

TO STUDY & COMPARE THE IMPACTS AND CHALLENGES OF BACKYARD GARDEN USING GREYWATER IN PLAIN AND HILLY REGION OF RURAL ODISHA

Dissertation Submitted to



The IIHMR University, Jaipur

**for the partial fulfillment for the award of the degree of Master of Business Administration
(MBA)**

in

Development Management

By

Rinku

Under the Supervision and Guidance of

Dr. Ratna Verma

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DECLARATION BY STUDENT

I hereby declare that this dissertation titled “To study & compare the impacts and challenges of Backyard garden using greywater in plain and hilly region of rural Odisha” is the bonafide record of my original research work. I declare that it has not been submitted to any other university or institution for the award of any degree or diploma. Information derived from the published or unpublished work of others has been duly acknowledged in the text.



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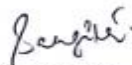
Certificate of Experience

This is to certify that **Ms. Rinku**, G-80, Mangalam City, Hathoj, Jaipur, Rajasthan – 302012, pursuing MBA in Development Management, IIHMR University, Jaipur, did her internship with Gram Vikas, Odisha from March 16, 2023 till May 20, 2023.

Rinku worked in the Sanitation and Health thematic area and was involved in a project “To study and compare the impacts and challenges of backyard gardening using greywater in plain and hilly region of rural Odisha” related to greywater reuse and backyard gardening in the villages of Ganjam and Gajapati districts of Odisha. During her internship, she conducted extensive field visits, covering eight villages across these districts. These visits, combined with her thorough literature review, enabled Rinku to prepare a comprehensive assessment of the subject matter. Furthermore, Rinku prepared a report that effectively showcased the differences between the challenges and impacts of greywater reuse and backyard gardening in both districts. Through her field visits and extensive literature review, Rinku was able to gather valuable data and insights for a well-rounded assessment of the situation.

We found her to be attentive, sincere and hardworking during the internship period.

We wish her success in all her future endeavours.


Sangita Patra,
Thematic manager
Gram Vikas



Certificate from Faculty Guide and School Dean
CERTIFICATE

This is to certify that dissertation titled “To study & compare the impacts and challenges of Backyard garden using greywater in plain and hilly region of rural Odisha” is a record of the research work undertaken by (Name of Student) in partial fulfillment of the requirements for the award of the degree of MBA (Hospital and Health Management)/MBA (Pharmaceutical Management)/MBA (Development Management) from the IIHMR University, Jaipur under my guidance and supervision and his/her approach to the research study has been sincere, scientific, and analytical.

Faculty Guide IIHMR University, Jaipur

School Dean IIHMR University, Jaipur

Abstract

With the rapid urbanization and increasing demand of fresh water, it is high time we became conscious of how we use water resources. And to solve this raised concern, scientists from worldwide are working on solving this problem and have recommended reusing wastewater. Moreover, Government of Odisha through Odisha Livelihoods Mission (OLM) launched a Nutrition Project “Mo Upakari Bagicha” partnered with Azim Premji Philanthropic Initiatives (APPI) to enhance the knowledge of nutritional outcome from dietary diversity by promoting formation of nutrition gardens in the rural households. In accordance with this Gram Vikas is promoting Backyard Garden using greywater to reuse the wastewater.

The purpose of this study is to bring out a comparative analysis of implementation of reuse of greywater through backyard garden by considering the challenges and impact of it on communities of plain and hilly terrain of rural part of Orissa. In accordance with that, we selected Ganjam and Gajapati for the analysis of plain and terrain respectively, for which only qualitative data was used to get the in-depth analysis.

After analysis, the challenges and impacts were divided into 9 and 2 categories respectively.

Acknowledgement

I would like to express my sincere gratitude to all those who have supported and contributed to the successful completion of this research project.

First and foremost, I am deeply grateful to my mentor, Dr. Ratna Verma, for her guidance, encouragement, and valuable insights throughout the entire research process. Her expertise, feedback, and support have been instrumental in shaping our research and achieving our goals. And also Dr. Rahul Ghai for suggesting to me such a fruitful organization for my research and learning at grassroot level.

I would also like to thank the participants of this study, whose willingness to share their experiences and insights has made this research possible. Their time and effort are greatly appreciated.

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Abbreviation

OLM- Odisha Livelihoods Mission

APPI- Azim Premji Philanthropic Initiatives

VDC- Village Development Committee

SHG- Self Help Group

Introduction

Water is the most basic necessity and the most usable resource for every humankind to perform every single job. Still there are many areas where people have low or no accessibility to this resource. People have to travel for miles to fetch few litters of water. And with the rapid urbanization and increasing demand of fresh water, this resource is depleting way faster than we think. So, it is high time we become conscious of how we use water resources. And to solve this raised concern, scientists from worldwide are working on solving this problem and have recommended reusing wastewater.

Another such problem that has plagued development professionals to consider combating is Malnutrition, a health condition that develops when human body is deprived of the necessary nutrients it should have leading to various serious ill-health conditions like weakened immune system, bloated bodies, mood swings, kwashiorkor etc. To address this situation, every country and every state in India is experimenting and exploring new solution. One such solution is provided by Odisha government where; Government of Odisha through Odisha Livelihoods Mission (OLM) launched a Nutrition Project “Mo Upakari Bagicha” partnered with Azim Premji Philanthropic Initiatives (APPI) to enhance the knowledge of nutritional outcome from dietary diversity by promoting formation of nutrition gardens in the rural households.

Similarly, Gram Vikas has also found its own way to address both the problems, water crisis as well as malnutrition. So now they are constructing Backyard gardens either at household or community level using Greywater in various rural parts of Ganjam and Gajapati Districts of rural Odisha where they had already setup toilets to stop the open defecation practices.

Key words: Greywater, Backyard Garden, Hilly region, Plain region, Odisha

Literature Review

What is Greywater?

Greywater is defined as domestic wastewater created in residences or office buildings from uncontaminated streams, excluding wastewater from toilets. Sinks, showers, bathtubs, washing machines, and dishwashers are all sources of greywater.

According to Shrikant Navrekar as he mentioned in his webinar on Grey water management in Phase II of SBMG 28 Sept. 2020, Greywater is a part of Liquid Waste.

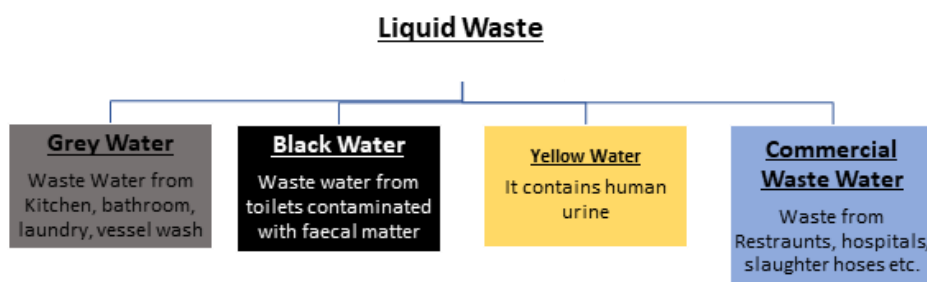


Figure 2.1.1. Composition of liquid waste

Antoine Morel and Stefan Diener in their report “*Greywater Management in Low and Middle-Income Countries*” summarizes the composition of greywater from different sources as-

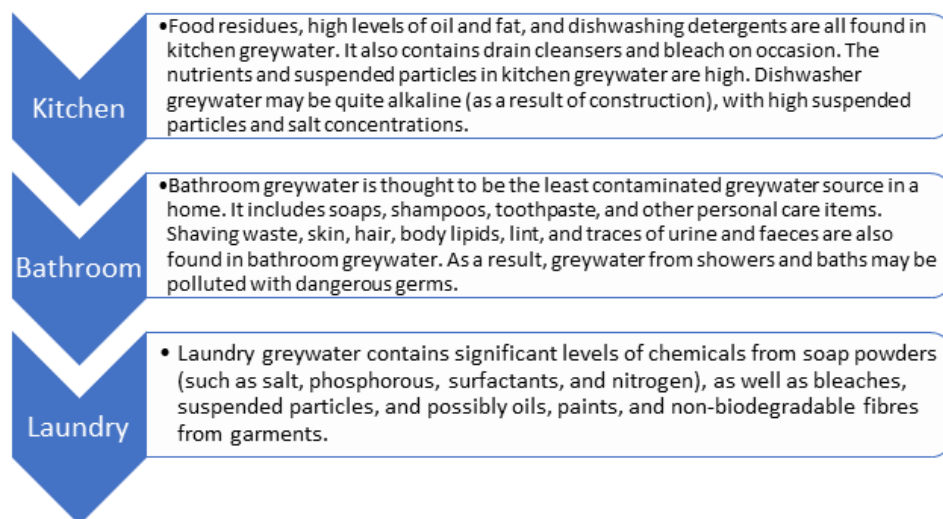


Figure 2.1.2. Composition of Greywater

Characteristics of Greywater

Antoine Morel and Stefan Diener in their report “*Greywater Management in Low and Middle-Income Countries*” has categorised into two characteristics-

<u>Physical</u>	<u>Chemical</u>
• Temperature- The temperature of greywater is higher than that of the water supply. For biological treatment operations, these temperatures are not critical. Furthermore, higher temperatures can promote bacterial growth and decrease CaCO₃ solubility, resulting in precipitation in storage tanks or piping systems. • Suspended Solids- Food, oil, and dirt particles from the backyard, as well as hair and fibres from the laundry, can contribute to high solids content in greywater. These particles and colloids generate turbidity in the water and may even clog the pipes, pumps, and filters used in the treatment process.	• pH and Alkalinity- Greywater should have a pH in the range of 6.5-8.4 for easier treatment and to minimise detrimental effects on soil and plants when reused. The pH of greywater, which is highly dependent on the pH of the water source, is normally within this ideal range unlike laundry wastewater which is more basic because of high use of detergent and soap. When used as irrigation water, greywater with high pH values is not troublesome in and of itself, but the combination of high pH and high alkalinity, a measure of the water's ability to neutralise acidity, is of special concern.

	• Salinity and Sodium Absorption Ratio (SAR)- Greywater contains also salts, indicated as electrical conductivity which describes the salinity of water. Use of saline greywater for irrigation over a longer period may lead to increased salinisation of the topsoil. • Biological and Chemical Oxygen Demand (BOD, COD)- The organic pollution in the water is measured by these parameters. Discharging greywater with high BOD and COD concentrations into surface water results in oxygen depletion, which is then no longer available for aquatic life.
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Table 2.2.1. Characteristics of Greywater

Why do we need to manage Greywater?

According to the 2021 data, India has a population of about 140.76 crores which is second highest in the world after China. And with this increasing population increases the demand of fresh water which is also depleting with climate change and the huge demand. So, to solve issues like these the concept of management of greywater came forward. Along with this it is also aimed at achieving Sustainable Development Goal 6 which aims to provide universal access to safe and clean drinking water and sanitation. And not just the freshwater demand, there are other issues that it will solve such as- (source: <https://www.conserve-energy-future.com/ways-and-benefits-of-using-greywater.php>)

- **Freshwater Conservation**- The reuse of greywater reduces the amount of freshwater consumption for household purposes which adopting in large amount can create a positive impact on environment, most importantly in areas experiencing droughts.
- **Reduction of water wastage**- The usage of fresh water for all of the numerous tasks in a house generates a lot of wastewater, which all ends up in the sewer systems. This results in unneeded waste. The quantity of water wasted can be cut in half by utilising greywater for another purpose before it is deposited into the sewage.
- **Reduction in energy consumption**- With lower freshwater demands for each household, the energy required to pump the water into the house is reduced. Second, water reuse reduces the load on treatment centres to ensure that it is purified, lowering the total energy required by both water distribution and sewage purifying companies. Lower energy use implies less electricity, which in turn means reduced use of fossil fuels, eventually helping to reduce greenhouse gas emissions. That means that energy can be shifted to meet other resource-intensive needs or stored for later use.

- **Reduced chemical consumption-** The reduction in the amount of water sent to sewage plants also results in a reduction in the amount of chemicals used in the treatment of the water. With a reduced load, sewage treatment plants do not need to employ as many chemicals, which is good for the environment and lowers the cost of sewage treatment. It also decreases the possibility of sewage treatment companies accidentally dumping chemical waste. Because the water already contains nutrients, using greywater lowers the need to fertilise the yards with chemical fertilisers.
- **Increase in green cover-** The use of greywater to water yards gives an alternate source of irrigate for plants, particularly in dry areas. Reclaimed greywater regions thus give an alternate use for water that would otherwise go to waste. As a result, it generates stunning landscapes since plants retain their greenness and bloom even in difficult temperatures. When combined with other technologies such as mulch and drip irrigation, the water provided can last longer, ensuring that the attractive state of one's yard is maintained even during the driest of seasons.
- **Reuse of nutrients-** Greywater reuse reintroduces nutrients that would otherwise be lost to the sewage system. The backyard and bathwater have a high concentration of organic material that is not toxic to plants.
- **Groundwater replenishment/recharge-** Greywater is frequently filtered by the soil as it flows downward and eventually ends up in groundwater, replenishing its levels. This is a beneficial thing because it ensures that waterways like rivers that get their water from subsurface aquifers are always fed.
- J. S. LAMBE and R. S. CHOUGULE in their article “Greywater - Treatment and Reuse” enlist some other advantages like
- Prevention of greywater stagnation.
- It prevents vector breeding.
- It's use in flushing toilets to make toilets functional.

Technologies available

Technology Options for Greywater Management



Figure 2.4.1. Technologies available for greywater treatment

(Source: 'Sujalam 2.0' Grey Water Recycling Project)

Technological Approach

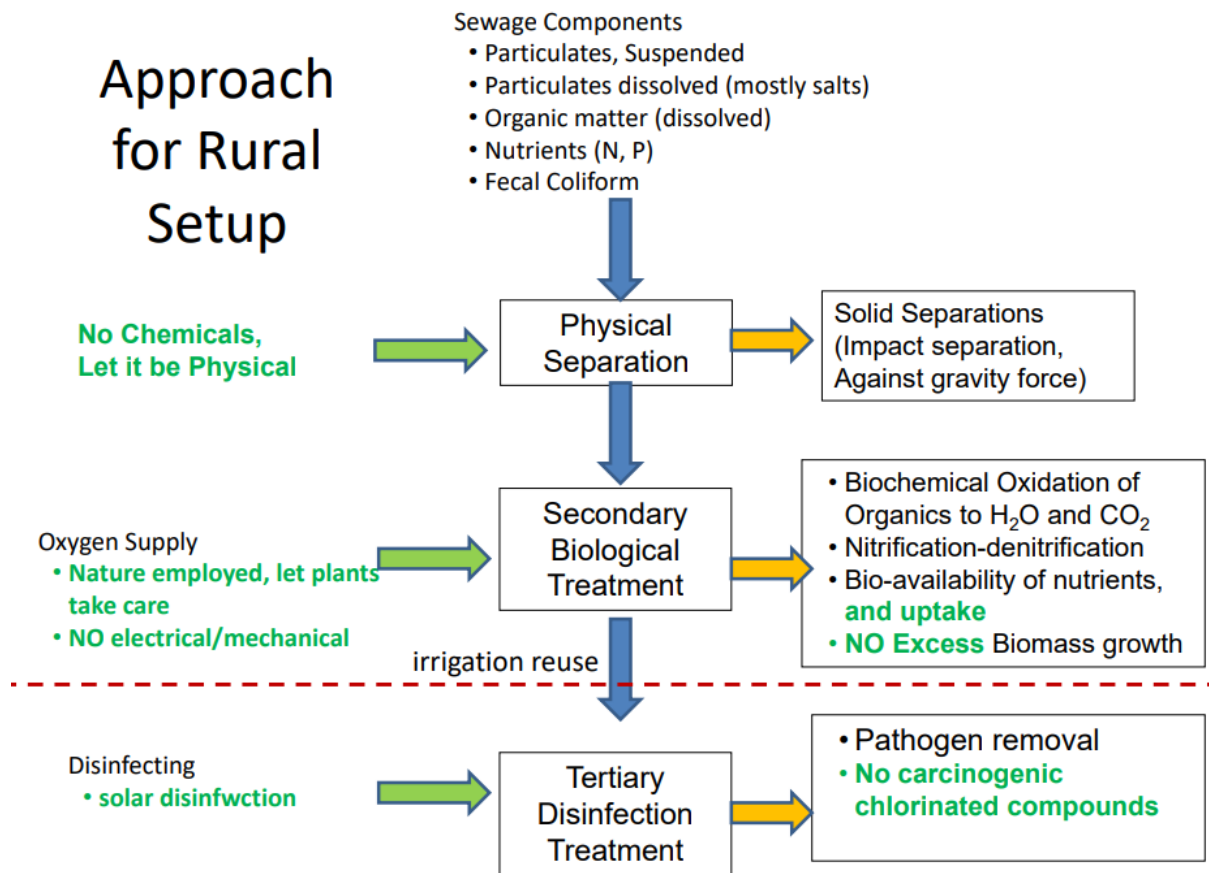


Figure 2.4.1.1. Technological approach for rural setup

(Source: Grey-water Treatment and Technologies by Rajesh B. Biniwale)

Operation & Maintenance

J. S. LAMBE and R. S. CHOUGULE in their article “Greywater - Treatment and Reuse” enlist some basic and important things to keep in mind about maintaining the system-

- The grease trap, filters, and sponge must be cleaned on a regular basis.
- The gravel and sand from the filtration unit must be washed on a regular basis.
- Every month, sedimentation tanks must be de-slugged.

Greywater management in irrigation

Irrigation is the most common method of greywater reuse which has been proved to be potentially solve the problem of water scarcity. However, it can have long term impact on quality and productivity of the soil, environment or health and economic condition of the stakeholder.

Effect on soil and plants

According to the report “Resuse of domestic greywater for the irrigation of food crops” by Sara Finley it has been suggested that irrigating with insufficiently treated greywater can cause soil to take hydrophobic properties and can adversely affect the productivity of the soil over the long

term due to access alkalinity which will be highly dependent on water composition, the degradation rate of chemical components, sorption, loading rates, soil types, leaching, and plant uptake. It may also lead to transfer of heavy metals like Cu, Pb and Zn to the soil and eventually to the plants.

Pathogen Transmission

A review paper by Santamaria and Toranzos (2003) suggests that enteric pathogens applied to the soil are most likely to travel and spread under wet conditions, in clay soils, and under low temperature and pH conditions.

Edible part of crop can get adversely affected when come directly in contact of untreated water. For example, root crops are in constant contact with the soil, they are more likely to show signs of contamination when bacteria-rich irrigation water is used.

Challenges faced

Plain	Hilly
- Only a few numbers of crops can be grown here due to a greater reliance on monsoon rainfall as during summer season it's hard to get water even for drinking purposes.	- Soil in hilly areas has relatively low fertility. Also, it can't give agricultural plants a strong foundation since it is shallow in depth and have hardpans/rocks in the higher layers. These soils are frequently acidic and harmful to agricultural plants. - Soil in hilly region is highly susceptible for erosion. Also planted crop may require frequent irrigation as the water may run off due to slope. - The operational land holding in these areas is also low. - Only a few numbers of crops can be grown here due to a greater reliance on monsoon rainfall as during summer season it's hard to get water even for drinking purposes. - Getting a desired directional flow of water for the backyard garden is difficult. (Source: Hill horticulture – status, problems and strategies by T Janakiram and Vijay Rakesh Reddy)

Table 2.5.2.1. Challenges faced by Backyard Garden in both region.

Impact of Backyard Garden

<u>Socio-cultural</u> – It helps in community building as Backyard gardens can serve as a gathering place for community members, providing an opportunity for neighbours to come together, share knowledge and skills, and build relationships.	<u>Economic</u> – Backyard gardens can save people money by reducing the need to purchase produce from market. Additionally, excess produce can be sold or traded with neighbours, providing a source of income. – It allows to have access to fresh and healthy produce which can help to increase their access to nutritious food and improve their overall health.
<u>Environmental</u> – Backyard gardens can help to reduce the carbon footprint by reducing the need to transport food from other regions. – It also serves as habitat for local wildlife, increasing biodiversity and promoting ecosystem health.	<u>Educational</u> – Backyard gardens can provide educational opportunities for children and adults alike, teaching them about gardening, healthy eating, and environmental sustainability.

Table 2.5.3.1. Impact of Backyard Garden

Rationale of the Study

I used greywater for my research as it is the most easily treatable wastewater. Moreover, not many research studies are available about constructing backyard garden using greywater.

Although the Government is implementing water reuse methods under Swatch Bharat Abhiyan, but Gram Vikas is reaching out to the hard-to-reach areas and training community to reuse greywater with minimal resources.

Methodology

Villages from Ganjam (plain) and Gajapati (hilly) districts of Odisha where Gram Vikas is currently working on Backyard Garden using Greywater have been selected for the data collection. Using same questionnaire in both the regions a comparative study will be done to understand the impact and challenges faced by backyard garden using greywater which is generally consider as wastewater.

Villages were selected on the status of work being done such as-

- Village with community backyard garden
- Village with Household backyard gardens
- Village where the work has just been started
- Village where its community backyard garden is there but only the landowner is getting benefited.

2 KII were conducted in each region with the District Manager of Gumsur and Field Expert at Koinpur Office of Gajapati districts. Along with these, 4 Face-to-face interviews were conducted with the presidents of Village Development Committee (VDC) of the villages in both the districts. Also, conducted 2 FGD with SHG and VDC member of Noragadu and Tumbo village in Ganjam and Gajapati District, respectively.

Result and Discussion

Case Study of Ganjam (plain region)



Village Visited-

- Noragadu
- Badhav Bhumi
- Gramdevati
- K Piri Gachha

Villages in Ganjam have 10-35 houses with same caste system resulting in better bonding and understanding and hence matriarchy could be seen in these areas. These villages have 4-5 members in most of the household producing about 50L of wastewater to irrigate the backyard garden which is mainly present at the back of their toilets. Villagers use to go to the forest in the morning for mahuli and cashew nut collection and comeback in evening and whoever among the family members has time spends 1-2 hour for the maintenance of garden like watering it, uprooting the weed, putting boundaries, etc. Villages avail government facilities like electricity supply, better infrastructure like better roads.

Gram Vikas Intervention

The project was started 1.5 years ago after Gram Vikas supported them with water supply and toilets and bathroom facilities with focus on to prevent the condition of stagnant water which will be a breeding place for the mosquito, hence various disease could spread, to provide the beneficiaries with an extra source of income as they can sell the surplus to the market, and it can be another source of livelihood for them, and a feeling of ownership will come and if not livelihood, it will definitely add a nutritious diet to their lifestyle with nutrient-rich fruits and vegetables fresh from their own garden without any kind of chemical. The team had the funds and with time got support too but the main concern was for those who don't have land for greywater management than the water will remain stagnant and will spread the disease and another concern was ensuring proper channelizing of grey water to the garden. Other than this, in the starting phase the concept was new to the community, so they resisted but the Gram Vikas team continuously made the efforts of having meetings with the gram panchayat, the SHG groups to convince them first and demonstrated some backyard garden within the village and then getting interest from that everyone's started too. Now it has been adopted by almost every house in the village who have land even if it is very small. But as of now nothing can be done for

those who have no land. Gram Vikas has also provided training about reuse and also distributed the seedlings.

Backyard Garden Status

Villagers in Ganjam use 100% greywater to irrigate the backyard garden directly through a piped outlet from the source (bathroom and washing area) without any treatment and through these pipes the garden is being irrigated. And if the area is more, then two pipes are joined together without collecting or storing the access as it may create foul smell or mosquitoes may breed there causing malaria and other water borne diseases.

They use it for planting their preferred vegetables and fruits like chilies, banana, pineapple, brinjal, onion, radish, drumstick, papaya during the rainy season and consume it throughout the year one by one and uprooting the plants once harvested and the area remains barren for rest of the year until all other crops are uprooted. They don't plant new crop until the whole patch which was shown in rainy season is consumed and uprooted.

They applied boundaries to protect the crop from cattle, small individual boundaries around small saplings to protect them and their flowers from being destroyed by birds. Other than this, the community is also using nets to cover it from hens which fly off the boundary. Also, everyone is using compost except Gramdevati village where a little bit of fertilizer is also being used to maintain the quality and quantity of the produce.

Impact

The implementation has improved their health condition as backyard gardens are using greywater which was earlier gets collected at one place and this stagnant water used to serve as breeding ground for mosquitos causing malaria and other water borne diseases. Also, as reported chances of skin diseases in the implementation area has also been reduced.

Most of the people are using the produce for their own consumption while few are selling it to a middleman from the nearby villages who are small vendors who sells the produce at Daspalla market as the quantity is very less which could range from few grams to 1-2 kgs. The villagers don't know the exact MSP of the produce, so they sell it to whoever is willing to buy it for a higher price among the vendors. Hence, it has become a source of extra income by allowing people not to buy vegetables and fruits from market for some period of time and also earning some extra by selling the surplus.



Water from the source through a piped outlet



Two or more pipes connected to irrigate accordingly



Planting in cluster



Boundaries applied to individual sapling to protect from hen



Gajapati (Hilly region)



Villages visited

- Belapadar
- Kinnoda
- Landu Shai
- Tumbo

Villages in Gajapati has about 15-80 villages having different caste system and more of a patriarchal region. These villages have 4-5 members in most of the household producing about 50L of wastewater to irrigate the backyard garden. In Gajapati backyard gardens are a mix of household and community gardens where the greywater from the individual household irrigates the community garden which is owned by one person and only the owner gets benefitted with produced crop and it has been done through mutual understanding of the community. Villagers use to go to the forest in the morning for mahuli and cashew nut collection and comeback in evening and whoever among the family members has time spends 1-2 hour for the maintenance of garden like watering it, uprooting the weed, putting boundaries, etc. The villages avail government facilities like community water supply, electricity connections, Indira Awas Yojana for constructing pukka house, better connectivity with the outside world through better road connectivity.

Gram Vikas intervention

With a vision to provide the community with better nutrition and improved health, Gram Vikas' team take help from VDC members for community mobilization by conducting few meetings and motivated villagers to started their own backyard gardens. Initially, only one or two started with and after some positive results after 2-3 months people started accepting more of this practice and made their backyard gardens near their washing areas and toilets. Although the

project came out well steadily but while planning lots of concerns were raised like water availability as during summers villages face water scarcity, flow of water, size of land as in most of the houses very few meters of land is available and whether greywater can be disposed there was also concern due to presence of slope.

Backyard Garden status

Due to water scarcity, less land holding and multi directional flow of water in hilly slopes only 6-7 houses have backyard garden of size 1-5 sq. meter which are not necessarily present behind the house, it could be present in the periphery of the village where the greywater reaches through a small drainage system where, water is being collected from the connected houses and irrigates the garden and only the land owner is getting benefitted from the produce.

Here, due to water scarcity, villagers need to go to spring for bathing other than rainy season, so greywater generated is insufficient for the irrigation and they need to use portable water also. In some of the houses, the utensil washing area is not located appropriately so greywater generated is not able to reach garden even through pipes. Therefore, they wash their utensils in a tub and the greywater generated is used to irrigate potted plants and hence this is providing better use of space.

They use it for planting their preferred vegetables and fruits like chilies, banana, pineapple, brinjal, onion, radish, drumstick, papaya in the month of November and consume it throughout the year one by one and uprooting the plants once harvested and the area remains barren for rest of the year until all other crops are uprooted. They don't plant new crops until the whole patch which was shown in November is consumed and uprooted. And during rainy season, they plant food crops like maize.

After consumption, the surplus is sold within the community at market price and given some extra pieces by choice. This is profitable for both seller and buyer as it saves up the cost of transportation fuel for both and creates better bonding as the consumer is getting a few extra grams.

To protect the crop from cattle, they have applied bamboo boundaries but no such measures for protection from birds, especially hen which destroys some of the seedlings. For better production they use compost of excreta of the cattle.

Impact

It has become a source of extra income by allowing people not to buy vegetables and fruits from market for some period and also earning some extra by selling the surplus to the neighbors at market price saving the transport cost for both seller and the buyer. It also has reduced malaria due to prevention of stagnant water.



Unstructured use of space, just planting banana crop



Unstructured irrigation through community tap to community backyard garden



Efficient use of space by planting in pots and irrigating through collected water.

Tumbo, a Tale of Community Selfless Bonding: Case Study



Tumbo is a village of 80 houses in Gajapati District 2 km away from Gram Vikas Koinpur office, where villagers enjoy government services like roads, electricity connection, water supply, MGNREGA. The village has 2 community backyard gardens that have been set up with the help of Gram Vikas considering the flow of water as the village is situated on a hill, where only the landowner of the garden benefits. The garden is

connected with washing area of the households through a concrete drain carrying greywater to irrigate these gardens. However, due to water scarcity in the area not enough greywater is being produced so the beneficiary needs to use portable water also to sustain the garden where they grow vegetables and fruits like chilies, banana, pineapple, brinjal, onion, radish, drumstick, papaya, pumpkin, bitter gourd, tomato. They grow these in rainy season due to water scarcity during summer season which they have reported is due to a big stone present in between the stream which is minimizing the flow of water and very little water is able to reach the water tank in the village. For better production they use compost of excreta of the cattle. To protect the crop from cattle, they have applied bamboo boundaries but no such measures for protection from birds, especially hen which destroys some of the seedlings. However, during summers the grazing grounds have less or no grass to graze by cattle so the area has been declared as free grazing zone so even after boundaries have been applied, some bulls jump over the 2-meter fencing and destroys the crop hence it becomes another reason other than water scarcity to not being able to grow anything in summers.

After consumption, the surplus is being sold first to the community at a price lower than the market, then rest is sold in market, where the profit could be from 10 Rs. to double which is received from the community according to the market price of that area.

According to the villagers, the implication of reusing greywater which was earlier going waste running down sewer has been put to better use with the help of Gram Vikas by using it to irrigate backyard garden which helped the community getting excess to fresh as well as nutritious vegetables and fruits and also saving few bucks on no need to purchase some vegetables from market for few months.

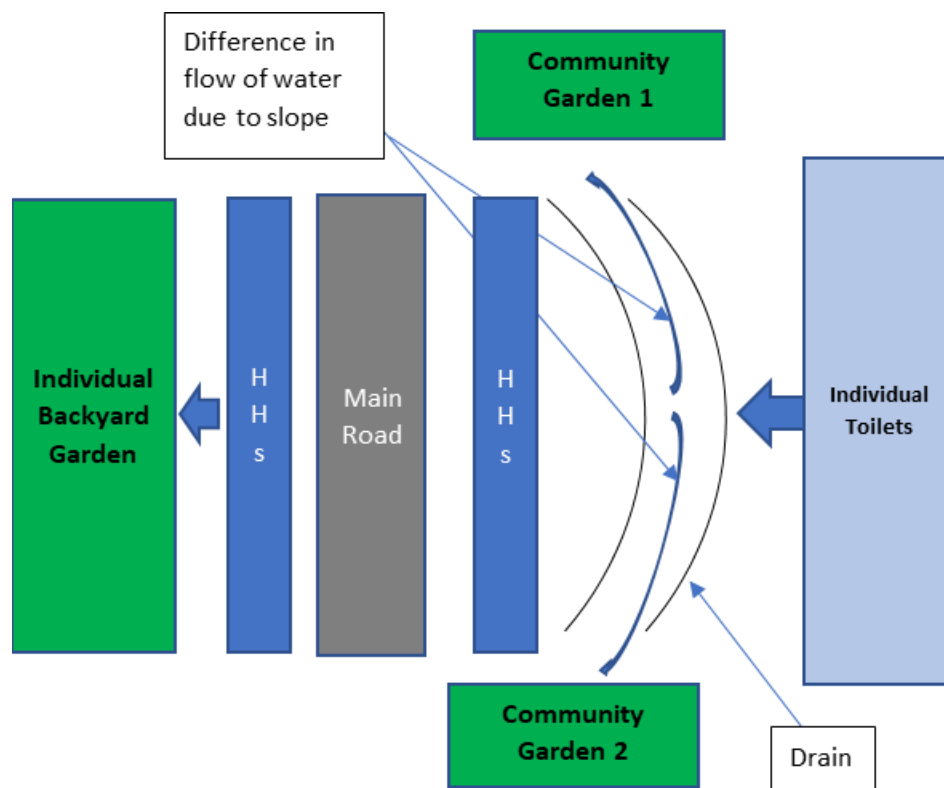


Figure 5.3.1 Village Layout of Tumbo

Analysis

Difference

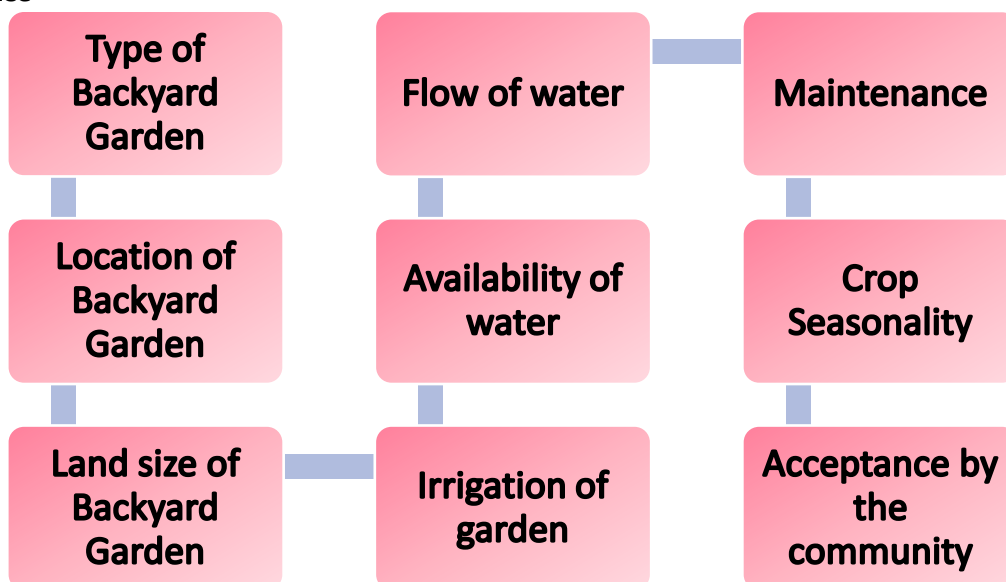


Figure 6.1.1 Differences in findings

- **Type of Garden**

In Ganjam, a backyard garden is present at every household whereas Gajapati has both households as well as some community garden.

- **Location of Backyard Garden**

In Ganjam almost every household has small land at the back of their house designated to kitchen garden only, whereas in Gajapati only 6-7 houses which have household gardens where they can do kitchen gardening using greywater.

Also, some 1-3 community gardens are also present in the villages necessarily be present at the back of the source of greywater but is near to village.

- **Land size of Backyard Garden**

In Ganjam almost every household has small land of 1-3 sq. meter whereas land size of Gajapati household gardens can be 1-5 sq. meter.

- **Flow of water**

Ganjam, being more of a plain region has a directional flow of water whereas in Gajapati due to hilly slope flow of is unidirectional and garden is made considering that. So, they have community kitchen gardens where greywater water comes from two or more houses but only the landowner gets benefitted.

- **Availability of water**

The water supply is irregular in Gajapati, so greywater generated for the kitchen garden is not enough in this region.

- **Irrigation of garden**

Due to water scarcity in the Gajapati region, enough water is not being generated so people have to use portable water also to irrigate the garden while in Ganjam region people use only greywater.

- **Maintenance of Garden**

In Gajapati, only external boundary of bamboo is being applied to protect the kitchen from cattle and no measure to be taken for the protection from hen which fly directly into kitchen garden and destroys the seedlings. Whereas in Ganjam, people use an outer bamboo boundary for protection from cattle as well as for protection from birds, they use nets during flowering and seedling stage or surround individual seedling with small sticks from being eaten by hen.

- **Crop seasonality**

In Gajapati, due to less land holding for agriculture, most people use the land for kitchen garden also for growing cash crop like maize in the rainy season and grow vegetables after it's harvesting in November. While in Ganjam, they use the land only for kitchen garden purpose growing different vegetable and fruits and consume whole year.

- **Interest/ acceptance of the community/ reach**

Communities in Gajapati still do not understand the purpose of kitchen garden, they are using it for growing food crop during rainy season.

Similarities

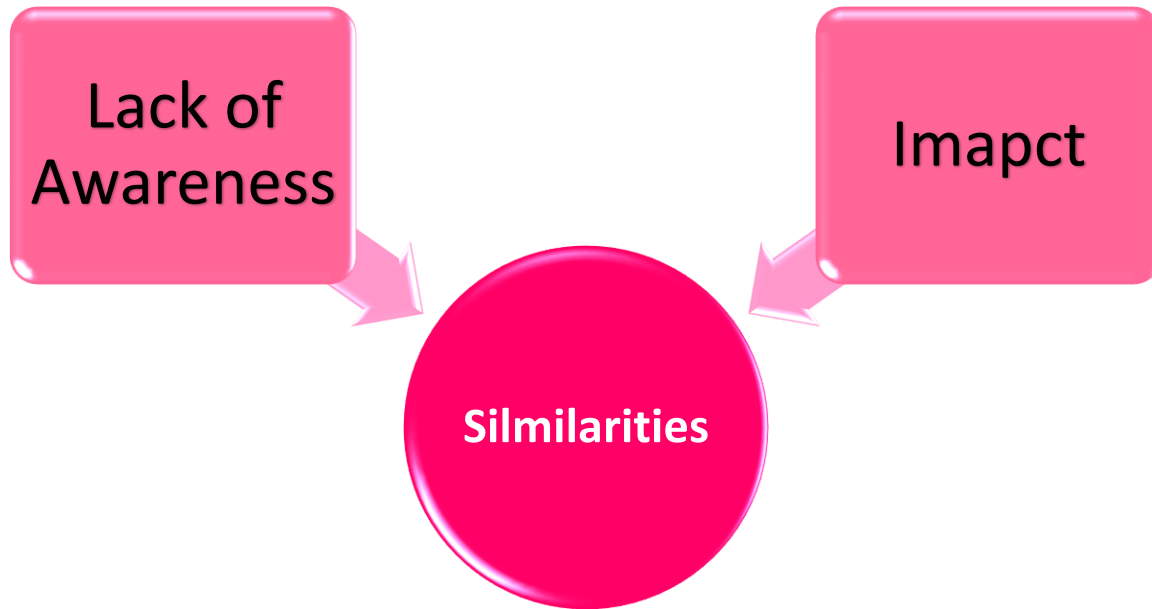


Figure 6.2.1. Similarities in findings

Lack of awareness about

- Use of space as in some of the house's, lot of banana plants were grown and little and no space was left for other crops and shadow of these plants doesn't let survive the small vegetables seedlings due to insufficient exposure to the sun rays.
- Crop seasonality- which crop should be grown in which season.

Impact

<u>Economic</u>	<u>Environmental</u>
– People are <u>saving money</u> by reducing the need to purchase produce from market. Additionally, excess produce is being sold or traded with neighbours, providing a source of income. – It is also allowing villagers to have <u>access to fresh and healthy produce</u> which can help to increase their access to nutritious food and improve their overall health. Hence, reducing the expenditure on health facilities. –	– It is helping to <u>reduce the carbon footprint</u> by reducing the need to transport food to the market as most of the surplus is being sold to the neighbours. – It is also responsible for <u>preventing water stagnation</u> in the area hence, preventing many waterborne diseases.

Table 6.2.1. Impact study of findings

Suggestions

- From the survey conducted it can be suggested to first treat the water before reusing to prevent pathogen ingestion through consumption of raw vegetables which are inadequately irrigated with untreated greywater. The untreated water may have a negative effect on human health, soil, and groundwater quality. Also, excessive discharge of surfactants can clog soil pores and change the hydro-chemical characteristics of soil. Use of saline and sodium-rich greywater for irrigation over a long period can cause complete and irreversible salinisation and deterioration of the topsoil. (Source: Antoine Morel and Stefan Diener in their report “Greywater Management in Low and Middle-Income Countries”)
- Proper channelising or irrigation system will help growing more crops and utilizing the water efficiently. They can arrange crops on the basis of water requirement, having more water consumption crops nearest to the piped outlet followed by lesser ones.
- Villagers can grow useful plants near the handpump as water was getting collected there or soak pits can also be constructed near the handpumps or the community taps.
- SHGs could be updated with the MSP of different vegetables and fruits so that the villagers sell their produce accordingly and reduce the chance of getting to be cheated.
- Sufficient information could be provided about the crop (vegetables and fruits) rotation according to season.

Commendation

- Remark of VDC president of Noragadu about the project “*Aage amar gaa ra lok Greywater ke atki samarthan nei de e thir, lekin abe sab lok etki prabhabit he e gale jeki sab lok aha ku khet re bi byabahar karbar lagi chahuchhanti.*” (earlier the villagers were not much accepting to the idea but now with time they are so impressed that they would like to use this system at a larger scale to the agricultural fields)
- Remark of Gram Devati VDC member “*Amke bahut bhal lagla je ki tame gute etki dur Rajasthan ru amar gaa ke janba lagi asichha, etir lagi amar gaa ke gute chinhat milba.*” (We liked it very much that you come from so far from Rajasthan to learn about our village, it will also give our village also recognition)

Annexure

KII tool

1. What was the objective behind the idea of using grey water at household level?
 2. What is the primary concern after the project came into action?
 3. What were the challenges faced during implementation? And how frequently do the challenges occur?
- *(To know the people perception when the idea was being provided)*

Interview Tool

1. How much grey water is produced daily and from which source?
 2. How do you collect it? If not, why?
- *(To know the strategy about its collection to use it efficiently)*
3. For what purposes is it being used?
 4. Do you use it directly or treated?
 5. How is Gram Vikas helping with grey water management? If someday Gram Vikas moves out from Village, will you be able to sustain the work by yourself?
- *(To know Sustainability of the model)*
6. Do you have access to any government scheme?
 7. How does the greywater reach the backyard garden?
- *(To know the usage pattern and practices used)*
8. DO you use only grey water for the garden, or do you use potable water also?
 9. *(To check the 100% usability of the water)*
 10. How many months do you receive water?
 11. *(To know the water availability in the region)*
 12. Since when you are growing the backyard garden using grey water?
 13. What vegetables do you use to grow in starting?
 14. What type of vegetables are you growing now?
 15. Does this practice allow you to grow your preferred crop?
 16. From where do you bring the seed or seedling?
 17. How do you protect it from cattle and birds?
 18. Do you use compost or fertilizer to maintain fertility? If you use compost, then what kind and how do you prepare it?
 19. What are the challenges that you face in maintaining the backyard garden?
 20. How much time do you spend in the garden and who spends it? (Understanding the gender dimension behind it)
 21. Does this fulfill the purpose of own use, or do you get some income from this?
 22. When the backyard garden was not there how many vegetables or fruit do you use weekly?
 23. And how much do you buy now after its implementation?
 24. Has it added some value to your health?
 25. According to you, what else do you think can add value in the improvement of the process?

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