

Solid Waste Management in Vadange Villages

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Abstract— Waste generation, collection, transportation, segregation, recovery and recycle, disposal this are the key factor in the waste management system in order to reduce and reuse the solid waste in rural and urban areas. It includes disposal of solid waste in cost effective manner, using waste to energy sanitary techniques, composting of organic waste and, land fill technique. In this paper we have studied solid waste management in Vadange village near Kolhapur. The predominance of open dumping and the absence of reliable data regarding generation and characterization of waste has created a difficult situation for rural local bodies responsible for managing solid waste generated in the village composting. Most common practice of waste processing is uncontrolled dumping which causes pollution. If the wastes are disposed in an uncontrolled manner these may cause adverse impact on public health & environment. Therefore, the solid wastages are still a major problem in this rural area. To overcome these problems, we have proposed to Recycling, Waste to energy, Composting this method and give to plan of proper collection system of Vadange village.

Key words: Solid Waste Composting, Open Dumping, Pollution, Waste to Energy, Sanitary Land Filling, Recycling

I. INTRODUCTION

Solid waste has turned out to be one of the most concerning issues and its management is one of the real issues now days for our condition. The problem is not restricted to a single place rather it covers all parts of the environment which leads to toxic pollutants. Developing countries face major problem i.e. waste administration in urban and in addition in country regions. The most obvious environmental damage caused by solid waste is aesthetic. A more serious risk is the transfer of pollution to ground water and land as well as the pollution of air from improper burning of waste.

It is necessary to have accurate information on planning a proper solid wastes management in rural areas of country. On the other hand, lack of knowledge on the unfavorable health outcomes of solid wastes has increased the occurrence of infectious diseases. In the present scenario, with the fast growth and development of economies, especially in the developing countries, solid waste generation and its management has emerged as a continually growing problem at global, regional, and local levels. The collection of reliable data regarding generation and characterization of the waste is the key to a successful solid waste management. Presently, lack of absence of dependable data and information with respect to generation rate, amount, and nature of solid waste makes a deterrent in building up a suitable waste management plan. The target of solid waste management in rural regions is to collect the waste at the source of generation recovery of recyclable materials for reusing transformation of natural waste to compost and secured disposal of remaining waste. Current problems associated with the collection and disposal of house, trade and industrial wastes have combined to produce the most frustrating, complex and challenging era

this service has yet known. Inadequate waste collection and waste management systems are the cause of serious urban pollution and health hazards, especially in cities in developing countries.

The total geographical area of village is 1030.17 hectares. Vadange has a total population of 13,507 peoples. There are about 2,880 houses in Vadange village. Kolhapur is nearest town to Vadange which is approximately 3km away.

II. RESEARCH WORK

- To Study the solid waste generation in Vadange Village
- About Vadange Village

Census 2011 information the location code or village code of Vadange village is 567405. It is situated 10 km away from Kolhapur, which is both district & sub-district headquarter of Vadange village. As per 2009 stats, Vadange is the Grampanchayat of Vadange Village.

The total geographical area of village is 1030.17 hectares. Vadange has a total population of 13,507 peoples. There are about 2,880 houses in Vadange village. Marathi is the Local Language here.

- Near River: 2.5 Km Pancha Ganga
- Near Tourist Place: Panhala 17Km, Jotiba 13Km, Kent Club 14 Km., Chinmayganpati & gandharva 13 km New Rajvada 4Km, Rankala 5 Km
- Village Temple Name: Parvari Temple, Mhadeo Temple, Total 16 Temple
- Villahe Talav: Shivaparvari

Grampanchayat :	Vadange
Block / Tehsil :	Karvir
District :	Kolhapur
State :	Maharashtra
Pincode :	416229
Area :	1030.17 hectares
Population :	13,507
Households :	2,880
Nearest Town :	Kolhapur (10 km)

Table 1: Vadange - Village Overview

Particulars	Total	Male	Female
Total no. of house	2880	-	-
Population	13507	7048	6459
Child(0-6)	1330	770	560
Schedule caste	1937	970	967
Schedule tribe	88	48	40
Literacy	81.10%	87.16%	74.66%
Total worker	5171	4010	1161
Main worker	4975	0	0
Marginal worker	196	92	104

Table 2: Population of Vadange According to Census 2011 Grampanchayat



Fig. 2: Vadange Grampanchayat

Vadange Gram panchayat was established in 1962. It is situated in mid of Dukanline. Mr. Sachin Chaugule is Sarpanch and Mr. Suraj Patil is deputy Sarpanch in Grampanchayat. Mr. Vijay Patil is Gramsevak at Grampanchayat. It is situated near Panchagagariver.

A. Population Projection

The waste generation is function of population and lifestyle of people. Therefore, it is essential to project the population for 20-25 year setting out the infrastructure for SWM the population projection in Vadange Village is carried based on following method

- 1) Incremental increase method
- 2) Arithmetic increase
- 3) Geometric increase, and
- 4) Exponential method.

Name of village	Vadange
Name of district	Kolhapur
Incremental increase method	$P_{2011} + X \times n + Z \times n \times (n+1)/2$
Arithmetic increase	$P_{2011} + (X) \times n$
Geometric increase	$P_{2011} \times (1 + M/100)^n$
Exponential method.	$P_{2011} \times e^{rt}$

Table 3: The Calculation for Population till by each of Above Method is Given Bellow

Where,

- Pn = Known Population Year
- X = Avg Population Increase Per Decade
- Y = Net Incremental Increase Per Decade
- Z = Avg Incremental Increase Per Decade
- M = Avg Percentile Increase In Population Per Decade
- E = Base on Natural Logarithms
- R = Average Ratio of Growth
- n = No. of Decades

Year	Population	Increment	Geometric Increase Rate of Growth	Incremental Increase	% Increase Per Decade
1961	6410				
		1060	0.165366		16.53666
1971	7470			180	
		1240	0.1659973		16.59973

1981	8710			207	
		1447	0.166130884		16.6130884
1991	10157			241	
		1688	0.1661908		16.61908
2001	11845			-26	
		1662	0.1403124		14.03124
2011	13507				
	Sum	7097	Geometric mean (IG)	Avg. Incremental Increase (Y)	U Avg.
	Avg.	1419.4	0.100499748	150.5	16.0799597

Table 4: The Population % Increase per Decade

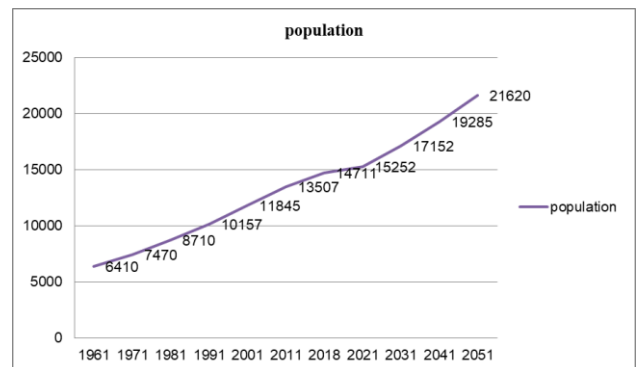
N	Year	Population by method 1	Population by method.2	Population by method.3
0.7	2018	14590	14501	15042
1	2021	15077	14927	15752
2	2031	16798	16346	18370
3	2041	18668	17767	21423
4	2051	20690	19185	24984

Table 5: The Population Projection based on above Methodology

Sr. no.	Year	Population
1	1961	6410
2	1971	7470
3	1981	8710
4	1991	10157
5	2001	11845
6	2011	13507
7	2018	14711
8	2021	15252
9	2031	17172
10	2041	19285
11	2051	21620

Table 6: Population Projection for Vadange Village

B. Graphical Method



Population projection by graphical method

C. Waste Generation in Vadange Village

Main waste generation in that village is 2,880 houses and total hotel is 5 generate daily waste. Waste generate daily is 2 to 3 ton. In wedding occasion this waste quantity varying.

Normally comprised of food wastes, rubbish, demolition and construction wastes, street sweepings, garden wastes, abandoned vehicles and appliances. Factors influencing are climate, social customs, per capita income, and degree of urbanization and industrialization.

Waste in mix condition following are its constituent's Plastic, Rubber, Paper, Food, Glass, metal, Clay, Ash, Construction waste, Electronics waste etc.

D. Composition of Waste

Field studies showed that about 2 to 3 Ton of residential solid waste per capita is generated in villages every day. Total amount of solid waste is about 2475 kilograms per day. The average amount of medical waste is about 6.7 kilograms per hygienic unit. Waste Composition in Vadange villages is: putrescible materials: 43.39%, construction and demolition: 12.7%, paper and cardboard: 7.97%, plastics: 7.34%, wood: 6.50%, metal: 5.62%, glass: 5.39%, rubber and leather: 5.3% and textile: 5.08%. One tractor can carry nearly 589 kg of waste, 3 to 4 trips are done in one day. According to this study, the main obstacle to recycling program is the unbiased collection of waste in rural area. Source separation includes degradable matter and dry wastes (paper, plastics and metals). From the economical point of view, incineration with energy recovery cannot be a good alternative for rural waste disposal in Vadange province.

– Storage of Solid Waste

Waste generation and storage at source eg. House, Clinic, Shops, Hotels, Temple, Office.

– For studying of solid waste collection, transportation, processing and disposal in Vadange Village

– Collection of solid waste:

The Gutter which is clogged by solid waste is removing by the 8 female workers and is dumped in tractor. Solid waste collection by one tractor.



Fig. 3: Waste Collection By Tractor

Monday	Indiranagar, Gosavvada, Parvatigalli, Shivajigalli, Sakalkargalli, Vetalgalli.
Tuesday	Housing society.
Wednesday	Malvadi, Milindnagar, Sathenagar, Ambegalli, Dhangarvada, Vittalgalli, Guravgalli, Shelarvada.

Thursday	Indiranagar, Gosavvada, Parvatigalli, Shivajigalli, Sakalkargalli, Vetalgalli.
Friday	Housing society.
Saturday	Malvadi, Milindnagar, Sathenagar, Ambegalli, Dhangarvada, Vittalgalli, Guravgalli, Shelarvada.
Sunday	Holiday

Table 7: Given Bellow is the Rout of Tractor for Waste Collection



Fig. 5: Collection System



Fig. 6: Collection System

– Transportation of Solid Waste

Solid waste is dumped on dumping site by tractor carrying waste up to 600 kg to 700 kg per trip, per day 3 to 4 trip are done fuel consumed by tractor is about 6 lit



Fig. 9: Waste transportation

- Processing & Recovery of Solid Waste
There is no any treatment process and recovery process and total waste directly dump on side.
- Disposal of Solid Waste
Disposal of solid waste is done in 4 wells is located near village and two well complete filled up.



Fig. 10: Dumping Ground 1

Stages in the waste cycle

- Generation
- Storage
- Collection
- Transfer and Transport
- Processing and Recovery
- Disposal

There is one other part of the process, which is separation. This can occur at either the generation or collection stage.

Sr.no.	Storage time	Status of garbage
1	12 hrs. (cattle)	Odorless free raw material
2	24hrs. (put in bio-digestion)	Smelly decomposed material
3	48 hrs.	Stinking waste
4	72 hrs. and more	Worm (maggots) infested waste

Table 8: General Storage Time of Garbage

Sources	Typical Waste generation	Components
Industrial	School, small hotels, markets, office building. Small hospitals.	Paper, cardboard, plastic, wood, food, waste, glass, metal, Thermocol.

Residential	Single and multifamily dwellings	Food waste, garbage, paper, cardboard, plastic, textiles, glass, metal, ash, special waste, Leather, rubber, Earth ceramics.
Drainage	Public, Natural	Mud, Silica, Earth.
Agriculture	Farmers, Animals	Wood, Earth, Cow dung, Animal waste, leaves, glass, cattle food waste.

Table 9: Sources of Solid Waste

- To identify the public health risks and environmental impacts of the rural area.

E. Problems

- Solid waste is not segregate at source.
- Collection is done after 3 days so the waste get storage at one place for 3 days.
- The rate of transportation not properly.
- Recovery and reuse process is not done.
- Disposal is not proper and waste get dumped into the well which is already full, so dust get accumulate around it and it causes problem to habitant nearby it.
- As waste is dumped in well the ground water get contaminated nearby.

F. Public Health Risks & Environmental Impacts

The group at risk from the unscientific disposal of solid waste include the Vadange village where there is no proper waste disposal method, especially the pre-school children; waste workers; and workers in facilities producing toxic and infectious material. Other high-risk group include population living close to a waste dumping well and those, whose water supply has become contaminated either due to waste dumping or leakage from landfill sites. Uncollected solid waste also increases risk of injury, and infection.

In particular, organic domestic waste poses a serious threat, since they ferment, creating conditions favourable to the survival and growth of microbial pathogens. Direct handling of solid waste can result in various types of infectious and chronic diseases with the waste workers and the rag pickers being the most vulnerable.

Waste from agriculture can also cause serious health risks. Uncollected solid waste can also obstruct storm water runoff, resulting in the forming of stagnant water bodies that become the breeding ground of disease. Waste dumped near a water source also causes contamination of the water body or the ground water source.

The unhygienic use and disposal of plastics and its effects on human health has become a matter of concern. Coloured plastics are harmful as their pigment contains heavy metals that are highly toxic.

- To suggest suitable system with the ability of solid waste (source to disposal) in Vadange Village.

- Generation

Solid waste generation rate depend on Geographic location, season of the year, collection frequency, use of kitchen waste grinders, characteristics of populace, extent of salvaging and recycling, public attitudes, legislation. To reduce solid waste generation people should follow the rule.

- Storage

Storage at sources like Separation of waste at sources level (Dry waste and wet waste are separated at home itself).

- Collection and Transfer

- Recommended Solid Waste Management Plan for Vadange Village

The village does not have any solid waste management plan. Hence, by considering safety of health of villagers and clean campus, following solid waste management plan is prepared.

- Generated Estimating Total Quantity of Wastes

The population of Vadange village is 13507, as per Kolhapur district census 2011. The rate of population growth during 2001-2011 for Kolhapur district is 16.62%. For calculating population of 2021, by using Geometric increase forecasting method.

- Formula

$$P_{2021} = P_{2011} \times (1 + M/100)^n$$

Where,

P_n = Known Population Year = 2011

M = Avg Percentile Increase In Population Per Decade

n = No. of Decades

$$P_{2021} = 13507 \times (1 + \frac{16.62}{100})^1$$

$$P_{2021} = 15751.86 \cong 16000$$

The future population in year 2021 will be 16000.

The solid waste management system will be designed for this population.

Although only a few reliable statistics are available on generation of solid waste in India, yet Central Pollution Control Board (CPCB) has estimated that the daily per capita solid waste generation in India ranges from about 0.1 kg in small towns to about 0.5 kg in larger cities.

- Assuming, solid waste generation in is 250 gm. / cap / day.

- Daily solid waste generation in weights/day = 16000×250

- = 4000000 gm/day

- Daily solid waste generation in weights/day = 4000 Kg/Day

- Daily solid waste generation in weights/day = $4.000 \text{ m}^3 = 4 \text{ m}^3$

- Daily solid waste generation in volume/day = 4 m^3

G. Proposed Management Organization

For a future population producing approximately 4 Cubic Meters of waste weighing 4 Tons every-day is estimated. So, existing set up is inadequate. The operation of all services indicated in TERI specifications would need 1 – 3 manual workers/1000 population and one heavy motor vehicle for about 20000 population or use 4 small garbage tempo

Manual workers needed = 2 manual workers / 1000 population.

$$= (2 \times 16000)/1000$$

$$= 32$$

The organization of solid waste management services for Vadange would need a set up as recommended below:

- Manual workers = 32 No's

- Ward In charge /Supervisors = 1/ 10 manual workers = 3 No's

- Administrator = 2 no.

Following of the route of collection

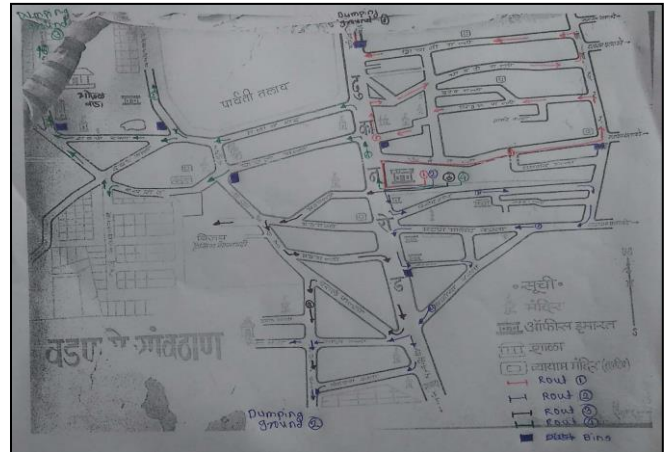


Fig. 12: New Collection System

1 st small garbage tempo	Starting point of collection route is Grampanchayat office, Ambegalli, Dhangarvada, Vittalgalli, Guravgalli, Dukanroad, Shelarvada, Chavadigalli, Shivajigalli, Dukanroad, Patil/Jadhavmala and final dump to dumping ground 1.
2 nd small garbage tempo	Starting point of collection route is Grampanchayat office, Malvadi, Milindnagar, Sathenagar, Naikgalli, Matanmarket, Dukanroad, Thalobaroad, Randivegalli, Lohargalli, Gavthanroad, main Kolhapur road and final dump to dumping ground 2.
3 rd small garbage tempo	Starting point of collection route is Grampanchayat office, Matgalli, Vijay Housing Society, Matgalli, Dukanroad, Varligalli and final dump to dumping ground 3.
4 th small garbage tempo	Starting point of collection route is Grampanchayat office, dukanroad, parvatigalli, talavroad, panchayatplot, devanegalli, shalecharoad, gosavigalli, gopalvada, sasaneroad, and final dump to dumping ground 3.

Table 10: Daily Collection Route (Monday to Sunday) by using 4 Small Garbage Tempo

7 dust bins are kept in following areas

- Ambegalliroad.
- Dukanroad.
- In front of Ambegalli.
- In front of Shivajigalli.
- In front of Parvatigalli.
- In front of Gosavivasahat.
- Sasaneroad.

III. PROCESSING & RECOVERY

Recycling is a resource recovery practice that refers to the collection and reuse of disposed materials such as empty beverage containers. The materials from which the items are made can be reprocessed into new products. Material for recycling may be collected separately from general waste using dedicated bins and collection vehicles, or sorted directly from mixed waste streams.

In Vadange village most common consumer products recycled include aluminum such as beverage cans, copper such as wire, steel food and aerosol cans, old steel furnishings or equipment, polyethylene and PET bottles, glass bottles and jars, paperboard cartons, newspapers, magazines and light paper, and corrugated fiberboard boxes. PVC, LDPE, PP, and PS (see resin identification code) are also recyclable. These items are usually composed of a single type of material, making them relatively easy to recycle into new products. The recycling of complex products (such as computers and electronic equipment) is more difficult, due to the additional dismantling and separation required.

Use 4 R concept (Reduce, Reuse, Recycle and Recovery) in this waste.

A. Disposal

Method of waste disposal and management are as bellow

- Ocean dumping
- Sanitary landfills
- Incineration
- Open dumping
- Recycling
- Open burning
- Waste to energy
- Composting
- Fermentation and biological digestion

B. Ocean Dumping

1) Advantages

- Convenient
- Inexpensive
- Source of nutrients, shelter and breeding

2) Disadvantages

- Ocean overburdened
- Destruction of food sources
- killing of plankton
- Desalination

C. Sanitary Landfill

1) Advantages

- Volume can increase with little addition of people/equipment
- Filled land can be reused for other community purposes

2) Disadvantages

Completed landfill areas can settle and requires maintenance requires proper planning, design, and operation

D. Incineration

1) Advantages

- requires minimum land
- can be operated in any weather

- produces stable odor-free residue
- refuse volume is reduced by half

2) Disadvantages:

- Expensive to build and operate
- High energy requirement
- requires skilled personnel and continuous maintenance
- Unsightly - smell, waste, vermin

E. Open Dumping

1) Advantages

- Inexpensive

2) Disadvantages

- Health-hazard - insects, rodents etc.
- damage due to air pollution
- ground water and run-off pollution

F. Recycling

1) Advantages

- key to providing a livable environment for the future

2) Disadvantages

- Expensive
- Some wastes cannot be recycled
- Technological push needed
- Separation of useful material from waste difficult

3) Open Burning

Not an ideal method

G. Waste to Energy

1) Advantage

a) Bio-Ethanol Production

Bio-ethanol can be produced by treating a certain range of organic fractions of waste. Different technologies exist; each of which involving separate stages for hydrolysis (by enzymatic treatment), fermentation (by use of microorganisms) and distillation. Other than bioethanol, it is possible to obtain hydrogen from the use of these technologies, which is a very useful and promising energy carrier

b) Dark Fermentation & Photo-Fermentation Producing Bio-Hydrogen

Dark fermentation and photo-fermentation are techniques that can convert organic substrates into hydrogen with the absence or presence of light, respectively. This is possible because of the processing activity of diverse groups of bacteria. These technologies can be interesting when it comes to researching valuable options for waste water treatment

c) Biogas Production from Anaerobic Digestion

Anaerobic digestion is a biological conversion process which is carried out in the absence of an electron acceptor such as oxygen. The main products of this process are an effluent (or digest) residue and an energy-rich biogas. The entire conversion chain can be broken down into several stages in which different groups of microorganisms drive the required chemical reactions. The obtained biogas can be used either to generate power and heat or to produce biofuels. The digest can also be utilized in many different ways depending on its composition. Several technologies utilizing this process have been developed throughout the years but are still considered

to be immature and not economically competitive compared to other WTE technologies.

d) Biogas Production from Landfills

Other than in an anaerobic digester, it is possible to extract biogas directly from landfill sites, because of the natural decomposition of waste (Tchobanoglous et al.). In order to do so, it is necessary to construct appropriate collecting systems for the produced biogas. Biogas in landfills is generally produced by means of complex bio-chemical conversion processes, usually including different phases like Initial Adjustment, Transition Phase, Acid Phase, Methane Fermentation and Maturation Phase.

e) Microbial Fuel Cell

A microbial fuel cell is a device that is able to produce electricity by converting the chemical energy content of organic matter. This is done through catalytic reaction of microorganisms and bacteria that are present in nature. This technology could be used for power generation in combination with a waste water treatment facility.

H. Composting

1) Advantage

There are a lot of advantages in using homemade fertilizers on your garden. It is practically free, since you are re-using materials that you already used or recycling materials that you don't need any longer. You can also get these materials for free from family and friends or neighbors or even in bags on the street when people put out yard clippings and leaves in trash bags on the street to be collected. You can also sometimes get manure from local farmers for free, or for very low cost if they deliver it to your home.

Preparing your own fertilizer is very environmentally friendly and a lot of people are trying to do more to help the environment these days. If you want to garden in an eco-friendly way that reduces your footprint on the planet, natural homemade fertilizers are a great way in producing and providing the needs of your garden.

2) Disadvantage

There are also some downsides to it. It's dirty, and it can be smelly too depending on what materials you use. Your neighbors might not appreciate the smell from your compost pile or having a big pile blocking their view. It can also be inconvenient to gather up all your kitchen waste and either put it in a compost pile or put it in a bin outside after every meal.

- Fermentation and biological digestion
- 1) Biodegradable waste – convert to compost
- 2) Recycle whatever is possible
- 3) Hazardous waste – dispose it by suitable methods
- 4) Landfill or incineration the rest.

Following are the methods which are effective and suitable for Vadange village

- Recycling
- Waste to energy
- Composting

IV. CONCLUSION

Population is continuously increases due to availability income source. After 25 years population of Vadange village cross 20 thousands. At present condition lot of issues

emerging regarding solid waste management such no housetop house collection, no scientific disposal of solid waste, solid waste dumped openly anywhere along roads or well. This condition creates unhygienic environment in the society. It needs the proper solid waste management plan.

A. Probable Solutions for Solid Waste Management at Village Level

So after above study following options are very beneficial for the Vadange village solid waste management.

- Composting is a well-known technology. As a process for handling organic residuals, it represents a better approach for solid waste management.
- Composting is compatible with sound environmental principles that value conservation of resources and sustainable practices.
- Composting is the traditional method, WTE is the better option in this energy crises, WTE fulfills the need of electricity of village and steam generation for the other use. So first manufacture the proto type model for treatment of VSW is necessity to face this problem.
- Waste to energy is the better option in this energy crises because 80% of village solid waste is used as fuel for Energy generation.
- Waste to energy fulfills the need of electricity of village and steam generation for the other use. Development of proto type model for treatment of VSW is necessary.

B. Awareness of Solid Waste Segregation in Vadange Village

कचरा नियोजन की विधि



Fig. 14: Solid Waste Segregation

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