TOPIC APPROVAL PERFORMA

Lovely School of Architecture and Design

Program : P772-NN1::M.Design (Interior & Furniture)

COURSE CODE : IFD623 **REGULAR/BACKLOG :** Regular **GROUP NUMBER :** ARCRGD0103

Supervisor Name : K.N.N. Singhara Kannappan **UID :** 21158 **Designation :** Assistant Professor

Qualification : _____ **Research Experience :** _____

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PROPOSED TOPIC : Xeriscaping : Solution for sustainability

Qualitative Assessment of Proposed Topic by PAC		
Sr.No.	**Parameter**	**Rating (out of 10)**
1	Project Novelty: Potential of the project to create new knowledge	7.00
2	Project Feasibility: Project can be timely carried out in-house with low-cost and available resources in the University by the students.	8.00
3	Project Academic Inputs: Project topic is relevant and makes extensive use of academic inputs in UG program and serves as a culminating effort for core study area of the degree program.	8.00
4	Project Supervision: Project supervisor's is technically competent to guide students, resolve any issues, and impart necessary skills.	7.33
5	Social Applicability: Project work intends to solve a practical problem.	8.00
6	Future Scope: Project has potential to become basis of future research work, publication or patent.	7.67

PAC Committee Members		
PAC Member 1 Name: Anuradha Kumari	UID: 20420	Recommended (Y/N): Yes
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Final Topic Approved by PAC: **Xeriscaping : Solution for sustainability**

Overall Remarks: Approved

PAC CHAIRPERSON Name: 1114::Atul Kumar Singla **Approval Date:** 27 Nov 2017

Lovely Professional University

Xeriscaping

Solution for sustainability

A Dissertation

Presented to the Faculty of the Lovely School of Architecture & Design

Lovely Professional University

In Partial Fulfilment

Of the Requirements for the Degree of

Masters in Interior and Furniture Design

By

Misha Singla- 11605991

November, 2017

CERTIFICATE

This is to certify that **MISHA SINGLA** bearing Registration Number **11605991** has completed her project titled, "**XERISCAPING : SOLUTION FOR SUSTAINABILITY"** under my guidance and supervision.

To the best of my knowledge, the present work is the result of the original investigation and study. No part of the project has ever been submitted for any other degree at any university.

This paper is fit for submission and the partial fulfilment of the conditions for the award of the degree of Masters of Interior and Furniture Design.

Signature and Name of the Research Supervisor

K.N.N. Singhara Kannappan

Designation: Assistant Professor

School: Lovely School of Architecture & Design

Lovely professional University

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Date:

CANDIDATE'S DECLARATION

This is to certify that the work is entirely my own and not of any other person, unless explicitly acknowledged (including citation and referencing of published and unpublished sources). I, the student of Interior and Furniture of Design under Lovely School of Architecture and Design, Lovely Professional University, Punjab, hereby declare that all the information furnished in this paper is based on my own intensive research and is genuine with credits given for information collected from any other source.

Date: Name and signature of the student

ACKOWLEDGEMENT

First of all, I would like to thank God for keeping me in good health throughout the project development and also I would like to thank my parents who motived me and for giving me strength to be able to complete the dissertation.

I would like to express deep gratitude to my guide, Mr. K.N.N.Singhara Kannappan my mentor, for his guidance, encouragement and gracious support throughout the course of my work for his expertise in this field that motivated me to work in this area and for his faith in me at every stage of this research.

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Abstract

In modern world we are just getting distant from nature because of urbanization and lack of greenery around us. Because increasing of professional alertness, alternative practices such modern edible landscaping and xeriscaping have been taken footing in residence. Everyone loves to be a part of nature so the trend of landscaping in house interior or in garden is functional and maintained but what about public areas? There is no such facilities for maintaining the landscape in public areas especially in metropolitan cities as well as drought prone areas where shortage of water is common issue. So, is there any solution to sustainability?

Xeriscaping is a terminology derived from Greek word "zeros" which means dry landscaping. Xeriscaping needs less water to survive and can be so useful for drought prone areas or metropolitan cities where shortage of water cannot stop it to grow. Maintenance will still require for aesthetics but water efficiency will be great convince. Various other benefits as well as principles for this landscaping. There are many ways in which we can implement the xeriscaping in public areas and also many types which we will find out in this paper.

Key words: landscaping, modern, sustainability, aesthetics.

CHAPTER 1 - INTRODUCTION

Xeriscaping was a word invented back in 1981 by Denver, Colorado, (Rodomsky-Bish, 2015) which was one and only the first urban areas to support xeriscaping. Xeriscaping, or dry-space is a technique of landscaping, eventually developed for drought affected areas, where water conservation and exclusive aesthetics are a main impact to promote its installation. Xeriscaping is all about planning, sustaining, visual appealing of landscaping, gardening and implementing it in our urban life by using less water and also rain water harvesting. Xeriscaping, water preservation through innovative landscaping, proposes a feasible substitute to old-style sites which require high efforts of water and labor. Xeriscaping is not cactus and rock propagation; but, superiority landscaping conjoining attractive, function, and water efficiency. Green vegetable and water industries across the nation have believed Xeriscaping as an optimistic, education instrument to control excess water-use by the private and public sectors. In a period somewhere water may become the controlling feature in economic growth for many provinces of the nation, Xeriscaping may really be the state-of-the-art.

What xeriscaping is not?

- Is not only just rocks and stones.
- Is not just inhabitant plant only.
- Is not certainly lawn –less landscaping.
- Is not dry only.
- Is not an uninteresting monaural- nation of spiny plants.

1.1 RESEARCH QUESTIONS

A. Why Xeriscaping is important?

B. What are the benefits of Xeriscaping over regular landscaping?

C. How Xeriscaping will save the water?

D. Why Xeriscaping is needed in public areas of metropolitan areas?

E. How it will save the resources like economy?

1.2 AIM:

To study about Xeriscaping, its types and implementation of Xeriscaping in public areas.

1.3 OBJECTIVE:

- Study about Xeriscaping in public areas.
- Types of Xeriscaping suitable for Indian climate.
- Many ways in which we can implement the Xeriscaping in public areas.
- Brochure design for Government project implementation and public awareness about Xeriscaping.

1.4 SCOPE AND PARAMETERS

There is no such studies to get information about Xeriscaping as it is a fresh idea to start with. Also, its types and implementation of Xeriscaping in public areas give a different view to the project as it is not common in metropolitan cities of India.

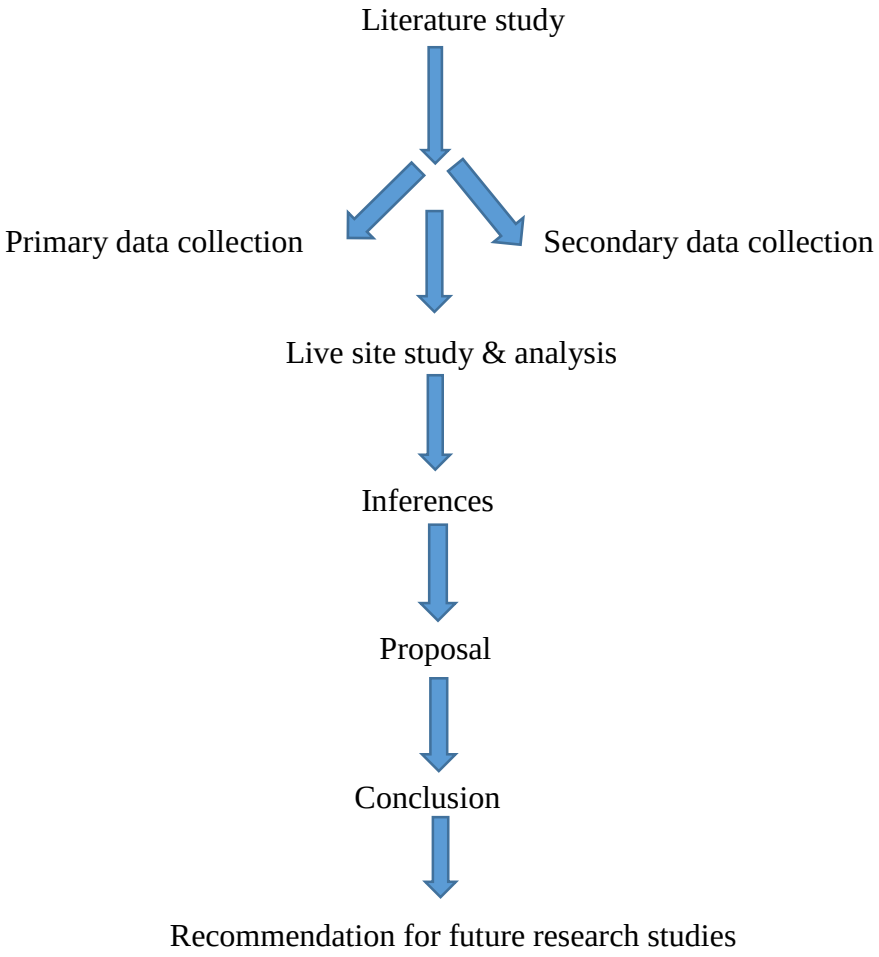
1.5 RATIONALE &JUSTIFICTAION

The purpose for selecting this topic is that Xeriscaping is not common in India so, there is no research regarding this topic. Even if there is some research about low water needed plants but still the usage and detail of topic was unclear.

1.6 LIMITATIONS:

Research paper of Xeriscaping study is done under a limitation with in the metropolitan cities of India.

1.7 METHODOLOGY



CHAPTER 2 - LITERATURE REVIEW

2.1 STUDY

2.1.1 Idea of Xeriscaping

This thesis is illustrating in what way Xeriscape strategies can be reformed to inhabited gardens in Cyprus, a Greek island located in the Eastern Mediterranean Sea. "Xeriscape means water preservation through innovative landscape, which initiates from the Greek term "xeros," significance "dry" from the term "scape" from the name "landscape." The idea of Xeriscaping invented with the Denver Water Division. It stimulates the usage of natural plants, of drought tolerant plants, and additional associated principles, such as the use of coverings, capable irrigation schemes, soil inspection, and conservation. This will give an idea about how we can implement it in our project and public areas too. (UNLV Facilities Management, 2015)

2.1.2 Weather and location effect on Xeriscaping

Strategies should provide for sufficient shade near the dwelling to take benefit of the chilling effect that trees provide. If winter warmth is desired, the trees should be deciduous. Plants that block exposure to breezes may be evergreen. If potential, contour the landscape to provide for the capture of natural precipitation if possible. Most metropolitan situations require homebuilders to effort on the opposite opinion, certifying quick drainage away from the building. If your landscaped area allows for retaining, the deep saturations provided to your plants will be an amazing advantage. (Iannotti, 15)

The location practices mulch and organic matter to hold moisture in the soil. It also clusters plants with similar water necessities. For example, dianthus, silver mound and day lilies are gathered together as they're sun-loving and drought forbearing. However, the site's irises, baby's smell and roses grow better with a little dampness, which is why they're placed near the false creek in the site design. This shows that surroundings are also vital for project. (Assiniboine lights and landscapes, 2016)

2.1.3 Drought Tolerant Xeriscaping

2.1.3.1 Table1: A Partial List of Drought Tolerant Plants (Brown, 2007)

BOTANICAL NAME	**COMMON NAME**	**FEATURES**
Achillea	Yarrow	Garden flower ,hardy , North American native plant, soft, feathery, aromatic foliage, love heat and sun and low maintenance required
Asclepias tuberosa	Butterfly Weed , Indian paintbrush, orange milkweed, pleurisy root	Native plant of U.S, lady beetles and bees attracted towards it, grows well in rocky , dry ,clay soil and stand even in drought condition

Coreopsis	Tickseed	Native American prairie and woodland plants, soil pH, need water regularly when cropped but are quite drought tolerant
Origanum spp. and cultivars	Oregano	Flavor of Mexican, Spanish and Italian dishes, need full sun to grow and partial shade, Climate, soil, and moistness can be reason of flavor cause
Nepeta spp. and hybrids	Catmint, Catnip	Cat are attracted towards it, fuzzy, gray leaves, grown in full sun , floppy and bushy plants
Lavender (*Lavandula*)	Lavender (*Lavandula*)	Romantic flower, native of the Mediterranean, blossom in warm, well-drained soil and full sun, Can be used uncooked in salads and soups

Sedum	Showy Stonecrop, Border Stonecrop	Attract butterflies and pollinators, drought and rainfall tolerant

There are many more drought tolerate plants such as Alyssum , Artemisia, Beebalm, California Poppy, Campanula carpatica (Bellflower), Campis (Trumpet vine), Cosmos, Cranesbill ,Geranium ,Iris, Rudbeckia

2.1.3.2 Table 2: A Partial List of Drought Tolerant grass

BOTANICAL NAME	**COMMON NAME**	**FEATURES**
Calamagrostis xacutiflora	Feather reed grass	Grows in cool season, remain tall and straight, virtually pest free, drought tolerant
Miscanthus	Maiden grass	Grown in china , japan and Korea, gets large quickly, drought tolerant, used in hedges and it is winter landscape

Fescue, Fountain Grass (Pennisetum), Switch Grass (Panicum) are other drought tolerant grasses. There are some of the drought prone shrubs such as Amelanchier (Shadbush), Aronia (Chokeberry), Buddleia (Butterfly Bush), Caryopteris, Cotoneaster, Hypericum (St. Johnswort), Juniper, Potentilla, Cytisus (Scotch Broom).This table description will help to the to grow the plants for public areas.

2.2 PRINCIPLES OF XERISCAPING

There are 7 main principles behind the motivation and proper installation of a true Xeriscaping landscape given by Denver Water Department. (Rodriguez, 2011)

2.2.1 Planning and design

- Planning is one of the most crucial while designing xeriscaping as it will affect the whole concept. Choosing an area can be little difficult but it will justify the whole xeriscaping concept.
- With respect to the building structure, driveway and actual vegetation planning we have to perceive the positioning of the sun.

Considerations:

- High and low maintenance landscape.
- Typology of plants needed with surplus hardscape materials such as deck, courtyard and pathways.
- Classify problems as well as issues and abilities.
- Also integrate shade and suitable plant assortment as shown in figure 1.

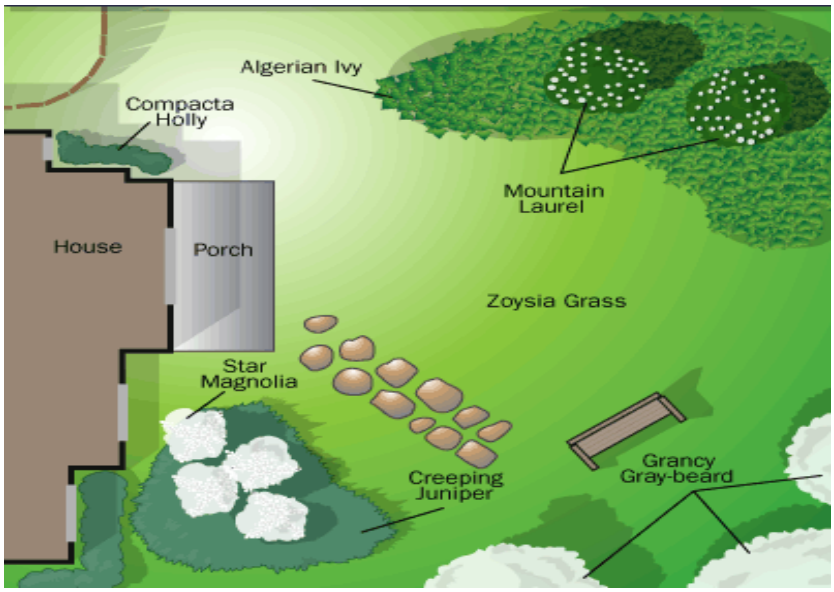


Figure 1: Planning of house lawn with xeriscaping

[Source-Howstuffworks 2008]

2.2.2 Soil development

Mark sure to use good class of soil when doing several planting. The main objective is to increase fertility, progress water preservation and create deep roots. If implanted in dense clay, it's potential that digging may be stunted and the soil may not be able to absorb adequate water to support the plants. The important feature is integrating substantial quantities of organic material which will progress water penetration and retaining in whichever nature of soil as shown in figure 2 and 3.

Figure 2: Soil analysis in fields

[Source-Plant solution]

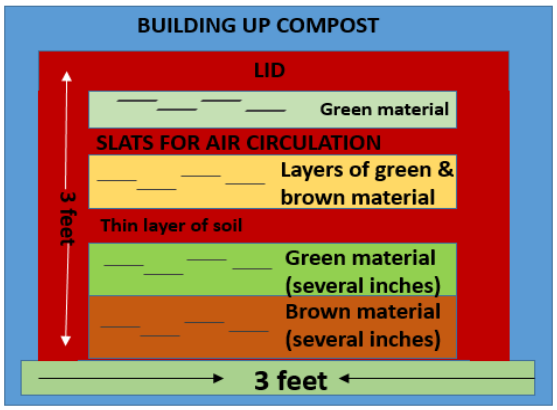


Figure3: Compost making

[Source- (Rodriguez, 2011)]

2.2.3 Limited turf areas

Ensure method is suitably sustained and working correctly. Select the best technique and frequency of irrigation based on the plant material in each area of your design. Reduce the extent of turf areas as much as possible, while retaining some lawn for open space, functionality and visual appeal.

a. It controls top soil erosion and engrosses heat conserving the atmosphere around it.

b. While designing the turf areas consider:

- In waiting four-sided area big enough for practical use but with lesser boundary to preserve water.
- Use drought forbearing shelters or coverings as an alternative of turf on slants which are tougher to move.

Figure 4: Turf for home lawns

[Source-Indian gardens 2015]

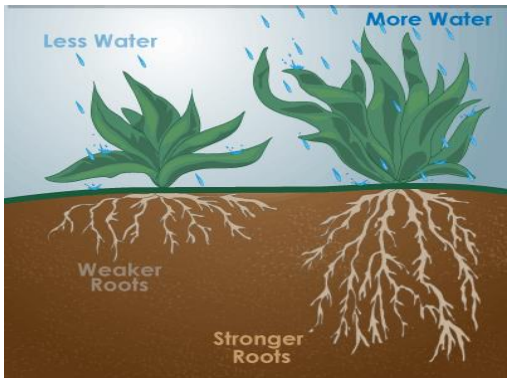


Figure 5: Showing the weakness of roots without water

[Source- Howstuffworks 2008]

2.2.4 Suitable plants and zone selection

- Planning zones that are settled by plants with similar water requirements will approve you to maintain areas that need more water while reducing irrigation to small water areas.
- There are three elementary varieties of soil -- sand, silt and clay.

Utmost soil is a mixture of the three, but silt working the finest for a Xeriscaped lawn. Sand permits too ample drainage to slip through, while clay holds moistness for too long.

Consideration steps for choosing plants:

i. Color – supplement color to the landscape with blossoming shrubs, flowers, trees and perennials.

ii. Matured extent and form – study the plant scale as it raises and control overgrow sizes plant that contend with additional plants for nutrients and moistness.

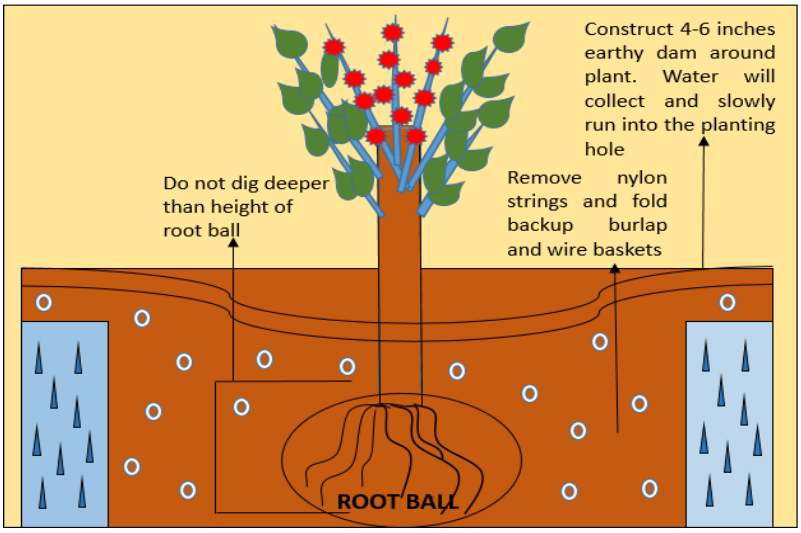


Figure 6: Dig pitting details

[Source- (Rodriguez, 2011)]

2.2.5 Mulch

Utilizing covering in every planted area, with a low or high water requirement, should be a common practice. Mulch shadows the soil, reducing water loss from disappearance and the growth of weeds. Bark, wood chips and other organic mulches decay over time, paying their nutrients to the soil, something rock and gravels never do. There are many types of mulches which has their own advantages and disadvantages as shown in figure 7.

Types of mulches and how they are used:		
TYPE	ADVANTAGE	DISADVANTAGE
Pine straw.	Excellent for water conservation.	Flammable when dry Decomposes quickly.
Pine bark.	Conserves moisture well. Use the mini nuggets.	None.
Leaves.	Readily available. Hold moisture well.	Not as neat in appearance as bark.
Grass clippings.	None.	Use for compost.
Gravel.	Long lasting.	Absorbs too much heat; can damage plants.
Newspaper.	Layer two sheets under organic mulch. Helps conserve moisture.	Acts as a moisture barrier if placed too thick.
Fabric.	Keeps moisture nutrients in, weeds out.	Hard to install.
Plastic.	None.	Blocks oxygen, water and nutrients.

Figure 7: Type and use of mulches

[Source- (Rodriguez, 2011)]

Figure 8: Mulching of crop

[Source- Gardeningknowhow]

2.2.6 Efficient Irrigation

- Xeric planting requisite good irrigation in leading few ages to root arrangement of plant. Replacing lawn with a low water garden is a great step to gain conservation. But when turf is vital in an area, consider using a low water, low care species of turf.
- Drip irrigation and sprinklers method is the finest technique for watering sprinklers are best for lawns and gardens and drip irrigation is good for wetting vegetation as shown in 9 and 10.

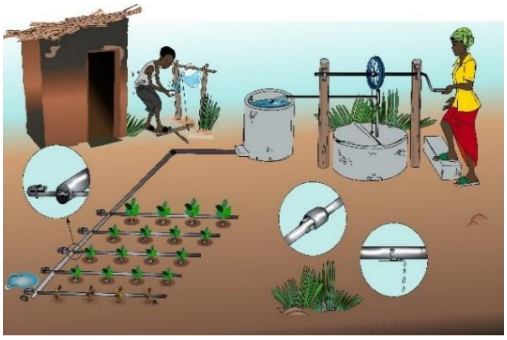


Figure 9: Drip irrigation layout

[Source-Agrifarming]

Figure10: Sprinkler system

[Source-Modern Farmer]

2.2.7 Maintenance

Landscapes of any kind need maintenance and xeriscapes are no exception. An added advantage of low water areas is that numerous common weed species will struggle in the dry circumstances, while drought tolerant plants thrive. (Rodriguez, 2011)

Each of these principles helps to create a low impact, environmentally friendly landscape.

2.3 BENEFITS OF XERISCAPING

- **Saves water:** Landscape with permanence and durability that consumes a lesser amount of time to maintain than traditional landscapes such as lawns and greens.
- **No fertilizers and pesticides:** More use of the organic nutrient soil welcoming solutions there is no usage of fertilizers and biochemical interference to stay healthy.
- It can be functional to any landscape design formally or informally though it take 2 or 3 years to begin.
- **Needs less maintenance:** Outdoor of a little clearing and trimming, needs minimal effort and need simple irrigation system.

- Xeriscaping recovers property price. The budget of the technique is too overshadowed by the increasing the property rate. (Smith, 1995)

- **Pollution free**: toxic free and the usage of fossil fuels to control grass mowers is reduced.

- Xeriscape can be grown in any landscape style and climatic condition (REDDY, 2012)

2.4 DESIGN STRATEGIES OF XERISCAPING

Planning a resource-efficient landscape which involves the integration of a few design strategic features:

Zoning – assembling vegetation in the landscape according to their water necessities. For example, water-loving plant life must be clustered separately from drought-tolerant plants. This permits that the appropriate extent of water to be circulated to the plants as they want it.

Usage of drought-tolerant vegetation – plants with entail minimum amount of water and are altered to drought conditions and loams with small water-holding abilities.

Drought-tolerant lawn - Bahia grass, Bermuda grass and zoysiagrass all have outstanding drought acceptance. Agree the grass to go resting during dry eras. As soon as the rain shower derives, these grasslands will go green over again.

Mulch - since mulch lessens evaporation, it is used widely in xeriscaping to substitute spaces that need extensive dampening. Covering can also be used to make pathways or walkways all over the landscape (Hostetler, 2014).

2.4.1 ADVANTAGES OF XERISCAPING

- Lesser water charges.
- More availability of water can be used for other purposes such as washing, showering and other household purposes.
- Less time taking and require inferior maintenance making our daily routine stressed free.
- Slight or no grass mowing (protects gas).
- Xeriscaping vegetation laterally appropriate with bed design tends to complete benefit of rainwater by rain water harvesting purpose also.
- After water constraint are applied on xeriscaping plants with apt to stay alive further but the traditional vegetation cannot. (Slagell, 2017)

2.4.2 DISADVANTAGES OF XERISCAPING

- Extra start-up effort is necessary for implanting then basically arranging lawn and planting most old-style planting.
- Considerable the plants used is coarse, with shrill spines and ends.
- Problematical irrigation technique is mandatory and is not suitably succeeded.
- Wildflowers and debris may be a higher delinquent as several landowners connotations may object to non-traditional foliage. (AndrewT, 2014)

2.5 XERISCAPING GARDENS STYLES

a) DESERT /SOUTHWEST STYLE

b) MEDITERRANEAN/TUSCAN STYLE

c) JAPANESE STYLE (Landscaping network, 2010)

2.5.1 Desert /southwest style:

This landscape design signifies the dry arid regions of the west. The southwest style is well-known for its Native American and Spanish details that contribute to the whole modest, efficient and low conservation landscape. This style contains native plants, and integrates bright, vibrant and colorful building materials.

Elements for desert style gardening:

- Native American décor
- Terra-cotta tiles
- Fountains
- Natural stones
- Wood
- Pebbles
- Decomposed granite
- Red clay pavers
- Plaster walls

Patio - A sheltered space is an essential mainly in areas with extreme high temperature in the summertime. Maximum courtyards offer a big shaded performing area an extension in house that is living space.

Terracing - is suggested in spaces where topography is inclined. Construction constituents like stone, rocks, or railroad ties can be used to contribute to southwestern project.

Colorful plantings - native and woody are perfect for southwest houseplant palette. Flowering bushes that fascinate flora and fauna perfectly with the desert painted hardscape substantial.

2.5.2 Mediterranean/Tuscan style

The lawns and gardens during Tuscany and the Mediterranean region have remained familiar from eras for their exciting design. Since the Medici gardens to minor villas within the rolling Tuscan hills, the landscapes express the story of their preceding. Tuscan landscaping are famous for their casual class. Stimulated by the coastal areas of Spain, Italy and France, this style of garden combines calm resources and plants using prescribed accents and designs. Terra cotta pots, tiered fountains, sculptures, Roman columns and bocce ball courts are all trademarks of Mediterranean gardens.

Elements for Tuscan style gardening

- Terra-cotta pots
- Gravels
- Pots
- Water feature (fountains)
- Potted plants

- Boxed hedgerows
- Mediterranean plant pallet
- Stonework including walls and pathways

Tuscan style landscape is prepared of plants that offer texture feeling, shade of color and structure like lavender, cypress plants and decorative meadows. (Landscaping network, 2010)

2.5.3 Japanese style:

Zen garden is a style of Japanese garden. Traditional Japanese gardens are considered for peaceful meditation. The main emphasis of a Japanese garden symbolize natural elements and mimic.

Elements for Japanese style gardening

- Artificial Rocks and stones
- Plants
- Ornamentations
- Use of geometry spaces and shows balance
- Lanterns lamps (Landscaping network, 2010)

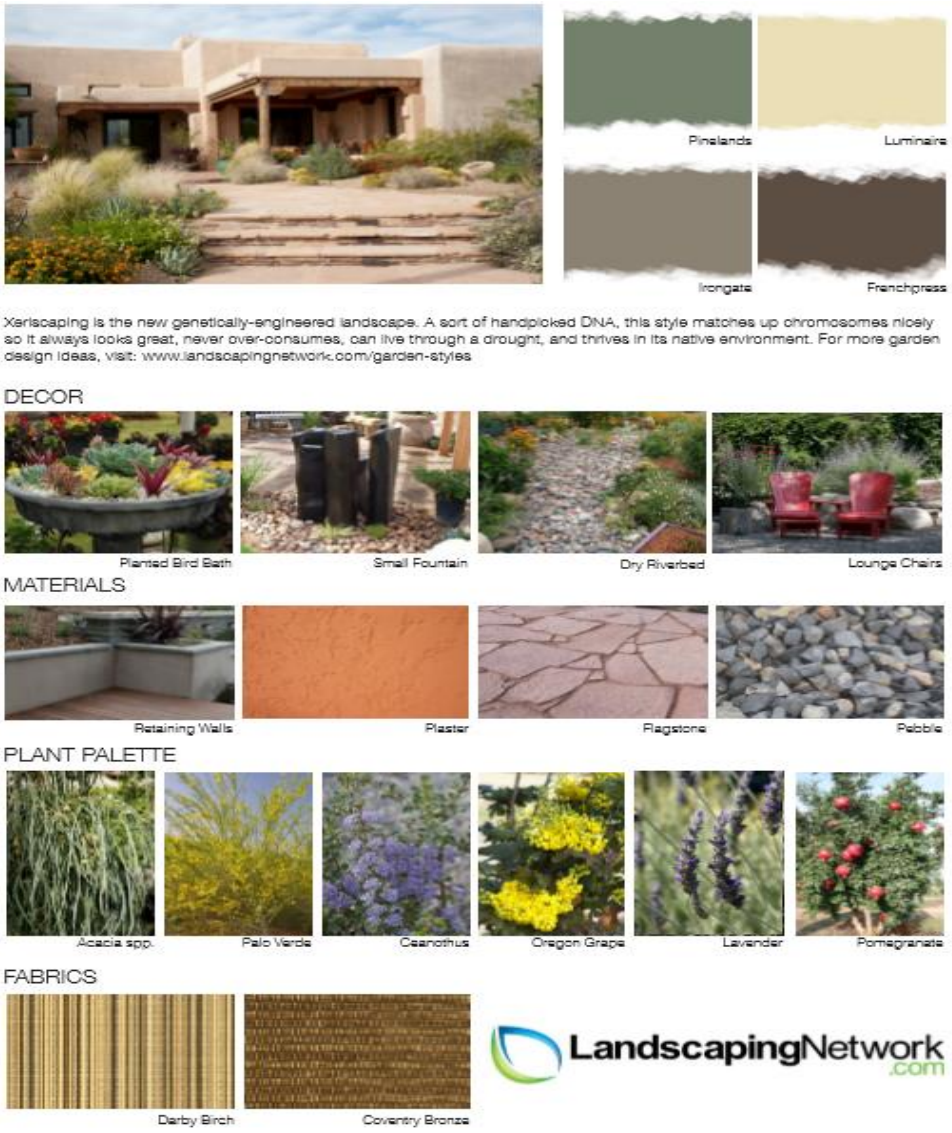


Figure 11: Different design elements used for xeriscaping landscape

[Source- (Landscaping network, 2010)]

2.6 TYPES OF SOIL IN INDIA

a) Black soil

b) Red soil

c) Alluvial soil

d) Desert soil

2.6.1 Black soil

Cotton plant grows well in black soil which also named as regur soil. There are many other crops which grow well in this soil such as maize, ragi, tobacco, oilseed and jowar. Its color is dark gray with slightly changes to black color also. It is rich in calcium, potassium and magnesium but lacking in nitrogen. Black soil has brilliant capacity to retain moisture content and holding capacity.

2.6.2 Red soil

Red soil originates in states of Tamil Nadu, southern parts of Karnataka and also in some parts of Madhya Pradesh, West Bengal, Rajasthan and Maharashtra. It is reddish in color because of high amount of iron content in present in soil. It is sandy in nature and is formed through crystalline rocks but lacking in nitrogen, lime and phosphorus. There are many crops which grows well in red soil crops such as wheat, tobacco, millets, groundnut, potato and sugarcane.

2.6.3 Alluvial soil

It is brown in color and fertile in nature. It is located in northern parts of India. Potassium and nitrogen has poor content but is rich potash content. There are wide variety of crops which can survive in this type of soil are wheat, rice, cotton, sugarcane and jute.

2.6.4 Desert Soil

Desert soil is located in Rajasthan and parts of Haryana, Punjab and Gujarat. It is rich in rich and reddish in color. Desert soil has 90 percent clay content in it. It has zero moisture content and also deficient in nitrogen and phosphorus but rich in nitrates and phosphates content. It has more salt content in nature. Indian planters cultivate highly resistant crops like barley and millets in this soil. (**Invalid source specified.**)

CHAPTER 3 - SUSTAINABILITY

Saving the resource for future by limiting the usage in present is called sustainability. In other words, using the resources in such a way that it does not damages the environment and holding it for future generations.

3.1 PRINCIPLE OF SUSTAINABILITY

Conserving water and energy for future use is the main goal of sustainable landscape design. This will be only possible if we reduce the waste and runoff. Reuse is also a crucial considerations as we are not using this water for drinking purpose. (Landscaping network, 2010)

There are 3 major principle to take care while designing:

3.1.1 Water is a resource

We cannot live without water. Other than drinking, we need water for many purposes so, the demand of water was, is and will always be high. There is so much water wastage in traditional landscaping which needs lot of water to survive. Other than landscape need rain water runoff is also a pure wastage of clean.

A sustainable xeriscaping will be a solution of this water resource wastage. Usage of low water requiring plants will reduce the wastage of water. Additionally, that water can be collected by rainwater harvesting technique which will reduce the water demand in landscaping. (Ben-Eli, 2005)

3.1.2 Treatment of soil

Non bounded soil or soft layer of soil can cause many problems such as soil erosion, water runoff, lack of fertility layer etc. this can treated by growing grass which will hold the water and doesn't lack the water runoff freely. This will also hold the fertile layer of soil so, there will better growth in plants.

3.1.3 Use of native plants

New soil or new type of plants which cannot grow in healthy way as it was made to grown in other climatic zone. If we don't have any other option only then we can grow nonnative plants. But everywhere else we should use native plants.

3.2 LANDSCAPE DESIGN AND SUSTAINABILITY

There are four considerations in designing a sustainable landscape. The landscape must:

a) Aesthetically pleasing
b) Practicality
c) Pocket friendly
d) Maintenance

a) Aesthetically pleasing

Landscape should be aesthetically appealing as public area will be an open display for everyone. Visually pleasing will always give a fresh look and view to all the people pass from this area. The plants which grow all year will be a good

idea as these plants will not look bad even in autumn time and give a pleasing look all year long.

b) Practicality

Landscape needs to be functional. It should be done on those areas where it will be used somehow and should not be just for aesthetic values. Polluted cities are good example of functionality as it will save the people of cities from pollution and there will an extent amount of oxygen available.

c) Pocket friendly

Landscaping should be pocket friendly as it is a large scale implementation, there should not be much need of additional resources such as manure expenses or high water requirement which ultimately adds in water bills.

d) Maintenance

Maintenance is one of the most crucial consideration which will led to long term problems and expenses if we won't take care of it. Everything needs maintenance but the point is how much. Some plants needs more cutting, trimming, watering and manuring while others doesn't require any of it so much. We should use low maintenance plants as public area will not have so much caring workers. (Assiniboine lights and landscapes, 2016)

3.3 METROPOLITAN CITIES

Metropolitan cities is derived from two Greek words “mother” and “city”. Generally these cities consists dense population in its core and surroundings are less populated usually carries industry, factories and worker housings. These cities have multiply municipalities, all the luxury of hotels, restaurants, cinemas, parks plus all the basic needs like schools, collages, residential areas, corporate areas and hospitals. These cities became the keystones of country’s economics. It usually includes more than one urban areas in it. (Cpcb, 2014)

CITIES	AREA (sq.km)	POPULATION IN THOUSAND
Greater Mumbai	437.71	16,368,084
Kolkata	187	13,216,546
Delhi	862.18	12,791,458
Chennai*	170	6,424,624
Bangalore	125.9	5,686,844
Hyderabad	172.68	5,533,640
Ahemadabad	190.94	4,519,278
Pune	198.00	3,755,525
Surat	111.16	2,811,466
Kanpur	NA	2,690,486
Jaipur	200.4	2,324,319
Lucknow*	310.1	2,266,933
Nagpur	217.17	2,122,965
Patna	99.45	1,707,429
Indore	130.17	1,639,044
Vadodara	108.26	1,492,398
Bhopal	284.9	1,454,830
Coimbatore*	314.84	1,446,034
Ludhiana*	134.67	1,395,053
Kochi	39.58	1,355,406
Vishakhapatnam	78.33	1,329,472
Agra*	NA	1,321,410
Varanasi	83.6	1,211,749
Madurai*	115.48	1,194,665
Meerut*	NA	1,167,399
Nashik	NA	1,152,048
Jabalpur	NA	1,117,200
Jamshedpur	NA	1,101,804
Asansol	NA	1,090,171
Dhanbad	NA	1,064,357
Faridabad	NA	1,054,981
Allahabad	NA	1,049,579
Amritsar	NA	1,011,327
Vijayawada*	NA	1,011,152
Rajkot	NA	1,002,160

Figure 12: Metropolitan cities of India

[Source – CPCB]

3.3.1 Most polluted cities in India

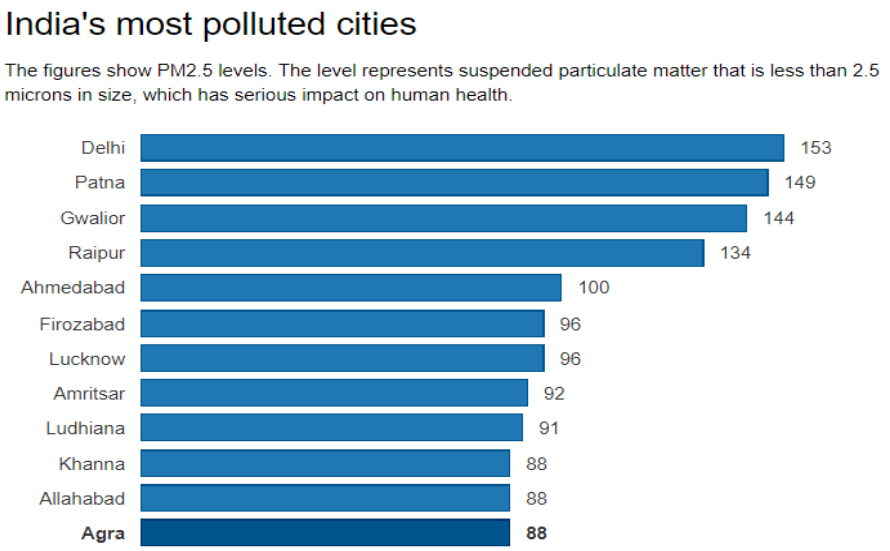


Figure 13: Polluted cities in India

[Source – Statics]

3.4 PUBLIC AREAS

An open place where each person has accessibility to move around is known as public space also social spaces. Roads, pathways, parks and temples are various examples of public space. These areas doesn't have any restriction to for roaming and sitting of public. These areas are the public property so it always remains in rush. These areas used for retails, cinemas, plazas and shopping malls.

Public pathways are most used area for landscaping. These pathways are used to connect the areas together so, landscaping is always a good idea for public pathways. Pathways will either paved ones or landscaped ones. Paved pathways will also use landscaping along with it. So, landscaping will be used in both cases.

CHAPTER 4 - QUESTIONNAIRE & ANALYSIS

4.1 QUESTIONNAIRE SURVEY

Figure 14: Xeriscaping landscaping – Before and after

[Source - CNN]

Xeriscaping is growing low water needed plants to save water, there are many elements of xeriscaping like drought prone vegetation, paved pathways, fountains, sculptures etc.

1. Are you aware of xeriscaping?

   ☐ Yes ☐ No

2. Do we really need less water consuming plants in metropolitan cities?

   ☐ Yes ☐ No

3. What changes will xeriscapes do in present scenario?

   ☐ Sustainable environment

   ☐ Water saving

   ☐ Pollution free cities

   ☐ Aesthetically appealing

   ☐ All of above

4. Which less water consuming plants plant do you prefer? Mention its name.

   ……..

5. How do less water consuming plants look in public area?

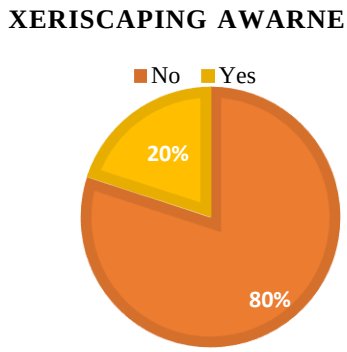
   ☐ Good ☐ Bad

6. Will it helps the environment to control the pollution?

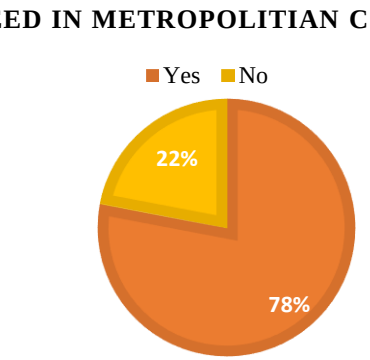
   ☐ Yes ☐ No

4.2 ANALYSIS OF QUESTIONNAIRE SURVEY

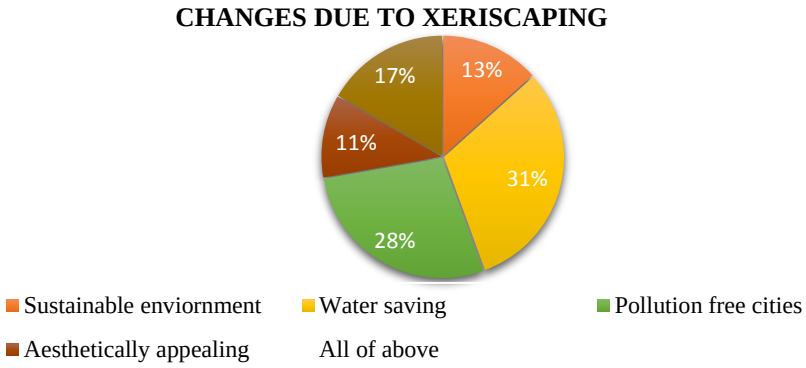
1. Are you aware of xeriscaping?



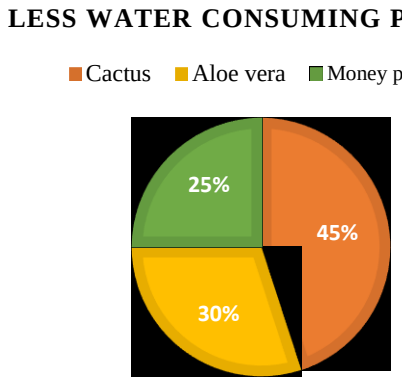
2. Do we really need less water consuming plants in metropolitan cities?



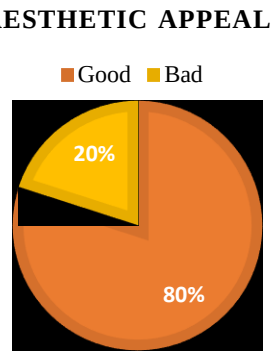
3. What changes will xeriscapes do in present scenario?



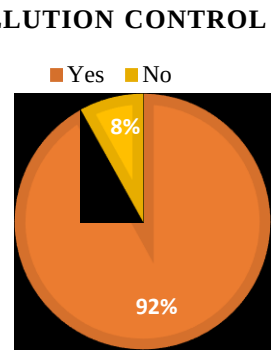
4. Which less water consuming plants plant do you prefer? Mention its name.



5. How do less water consuming plants look in public area?



6. Will it helps the environment to control the pollution?



CHAPTER 5 - CASE STUDY

5.1 INTERNET / ONLINE CASE STUDY

To conclude xeriscaping is related through lesser water depletion, two case studies have recently been concluded. The other three studies demonstrate on average 20 to 40 percentage decrease in water consumption in xeriscapes housing sites and three study concludes about NGO of Delhi – Noida makes oxygen bombs which fight against air pollution.

The Mesa study, the East Bay MUD study, and the City of Austin has a case study on xeriscaping used collection associations to develop fundamental interpretations.

In Arizona and California used xeriscaping in common but have difference in climate with decrease turf spaces and enormous drought tolerant grassland are used.

5.1.1 Mesa, Arizona

- Xeriscaping in Mesa is the usage of desert plant resources.
- It connected with a 33 percent decrease in water consumption.
- The study inspected 138 different landscapes (75 Discount group and 63 control group).
- 5 percent per year increase in low water usage landscaping mounted in new residences.

5.1.2 East bay municipal utility district, California

- Xeriscaping was associated with an average reduction of 43 percent in water usage.

- A huge example of 1,040 housing sites was used (520 xeriscapes and 520 traditional landscapes). Coordinated xeriscape and contrasting groups were selected from neighboring residences providing certain control for "nuisance" variant in water consumption due to alterations in geographic and demographic features.
- Irrigation classifications were related with a 36 percent growth in water consumption. It is relatively possible that the suspected xeriscape determined savings in water consumption was affected by a connection amongst traditional landscaping and the occurrence of irrigation systems. (Wandiga, 2007 -2017)

5.1.3 Noida and Delhi, India

Air contamination in cities like Delhi and Noida lasts to produce a hazard not only to the atmosphere but also to the health of million citizens, there is a crucial necessity to put forward each exertion to confirm the air is more breathable and harmless.

- As Delhi comes in the hit list of world's most pollutes city in India, the NGO and organization acquired it into their hands to comfort the occupant's breather cleaner airborne and alive healthier (Subramanian, 2017)
- The Citizens Environment Improvement Society (CEIS) in Noida, has been growing various plants ever since 2016 to dual up the air more filter and purifier.

- So the organization has distributed “oxygen bombs” around the whole city with nominal cost and fresh air .The plants they cultivated are aloe vera, musli, sansevieria giant, sansevieria dwarf, syngonium and lemongrass.

5.2 LIVE CASE STUDY

Figure 15: Entrance of Japanese garden

Figure 16: Main starting of garden

Figure 17 : Engraved information marble

Figure 18 : Sculpture forms inside garden

Figure 19: Paved area of garden

Figure 20: Information board about garden

Figure 21: Buddha sculpture with plantation

Figure 22: Buddha idol on corner

Figure 23: Pagoda tower

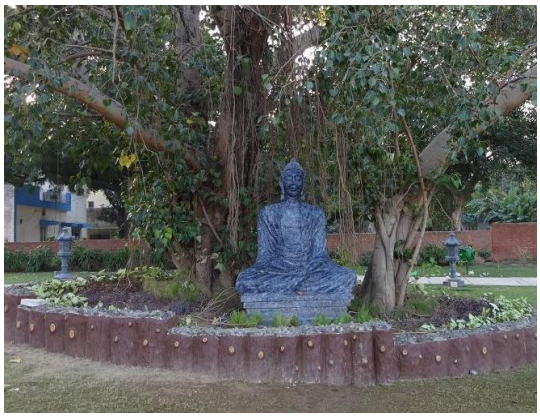


Figure 24: Meditation shelter

5.3 ANALYSIS ON CASE STUDY

Japanese Garden in Chandigarh is relevant and useful for this research paper as it covers lot of information about xeriscaping and its live implementation. So, study of Japanese garden in Chandigarh is done.

Designed and inaugurated in November 2014, it is one more supplementary magnificence beauty to the Chandigarh city. The garden settled over an extent of 13 acres which displays fine art, values, cultures and numerous plantation of Japanese style. The foremost fascination of this garden includes Zen garden with xeriscaping - less water consuming plants, rock stones sitting, paved pathways and sculptures of Buddha, pagoda tower, meditation shelter and lanterns & lamps are all the elements of this garden.

5.3.1 Elements of garden:

- KARESANSUI (Zen garden) – The Japanese rock garden or "dry landscape" garden, frequently called a **zen garden**, generate miniscule artificial landscape through prudently composed arrangements of rocks, water features, moss, bushes trees and greeneries, stones or gravel that is collected to signify waves in water.
- PAGODA TOWER –The unique determination of a Japanese pagoda was the house artefact and scared fictions of Buddhist admired figures. The four-sided shape signifies the world. Every level symbolize one the five essentials: wind, water, earth, fire and sky.

- MESISO KOYA (Meditation shelter) – It is a mystical space in garden formed for sitting silently to peaceful clam the mind and to attain a stress-free mental state.
- Sculpture – Several sculpture are made of fibers are made as a picture point for the tourist.

CHAPTER 6 - INFERENCES

Water is a valuable resource because we cannot live without it. We need to save this resource which is already limited. Other than water saving, there are many places which are being misused just because there is space so do wrong things. Many areas where people and animals find space it start to become place for garbage throwing. Our metropolitan cities needs to be most clean as they reflect our country's beauty but sadly top 5 metro cities of India also tops in most polluted cities of world. This in not because municipal workers didn't grow the plant but problem is maintenance .Those plants needs lot of water, cutting, trimming, fertilizers and seasonal changes.

Xeriscaping is solution to all these problems as it needs less water, less cutting, less fertilizers too. It grows in all the seasons so doesn't require any changes. Many factors and elements make xeriscaping suitable for these rough areas .There are many types of xeriscaping and many types of implementations too which can be useful for not only in public areas but in any sector. It will make cities much economical, sustainable, cleaner and healthier to live in.

CHAPTER 7 - PROPOSAL

7.1 Need of proposed solution

7.1.1 Problems in present scenario

Figure 25: Article by Sneha Aggarwal about rubbish piles in Delhi

[Source – Mail online India]

Mail. U.K. posted an article on august 20, 2015 about Delhi that there is no cleaning in the capital. There was a long running legal fight between workers and government. Municipal workers had already done striking 5 times in just one year i.e.2015.after

completion of all the quarrel, by paying worker, still there are piles of dirt and garbage still across the capital.

Figure 26: Roadside garbage pile

Figure 27: Roadside unwanted plantation and animals

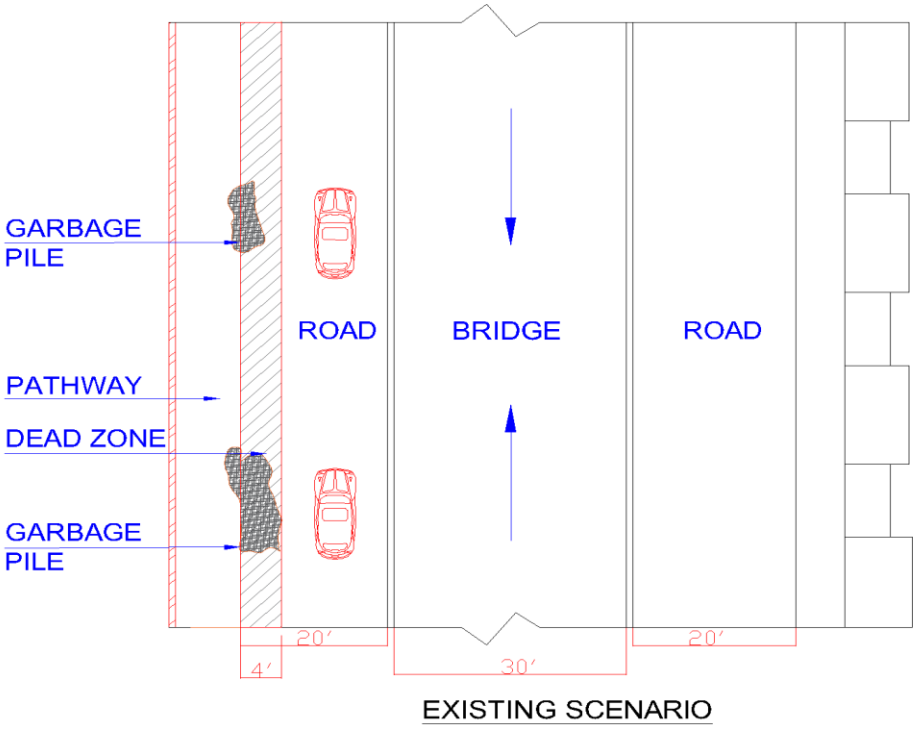


Figure 28: Existing scenario of Delhi roadside (Author)

The basic problem found after studying many areas in Delhi, Ludhiana, Ahmedabad, Agra, Vadodara, is that people has the mentality to through the garbage and waste material where they found space which is non using. In figure we can see a single way road under flyover. Left side of that road we can see lot of garbage and waste which is destroying the beauty of city. In figure we can see a stray cow grazing around the road. If this cow came on road it will give rise to serious accident. Also, there is garbage on that area which will give birth to many problems which are written following:

- Pollution – In world's top 20 most polluted cities 9 places are occupied by Indian cities. These cities are Delhi, Ludhiana, Gwalior, Allahabad, Patna, Raipur, Kanpur, Firozabad and Lucknow. So there is something wrong in India that is why we are facing many problems.
- Foil smell and Dirtiness
- Smog – pollution give birth to many problems and smog is the worst problem among them. Mixture of fog and smoke is called smog it is a thick airy substance which creates an airlock in atmosphere. It blocks the vision and became one of the reasons of chain accidents happed end in November 2017 in various parts of north India.
- Diseases – Waste and garbage is main reason of mosquitoes, flies which give birth to numerous disease such as dengue, malaria, chikungunya.

7.1.2 Proposed solution

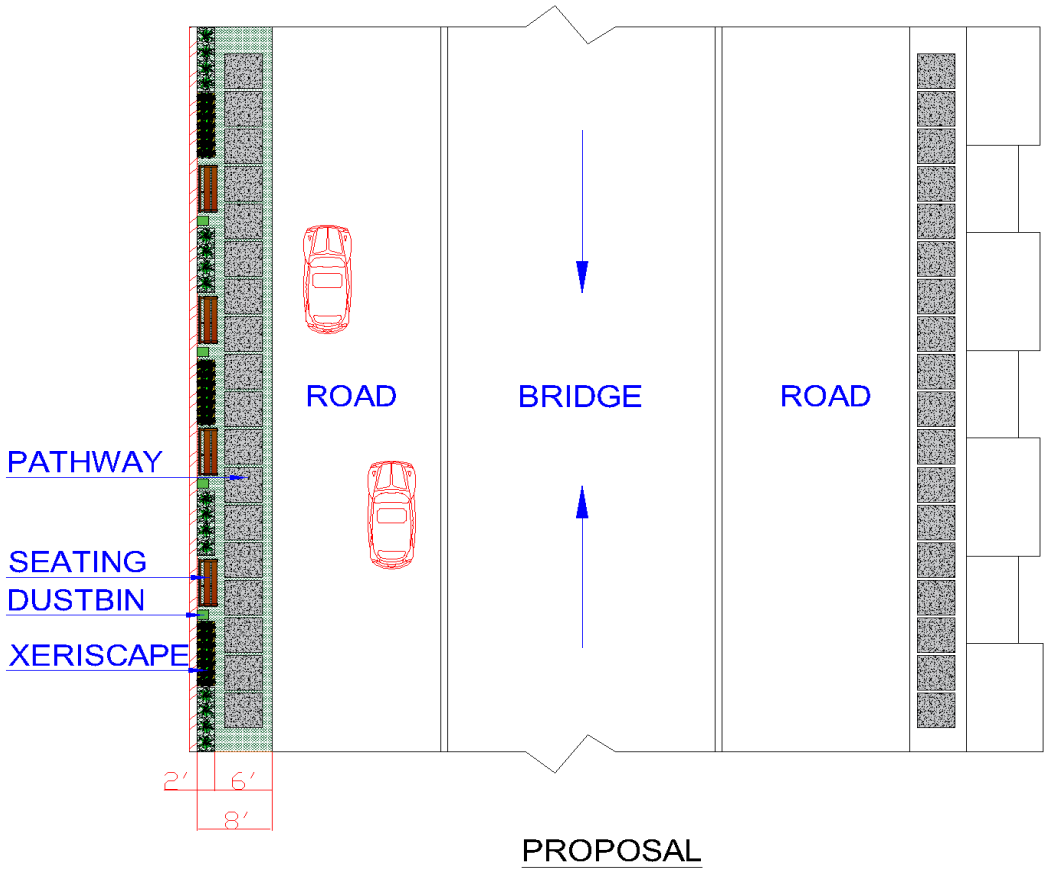


Figure 29: Proposed design idea (Author)

7.1.3 Problem in existing landscaping

- Needs heavy water demands
- Need regular maintenance
- Needs fertilizer very often
- Most of the landscapes are seasonal

7.1.4 Xeriscaping the solution

Problem 1- Regular landscaping needs heavy water to grow

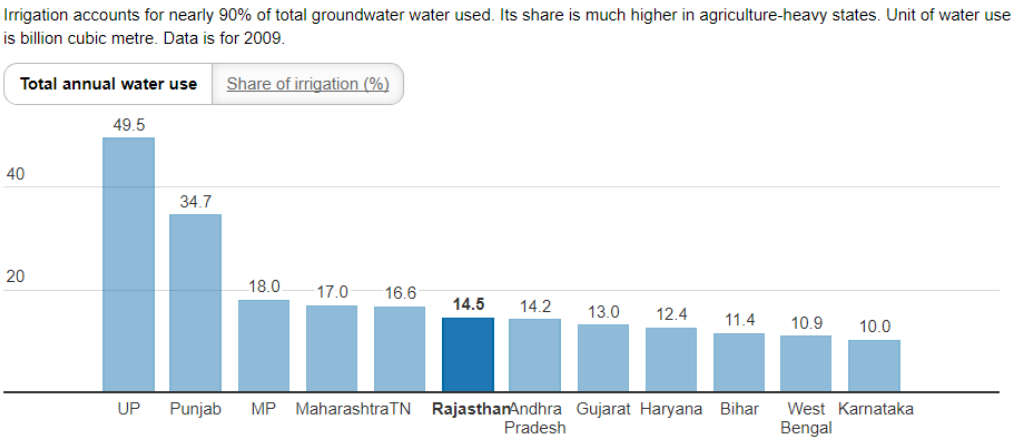


Figure 30: Groundwater usage pattern of different major states
[Source – Central ground water board]

Solution 1- Xeriscape needs less water

Cactus, Aloe Vera, money plant, peace lily, bamboo plant, spider plant and tulsi will consume much less water. On an average plants require water twice a day healthier.in other hand xeriscape plants need water once a week to grow healthier. It will save a lot of water in the cities where water storage is common.

Problem 2 - Regular landscaping needs heavy maintenance

All the present landscaping needs heavy cutting and trimming to keep them in shape which required workers. Maintenance become heavy headache as labor becomes a problem for cities.

Solution 2- Xeriscape needs less maintenance

Cacti family grows in defined form so there is no need of cutting and trimming regularly. It will need cutting of some dried leaves of course but that will be once or twice in a month so the maintenance cost will be decreased.

Problem 3 - Regular landscaping needs fertilizer very often

Solution 3 – Xeriscape plants doesn't need fertilizers so often they can grow without fertilizers and manure. These plants doesn't need much proteins so they can survive for longer period of time without being manured.

Problem 4 - Most of the landscapes are seasonal

Solution 4 – Unlike other seasonal landscape, cacti plants are not seasonal. They can grow in all the seasons and does not get dried in autumn season. They can bear rain, storms and wet seasons as well as 50 degree of heat in summer season.

7.2 Process of implementation

7.2.1 Build a xeriscaping style in public places

Firstly we should appoint a professional expert of xeriscaping process as it is a challenging type of landscaping because it has many different impressions such as planting of drought tolerant tress and less water consuming tress. Other than function, xeriscaping can make an area look attractive as well as pocket friendly and easy to maintain.

Considering an area

Each and every landscape is slightly different from each other, so we need to consider following factors:

- Which types of plants can be grown in the area according to climatic conditions and soil type?
- When it showers, where will be the water flow and get collected? Is the area flat, or there are slopes to taken care of?

A. Get purge of aged grass and dried plants

For xeriscape an existing landscaped area, we need to get purge of existing grass or dried plants which have grown there. To get complete rid of those plants, we need to remove the radicles as it can cultivate again and destroy or interfere in new types of plants. Only then new plants i.e. xeriscaping will last longer and grow healthier. There are many ways to purge the existing landscape

1. MANUALLY
2. SOLARIZATION
3. HERBICIDE

- **Manually**: This way of purging is most affordable but need high level of craftsmanship and also a time taken process as the work will be done by laborers. We can plough the meadow up with a spade or usage a rudder to build the course a slightly easy (and to retain the topsoil more nutrients complete).
- **Solarization:** As this technique take longer time to do but relatively easier. Whole area, we need to destroy, will be watered and then covered with black

clear plastic wrap. Lack of sunlight will destroy all the microorganisms and stop the photosynthesis process ultimately killing all the microbes present in soil.

- **Herbicide:** This is the fastest way to kill the greenery as a chemical substance is sprayed all over the area you want to be plant free. The chemical substance will kill all the bacteria which helps to grow the plant. However this way is much more risky than all above as it harms the environment and surroundings which lack to harmful results. It can be used for optimum results if it is used with proper care and instructions.

B. Soil and mulch preparation

Usage of native plants won't affect your growing or fertility but if you are using non-native plants or the soil is from other region we need to do some extra efforts to make it work right. The main practice used to grow the plant healthier and to enrich the soil is called compost. Compost will make the non-native plant or soil filled with useful bacteria and microbes which will help the plant to grow in healthier way.

Mulch is an addition to compost which will be done for water retaining. Thin layer usually 2-4 inches, or depending on mulch type or soil type, will spread on the top. It will trap the water inside and retain moisture for long time which will help and improve the speed of photosynthesis process. Also with water weeds will also get trapped in this layer so it automatically do the work of manure.

C. Fixed up the Irrigation system

To get optimum results, there are so many factors to consider for example- how we will save the water, how we will make the best use of water which technique will be use etc. all these questions will be answered if we fix up the irrigation system.

- **Drip Irrigation**

This type of irrigation is more efficient way as compared to sprinkler system as it doesn't need any motor or showers to spray the water in landscape. In drip irrigation, plastic pipes with holes will be used to run off the water in desired area. Water will be spread in field through no of holes so it doesn't need any motor or mechanical tool to distribute the water. Hence, proved as efficient way then sprinkler system.

- **Smart irrigation**

If we want the irrigation to be more hazel free rather than pocket friendly we have, smart systems which can work flawlessly. These automatic systems will work according to weather and need. It will only work when the plant or irrigation needs it so ultimately saving energy for you. The Initial cost and maintenance cost will be little high but it will save energy, time, and efforts by providing hazel free operation.

- **Rainwater harvesting**

In drought prone areas, rainwater harvesting is always a great idea to follow. In this technique water will be collected from rain and used it in irrigation. The extra amount

of space will be needed as we need to collect the water and store it for some time before using. It is a sustainable idea which will save the water from being wasted and use it properly and according to ours needs. This technique is always recommended in not only drought areas but everywhere including metropolitan cities as metropolitan cities are always prone to water shortage because of heavy population and busy life style. Where people don't have time to save water or think about it. So, rainwater harvesting is ecofriendly and always a smart technique to use.

7.2.2 Local Vegetation

As mentioned earlier, native plants and vegetation is always a good idea and it has several valid reasons-

They are born to grow in local climatic conditions. Also, if you grow native plants in local soil it will need less manure and fertilizers because the soil has all the nutrition required for that plant to grow. Many native plants are getting rare as everybody want to use foreign plants in their urban landscapes. So, using native plants will save them in at least your area. Native plantation also gives food and accommodation to fauna of particular area which includes insects, reptiles etc. Local vegetation also support regional biodiversity.

Outdoor plants that need less water to grow in North India region:

a) Aloe Vera
b) Money plant

c) Cactus plant
d) Peace lily
e) Tulsi
f) Bamboo palm
g) Dendrobium
h) Snake plant
i) Spider plant
j) Century plant
k) Cast iron plant

Aloe Vera: Also known as aloe grows in warm weather condition. Grows up to 1-2 feet tall with lush green color leaves and with yellow flowers. It need full sun for growing and can bear dry air.

Soil – Can tolerate extreme dry and poor soil and even it can grow in different soil types

Water – aloe Vera requires less amount of water to survive but do not grow well in wetland. It can even tolerate drought prone condition and during winter it does not require water.

Money plant: Also known as golden pothos it is an evergreen climber plant mostly available in parks and residences also. According to Feng Sui and vastu it a good luck plant and gives wealth and energy.

Soil and water – it can grow both in water and soil. It needs water after 8- 10 days. Over watering may cause harm to the plant.

Cactus plant- also known as cacti need little water and zero attention can grow in any weather condition as it doesn't have leaves but have green fleshy skin with spines on it. It can even tolerate harsh summer and have certain geometric forms.

Peace lily – Spathiphyllum is genus name to peace lily grown well in winter seasons. It depends upon light and foliage. It is also has lush green color leaves with white flower foliage. Even it fives freshness to the environment.

Bamboo palm- Known as reed palm with genius Chamaedorea sefritzii. Grows up to 5-8 feet tall yellow butterfly palm leaves and often generate berries and flowers also. It need full sun and shade also but needs less water to grow.

Dendrobium – it is genus of orchid which grows quickly in summer and take rest in winter season. Needs good amount of sunlight to grow. It is a long lasting flower and needs minimum water to plough.

Snake plant – Botanical name Sansevieria has a sword shaped evergreen leaves it is little expensive. It can grows from 8 inches to 12 feet height. It doesn't need direct sunlight and it consume little water content in winter.

Spider plant – It is a green – creamy and white striped or ribbon shaped leaves. Butterflies and spider attract to this plant. These can be planted in any season and need little wet soil to grow faster.

Cast iron plant- Also known as Aspidistra Elatior plant with dark green broad leaves. As it need complete darkness and even direct sunlight to grow and need less water every week.

7.3 BROUCHURE DESIGN

There is a proposed brouchure design which can be used by Government to promote xeriscaping which can change the cities and their present situation.Government will itself applies this idea to the public areas and this brouchure will help to promote it to private gardens and resendential areas too which will increase the positive effect to bigger scale.Brouchure design will be additional benefit

CHAPTER 8 - CONCLUSION

Landscaping is very crucial part of metropolitan or every place as everyone love greenery around them but there are many problems in existing landscaping such as water wastage, high maintenance, seasonal changes, regular manure and fertilizers. Metropolitan cities have shortage of water and maintenance all the time so landscaping conditions always stays miserable. Lack of greenery makes metropolitan cities polluted which is harmful for health and make negative image of our country on tourists. Other than pollution , people finds empty places and start throwing garbage over there and in months , that place becomes default location for local garbage. Lack of greenery gives birth to soil erosion which is other big challenge to face so we need to change the present scenario.

Xeriscape can be a nearly perfect solution of these problems as it needs less water to sustain, it doesn't require high maintenance, bears all seasons and can survive months without fertilizers. If public places and walkways are xeriscaped beautifully, crowd will also enjoy the beauty instead of throwing garbage. Greenery will make the pollution free cities and hopefully top 5 Indian metropolitan cities will not be the part of most polluted cities in world. Soil erosion will also be controlled as plants and greenery will catch the fertile soil to get eroded.so xeriscape can be the solution to present problems and will promote the sustainability.

8.1 FUTURE SCOPE

Future scope of xeriscaping is vast as there is a wide scope of xeriscape in all sectors. In public spaces electricity is also a rising issue which needs to be deal with, as we are talking about sustainable future .Xeriscaping can be used as a solvent of this problem too. There are researches going on about glowing plants and trees .Luciferin substrate is an element which is light emitting compound which glows in dark by capturing the light whole day. This elements can be injected in stem and leaves which will make the trees glow for months. This can be implemented on public areas where pathways side trees will act as street lights. This can be used on roads to show the path in night time or dark overcast days. This will make electricity usage much lesser than present scenario. This can be the future of xeriscape as these experiments are going on rapidly and will be merged in xeriscaping soon. It will also increase the beauty of xeriscaping as it will be eye pleasing and surprising for every user.

BIBLIOGRAPHY

AndrewT. (2014, April 02). What is Xeriscaping, and Could it Work for You? Retrieved from October,2017 blog.lawneq.com/what-is-xeriscaping-and-could-it-work-for-you/

Assiniboine lights and landscapes. (2016, July 13). Retrieved from October,2017 www.assiniboine.com: www.assiniboine.com/xeriscaping

Ben-Eli, M. (2005). *Five Core Principles.* Retrieved from www.sustainabilitylabs.org/assets/img/SL5CorePrinciples.pdf

Brown, M. M. (2007). *Best Plants for 30 Tough Sites.* Regents of the University of Minnesota. Retrieved from November,2017 xeriscaping/08464-complete.pdf

Cpcb. (2014). *METRO-CITIES OF INDIA* . Retrieved November 2017, from www.cpcb.nic.in/EnvironmetalPlanning/ground/Chapter3.pdf

Hostetler, E. S. (2014, 11 26). *Living Green In Madera*. Retrieved from www.wec.ufl.edu: www.wec.ufl.edu/extension/gc/madera/landscaping/xeriscape.html

Iannotti, M. (15, 05 25). Xeriscape Gardening - Planning for a Water Wise Garden. Retrieved from www.thespruce.com/xeriscape-gardening-1402341

Kyra Dziedzic University of Lethbridge Department of Geography April 30, 2012 . (n.d.). *Grass to Xeriscape Cost Benefit Analysis and Qualitative Stud.* Kyra Dziedzic University of Lethbridge Department of Geography . Retrieved from November,2017 xeriscaping/GrassToXeriscape.pdf

Landscaping network. (2010). XERISCAPE LANDSCAPING. Retrieved from www.landscapingnetwork.com/Xeriscape-landscaping/

Rai, R. (2017). Eco landscape . Retrieved from October,2017 www.academia.edu/19003775/Eco_Landscape_A_Case_Study_For_Bangalore

REDDY, N. C. (2012, July 7 Saturday). Go for xeriscaping. *The Hindu*.

Rodomsky-Bish, B. (2015, October 20). *The Seven Principles of Xeriscape.* Retrieved November,2017 from yardmap.org: yardmap.org/learn/the-seven-principles-of-xeriscape/

Rodriguez, V. (2011, Febraury 23). Seven elements of xeriscaping for less water, less maintenance. Retrieved from October,2017 www.hilltoplandscaping.com/

Singh, P. (2017, November 24). *6 charts that explain India's water crisis*. Retrieved from November, 2017 www.livemint.com/Opinion/97fuaF2aQkO9IjPiPAjMyL/Six-charts-that-explain-Indias-water-crisis.html

Slagell, J. (2017, September 08). *xeriscaping*. Retrieved from October,2017 ezinearticles.com/?6-Advantages-of-Xeriscape-Landscape-Design&id=9787788

Smith, A. (1995). *do it yourself*. Retrieved from www.doityourself.com: www.doityourself.com/stry/benefits-of-xeriscaping

Subramanian, A. (2017). Oyxygen bombs used in Delhi and Noida. *The Better India*. Retrieved from October,17 www.thebetterindia.com/94549/oxygen-bombs-purify-delhis-polluted-air/

UNLV Facilities Management. april 03, 2015,. *What is Xeriscaping?* Las Vegas. Retrieved from November,2017 xeriscaping/What-is-Xeriscaping_-_-Landscape-Grounds-and-Arboretum-_-Facilities-Management-and-Planning-_-UNLV.pdf

Wandiga, C. (2007 -2017). Defining Sustainability: A Process and Strategy Focus. *Sustainablebrands*. Retrieved from October,2017

www.sustainablebrands.com/news_and_views/communications/defining-sustainability-process-strategy-focus