

Design of Smart Strategies for ‘GARTAD’ Village: A Study

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ABSTRACT— 70% of population of India still lives in villages with minimum resources. The people in villages are still suffering for basic needs with their standard of living being very low. Most of the villagers are trapped in the vicious circle of poverty due to lack of employment, skill and education. It is necessary to equip the village with smart strategies so that the villages will become more and more independent in terms of development. The project is aimed at designing a smart village for which Gartad Village in Dhule District, Maharashtra is selected as project village. The village is sunk deep into problems of poor road network, lack of education and commercial infrastructure and sanitation. The project studies have suggested some of the smart techniques like small scale RO plant for drinking water, stabilising ponds for waste water, market and commercial area for economic development, educational and recreational rea for social development. The modified proposed layout is equipped with all the basic services for the village which will ensure the betterment of social as well as economical life in the village.

KEYWORDS- Standard of living, circle of poverty, employment, skill, education, Gartad Village, commercial infrastructure and sanitation.

I. INTRODUCTION

A rural area is a geographic area that is located outside cities and towns, while rural areas are also known as 'village' in India. In these villages, agriculture is the chief source of livelihood along with fishing, cottage industries, pottery, etc. According to the previous Planning Commission of India, a settlement with a maximum population of 15,000 is considered as “Village”. Much of India’s rural population lives in nucleated villages, which most commonly have a settlement form described as shapeless agglomerate. India being a rural dominated country, the smartness concept is not even thought about the rural areas.

As per Census of India, 70% of population of India still lives in villages with minimum resources. The people in villages are still suffering for basic needs with their standard of living being very low. Most of the villagers are trapped in the vicious circle of poverty due to lack of employment, skill and education. The only solution for their problems which remains is to move out of village in search for livelihood. So the basic solution we must provide is development of villages and making them self-sustained. A village using its own resources can lead a better environment for each and every citizen.

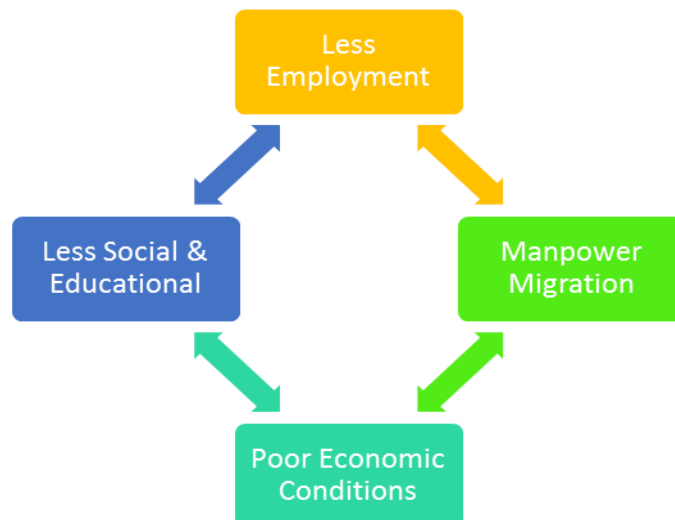


Fig.1 Vicious Circle of Villagers’ Life

II. LITERATURE SURVEY

As per Ranade Petal A “Smart Village” will provide long-term social, economic, and environmental welfare activity for village community which will enable and empower enhanced participation in local governance processes, promote entrepreneurship and build more resilient communities. At the same time, a “Smart Village” will ensure proper sanitation facility, good education, better infrastructure, clean drinking water, health facilities, environment protection, resource use efficiency, waste management, renewable energy etc. Hence Smart Villages are the need of the hour as development is needed for both rural and urban areas for better livelihood and Information technology will offer effective solution. There are successful technologies available, which have been implemented in urban areas. There is tremendous pressure on urban landscapes due to migration of rural people for livelihood. Smart Villages will not only reduce this migration but also irrigate the population flow from urban to rural area.

As per G M Virktashram, the developer of Dharmaj Smart Village in Gujrat, a village in Petlad Taluka of District Anand in Central Gujarat is a village having rural atmosphere with all urban facilities. It's truly a Rurban entity. With population of just 10500, Dharmaj has all modern facilities for Education, Medical, Public Amenities, Recreation, etc. Dharmajians started migration in 1895 and today they are settled across the globe. Team Dharmaj is doing wonderful job by doing various activities for the betterment of village. Dharmaj Village Panchayat has produced a model by developing common waste land which made its Panchayat self-reliant. It also provides green fodder to village people from this land at quite reasonable rate all-round the year. This grass is produced by using waste water of village to maintain cost effectiveness.

As per John Holmesetal, worldwide, 1.3 billion people remain without access to electricity and 2.7 billion are still cooking on harmful and inefficient stoves¹. Many live in remote rural village communities, and until they have access to energy services, little progress can be made to develop and improve their lives. Soon Smart villages will be stewards of the environment, monitoring forest health, water quality, soil conditions and changes to the landscape

As per Deepak Nayyar, The perennial poor are concentrated in three regions of the developing world. In 2012, 415 million lived in Sub-Saharan Africa, 399 million in South Asia and 157 million in East Asia and the Pacific: altogether 971 million, of whom 292 million lived in India and 84 million in China. In addition, Latin America and the Caribbean were home to 27 million perennial poor, and 11 million lived in the Middle East, North Africa and Central Asia. In 1981, nearly 2 billion people lived in this wretched poverty. This number has halved in three decades. Even so, it remains unacceptably large.

In 2012, despite a slowing global economy, India's electricity demand continued to rise. Electricity shortages are common, and over 40% of the population has no access to modern energy services. India's electricity demand is projected to more than triple between 2005 and 2030. In the recently released National Electricity Plan (2012) the Central Electricity Authority projected the need for 350-360 GW of total generation capacity by 2022. Despite major capacity additions over recent decades, power supply struggles to keep up with demand. India had another record year of new wind energy installations between January and December 2011, installing more than 3 GW of new capacity for the first time to reach a total of 16,084 MW. As of March 2012, renewable energy accounted for 12.2 percent of total installed capacity, up from 2 percent in 1995. Wind power accounts for about 70 percent of this installed capacity. By the end of August 2012, wind power installations in India had reached 17.9 GW. However, for India to reach its potential and to boost the necessary investment in renewable energy it will be essential to introduce comprehensive, stable and long-term support policies, carefully designed to ensure that they operate in harmony with existing state level mechanisms so as to avoid reducing their effectiveness.

So, the referred material highlights the need of Smart Village and hence the project aims at converting an existing village of “Gartad” into a smart village by suggesting some energy efficient techniques.

III. CURRENT CONDITIONS OF GARTAD VILLAGE

(The village name shown in map GAD-UTAR is another name for our project village GARTAD).As seen in fig. 4.1, the project village can be seen on Dhule – Chalisgaon Road. Fig.2 shows the detailed map of Gartad village which shows its

boundary and land usage. The village can be seen to be spread over an area close to National Highway. Also, the village is in the vicinity of Dhule – Chalisgaon Railway Line as shown in Fig. 4.3. In the same figure, we can also see the water supply line coming to the village from nearby Tikhi Lake.

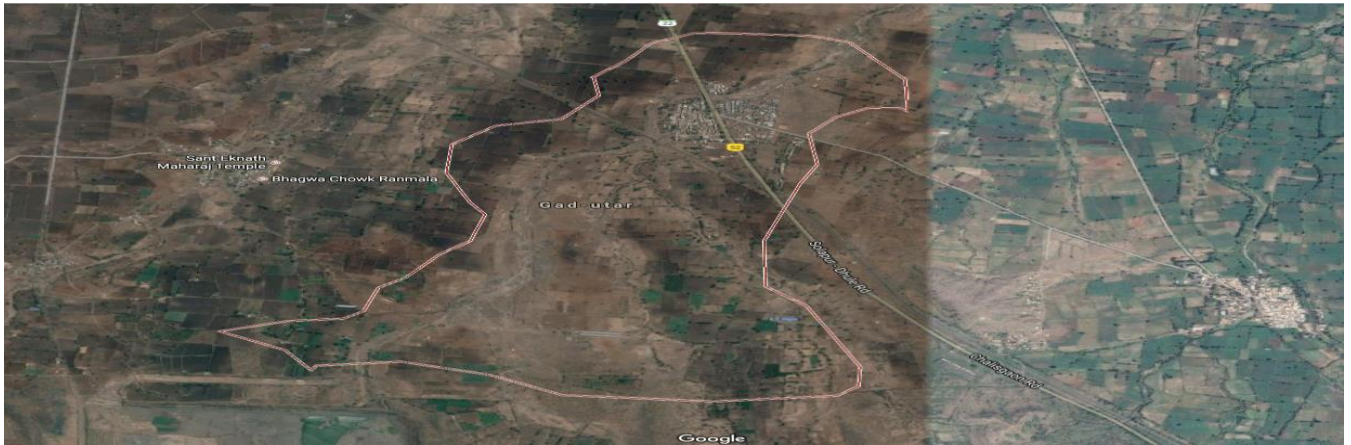


Fig.2 Land Usage of Gartad

Basic Information of Gartad Village

Following table throws light on some basic Geographical, Demographical and useful information of Gartad Village.

Table 1. Basic Information of Gartad Village

Sr. No.	Description	
1	Gram Panchayat	Gartad
2	Tehsil	Dhule
3	Town/ Sub-District/ District	Dhule
4	Coordinates	20°50'13''N 74°48'0''E
5	Population (As per 2011 Census)	2894
6	Area	483.2 Hectares
7	No. of Households	500

Current Social Conditions of Gartad Village-

Almost every village in India is facing the challenges of Education, Sanitation and basic utilities for living, and Gartad village is not much different from them. The village is having a below average standard of living. On conducting the survey of village, the key problems that have been identified are lack of infrastructure, lack of social hygiene, inadequate roads, lack of water purification and waste management. Figure 3 shows the market area of village which is nothing but few hawkers and stalls on NH-211. There is no other provision of market building or some space for market and hence the weekly market occupies portion of NH-211 and the traffic is obstructed. Figure 4 is the photograph of an open space in village which has been highly polluted due to presence of Public Sanitary unit besides it and due to untreated, raw wastewater. The surrounding is polluted and residents are so much tired of the smell and germs spread by the same. However, no initiative is being taken up to clean it or to avoid dumping the waste in it.



Fig.3 Market Area of Gartad Village



Fig.4 Sewage water Disposal

The households in the village are stacked in around one tenth of the total area of village and the roads connecting household don't form any grid or a connected loop. All the roads are quite narrow and barely some of them have been concreted. Figure 5 shows a narrow road in the village. It can be also seen in the image that; no road is having a provision of side drainage which should be provided to maintain hygiene in the area. Drinking water and potable water in the village is supplied through a well which is located about 2 km from the centre of village. However, form Fig 4.7 it is observed that the well is not protected against any physical contamination. Additionally, there is lack of infrastructure to treat the water before delivering it to residents of village.



Fig.5 Road Condition in village



Fig.6 Water Source of Village

Problems in Gartad Village- From the survey carried in the village, following key problems are identified which should be tackled first hand to increase the socio-economic status of village:

- Absence of water treatment process.
- Improper waste disposal system.
- Poorly planned road network.
- Lack of infrastructure for market.
- No employment options.
- Lack of basic utilities in the village.



Fig.7 (A) (B) Site Visit in Gartad Village

IV. DESIGN STRATEGIES FOR GARTAD VILLAGE

The village conditions discussed in previous chapter gives the intensity of challenges faced by its residents. And hence as per the problems faced by villagers, following solutions are discussed in this chapter.



Fig.8 Problems Vs. Solutions of Gartad Village

4.1 Small Scale Water Treatment Plant

a. Water Requirement –

As per IS 1172 – 1993, daily water requirement for a village of population up to 20000 must be taken as 40 lcpd (litres per capita per day). The current population of village is around 3000 which can be assumed to be tripled over a period of 50 years.

$$\begin{aligned} \text{Water required per day after 50 Years} &= 10 \times 5500 \\ &= 55000 \text{ litres per day} \end{aligned}$$

b. Water Treatment -

Treatment of water can be a very complex thing sometimes. Depending on the impurities and required standards, numerous treatments (Fig. 5.2) are applied to water to make it suitable for drinking. However, for lesser discharge, the entire treatment can be too much space occupying and costly. Also, for ground water source some of the important treatments are water softening and disinfection. Keeping the same in mind, a small-scale water treatment plant consisting of filtration and softening is included in the studies. The water from intake will be filtered to remove any turbidity and bacteria and then it will be supplied to an RO plant which will reduce the hardness of water.

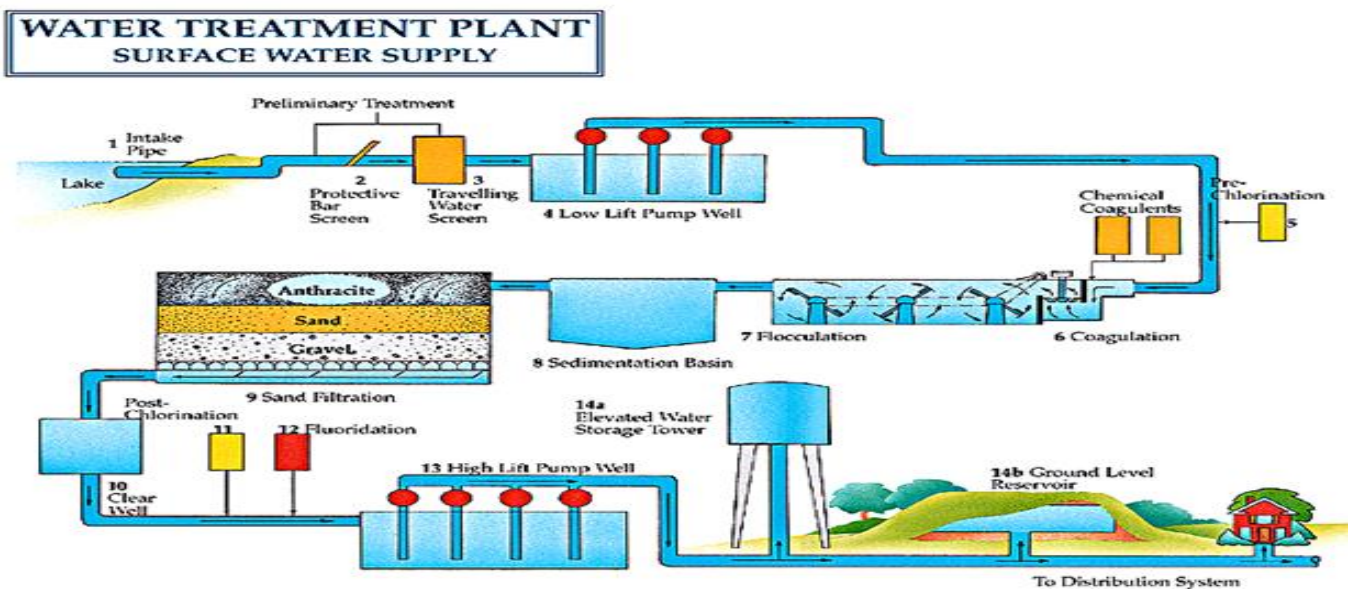


Fig.9 A Typical Water Treatment Plant

4.2 Wastewater Treatment

a. Generated Wastewater

$$\text{Design Life} = 50 \text{ Years}$$

$$\text{Design Population} = 5500$$

$$\text{Water Requirement} = 40 \text{ lcpd}$$

$$\text{Sewage Generated} = 40\% \text{ of water requirement}$$

$$= 0.4 \times 40 \times 5500 = 88000 \text{ lt/day}$$

$$= 88 \text{ m}^3/\text{day}$$

b. Waste Water Treatment Ponds

The waste stabilization plant comprises of four ponds. The first pond i.e. anaerobic pond receives raw grey water from the existing drainage system of the village, the second pond acts as a facultative pond and the remaining two ponds act as maturation ponds. All the ponds are connected in series and waste water flows by gravity.



Fig. 10 Typical Waste Stabilization Ponds

Waste water from the first pond, which is anaerobic pond, flows to the second pond, which is a facultative pond and the maturation ponds are empty as the effluent from the facultative pond is yet to reach the maturation ponds. This is due to over size of the ponds in comparison to daily inflow of waste water as well as leaching of waste water in soil. P.V.C. and R.C.C. pipes have been used for inlet, outlet and overflow arrangements. Slopes of the earthen embankments have been kept as 1V to 1.5H with a top width of about 2.5 metres.

4.3 Waste Management System

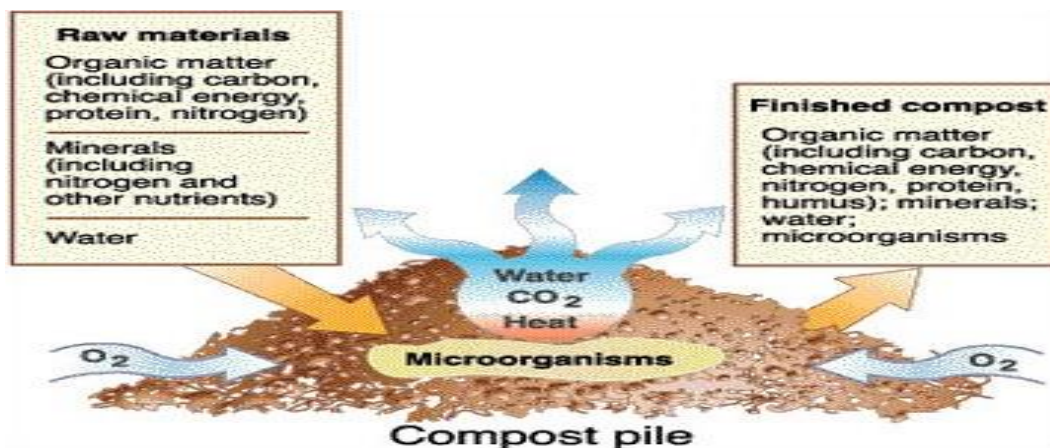
c. Composting Process- The village generated in village is mostly bio-degradable waste which consists of food scraps, cow dung and other animal exc reta, crop wastes, etc. All of these are disposed in open spaces around the villages thereby creating nuisance. Hence the solution composting holds water in this case. Composting is a natural process that turns organic material into a dark rich substance. This substance, called compost or humus, is a wonderful conditioner for your soil. Composting is comprised of four important points –

Air – Air will be required in composting for fast decomposition and hence the pile must be constantly turned.

Moisture – The compost pile must not be too dry or too wet or decomposition will be slowed.

Brown Material – Dry and dead plant material like weed, dry leaves will be used. The material must be moistened before mixing.

Green Material – Green leaves, Fruit & Vegetables scrap will be added to compost pile.



4.4 Solar Panel for Residential Building

a. Sun – Earth’s Oldest Friend

Every day, the sun radiates (sends out) an enormous amount of energy—called solar energy. It radiates more energy in one day than the world uses in one year. This energy comes from within the sun itself. Like most stars, the sun is a big gas ball made up mostly of hydrogen and helium gas. The sun makes energy in its inner core in a process called nuclearfusion.

It takes the sun’s energy just a little over eight minutes to travel the 93 million miles to Earth. Solar energy travels at the speed of light, or 186,000 miles per second, or 3.0 x 10⁸ meters per second. Only a small part of the visible radiant energy

(light) that the sun emits into space ever reaches the Earth, but that is more than enough to supply all our energy needs. Every hour enough solar energy reaches the Earth to supply our nation's energy needs for a year! Solar energy is considered a renewable energy source due to this fact. Today, people use solar energy to heat buildings and water and to generate electricity. Solar energy accounts for a very small percentage of U.S. energy - less than one percent. Solar energy is mostly used by residences and to generate electricity.

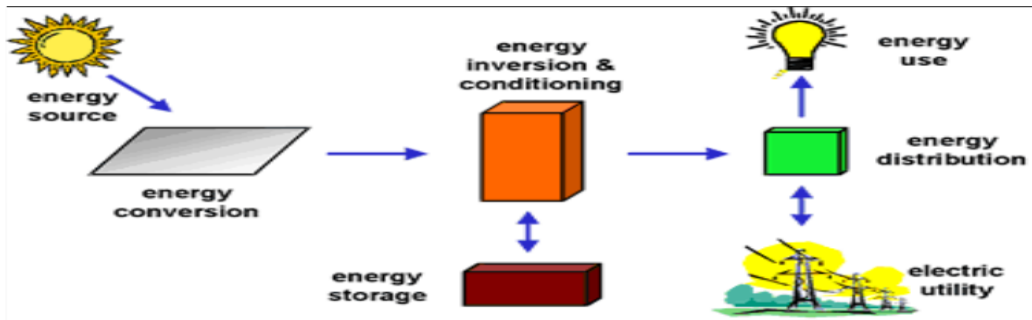


Fig.12 Solar Power System

b. Energy Consumption of a Typical Indian House

Since India has some extreme weather locations and most of the country suffering from high heat, the power consumption goes up due to heating/cooling appliances. As seen in Fig. 5.10, around 40% power is being consumed for heating and cooling which is going to be around 50% in year 2031.

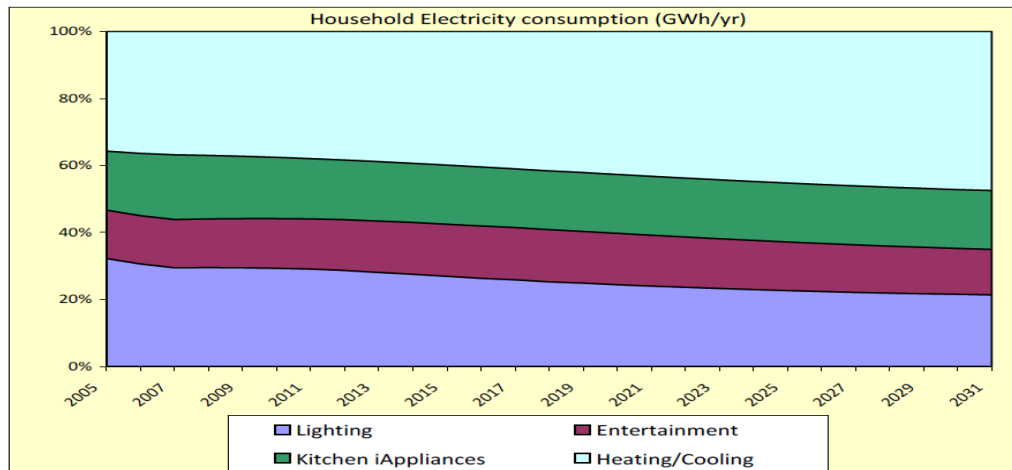


Fig.13 Household Electricity Consumption

The more and more energy demand is going to cause huge impact on environment and very soon the fossils are going to be extinct. Hence, it is necessary to provide solar panels for residential structures. The typical residential structure appliances like CFL Bulbs, Fans, Fridge and TVs can be connected to solar power which will ease the load of light bills on residents. Also, some of the power can be transformed into Grid which will also help the resident in his earnings.

c. Solar Panel Design

Solar panel design is carried out in following steps:

- Calculate the power consumption of appliances using their running time per day.
- Actual load is increased by certain percentage to allow for variations in loads which gives Design load.
- Design load obtained will be divided by number of Full sun hours so that power generation will be more.

The Solar panel system will have following parameters:

Table.3 Solar Panel Parameters

Sr. No.	Parameter	Quantity
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1	Total Photo Voltaic Module	1 kWh
2	Single Panel	250 kWh
3	No. of Panels	4
4	Batteries (150 Ah X 12 V)	2
5	Space Required	Around 50 square feet

Approximate Cost of the entire unit will be around ₹ 1 Lac.

Design Life of Solar System = 25 Years

Daily Units Produced = 5

Monthly Units Savings = 150

Monthly Bill amount savings – ₹ 1000/- (Approximate)

Total Annual savings = ₹12000/-

Savings in Design life – Minimum of ₹ 3 Lacs

4.5 Socio-Economic Growth of Village

a. Provision of Basic Utilities

To increase the social status of the village, it is necessary that every villager must be able to have access to basic rights. A village centre must be provided where all the Panchayat, Chawadi, Clinics and Cultural Centres are present. This hub should be on the central axis of village with easy access. Other buildings like Post Office, Post Chowki, Reading Room and Games club may be included in the hub.

So, in short, our project village must be equipped with following units:

- Gram Panchyat. (Already Present)
- Government Offices like Tehsil, Post Office, Banks. (Already Present)
- Public Health Centre with residential doctors and minimum 10 beds.
- Cultural Centre or Gathering Hall for at least 500 people.
- Reading room with 50-person capacity.

b. Awareness on Use of Smart Techniques

Every individual on Earth is responsible for protection of environment in which we live. Every villager must be given knowledge of use of Conventional Energy and they must be given with proper facilities and resources for implying the techniques in their lives.

For Gartad Village, following smart strategy are suggested:

- Use of Solar Panels to run light, fan and basic electric equipment.
- Setting up Solar Lamps on Streets.
- Setup of Compost Unit in Village which will collect biodegradable wastes from Households and the prepared compost will be used in Farms.
- Setting up drip irrigation in every field.
- Digging up storage tanks in farms and nearby area under “Jalyukta Shivar” scheme for water conservation and to increase ground water table.
- Promoting the purchase of Cattles and Pets to have a side business along with agriculture.

V. PREPARATION OF LAYOUT

5.1 New Layout Description

a. Zones

The village is divided into zones as follows –

- **Residential Zone** – The zone is spread on either side of the highway and is provided with number of inter connected roads.
- **Commercial Zone** – The space for weekly market and other commercial needs of villagers is provided very close to the highway and also it is easily accessible to all the villagers.
- **Educational Zone** – Primary and Secondary schools and play gardens will be provided in the educational area with a separate building of public library for students and adults both.
- **Administration Zone** –The offices for Gram Panchayat, Post office, Police Station and other administrative bodies will be provided in administrative zone. The administrative area is quite on the centre of village and hence can be easily accessed by every villager.
- **Space for Future Expansion** – As the population of village goes on increasing, it will need more & more space for residence as well as commercial purpose. Also, after development the village might have a Railway Station and a Bus Stand which can be provided in the space reserved for future expansion.

b. Roads

All the roads in the village are kept in parallel system to form a rectangular grid and also a service road is provided in the residential area parallel to highway to restrict traffic flow in village going from highway. The road network will ease the traffic in village and it has also divided the residential area uniformly.

c. Arrangement of Services

The Water Treatment Plant is placed on the higher end of village and the Sewage Treatment Plant is on the opposite end of village so that both water and waste water will flow under the action of gravity. A small seasonal stream also flows alongside the village and hence both Water and Sewage Treatment Plant are placed near the stream.

5.2 Comparison with Old Layout



Fig.14 Current Satellite Image of Gartad Village

The comparison of old layout and new layout can be written in a tabular form as follows:

Table.3 Comparison of Current Layout & Proposed Layout

Criteria	Current Layout	Proposed Layout
Zoning of Village	Current layout of the village shows scattered houses and buildings.	Proposed layout has been divided into separated zones for residential, educational and commercial spaces. The entire administrative space for Gram Panchayat and all other offices are provided at centre of village.
Road Network	The current conditions of road and their arrangement both are poorly conditioned which causes a discomfort to villagers.	A grid of road is proposed in the layout to shorten the access to each zone. A service road is proposed parallel to Dhule -Solapur Highway such that the highway traffic is undisturbed due to village traffic.
Service Lines	No special provision for Drinking water or Wastewater treatment.	Both Water Treatment Plant and Sewage Treatment Plant are placed such that the flow will occur under gravity.
Market Area	All the local shops and hawkers use the shoulder space of National Highway for selling goods.	A special space is provided for market and other hawkers near centre of village such that there will not be any hassle caused to the traffic flow on NH – 211.

Energy Source	All the houses in village are dependent on Electricity for their day-to-day energy consuming appliances.	Provision of solar panels is suggested for all the houses so that they can run their small appliances on solar energy causing a great relief from Power Cut-offs and Electricity Bills.
Future Expansion	All the space in village is not divided properly which does not leave any special space for future expansion.	Separate spaces are provided in residential as well as commercial zones so that the newly provided buildings will be placed easily in village. Also the space reserved alongside the railway line can accommodate the railway station and bus stand.

The current conditions in the layout seems pretty bad as the residential units are placed unevenly and in a scattered manner. The school and library are placed at the rightmost end of the village which is quite far for the students. The current layout also does not provide any space for market. The village currently grows in a random manner without any provision for future space. However, the new layout has been prepared to make sure that all the services and buildings are arranged properly and there is ample space for future expansion. The proposed layout also has provisions for educational area and market area. The future space of layout can accommodate a railway station and a bus stand.

VI. CONCLUSION

Gartad Village is located on NH-211 and also on Dhule Chalisingaon railway line. The village is quite small in terms of population but if properly planned, the village can become an important hub for goods and agriculture.

The project study is aimed at identification of problems in Gartad Village and suggesting smart techniques to overcome the same. Survey of village has shown that Gartad village is having lot of key concerns such as Untreated Water, untreated Sewage, poor infrastructure and lack of awareness. Also, most of the villagers are not happy with the lack of educational infrastructure and the load shedding problems.

The proposed layout of the village has been provided with a better road network in the village to divide the village into different zones uniformly. The zones of village are placed so as to maximise the efficiency of villagers. The commercial area and educational area are in the vicinity of the all the residential areas. The space is reserved for future expansion so that the later development of village will be carried out without any hassle.

In short, the proposed layout seems much better than the current one and it is one right step towards making Gartad a “Smart Village”. The proposed layout beats the old one in every aspect like zoning, road network, ease of access and developmental comfort.

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