 1 is a test addition of fertilizer to Biwa lakeI. Based on the news of Gendai business Pro 1 [52] that Biwa lake Shiga prefecture, Japan is dead because lack of oxygen. Dissolved oxygen level downed to 1 mg/L. This is caused by the lack of phosphorous and CO_2 assimilation is retarded. Biwa lake is closed water lake. No phosphorous is provided. Then if we provide phosphorous to the lake, CO_2 assimilation must be activated and plankton grow and much CO_2 is fixed and much fish will be produced.

The cost of fertilizer like urea, ammonium phosphate, TPP (Tripolyphosphate) 318 tone price 6.36 million dollar (318000 kg x 2$/kg) is 1/800 of lost money 8 hm dollar by the decrease of fish production [42,43]. 318 tone P is same amount as P eliminated at waste clean centers in Japan. We can get much precious fish.

Japan government is spending 5 billion dollar for protection of global warming yearly [53]. This money is enough to provide NP fertilizers. Nitrogen phosphorus concentration of sea increase to N 33 µg/L, P 2.9 µg/L to increase fish production to 200 million tone.

We can extend this strategy to the world, then we can increase fish production to 700 million tone fish fixing 700 x 25 = 17500 million tone (17.5 billion tone) CO_2. This indicates more than 14 billion tone CO_2 fix will be possible and GWPR become lower than1 and much food will be produced and national wealth will increase.

Velocity of CO_2 assimilation is carried out in proportion to the concentration of CO_2, H_2O, sunshine, nutrient N, nutrient P, metal like Fe as shown by following equation:

v=A (CO_2) (H_2O) (sunshine) (N) (P) (Metal)

If we investigate what is the rate determining substances, restricting substances, to do CO_2 assimilation. If we find some substance is effective for CO_2 assimilation, we can add such substance to the sea, lake and river, we can grow much plankton and weed and we can fix much CO_2 and we can get much fish and grain. Addition of additional nutrient element like ammonium phosphate, sodium triphosphate, Calcium superphosphate, ferric chloride, urea, lime might be effective to activate CO_2 assimilation to fix many times of 14 billion tone CO_2. Because plankton grow infinitively if enough N and P are supplied.

Products will increase 1000 times of present production. Sea, river, lake, mountain are fields to receive tremendous sun energy and do CO_2 assimilation fixing much CO_2 giving much food. Then global warming will not happen and much foods are produced and GDP and national wealth will increase.

Providing of N, and P to the sea, lake or river is other way to promote CO_2 fixing.

Fish Production at Biwa lake.

Yahoo news Gendai business Pro 1 reported that Biwa lake Shiga prefecture Japan is dying because lack of oxygen. Dissolved oxygen level downed to 1 mg/l [52]. Similar phenomena is reported at Suwa lake Nagano Prefecture Japan in 2020 May 13 [54]. Fish production at Biwa lake is reported by two authors [55,56].

Fish production at Biwa lake is shown at table 1.

	Total fish t/Y	Fish t/Y	Ayu t/y	Honmoroko t/y	Clam (shizimi) t/y
1955	10616				8000
1964		3000			
1969		3000			2060
1979		2400			840
1989		2800	1760	209	520
2004		1520			70
2014		1060		5	
2017	713		279	9	53

Table 1: Fish catch at Biwa lake.

Fish like ayu and honmoroko are decreasing. I think this is caused by the scare of phosphorus.

Fish (clam + fish) production at Biwa lake was10616 ton In 1955. The production decreased to 713 tone in 2017. Fish production. 2400 tone in 1979, 1520 tone in 2004, 1060 tone in 2014. Ayu production decreased 1760 tone in 1989 to 279 tone in 2017.

Honmoroko production decreased from 209 tone in 1889 to 5 tone in 2014 clam (shizimi) production decreased from 8000 tone in 1855 to 2060 in 1959, 840 in 1979, 520 in 1989, 70 in 2005, 53 in 2017.

Relation of fish catch with TP load (Total phosphorous load) is shown at table 2.

Year	Fish catch (t/Y)	T P Loads (t/Y)
1985	3000	460
1990	3800	440
1995	2200	420
2000	2000	340
2005	1400	280
2010	1200	220
2015	950	220

Table 2: Fish catch at Biwa Lake [55].

Phosphorous concentration T P lord is decreasing yearly. Phosphorous load is decreasing after 1985 by NP elimination policy and waste water purification.

In 1990 fish catch was 3800 tone, In 1995 2200 tone, in 2005 1400 tone, in 2015 950 tone. TP load in 1990 was 440 tone, in 1995 420 tone, in 2005 280 tone, in 2015 220 tone. Fish catch decreased when TP load decreased. One phosphorous can fix 106 CO_2 [50].

Decrease of ten thousand tone fish show 10000x 10 = hundred thousand tone plankton is not produced. Almost same amount of CO_2 assimilation is not done. As same weight of CO_2 give same weight of plankton. CO_2 assimilation give 32/44 weight of oxygen.

Failure of hundred thousand tone CO_2 fix mean failure of 100000 x32/44= 72727 tone oxygen generation is stopped. Therefore Biwa lake become no oxygen.

Clam (shizimi) production decreased. The reason will be decrease of Calcium.

Because calcium concentration is low at Biwa Lake and river coming in Biwa lake contain low concentration. There is no lime stone mountain around Biwa lake.

Eight thousand tone clam (shizimi) is produced yearly In 1955. Then Calcium ion at Biwa lake become scare and clam (shizimi) production decreased 2060 tone in 1964, 840 tone in 1979, 520 tone in 1989, 70 tone in 2004, 53 tone in 2017:

Throw in 920t/year phosphorous compound like ammonium phosphate to Biwa lake. Because 3000 t/y fish was caught in 1985 TP loads was 460. But in 2015 only 950 t/y fish was caught when TP load was 220.

Throw in 460 t/y Calcium phosphate to Biwa lake Because 8000 t/y clam (shizimi) was produced in 1955. But only 53 tone clam was produced in 2017.

I recommend to put in Calcium and phosphorous compound like Calcium super phosphate to Biwa lake Then lack of calcium and phosphorous are cured and clam and fish will be produced. Oxygen lack will be improved.

In order to protect decrease of fish production, we should not do NOx, NP elimination. By stopping of NOx, NP elimination and addition of Calcium compounds and phosphorous compounds to Biwa lake, we con fix 10000x25 = 250000 tone CO_2 and 10000 tone fish will be produced.

Fish Production at Seto inland sea

At around 1980, red tide appeared at near fishery plant at Kagawa prefecture Japan. Then Japan government build 2200 water clean center at all over of Japan and eliminated nitrogen and phosphorous completely by activated sludge process. Also NOx in exit gas of all plant was eliminated by ammonia. Then nitrogen concentration of sea deceased. From 1980 0.40 mg/L to 2015 0.05 mg/L. Total phosphorus decreased from 60t/day in 1980 to 25 t/day in 2010. Sea weed do not grow. Plankton do not grow Nori growing plant stopped. Fish production decreased from 1980 0.45 millions tone to 2018 0.05 millions tone as shown in table 3 [4,5,13,14,16,19,19,57,58]. Official of developed countries consider NP in waste water as pollution substance and inhibited the waste water dumping by London dumping convention. Then NP concentration decreased.

	N mg/L	fish mill t	Total nitrogen t/day	Total phosphorous t/day
1980	0,40	0. 45	670	60
1985	0.40	0.45	620	46
1990	0,30	0.32	620	42
1995	0,22	0. 22	620	40
2000	0.22	0.21	600	39
2005	0.15	0.22	450	32
2010	0.05	0.10	400	25
2015	0.05	0.08		
2018	0.05	0.05		

Table 3: Relation of NOx, NP elimination with Fish production at Seto inland sea.

Hyogo prefecture demonstrated the decreased production of sand lance (ikanago) by the decrease of nitrogen concentration. Ikanago production decreased from 8000 tone in 1980 to 1500 tone in 2016 by decrease of N concentration from 12 micro mole to 1 micro mole as shown in table 4 [39,59]. Decrease was observed at two times. First decrease was at 1980 to 2000. Second decrease was observed after 2000. First decrease is caused by NP elimination of waste water and second decrease is caused by Bon fir inhibition and NOx elimination [33] as shown at later chapter.

Test plan at Seto inland sea

Throw in 670 tone nitrogen compounds/day and 60 tone phosphorous/day to Seto inland sea. Because 0.45 million tone fish was caught in 1985 At this time N concentration was 0.4 mg/L, total nitrogen was 670 t/day, total phosphorous was 60 t/day. In 2010 only 0.10 mill tone fish was caught. N concentration was 0.05 mg/l and total nitrogen was 400 t/day, total phosphorous was 25 tone/day. Amount and kind of N and P compound are changeable by observing N, P concentration and turbidity and amount of fish production. Nitrogen compound like urea, ammonium sulphate are easily obtainable compounds. Phosphorous compounds, like TPP (Sodium tripolyphosphate), ammonium phosphate, or Calcium super phosphate are easily obtainable compound. Addition of such compounds is easy method to increase fish production and fix CO_2 and protect global warming.

	Sand lance (tone)	N concentration (micro mole)
1980	8000	12
1985	4000	5
1990	7000	9
2000	2050	5
2010	2530	3
2016	1500	3

Table 4: Sand lance production at Hyogo Prefecture.

Waste water NP should be released to ocean, field as it is: I investigated Yamazaki waste water purification center at Yamazaki, Kamakura in Japan [31]. This center cover 96881 persons. Water 98287 m3 containing Nitrogen 40mg/l, Phosphorous 4.2 mg/l is treated by activated sludge process. Air is bubbled for ten hours to give water containing Nitrogen 7.5 mg Phosphorous 2.7 31 mg/l. Consuming 8841200 kWh electricity. This data showed that 7.34 Kg Nitrogen, 2.65 Kg Phosphorous is eliminated in one day at this center. This data indicate 7.34 x 120000000/96881 x 365 = 3318 tone nitrogen, 318 tone phosphorous are eliminated in Japan in one year.

As one phosphorous can fix 110 CO_2, 2.65kg X 110 = 2915 Kg CO_2 is not fixed. CO_2 give same weight plankton. Phosphorus in the sea can be supplied by sea current or agitation of surface sea with deep sea. But in the case of Biwa lake, no phosphorus is supplied. Therefore phosphorous concentration decreased and plankton concentration did not increase and fish production decreased.

To increase the fish production, we must increase the concentration of phosphorous. We must come buck to the year of 1985, Stop NP elimination and use phosphorous compounds. Such as ammonium phosphate $NH_4 H_2PO_4$, Calcium superphosphate $Ca(H_2PO4)_2$.

Population of Shiga prefecture is 1.41 million. 7.34 kgs 1410000/96881 x 365 = 38.99 tone nitrogen and 2.65 kg x 1410000/96881 x 365 = 13.97 tone Phosphorous are eliminated at Shiga prefecture. One phosphorous can fix 106 CO_2. Therefore 13.97 x 106 = 1480 tone CO_2 can be fixed by 13.97 tone phosphorous. If 13.97 tone phosphorous is not eliminated, 1480 tone CO_2 is fixed and 1480 tone plankton is produced and 148 tone fish must be produced.

Sodium tripoly phosphate 60 thousand tone was used as detergent in Japan. Nori production 80 % was carried out at Setoinland sea before 1980. If wastewater purification is not done in Japan, 3315 x 20 = 6.63 hm tone CO_2 is fixed and 33 million tone plankton can grow and 33 million tone fish will be produced. I am proposing plan to throw in Sodium tripoly phosphate 60 thousand tone to sea. Then 10 million tone fish will be caught.

World is presumably eliminating N and P 20 times of Japan. 3318 tone x 20 = 6.63 million tone nitrogen and 119 x 20 = 2393 tone phosphorus are eliminated at wastewater purification center. 2393110 x 20 = 2200 billion kWh electricity is consumed for the treatment of wastewater of the world. If wastewater purification is not done at developed countries, 0.66x 20=132,6 hm tone CO_2 can be fixed and 13.26/20= 6.6 hm tone fish will be caught. I am proposing plan to throw in 3318 tone x 20 = 6.63m tone nitrogen and 119x 20 = 2393 tone phosphorus to sea. Then 20 million tone fish will be caught and and 2 billion tone CO_2 will be fixed.

Bon fire inhibition rule should be abandoned.

When something is burned. Ash produced by burning is said to be effective substance. But main effective substance is NOx [40]. CO_2 and NOx 1/25 of CO_2 are main compounds for CO_2 assimilation.

In Japan very special law about the garbage incinerator was set up in 2002 by the reason much NOx is produced at lower temperature [37]. By this rule, incinerator must be burned at higher temperature than 800 °C by adding excess fuel to keep higher temperature. Corrugated carton and fallen leaves must be burned at high temperature incinerator. Bon fire is inhibited by the reason bon fire produce much NOx. Burning of rice straw wheat straw at rice field is not possible. There is Nagoshi clean center at Kamakura, Japan This clean center burn garbage 0.03 million tone at Kamakura producing 0.045 million tone CO_2. Exhaust gas contain NOx. To eliminate NOx, this center used 40.94 kg ammonia in 2018. This mean 40.94 x 30/17 = 72.256 kg NO is eliminated by ammonia at Negoshi clean center [37]. Population of Kamakura is 0.172 million.

This kind of action must be carried out at Shiga prefecture. Clean center at Shiga prefecture. Garbage 0.249 million tone at Shiga producing 0.373 million tone CO_2. Exhaust gas contain NOx. To eliminate NOx, this center used 339.6kg ammonia in 2018. This mean 339,6 x 30/17 = 399.2kg NO is eliminated by ammonia at Shiga clean center [53]. Population of Shiga is 1.41 million. This data indicate 72.256 x 1410000/172000 = 599 million kg NO is eliminated at burning of garbage in Shiga. 40.94x 141/17.2 = 285.64 million kg NOx is eliminated by 255 million kg ammonia. 255 x 141/17 = 2115 million kg ammonia is produced from 447 million kg H_2. If NOx elimination is not done 706 x 141/17=5856 million kg CO_2 is not produced. 285 x 141/17 = 2363 million kg NOx can produce 2.363x 25 = 59.0 million tone plankton. 59.0 million tone plankton can produce 5.9 million tone fish.

Comparison of GWPR (global warming protection ratio. CO_2 em/CO_2 fix), GDP of Japan at 1980, 2018, 2022, 2030.

GWPR and GDP of Japan at 1980 (no Elimination of NOx, NP) and at 2018 (Elimination of NOx, NP) and 2022,2030 are compared as shown in table 5 [32-47].

Table 5 comparison of GWPR (global warming protection ratio), GDP of Japan at 1980, 2018, 2022 and 2030 CO_2 em(CO_2 emission),CO_2 fix, NOx con (NOx concentration at exit gas), Wd (Wastewater dumping), TPP (Sodium tripolyphosphate), GWPR, GDP (GDP increase ratio).

In 1980 CO_2 emission was 8 hm tone, and CO_2 fix was 5.5 hm tone. NOx emission was 0.5 hmt. GWPR was 8/5.5= 1.45 and GDP increase rate was 7. At 1980 severe NOx elimination and NP elimination were carried out and NOx emission was 0. Then CO_2 assimilation was retarded and fish production decreased from 11 hmt in1980 to 2 hmt in 2018 and GDP increase rate decreased from 7% to 0% in 2018. If Japan government stop NOx, NP elimination and start use of fertilizer, fish production will increase to 10 hmt. GWPR will decrease to 1 and GDP will start increasing. In 2030 and 2050

	CO_2 em	CO_2 fix	NOxem	NOxcon	Wd	TPP	Fertilizer	Fish	GWPR	GDP
	hmt	hmt	hmt	g/kWh		hmt	hmt	hmt		inc %
1980	8	5.5	0.5	1.6	do	0.05	5	11	1.45	7
2018	12.5	3.8	0	0.1	No	0	0	2	3.3	0
2022	10	10	0.5	1.6	do	0.05	10	10	1.0	3
2030	10	12.5	0.5	1.6	do	0.05	20	20	0.8	5
2050	10	15	0.5	1.6	do	0.05	50	50	0.6	7

Table 5

if much fertilizer is used, much plankton is produced and much CO_2 is fixed and GWPR decrease to 0.8 and 0.6 and GDP increasing rate will increase to 5 and 7 % respectively.

When we look at table 1 to 4, decrease of phosphorous by NOx, NP elimination might be big reason why fish production decreased. One other reason is use of TPP(sodium tripolyphosphate). Fifty thousand tone TPP was used as detergent additive. In 1980 TN (Total nitrogen) was 12 t/day. TP(total phosphorous) was 60 t/day and fish production was 11 million tone. And GWPR (CO_2 em/ CO_2 fix) was 8/3.5= 1.45. and GDP was 7. In 2018 TN decreased to 3 t/day, TP decreased to 25 t/day fish production decreased to 3 million tone and GWPR was 12.5/3.8= 3.3. GDP was 1. We must decrease GWPR to 1.

This is not easy. We can increase CO_2 fix by using 0.5 hm tone NP.

Japan must return to the state in 1980 by stopping NOx elimination and by stopping NP elimination. and reuse TPP. Plankton grow infinitively if sufficient NP are supplied. We must consider sea and lake as firm to grow fish and to fix CO_2. If we supply TPP or ammonium phosphate or Calcium superphosphate to sea and lake, we can activate CO_2 assimilation we can increase fish production to 20 million tone. 20 million tone fish eat 20 times plankton of his weight. Plankton eat same weight CO_2 of his weight.

If we can produce 20 hm tone fish, we can fix 20x25= 50 hm tone CO_2 by the growth of plankton.

GWPR and GDP of the world

Table 6 Comparison of GWPR,GDP of world at 1860,1980, 2018,2022,2030 and 2050 [33-47].

	CO_2 em	CO_2 fix	NOxem	NOxcon	Wd	Fertilizer	Fish	Population	GWPR	GDP
	Hmt	Hmt	Hmt	g/kWh		Hmt	Mt	Billion		Incr %
1960	100	100	4	1.6	do	0	3.5	30	1	
1975	170	170	6.8	1.6	do	0		40	1	
1985	200	150	8	1.6	no	0	35	46	1.33	
2018	360	220	14.4	1.0	no	0	150	73	1.63	1
2022	300	300	0.5	1.6	Do	10	300	85	1	4
2030	300	270	0.5	1.6	Do	30	500	100	0,9	5

Table 6

CO_2 em (CO_2 emission), CO_2 fix, NOx con (NOx concentration at exit gas), Wd (Wastewater dumping), GWPR, GDP(GDP increase ratio).

CO_2 emission and CO_2 fix was same at before 1975. GWPR was 1. Elimination of NOx and NP started at 1985. CO_2 fix become smaller than CO_2 emission.

GDPR at 1985 was 1.33 and GWPR at 2018 was 1.63.

By addition o fertilizer and stopping of NOx, NP elimination GWPR of 2022 will be 1 and GWPR of 2030 will be 0.9 and GWPR of 2050 will be 0.8 and GDP of 2022 will be 4%, 2030 5 %. 2050 6 %. These values are ideal value we are expecting to reach.

Dr Matsunaga is doing research on CO_2 fix by CO_2 assimilation [60] production of micro weed, phytoplankton grow 0.1 g/C/m^2/ day at sea. If enough Fe is given production increase 3gC//m^2/ day. If enough N and P is given production increased 72gC/m^2/ day. If enough light is given by light fiber production increased to 4320gC/m^2/day. Sun light is gibing 19.5 kcal/1h 72gCm^2 is given 3.69 hr sun shine.

Therefore if we know and add rate determining factor, restriction factor like Fe, N, P, light, CO_2, products can increase 1000 times of present production. Sea, river, lake, mountain are fields to receive sun energy and do CO_2 assimilation fixing much CO_2 giving food to all biology. We should give these fertilizer to sea, lake and river. Then global warming will not happen and much foods are produced and GDP will increase.

Conclusion

Promotion of CO_2 assimilation by following 5 items is necessary for protection of global warming to get national wealth

Add fertilizer like nutrient nitrogen, phosphorous to sea lakes river

Elimination process of NOx by ammonia at power station, chemical station and iron work station should be stopped.

Elimination process of N and P in drainage should be stopped. Ocean dumping, field dumping and forest dumping of excreta are recommended.

Bon fire should be encouraged. Bon fire ban rule should be abandoned.

Encourage the use of phosphorous detergent like sodium tripolyphosphate.

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