B. Tech Project Report

On

EXPLORING THE SCOPE OF DIVERSIFICATION OF WASTELAND USAGE

Submitted in Partial Fulfillment for the B. Tech Third Year Core Course on Human Geography and Societal Needs (HS202)

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CERTIFICATE

This is to certify that the B. Tech project titled "EXPLORING THE SCOPE OF DIVERSIFICATION OF WASTELAND USAGE" prepared by (names of the students) is approved for submission for the course on Human Geography and Societal Needs in the Department of Humanities and Social Sciences, Indian Institute of Technology, Ropar.

Signature of Examiner and Guide/s

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DECLARATION

I hereby declare that the report entitled "**EXPLORING THE SCOPE OF DIVERSIFICATION OF WASTELAND USAGE**" submitted by me, for the partial fulfilment of the course on Human Geography and Societal Needs (HS 202) in the third year of the B. Tech program in IIT, Ropar. The work carried out by us under the supervision of Dr. Devaraj. P, Assistant Professor, Department of Humanities and Social Sciences. We further declare that this written submission represents our ideas and other's ideas or words have been included. We also have adequately cited and referenced the original sources in the case of other's ideas or words. We have not misrepresented any idea/data/fact/source to the best of our knowledge. Therefore, we affirm that our group has adhered to all principles of academic honesty and integrity.

Place: Ropar

Date: 3-12-2019

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Introduction

Our project deals with the impact of barren and vacant land in any village and how it affects the villagers. In our model village of Dekhwala, this large part of land seemed like a missed opportunity for the villagers and we decided to study further on this topic. Upon further research, we found that unused land is a big problem for many of the Indian villages and suggesting any potential solution to such a problem required in depth analysis of the surrounding area and circumstances of the people. This indicated that instead of a unique solution, multiple custom solutions were required. However, there are many case studies and unconventional uses of such a land. This report aims to compile such cases and act as a rough comprehensive guide for such a problem.

Objectives

We have hypothesized that diversification of wasteland usage will bring out tangible gains for the public. In this direction, our primary objective is to investigate the possibilities of alternative wasteland usage planning for the community owned land and to bring out one or more of the following set of socio-economic impacts:

- Restoration of wasteland using one or many of the techniques specified.
- Exchange of infrastructure or any other set of benefits, by giving part or full ownership to an appropriate entity.
- Providing passive income stream for the land-owner(in this case the Panchayat) through any of the means specified.

A detailed explanation of the problems that we have targeted has been used works as evidence in favour of our hypothesis.

Theoretical and conceptual aspects of the problem selected

Our research in the direction of diversification of land usage has been conducted with a rural field of view. Rural development has always been easy to understand but very hard to implement. Through our research we aim to attack on various bottlenecks of rural development. Following are the problems that may be targeted through a policy implementation of one or several of the land usage reforms that we have talked about-

1. **Seasonal nature of rural economies-** Rural economies unlike urban economies are seasonal and not perennial. This seasonality is due to the very nature of crop growing

practices. The amount of work required at different stages of plant growth is very different. This seasonality has serious negative implications on villagers. For starters, the seasonal nature of the economy leads to a fluctuation of wages. According to village testimonials, a labourer will get far less money in a period of low labour requirement than in a period of high labour requirement. Similarly, a small farmer will have to pay labourers far more during a time of higher labour requirement than during a time of low labour requirement. Thus, labourers in a season are going to get very less wages, and small farmers (sometimes the very same labourers), are going to lose out on margins as compared to big farmers. In such a scenario of abrupt wage and profit distribution across the year, excess rain, lack of rain, decrease in Minimum Support Prices, have the potential to knock these people down in poverty by leaking out their disposable incomes which may be low to moderate corresponding to the time of the year.

2. **Depletion and Pollution of Groundwater-** Barring a few states, farmers in India used to be immensely dependent on monsoon for irrigation. This dependence was naturally declared as a bluff after irregular rainfalls, and occasional droughts. And this kicked in the need for farmers to tap into the one water resource that was always available, that is, groundwater. It was available to farmers for absolutely non-judicious usage until we started to completely run out of it a few years ago. Most estimates suggest that several states will completely run out of ground water in a few years. And thus the conclusion is that we cannot continue to use groundwater in the manner that we have been using and will have to promote sustainable irrigation techniques. Moreover, steps are needed to be taken to restore the groundwater levels. The excess fertilizers have made the woes even worse. These fertilizers have reached groundwater and ensured that the little groundwater that is left is toxic. The high cancer rates in the state of Punjab are the by-products of this underground poison.

3. **Land Pollution-** Faulty land use practices, ever increasing biotic pressure, coupled with extreme weather (due to climate change), are polluting land at rates never known before. Extreme weather events are eroding land which is being excessively exploited by biotic presence, and all this while the use of chemical fertilizers kills the builder and beneficial microorganisms of soil. India particularly has had it unfair when it comes to land. India shares 16% of the world population while its land is only 2 % of the total geographical area of the world. It is thus fair to assume that land in India is often

pressurized beyond its carrying capacity. And therefore, productive lands, especially the farmlands are in the constant process of degradation, and are turning into wastelands.

4. **Disguised Unemployment and Low Productivity-** Consider the following table that provides us with contributions of rural economy to the National Domestic Product and workforce.

Table 1 Share of rural areas in total NDP and workforce

Year	Contribution to National Domestic Product(%)	Contribution to workforce(%)
1970-71	62.4	84.1
1980-81	58.9	80.8
1993-94	54.3	77.8
1999-00	48.1	76.1
2004-05	48.1	74.6
2011-12	46.9	70.9

(Ramesh Chand NITI Aayog, S. K Srivastava and Jaspal Singh)

Moreover, during the four decades from 1970-71 to 2011-12, India's rural economy expanded from Rs. 3199 billion to Rs. 21107 billion. In the same period, employment expanded from 191 million to 336 million. Thus, despite almost seven times increase in output in rural India the employment could not even double in a long period of four decades. The given table also suggests that rural economy provides lesser contributions than urban economy despite employing more than twice the number of people. All this while youth is withdrawing from the rural economy, to chase their dreams in the realm of the cities. This has triggered an unplanned rural to urban migration, and put immense pressure on urban amenities forcing a large number of these migrants to live in despicable conditions. Thus, the addressal of the low productivity and disguised unemployment of the rural economy as concluded by the data above, is not just for the betterment of the villages, but also for the cities that are facing a different set of challenges because of the jeopardy of rural economy.

5.Lack of Diversification of the Rural Economy- Take the case of Punjab. The state was once known as the pioneer of Green Revolution. The state's farmers helped Punjab become the state with the highest per capita income, a feather in the cap that it holds very dearly till date. However, despite the bravado, Punjab is now on its way down. Thanks to unmitigated exploitation of nature using the gifts of green revolution, soil quality has declined, water tables have declined, and the water that there is at the moment happens to be a carrier of cancer. The decline in soil quality and water tables, have led to an increase in the cost of cultivation and mechanization of agriculture has destroyed the jobs of labourers. This is the failure of the state in diversifying beyond agriculture, and also diversifying in the way it does agriculture. Because of the state's failure to diversify, has meant that labourers have missed out on new kinds of jobs that could've been anything beyond the now seemingly dystopian and boring traditional agricultural jobs depending on how the state chooses to use its land. Sadly, though, this failure has led to a situation where youngsters have no interest in staying in agriculture, and they have no interest in staying in the rural economy at all.

But this problem is not unique to Punjab. This is a nationwide problem, the example of Punjab simply permits us to exemplify the importance of diversification of rural economy and/or diversification of agriculture in a general Indian context. If a rich state like Punjab can be forced to its knees by lack of diversification, how important is it for us to deploy the same means in states with less agricultural output, and with lesser per capita income.

Methodology

The Village

The village Dekhwala under our purview has a population of about 900 as per our conversations with people from the village. This is a huge increase from the 2011 census number of 538. We are yet to investigate whether this increase is due to an increase in the living standards of the village, or whether this increase in population has added to the woes of the people of the village. The census data attached below however, puts light on a serious issue with the village.

Particulars	Total	Male	Female
Total No. of Houses	109	-	-
Population	538	280	258
Child (0-6)	52	22	30
Schedule Caste	0	0	0
Schedule Tribe	0	0	0
Literacy	88.07 %	89.53 %	86.40 %
Total Workers	155	140	15
Main Worker	147	-	-
Marginal Worker	8	4	4

While the male and the female literacy rates are almost equal, there is a huge discrepancy in the number of working males as well as females where the number of working males outnumber the number of working females by more than a factor of 9. This inequality is too large to even blame it on the fact the work data often disregards the contributions of home-makers/housewives. The village clearly suffers blatant gender inequality.

The village is fairly well connected with highways on the outskirts and intra-village roads are cemented and in good condition. Unlike most Indian villages, this one isn't very prone to water-logging as evident in one of our visits to the village which was after decent showers. On the outskirts of the village, towards the panchayat owned land, there are no roads. However, this is currently not an infrastructure issue as most of this land holds no prominence because of it being unusable for almost any purpose.

There is a primary school (smart school as per Govt. standards) equipped with projectors and a biometric attendance system. The school seems to be equipped with all the basic educational tools like books, representational toys/figures etc. required at the primary level. The number of completed English workbooks inside the school may be seen as evidence of punctuality among students and teachers, and an overall consistency in the functioning of the school. However, the concern with education is the absence of a secondary school in the village. Our conversation with villagers suggest an inability of village students to crack govt. Services examination or any high school level entrance examinations. This presents us with a dilemma, on one hand, there is a concern of migration out of the village, and on the other hand the

presence of a high school or a coaching centre (for various entrance examinations) might further trigger migration outside the village. A good question here is whether education can be a catalyst for migration outside the village or retention inside the village.

The sewage of the village is a potential health hazard. Not only is it open, there seems to be no main outlet of the drain, rather there are small outlets, due to which the all the potential health hazards associated with the drain may get distributed in the village.

The water supply is adequate but one can easily notice the distinct taste of the water as we did on our first field trip when water was served to us at the Sarpanch's house. Our tasting suggests that either water has been immensely treated with chemicals, or if it is groundwater then the soil is drastically saturated with fertilizers, pesticides and weedicides.

The village does not seem to have shops or a common marketplace and they have to travel to large distances for several goods. The nearest place with a marketplace was our point of entry into the rural area of Rupnagar. It can be concluded that while domestic goods aren't nearby, they aren't necessarily inaccessible given the good state of connectivity of the village.

Villagers have been provided with free commercial power supplies for farming purposes but the domestic power supply is a cause of concern. Not only do the villagers have to pay the highest electricity rate in the country, they have to pay this rate for a highly attenuated, low voltage power supply. Several villagers had complaints of ACs, fans and tube lights running too slow or dim. This problem originates most probably because of faults in the transformer(s) that provide input domestic power supply to the village.

Nature of the study

Our research starts with a descriptive representation of the village and its problems. We then move on to ask the villagers what they think about our proposed ventures with the land. Most of them found our proposals to be unknown. However, most of them said that they would be indifferent to the type of land usage as long as it benefits the village. Villagers don't have a specific priority as to what should be done with the land even after explaining to them the benefits of the different proposals.

At this point we moved on to look at different experiments of land usage across India and different success stories some of which are mentioned in the report. The idea was that it is easier to convince villagers using success stories, and also to implement something that has already been implemented. Once we had a compilation of such stories, we went back to the villagers and told them about these stories. They largely agreed with all the proposals but still refused to have any priorities about it. This limited the scope of giving our research work a

village perspective, for the general consensus was that we are fine with it, as long as it benefits us in any way.

Nature of Research

The research was largely qualitative in nature. We have chosen this approach because we felt after our initial interactions that any statistical know-how obtained from the villagers which were optimistic, but indifferent could not have provided to us any value. Qualitative research however ended up giving us the unanimously approved comfort of providing any recommendations we please.

After some time, we moved beyond the confinements of the village and explored things that are bugging rural economies and rural development, not just in Punjab but across India. Then we explored several land utilization measures, their success stories and Government schemes (if any) that support their initiative.

Sample Selection

Our model village (Dekhwala) was chosen by the collaboration of Rupnagar District Commissioner's office and Indian Institute of Technology Ropar. The following points were taken into account:

1. The interest of the village community in being a part of this endeavor.
2. Different set of problems which can be represented at singular locations and not require high amount of time investment on the field so as to be feasible for the students and the staff keeping in mind the limited time availability.
3. Villages with high region wise marginalization were given preference.

Method of Data collection

Since our field work mainly included scoping the region, the data collected on the field was mostly verbal and included the response of the villagers to the enquiries regarding the barren and vacant piece of land bordering their village.

Operationalization of Solutions

Once we interviewed the villagers, the seasonal nature of the economy was fairly obvious to us from the interviews. It was also quite obvious to us that a few villagers were using resources in a very non-judicious manner. Remember the villager who thought extra fertilizers would increase the yield but it didn't. This made it very obvious to us that we had to investigate degradation of land and water.

However, our larger exploration of village economies beyond the village provided us with a few important problems. The first one was that not diversifying land usage may mean that villages may lose out on workforce and end up increasing the workload on the cities. It is this

very diversification that may end up creating several jobs as it involved building and operating new infrastructure for which you would need people.

Finally, the data about increasing rural output and decreasing rural workforce led to the conclusion of low productivity and implied that there was a need for people to be employed elsewhere in the villages. It served as a consolidation of the relevance of all that we propose in our research.

Limitations of the Methods

1. As most of the IIT students are from different parts on the country and the common language used is English, it posed a hurdle in communicating with the villagers as they only spoke Punjabi and were barely fluent in Hindi.
2. Most of the villagers were not willing to come forward to interact with the students. This can be justified due to the fact that during afternoon hours, most of the villagers are tired after a tough morning on the field and resting.
3. Most of the villagers were uneducated and could only tell us a range of basic problems with no concrete details or references. This made it very difficult for us to get insights and specific details for any problem that we considered.
4. There was ambiguity in the various claims made by the villagers about the details of the vacant land such as its size etc.
5. Because we were proposing to the villagers things that they found hard to understand, they many times refrained from delving into deeper conversations and simply nodded their heads in agreement.
6. There is a relative lack of experimental research in the direction of using a piece of land/wasteland for a variety of purposes and the arising benefits.

FINDINGS & DISCUSSIONS

The following heading are included under this topic.

The points mentioned in this section have been concluded based on the discussions in the Methodology section.

The Land

Dekhwala village is bordered on the south by a large piece of depressed land. This land is neither cultivable nor plain for any sort of commercial activity. The non-cultivability of the land arises because the soil in the region is arid which is quite rare in Punjab.

The land had been under a dispute between neighboring villages and now comes under the Dekhwala panchayat. Observing the land and inferring from other cases, we found that the issue of parts of unused vacant land is quite widespread and almost every village has such a piece of land. The villagers particularly were interested in somehow making the land a source of stable income for the village as farming is a seasonal job.

The presence of such a land in any village is a missed opportunity for the villages. This is where we decided that our project should focus on researching about the reasons behind the existence of such areas and what can be done to incorporate it into the livelihood and social well-being of the people.

The idea that we came up with was to create a guide for the usage of vacant lands using the compilations of similar cases. We have taken into consideration the fact that each piece of land is different and the set of practical solutions that can be provided to remedy are very much dependent on the factors such as:

- Surrounding area
- Circumstances of the people living nearby
- Need of the hour issues

We have further divided the proposed strategies into

- Agro-related
- Tackling Environmental issues
- Commercial
- Government associated schemes

The Farmers

Small scale farmers haven't been able to procure decent profits on their crops, unlike their large scale counterparts and this gap has kept on increasing over the years. Other people are employed as drivers and they too haven't been able to procure decent levels of profit. In the case of drivers, the lack of profits is more due to the low margin nature of the service that they provide. What they earn, also get eaten up by constant maintenance of the vehicles, without which the vehicles would become obsolete pretty soon.

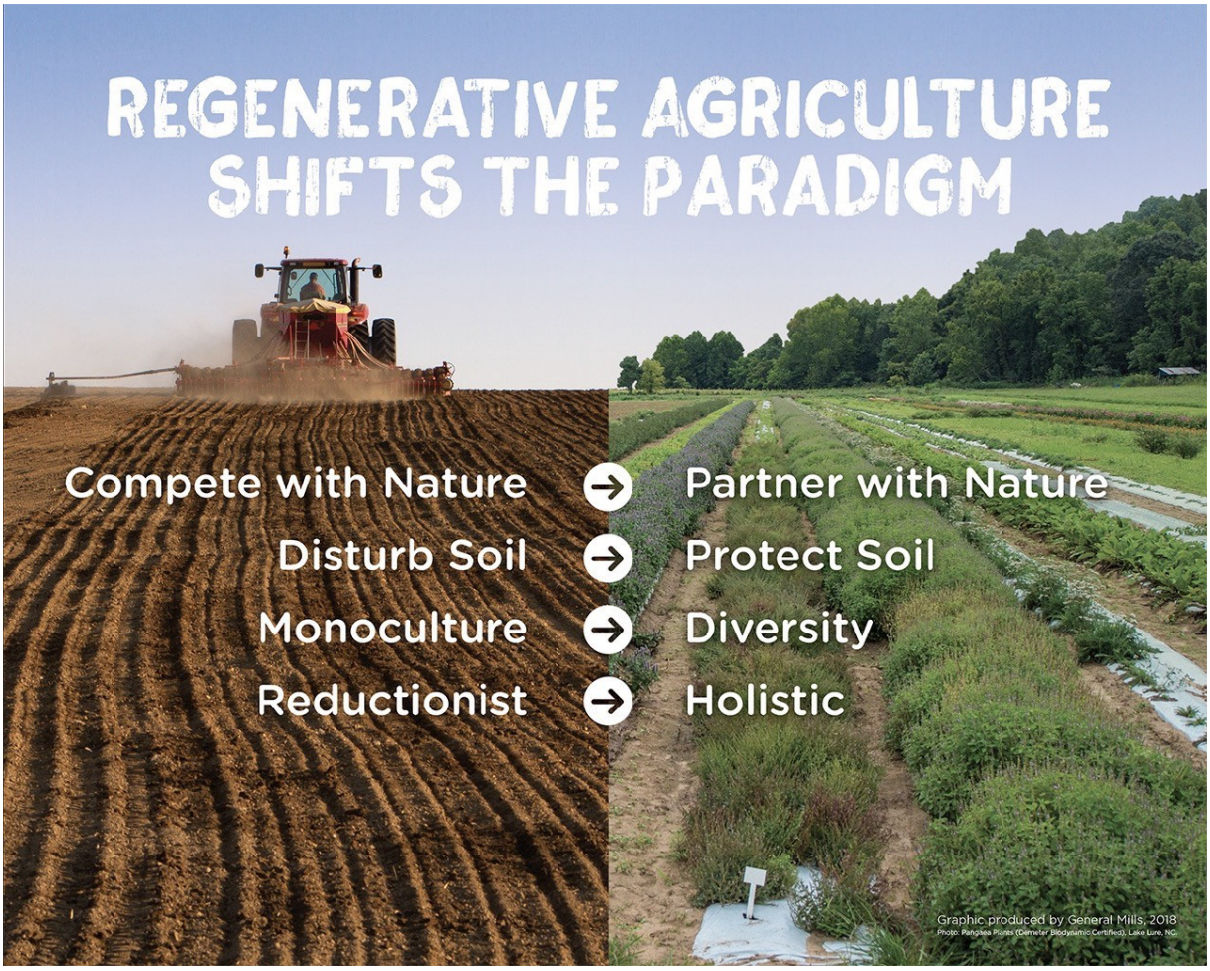
Small farmers of the village have been affected by the seasonal nature of the rural economy. They said that their wages and payments keep on fluctuating across different period of crop growth, and thus they have been extra-careful while spending money on anything beyond fundamental needs. Some farmers claimed that they are not producing as much as they used to before and they have tried to increase the amount of fertilizers to increase the yield but it hasn't helped them at all. When inquired whether they were aware that excessive usage of these fertilizers was harmful for the soils as well as for their health, some happened to be baffled while one villager, called it a necessary risk that had to be taken.

Strategies & Techniques for usage of vacant land

Agro-related[1]

Permaculture & Regenerative agriculture

Permaculture is a design principle which is centered on the idea of a shared and combined ecosystem which borrows its principles from natural ecosystems (Wikipedia, 2019). Regenerative agriculture is a subset of these principles which are particularly set for self-sustained agriculture practices (Wikipedia, 2019).



The major methods that are followed for reclamation of the barren land in regenerative agriculture are as follows (Duthel, 2018):

- **Water Harvesting**
    - Works on eroded soil.
    - Setup of harvesting structures such as trenches and percolation tanks.
    - Works to recharge the groundwater and revive old bore-wells.

[1] Agro-Related techniques are further emphasized in tackling of environmental issues with water due to the fact that there is overlap between the two areas.

    - Provide an alternative to sourcing water from the reservoir.
- **Revival of the soil by plantation**
    - Sapling plantation of various species of plants.
    - The specific species can be sourced from a government nursery.
    - This initial plantation needs to include varied species because regeneration of soil requires balanced nutrition.
- **Fencing**
    - Fires are common in arid regions and hence for safety of the land and to prevent damage.
    - Live fences are used i.e. the usage of Trees and shrubs for fencing.
    - This prevents the influx of strong winds which further prevents wind erosion and spread of wildfires.

Tackling Environmental Issues

Punjab is famous for the Green revolution. However, this did affect the ecosystem of the state in many ways and caused varied environmental problems. Following is a list of the relevant environmental issues that are being faced in Punjab right now (ENVIS center Punjab, 2017):

- **Growing population**
    - Average population density of Punjab (551 per sq. km) is higher than the national population density (382 per sq. km).
    - This is mostly attributed to the continuous migration and resettlement of workforce from other states like U.P. and Bihar.
- **Air**
    - Pollution due to Industries, Vehicles, Agriculture, Domestic Processes.

- 15,021 units in 2015-16 red category industries (highly polluting) using coal or rice husk as fuel and contributing high levels of suspended particulate, oxide nitrogen and sulphur, organic compounds and other pollutants in the air.
- Air pollution due to burning of Paddy Straw in the agricultural fields and generation of fly ash.

- **Water**
  - The depth of groundwater in most parts of state ranges between 5-20m below ground level (mbgl) except in south western parts where it is less than 5mbgl
  - Intensive Agriculture dominated by paddy wheat monoculture has led to over exploitation of water resources in Punjab.

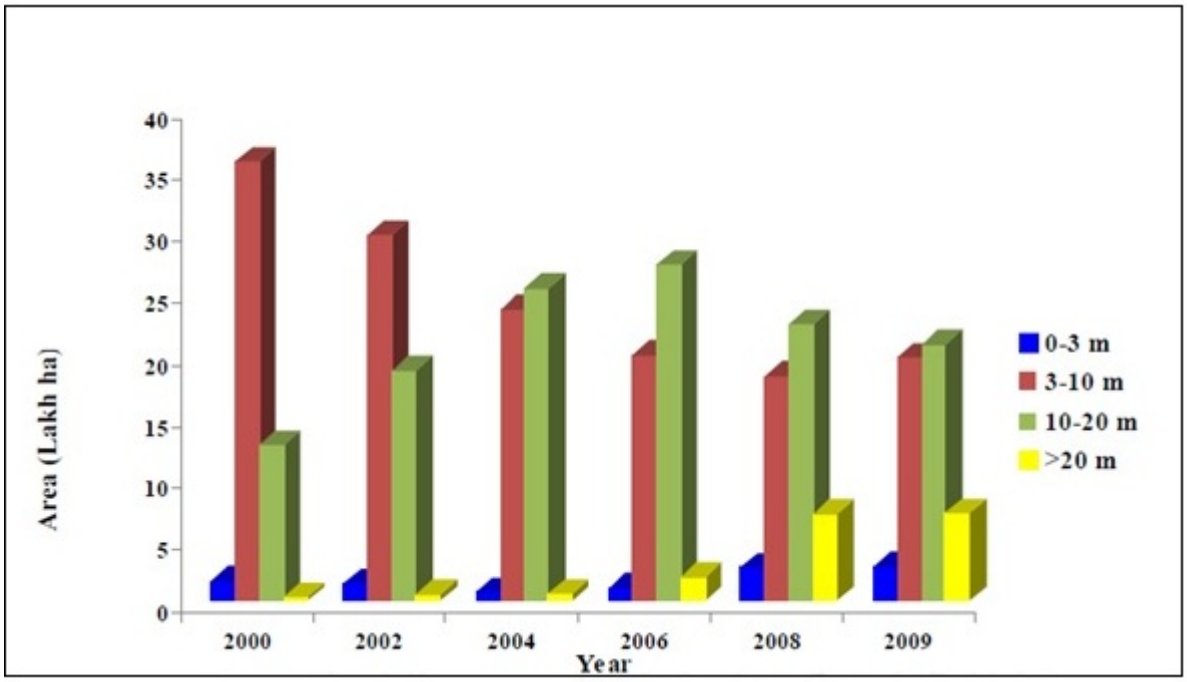


Figure 1 Area under different water table depths in Punjab

- The state has the highest stage of ground water development of 172 % (indicating the annual water consumption is very high compared to its annual recharge) amongst all the states in India (Source: Central Ground Water Board, 2017).

- The groundwater of the area is completely over exploited.

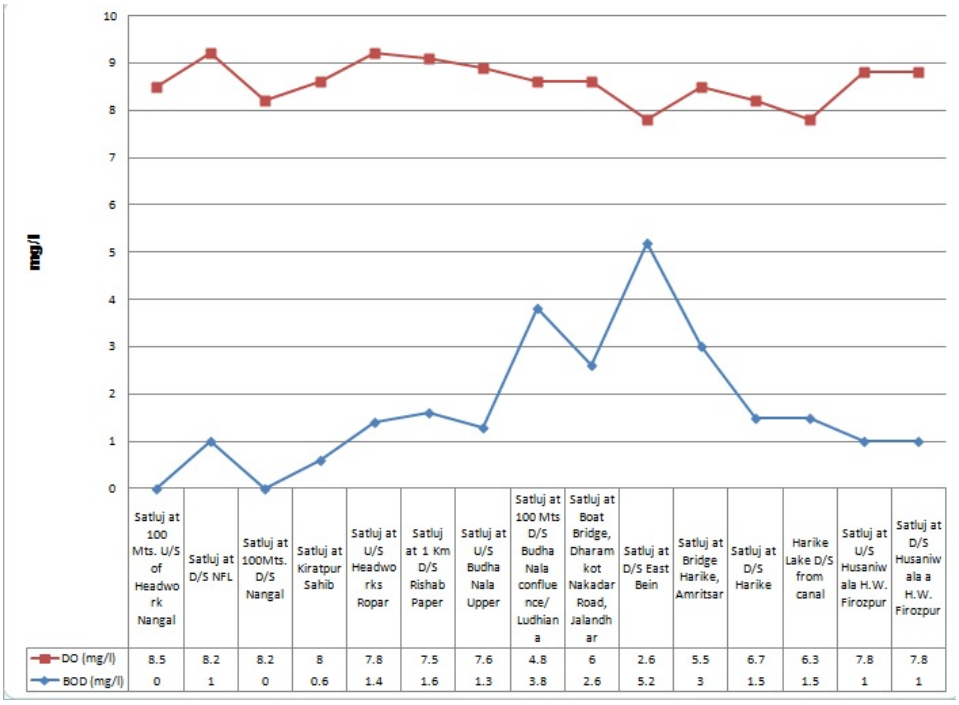


Figure 2 Status of water quality of Sutlej river Jan 2016

Figure 3 Depth of water level map of Punjab Jan 2014

- The depletion of ground water level is attributed to increase in number of tube wells. The number of tube wells has increased from 3 lakhs in 1975 to 14 lakhs in 2015-16. (Source: Statistical Abstract of Punjab, 2016)
- 14298 red category industries contributing as point sources of pollution. High level of BOD and heavy metals recorded from river Sutlej, Ghagger.

- **Agriculture**
  - Total consumption of NPK fertilizers in Punjab has increased from 19.11 lakh nutrient tones in 2010-11 to 19.43 lakh nutrient tons in 2015-16.
  - Consumption of chemical fertilizers (NPK) per hectare of gross cropped area has also increased from 242 Kgs in 2010-11 to 247 Kgs per hectare in 2015-16.
  - Farm Mechanization: The State has 5,17,743 Tractors i.e. on an average 76 tractors per thousand hectares (Net sown area as on 30.06.2016)

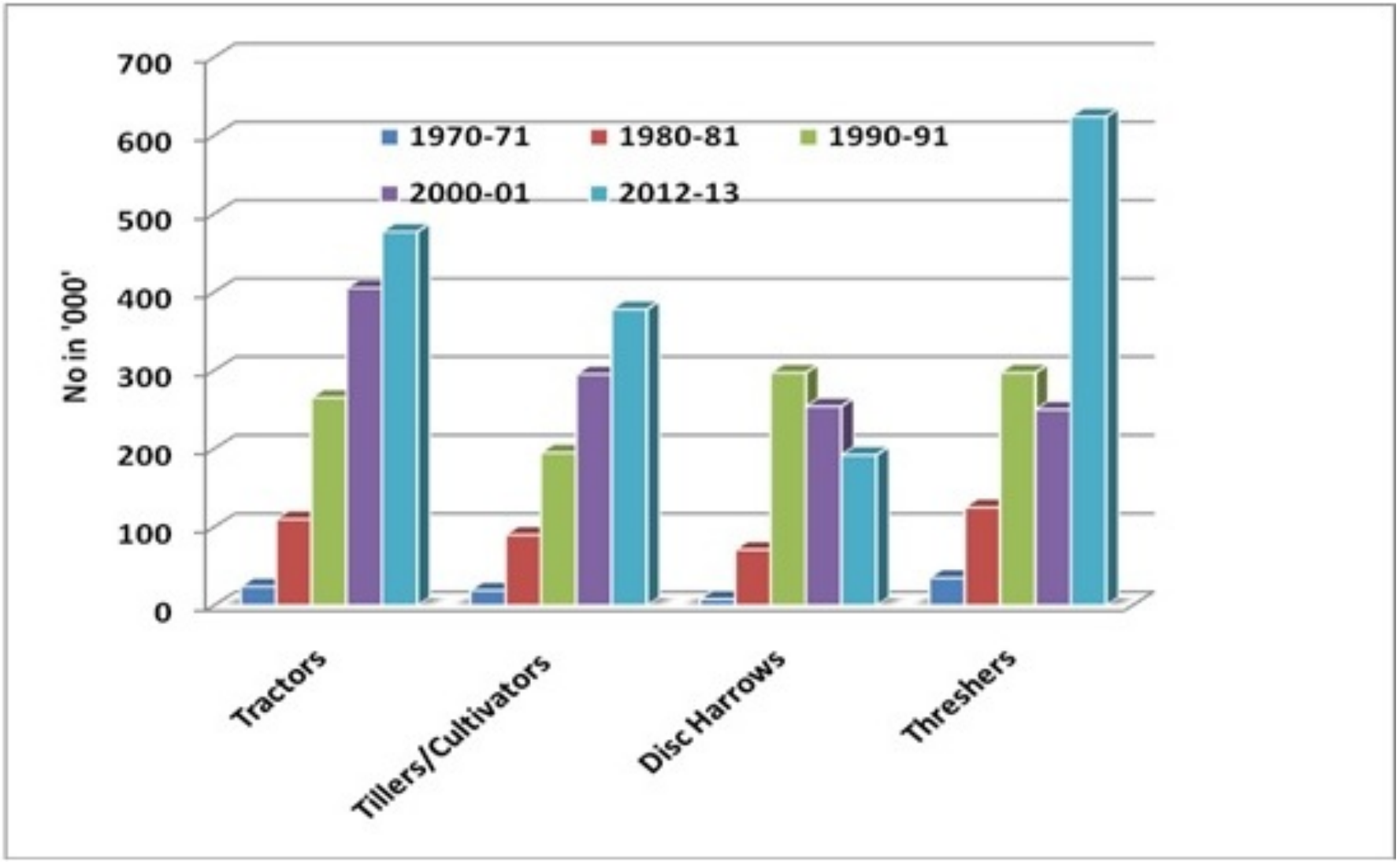


Figure 4 Growth of farm machinery in Punjab

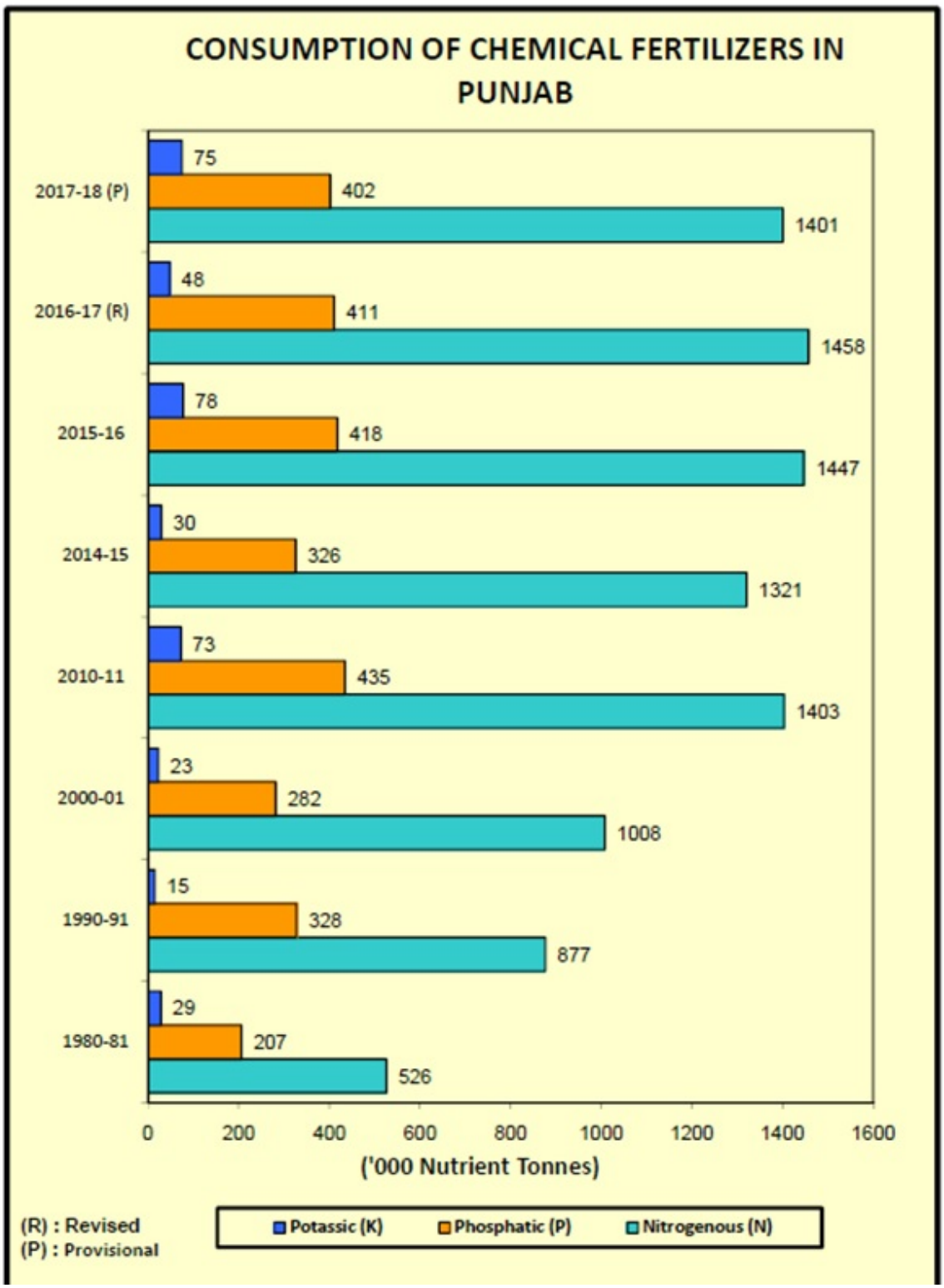


Figure 5 Consumption of chemical fertilizers in Punjab

Solid Waste

- Growth of population, industrialization, urbanization and western lifestyle resulting in generation of large volumes of solid waste.
- Three (Ludhiana, Amritsar and Jalandhar) cities with more than 1 million population contributing to large volumes of municipal waste.
- Solid Waste Collected & Treated 2015-16:
    - MSW: 1670122.93 MT Collected & 1861.5 MT Treated
    - BMW: 4783.325 MT Collected & 4783.325 MT Treated
    - Hazardous Waste: 27454.98 MT Collected & 27454.98 MT Treated (Source: Punjab Pollution Control Board, 2017)
- Many towns do not have proper collection and transportation facilities and MSW disposed of on landfill sites and remains uncovered resulting in environmental pollution of the surrounding area.
- Improved health care facilities led to generation of high volume of bio-medical waste.
- Biomedical waste generated from small clinics, dispensaries, etc. (which do not require authorization from PPCB) not disposed of properly.
- Lack of data on generation and management of e-waste.

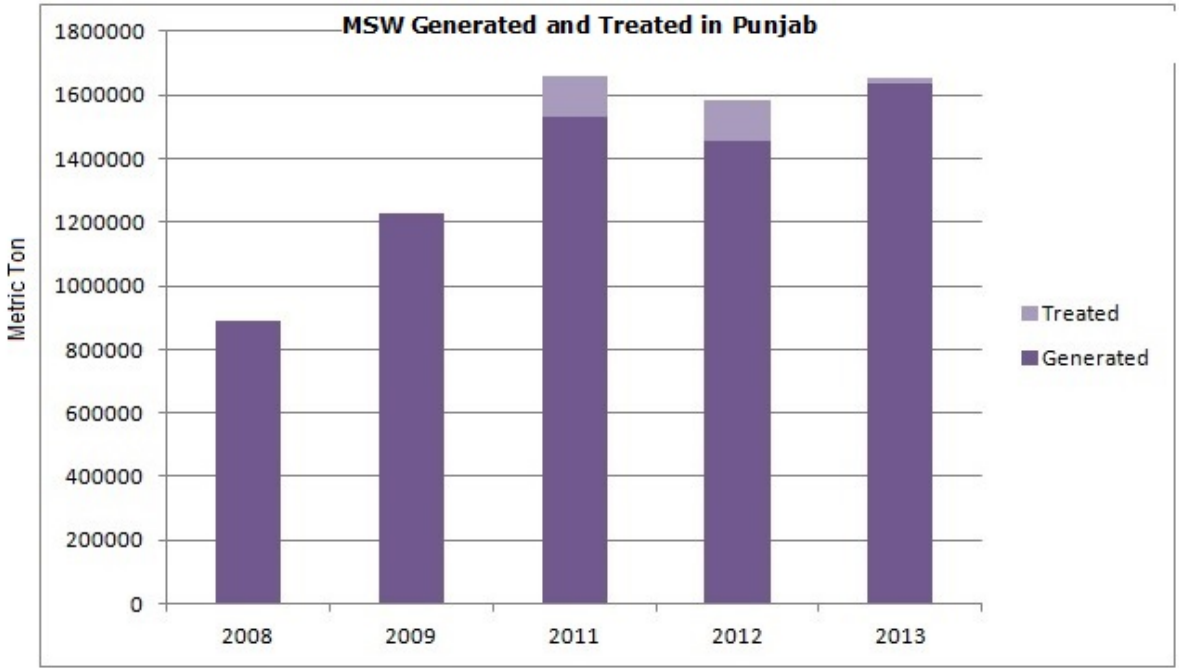


Figure 6 Municipal Solid waste generated and treated in Punjab

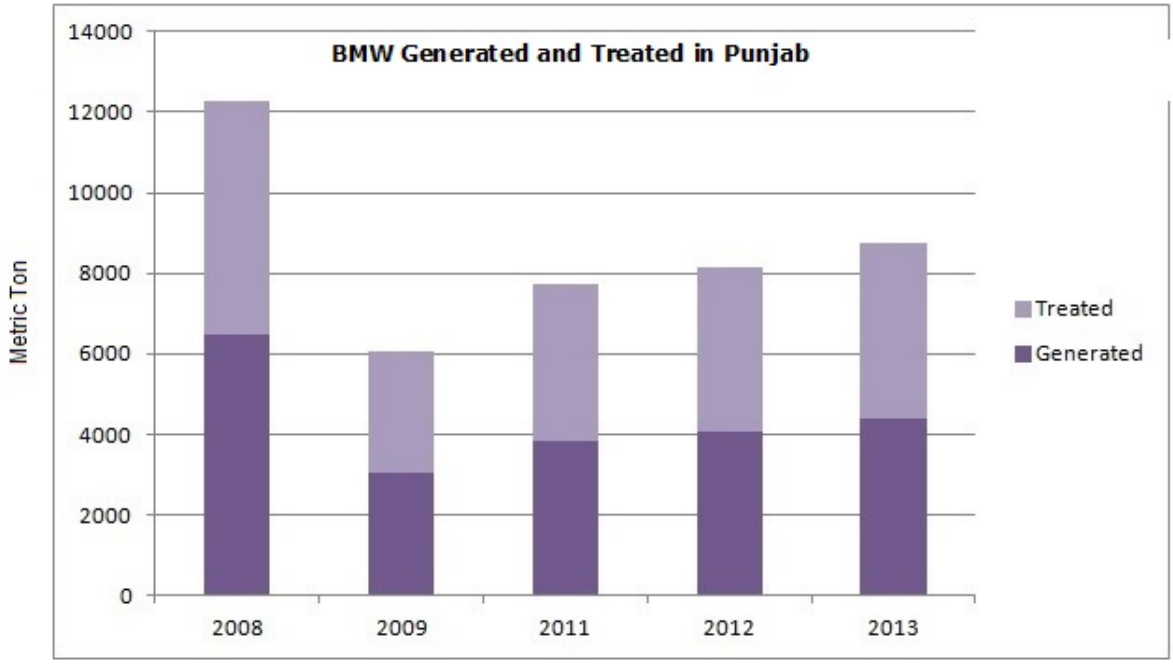


Figure 7 Bio Municipal waste generated and treated in Punjab

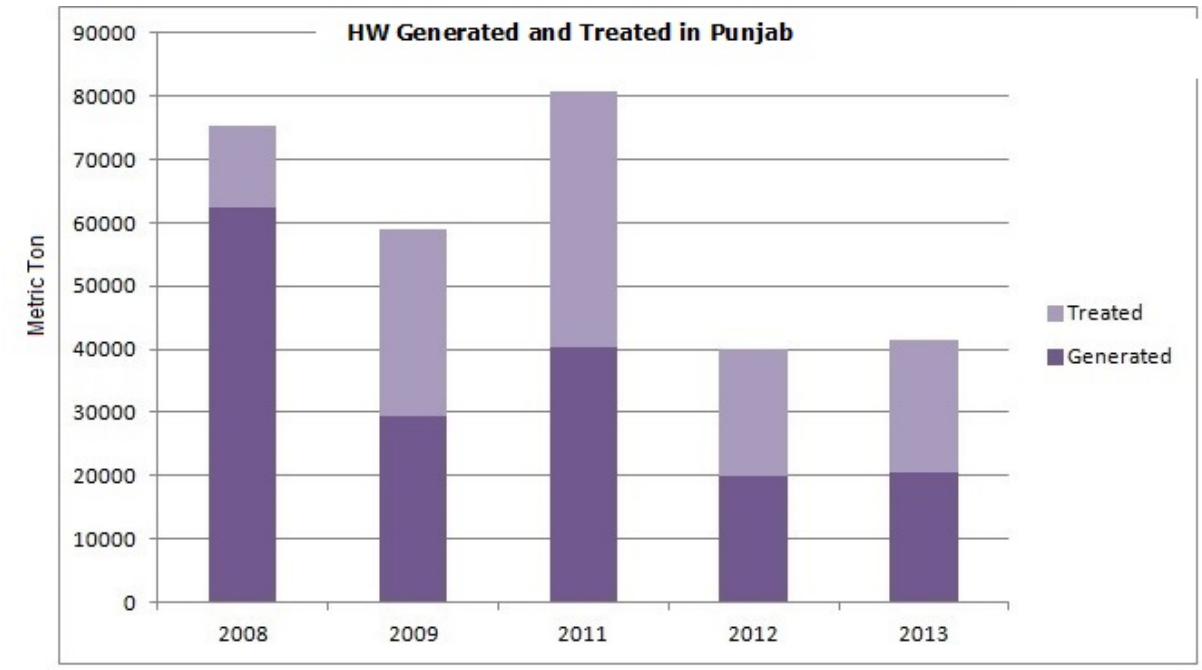


Figure 9 Home waste Generated and Treated in Punjab

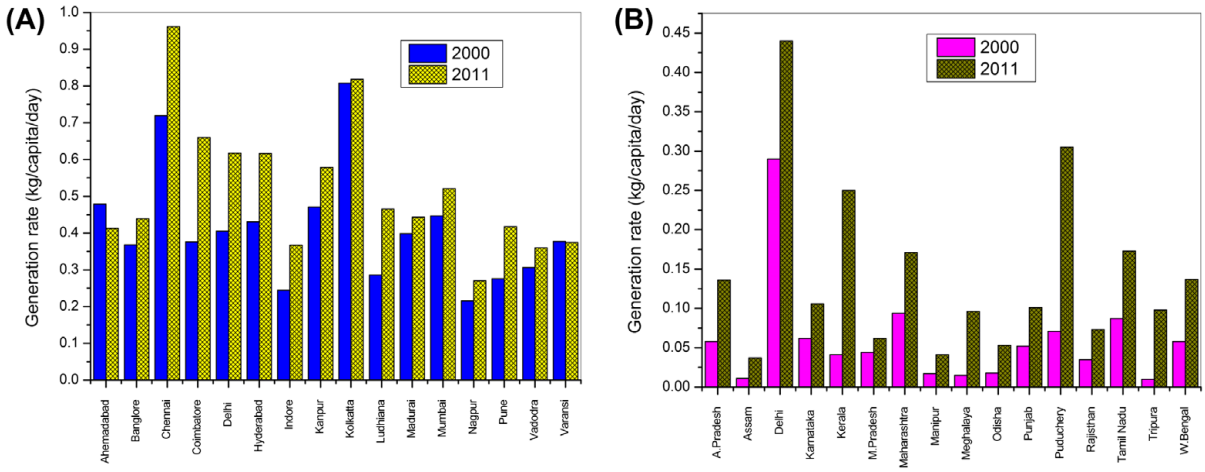


Figure 8 Per capita generation of MSW

a. per capita generation of MSW in selected Indian cities in 2000 and 2011
b. per capita generation of MSW in selected Indian states in 2000 and 2011

The abysmal state of and challenges in solid waste management (SWM) in urban as well as rural India is the motivation of our present topic. High population growth rates, rapidly varying waste characterization and generation patterns, growing urbanization and industrialization in developing countries are the important reasons for paying attention towards MSWM as more area is required to accommodate waste. Urbanization contributes enhanced municipal solid waste (MSW) generation and unscientific handling of MSW degrades the environment and causes health hazards.

This in-depth discussion of Environmental Problems in Punjab has shown us that there is a lot to be done. Vacant plots of land such as the one in Dekhwala are the best candidates for industrial solutions to these problems. Not does it only help improve the state of these issues by using novel ideas (granting recognition to the village in the process), but it also provides employment to the people of the village and help give a specialization to the village.

Let us now discuss the novel solution to these problems that make use of vacant and barren lands.

Novel solutions to environment problems by making use of the vacant and barren land

Solution to low water table

Groundwater recharge (Wikipedia, 2019)**:**

Groundwater recharge is a water movement process where surface water moves to the ground water. This is the primary method aquifers are recharged.

Although wetlands provide the main help in maintaining the water table, Depression focused recharge is what we will focus on for this land as the land is characteristically arid.

Running water doesn't help replenish the ground water as it does not exceed the "field capacity" (Wikipedia, 2019) of the soil. The land under consideration is a low lying land. Low lying land are the perfect place for groundwater replenishment. However, minor changes are required for this.

- The land needs to be locked.
    - This means that the water that runs down into the depressed region should stay there. This is essential for seepage into the ground.
- The larger the area focused on groundwater replenishment, the better is the discharge of groundwater into the aquifers. This calls for buildup of many small depressed regions instead of one big depression.
- The quality of water that is collected in these infiltration basins is of concern since it can lead to seepage of contaminants into the groundwater. For this a basic pre filtration system needs to be in place

- Pre-filtration takes place in shallow basins with an impermeable bottom made, e.g., of concrete, which are filled with a layer of gravel and sand of about 1 m thickness as filter material. Entering over a cascade, the water flows horizontally through the filter layer to a collector pipe located at the opposite side of the basin. During the passage, the purification processes described in the diagrams take place. Finally, the water is conducted to slow sand filtration basins where artificial groundwater recharge happens by vertical seepage of the water. (Balke, 2008)

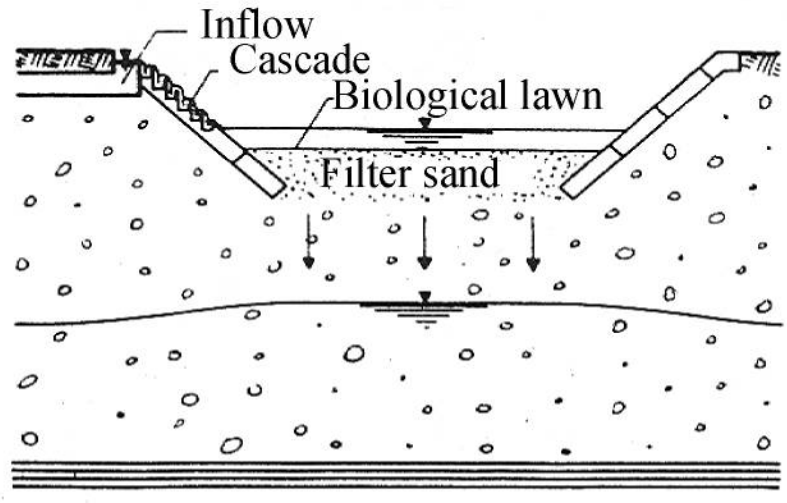


Figure 10 Cross section of an infiltration basin with cascade (ORL-ETHZ, 1970)

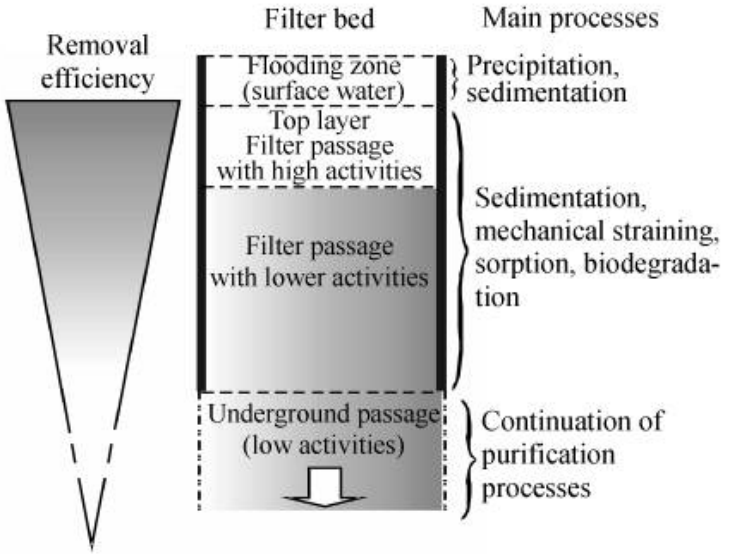


Figure 11 Purification process during vertical infiltration of water (Preuß and Schulte-Ebbert, 2000)

Solution to solid waste generation

Proximity of the village Dekhwala to the very epicentre of the urbanization makes it a potential location for establishment of the solid waste treatment plants. And the availability of the barren, unused and dispute free land adds up to it positively.

What can we get from the municipal solid waste disposal plant?

Since the municipal solid waste treatment plant is also called MSW sorting machine we, of course, will get classified garbage from it. The separated garbage can be sold directly or further processed by related machines to produce useful resources with higher prices and values, which can create great profits for our customers.

(Beston Machinery, n.d.)

Type	Main products	Corresponding equipment	Final resources
Construction waste	Dust, earth, sand, stone, broken glasses, etc.	Brick production line	Bricks for building;
Green waste (biomass waste)	Tree leaves, grass, fruit shells, wood, straw, etc.	Charcoal making machine	Carbonized into charcoal powder, which can be deep processed into briquettes for BBQ;
Organic waste	Food remaining, faeces, straw, tree branches, etc.	Biogas plant	Biogas to generate electricity;
Metal	Metal products such as caps, battery, etc.	Metal plant	Sold directly or smelt for making new metal products;
Plastic waste	PET	PET fibers production line	Processed into flakes, and then processed into fibers, which can be used for making clothes, pillow inner, bolster, etc.;
	PP, PE, ABS, PS, etc.	Auto packing machine	Packed and then sold directly;
		Beston pyrolysis equipment	Converted into fuel oil and carbon black for higher values.

Table 2 Types of waste differentiated and the corresponding products that can be made using those materials

Commercial uses of vacant land in villages

Agriculture Market

The Need?

An efficient marketing system can provide better prices to producers and improve the availability of competitively priced produce to consumers. In some cases, new markets or improvements to existing markets in rural areas can help overcome many of the marketing problems faced. However, before considering whether to carry out improvements to markets and what type of improvements to introduce, it is important to be sure that markets, or lack of them, represent the main problem. Other causes of inefficient marketing could be:

- poor roads;
- a lack of knowledge about marketing among farmers;
- an inadequate quantity of products to attract sufficient traders.

The benefits of markets

Formal markets in rural areas play an important role in improving agricultural marketing. They can:

- provide a location at which farmers can meet with traders
- increase retail competition by providing a convenient place where farmers can meet with consumers
- improve hygiene, if existing marketing activities are carried out in an insanitary manner
- reduce post-harvest losses by providing protection for produce from direct sunlight, rain, etc.
- make marketing a more pleasurable activity
- provide a focal point for rural activities

Identifying market channels in the rural areas

As a first step towards identifying requirements for new or improved rural markets it is important to understand how existing marketing functions. The most common transactions in rural areas are described below.

Farm-gate purchases:

Purchase of produce may be on an individual basis at the farm gate. Buyers go to the farm, usually at a pre-arranged time. In some cases, such as with fruit crops, the produce can be sold "on the tree" or "in the field" and the buyer arranges for its harvesting. In other cases, the sales may be through marketing groups or cooperatives. The farmers in this case may wait for the trader at collection centers.

Local (primary) markets:

These markets are usually for direct sales of small quantities of produce by farmers to village traders and rural consumers. Rural primary markets often form part of a network arranged on a periodic basis, such as on a specific day of each week. They are commonly organized at a central place in a village or district center or beside a village's access road. In some instances, markets in small towns also provide an assembly function.

Assembly markets:

Larger rural markets are found where greater quantities of produce are traded, either by the producers themselves or by traders. These "assembly" markets (gathering produce in larger quantities for onward sale to outside buyers) are often combined with local rural markets and are normally situated on main highways, other local main roads or near to ferries. Traders or collection agents working on behalf of urban wholesalers normally purchase produce. The market operations may be year-round or seasonal, depending on the types of crops being marketed.

Direct sales to urban markets: Farmers may also take their produce directly to urban areas, either to a retail market or to a wholesale market.

Defining responsibility for the decision making

There is no right way to operate a rural market. The extent to which the public sector and local communities are involved depends on who pays for the development and who maintains it. The involvement of central government in small marketing infrastructure is usually limited to capital

expenditure, the maintenance being undertaken by local government or the community itself using locally generated funds such as the market fees. A market committee (or, perhaps, a local rural development committee) would usually be the key decision-making body. The existing market users should be closely involved with decisions about whether to improve a market, or to develop new infrastructure. Most development should involve a high level of local initiative. Sufficient time should be given at the start to ensure the community's involvement in the design process and to establish ownership of the facility.

Our observations on the subject matter during the field trip:

1. The village is well connected to the nearby towns via roads which can support vehicles

ranging from motorbikes to medium sized lorries and tractors.

2. The villagers seemed to be well aware of the outer world and what is happening there, in essence, they have at least primary education.

3. The village has proper irrigation facilities and adequate amount of power supply which makes production easy and people are inherently motivated towards agriculture. We talked to a fairly young man in his mid-thirties and according to him, production almost increases every year.

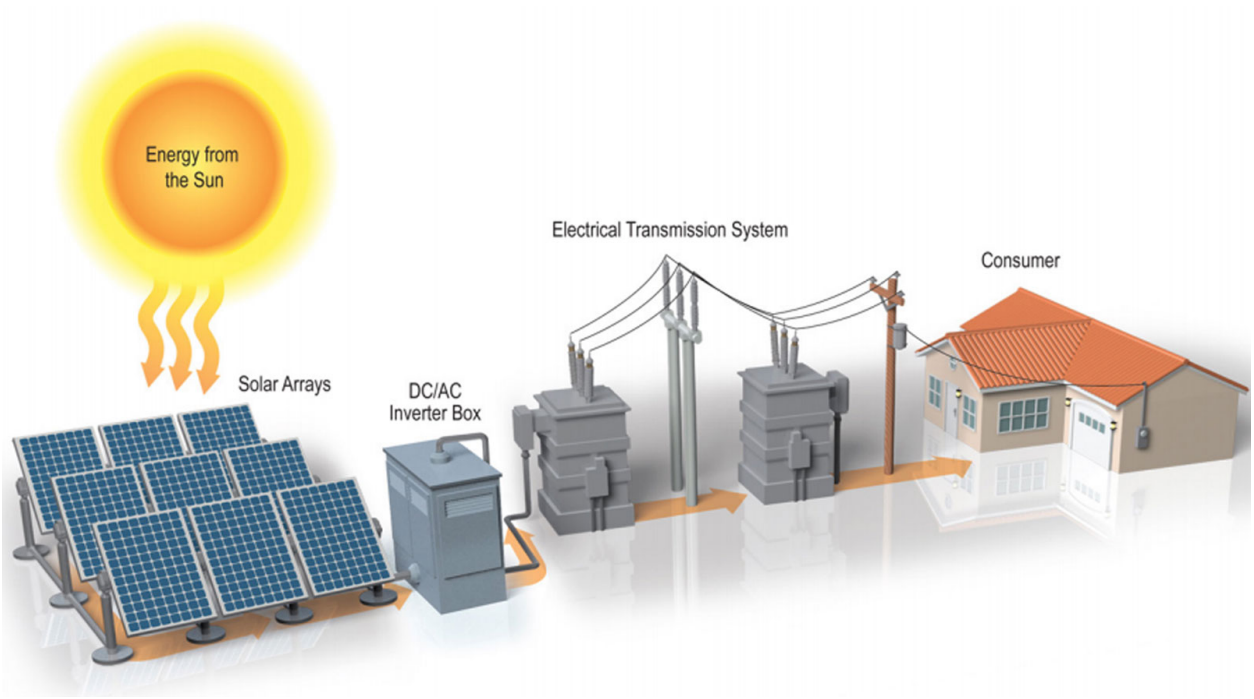
4. Surprisingly the village, in spite of having a significant population, had no proper markets as such. Small stalls were hard to find let alone a proper market...

5. Farmers have to go to the nearest town via their vehicles to get even elementary things and since they are used to do the same, they don't seem to have a problem with it.

Solar Farming

Importance of Solar Energy

Solar energy is renewable and it is formed by transforming the continuous flow of energy from the sun into electricity. There are no harmful emissions it does not require any fuel and hence has low operating costs after installation.



Even though the villagers quoted an engineer and said that they want to drop the idea of a solar farm, in our studies, we have observed that in the long run, there is potentially no harm of pursuing this endeavor.

Solar energy is the most abundant permanent energy resource on earth, and it is available for use in its direct (solar radiation) and indirect (wind, biomass, hydro, ocean) forms.

Solar energy can be used through two routes: Thermal and Photovoltaic

The thermal route uses the heat for water heating, cooking, drying, water purification, and power generation.

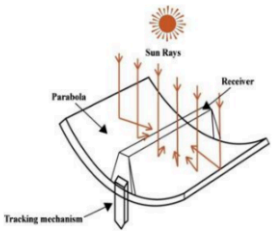
The photo-voltaic route converts the light in solar energy into electricity; it can be used for applications such as lighting, pumping, communications, and electrification of villages.

Most parts of India get 300 days of sunshine a year. The daily average solar energy incident over India varies from 4 to 7KWh/m2. Assuming 10% conversion efficiency for PV modules, the country receives enough energy which is 3 orders of magnitude greater than the energy demands in India.

Concentrating solar power (CSP) systems use lenses or mirrors to focus a large area of sunlight into a small beam. Most developed concentrating technologies include parabolic trough, Stirling dish, and solar power tower. In principle, working fluid is heated up in all of these devices and is then utilized for power generation.

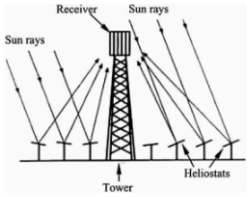
Photovoltaic and Concentrating Solar Systems

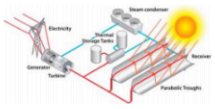
- Straight in one direction and curved in other two.
- Lined with a polished metal mirror.



Parabolic trough

Heliostats





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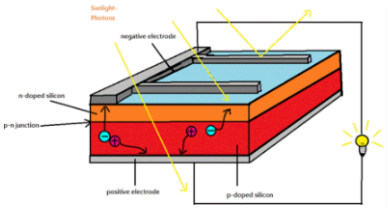
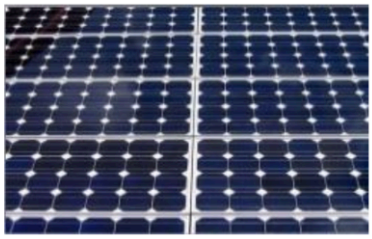


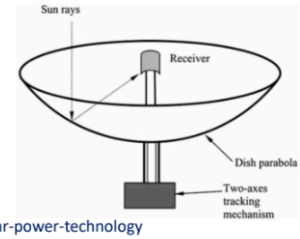
http://pvinsights.com/Knowledge/Principle.php

Stirling solar dish



Photovoltaics

https://www.youtube.com/watch?v=L_q6LRgKpTw



Soteris A. Kalogirou, Recent Patents on Engineering, 2007, 1, 23-33

https://www.slideshare.net/arvinddautaniy/csp-concentrated-solar-power-technology

So, with an endeavor to offer financial and water security to farmers, the Indian government has launched various schemes to promote the installation of grid-connected solar power plants and solar pumps.

According to the **Scheme for Allocation of Solar Power Projects to Land Owning Farmers** (PEDA gov, n.d.)**,**

> *"The Government of Punjab endeavours to promote solar energy projects by land owning farmers with a minimum capacity of 1MWp to a maximum capacity of 2.5MWp (per land owning farmer) in the state for sale of power to Punjab State Power Corporation Ltd. (PSPCL) at applicable generic tariff determined by Punjab State Electricity Regulatory Commission (PSERC) on annual basis. With Solar Power Projects located closer to the agriculture loads in distribution / transmission network, distribution losses will be reduced considerably and voltage drop at peak day time load will be minimized along with power supply and power factor improvement. These small solar PV systems shall act as a micro distributed utility at farm level. The solar power generation shall be available for enabling the agriculture pump-sets loads to be operated during the daytime, thereby allowing the utility to dispatch the power so saved from their central generating station to other area."*

The application fee of Rs. 50,000 and the processing fee of Rs. 2,00,000 is to be initially paid by the farmer or group of farmers. The farmers are to be paid the Electricity bill according to ongoing rates per Unit.

There are various clauses and eligibility terms and conditions which are specific to the farmer given in the full documentation of the scheme.

Government of India's Integrated Wasteland Development Program IWDP

(Department of Land Resources, n.d.)

The strategy

Development of wastelands to check for land degradation and putting them to sustainable use to increase bio-mass availability.

The scheme aims to achieve this by reviving village level institutions to give the power of decision making to the people. This development scheme aims to strike the perfect balance between adressal of environmental concerns and developmental aspirations.

Categories of Wastelands in India	
Category	Area (in sq.Kms.)
Snow Covered/Glacial	55788.49
Barren Rocky/Sheet Rock	64584.77
Sands-inland/coastal	50021.65
Land affected by salinity/alkalinity	20477.38
Gullied/or ravinous land	20553.35
Upland with or without scrub	194014.29
Water logged & Marshy	16568.45
Steep sloping area	7656.29
Shifting cultivation land	35142.20
Mining/Industrial Wastelands	1252.13
Degraded/pastures/grazing land	25978.91
Under utilised/degraded notified forest land	140652.31
Degraded land under plantation crop	5828.09

There is a grand total of **638518.31 sq. Km** of wasteland in India (Department of Land Resources, n.d.),

The basic objective of this scheme is an integrated wastelands development based on village/micro watershed plans. These plans are prepared after taking into consideration the land capability, site condition and local needs of the people.

The scheme also aims at rural employment besides enhancing the contents of people's participation in the wastelands development programmes at all stages, which is ensured by providing modalities for equitable and sustainable sharing of benefits and usufructs arising from such projects.

The program also encompasses **Training of the user groups** on topics like:

1. Concept of watershed development
2. Community organization
3. Technical issues
4. Administration
5. Sustainability and Equity issues
6. Role of Panchayat Raj
7. Involvement of women and weaker sections of the society.

This program's success totally depends on the willpower of the masses of the village. The willingness of Dekhwala villagers to participate in this endeavor of HUMAN GEOGRAPHY

AND SOCIETAL IMPACTS has a clear implication that these people have enough motivation and are the perfect target for this scheme. The viable options for the wasteland usage that we have discussed in the sections above have the ability to go hand in hand with this scheme and add to the benefits of the village and its people.

Exchanging Benefits by Giving Part/Full Ownership at a lower cost

This strategy is central to the idea of non-agricultural usage of wasteland in rural areas. Exchanging of benefits is the most practical way to attract investment into rural areas at the terms of locals. It is through this exchange that we incentivize investors to come and invest. It's not that rural areas are altogether deprived of investments. Investments do eventually fall in, but these investments are based on zero consideration for the village ecosystem.

Consider the case of an entity acquiring a piece of land at a certain price. The industry or service that takes shape there as a result will only support its bare minimum obligations of not polluting the adjoining environment. Once that requirement is done and dusted, there is absolutely zero gain for neighbouring village(s). They don't gain a single penny from the presence of a million-dollar industry or service right next to them. In some cases, even the employment opportunities may not be transferred to the neighbouring village(s) because villagers may lack the vocational skills to be employed at the facility, or the prerequisite number of workers are already there. Even if the employment opportunities are transferred, these opportunities may be at draconian terms. It is precisely because of these monstrous possibilities that a voluntary engagement with such an entity is the best option.

The reason is very simple: the process of land acquisition in this country has been very controversial in our country. It has led to political protests, mass agitations and even institutional bullying of land-owners. Any entity acquiring land in rural areas, even through legal means, directly comes into the crosshairs of human rights activists and political outfits who will milk the potential controversy to claim that land is being snatched away at using unfair means whether it is actually unfair or not. This vulnerability is easy for panchayats to capitalize on. They can give away land (at discount, part ownership or full ownership) and contractually oblige the opposite party to provide a certain set of benefits. These benefits may include voluntarily employing villagers, or bringing and maintaining infrastructure to the village(s). The opposite party is very likely to agree to those terms because of how much vulnerable it used to be while entering into similar transactions. There is complete avoidance

of controversy in this case as long as the terms under which the deal went through were the Panchayat's and the origin of the engagement was from the Panchayat's side.

An Example: Vijayawada

A great example of such a deal comes from Vijayawada (Ministry of Housing and Urban affairs, 2019). The Ministry of Housing and Urban Affairs had lauded this deal as an exquisite example of "inclusive development in the country". Vijayawada Municipal Corporation assembled 226.54 acres of land in Gollpudi and Jakkampudi villages adjoining the city. This was done without resorting to traditional land acquisition process. Under this model, through a series of meetings between the District and Municipal Administration authorities – Collector and District Magistrate, Krishna District and Municipal Commissioner, Vijayawada and land-owning farmers from the villages was persuaded to join hands with the State Government for providing 40 percent of their land for housing the poor and low-income segments. The State Government contributed Rs.25 crores for land development. The farmers in Gollapudi and Jakkampudi villages were given back 60 per cent of land with plotted development, equipped with required infrastructure facilities like approach road, international road, land levelling, water and other infrastructure connectivity at government cost, free land use conversion and layout approval by the planning and municipal authorities.

Under conventional land acquisition, farmers would get Rs. 58.4 lakh per hectare. Instead they received fully developed 1800 square yards plot per acre of land. The value of which was anywhere between 90 lakhs to 180 lakhs per acre. The farmers also saved money on conversion, registration and layout development charges. Under conventional land acquisition, Govt. would have had to spend Rs 5292 lakh, instead it developed the plots for only Rs 4600 lakh thus saving a total of Rs 692 lakh in the process. Cherry on top is that the remaining 40 percent of land would be used for housing of underprivileged sections of society.

Conclusion

While it is true that the questions about effective wasteland utilisation have been debated and researched upon for a very long time, and it may suggest that the solutions may be theoretically very simple or trivial, but the very fact that these questions have recurred and persisted may suggest that though the solutions are trivial in the theoretical sense, they may be nothing but noise for the villagers. And thus it is important to keep things simple, and offer a set of solutions that are not only simple enough for the villagers to understand, but have also been utilized in real life so as to gain the trust and cooperation which are the most important ingredients if we have to be able to go towards implementation.

Moreover, we need to move beyond conventions, and established premise of the vast binary research system that has often tried to separate agricultural usage with non-agricultural in the context of wasteland usage. The reason for this is that if it benefits the villagers and doesn't cause pollution, it should be done. Our premise is based on restoring the sad state of natural resources like land and water using sustainable land usage practices. We later move beyond that and offer a set of practical solutions to the question of optimum non-agricultural usage of a rural wasteland.

But please note that there is no optimum combination of these solutions that we can simply bestow upon a land and expect people to comply with. That combination of solutions will have to be based on the priorities of the locals and extent of the damage to the land. Only after taking into consideration both of these points can we tell people whether to opt for an agricultural solution or a non-agricultural one. In the process we may even encounter the ethical concern of dedicating a cultivable land to a non-agricultural practice. All these concerns are dictated by a single variable, which is the percentage of the land that we dedicate to each specific purpose. Quantification of the effects of changing this variable for different rural settings forms scope for future research in this direction.

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