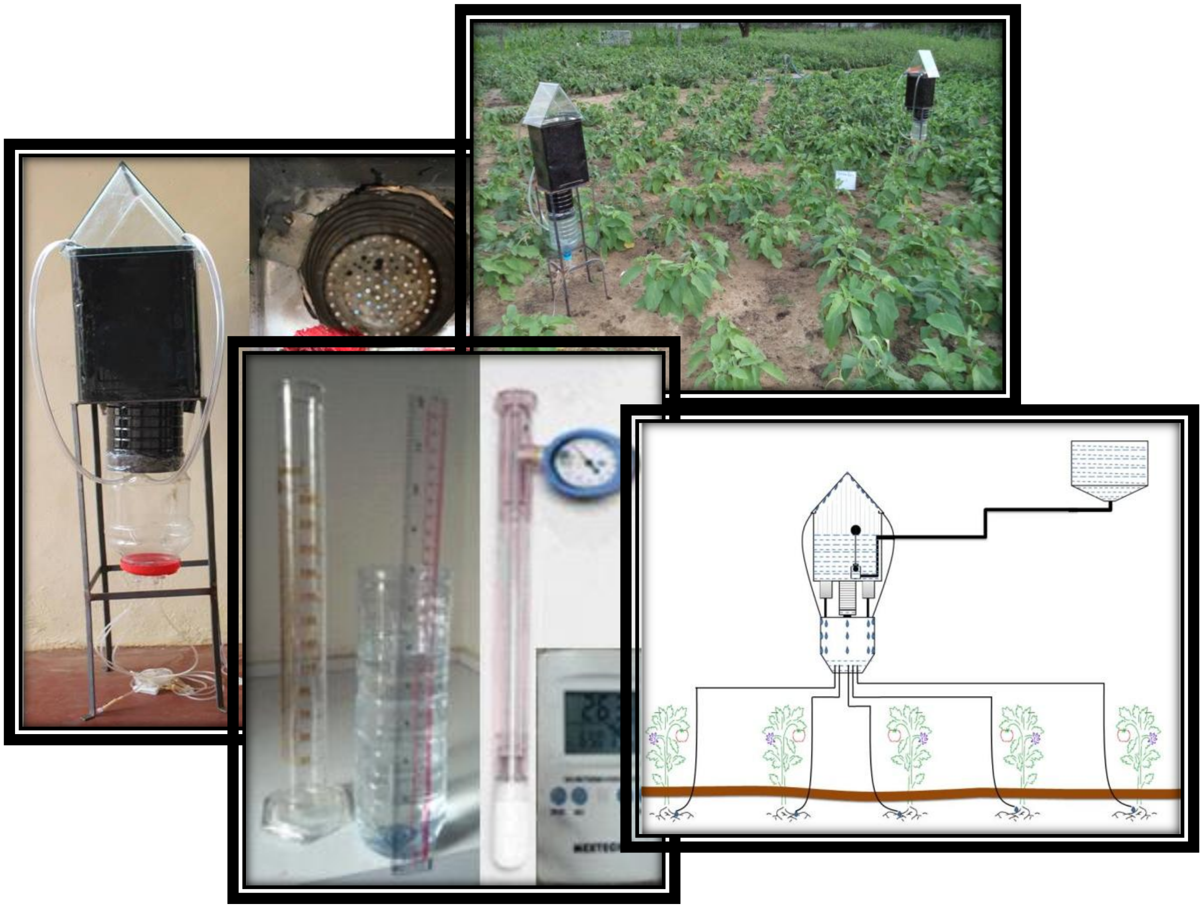
Entry to Stockholm Junior Water Prize [2014]

Cost effective Smart Drip Irrigation using Saline Water to optimize soil moisture for higher yield



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Abstract

The world population is growing exponentially. 200,000 more people are added to the world food demand each day. Can the Earth produce enough food to feed 10 billion people? In order to meet this growing demand, more land will have to be allocated to grow crops and this land will need more water and it is becoming scarce everywhere in the world. Irrigation uses about 70% of the total world water consumption. About 250 million hectares are irrigated worldwide today, nearly five times more than at the beginning of the 20th century.

Irrigation is also responsible for a huge amount of water waste. Even though widely discussed by most, this scarce resource is frequently wasted about 60 to 70 percentage through inefficiency of technology used for many agricultural/Industrial practices and many day to day activities of humans. Hence, water conservation in whatever possible manner is of utmost importance.

Sri Lanka is an agricultural country. Its main goal is to achieve an equitable and sustainable agricultural development through development and dissemination of improved agriculture technology. There are efficient ways of water cultivations such as drip irrigation to minimize the water consumption. But these methodologies are driven by manually set times for watering irrespective of the need. A better approach would be to water the plant based on the needs of the plants rather than on set frequency. In addition, there is a requirement for exploring the use of saline water for agriculture either by selecting suitable plants or by inexpensive treatment or a combination of both.

And we found an innovative methodology to irrigate the plants by dripping irrigation using saline water (Sea Water) in an automated way. This innovative research of saving water by introducing a novel methodology to water the plant depending on ambient soil and temperature conditions is much effective than other possible irrigating methods. By this method, in addition to the water conservation, seawater can be used for watering the plant. Also this novel innovation has many other social, economic and environmental benefits.

Table of Contents

Abbreviations and Acronyms

l	-	Liter
m	-	Meter
ml	-	milliliter
cm	-	Centimeter
g	-	Gramm
kg	-	Kilogram
m2	-	Square meter
0C	-	Centigrade
ppt	-	Parts per Thousand
mph	-	Miles per Hour
RZWS	-	Root zone watering system
Centibars (cB)	-	Unit of soil moisture measurement. Centibar (cB) is a measurement unit of pressure. This is an hundredth of one bar; a bar is equal to one hundred thousand Newton per square meter or Pascal.
CLEAN	-	Community Led Environmental Awareness Network

Acknowledgement

ℵ Our School "Shivananda Vidyalaya – National School, Batticaloa" which provided this golden opportunity and its blessings.

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1.0 Introduction

1.1 Problem Studied

Various types of irrigation techniques differ in how the water obtained from the source is distributed within the field. In general, the goal is to supply the entire field uniformly with water, so that each plant has the amount of water it needs, neither too much nor too little. Though the modern methods are efficient enough to achieve this goal; those techniques seem that it can only use fresh water for irrigation.

At present water is not quite enough to quench our thirst and using fresh water for irrigation also can’t be neglected. The world filled with water but highly saline water. Using saline water for irrigation with root zone watering system to achieve higher, profitable and sustainable plant production will be effective than the all methodologies used for irrigation.

Plants need a significant amount of water for its growth and food production. Overflow of water will be wasted and can cause soil and fertilizers washed out. Today large quantity of water used for irrigation to optimize soil moisture but mostly much amount of water evaporated and unused by the plant. Directing the water to the root part of the plant will be a solution to use minimum water to optimize soil moisture effectively. Commonly plant need around 8 inches of water to be moisture for its growth.

1.2 Background

It now appears that one of the main factors limiting future food production will be water. It is evident that in order to feed the world in the coming years, we will need more and more water. Or alternatively, we have to use the water more efficiently. This is precisely the aim of this project.

The process of irrigation is something that has been used for thousands of years, as long as people have had the ability to grow crops. Irrigation systems all function in the same way, in distributing water over a specific plot of land, but they vary in how they disperse the water and how they obtain the water from each source. The end goal with any is to supply the full field with water in the most uniform way possible, so that the plants all receive the right amount. What this right amount is will depend on the type of plant and their ideal growing conditions.

1.2.1 Irrigation Methods

- There are mainly 5 kinds of irrigation facility

1. Surface Irrigation
2. Localized Irrigation
   - Drip or Trickle irrigation.
3. Sprinkler Irrigation.
   - Center pivot irrigation
   - Lateral move (Side roll, Wheel line) irrigation
4. Sub-irrigation
5. Manual Irrigation using buckets or watering cans.

Surface irrigation

in surface irrigation systems water is moving over the land by simple gravity flow in order to wet it and to infiltrate into the soil. They can be subdivided into furrow, border strip or basin irrigation

Localized irrigation

Localized irrigation is a system where water is distributed under low pressure through a piped network, in a pre-determined pattern, and applied as a small discharge to each plant or adjacent to it. Drip irrigation, spray or micro-sprinkler irrigation and bubbler irrigation belong to this category of irrigation methods.

Sprinkler irrigation

In sprinkler or overhead irrigation, water is piped to one or more central locations within the field and distributed by overhead high-pressure sprinklers or guns. A system utilizing sprinklers, sprays, or guns mounted overhead on permanently installed risers is often referred to as a solid-set irrigation system. Higher pressure sprinklers that rotate are called rotors and are driven by a ball drive, gear drive, or impact mechanism. Rotors can be designed to rotate in a full or partial circle. Guns are similar to rotors, except that they generally operate at very high pressures of 40 to 130 lbf/in² (275 to 900 kPa) and flows of 50 to 1200 US gal/min (3 to 76 L/s), usually with nozzle diameters in the range of 0.5 to 1.9 inches (10 to 50 mm). Guns are used not only for irrigation, but also for industrial applications such as dust suppression and logging.

Problems related to these irrigation methods

- The level of moisture will be low as the water evaporates due to surface watering method.
- The fertilizers and other minerals will be washed out.
- Require huge amount of Water.

1.2.2 Soil and Water Management

1. Soil hydrology AEM [1]

The relationship between soil water content, soil water tension and soil pore size and the following soil parameters (and qualitatively understand how these parameters vary for different soil types) and their relationships to plant growth and the fate and transport of nutrients and pesticides.

1. **Field Capacity**
2. **Permanent Wilting Point**
3. **Available Water Capacity**
4. Total Soil Water Storage Capacity
5. Drainable Porosity
6. Soil Texture and Structure
7. Macroporosity/Preferential Flow

Field Capacity

The ***field capacity*** is the amount of water remaining in the soil a few days after having been wetted and after free drainage has ceased. The matric potential at this soil moisture condition is around -1/10 to – 1/3 bar. In equilibrium, this potential would be exerted on the soil capillaries at the soil surface when the water table is between 3 to about 10 feet below the soil surface, respectively. The larger pores drain first so gravity drainage, if not restricted, may only take hours, whereas in clay soils (without macropores); gravity drainage may take two to three days. The volumetric soil moisture content remaining at field capacity is about 15 to 25% for sandy soils, 35 to 45% for loam soils, and 45 to 55% for clay soils.

Permanent Wilting Point

The ***permanent wilting point*** is the water content of a soil when most plants (corn, wheat, sunflowers) growing in that soil wilt and fail to recover their turgor upon rewetting. The matric potential at this soil moisture condition is commonly estimated at -15 bar. Most agricultural plants will generally show signs of wilting long before this moisture potential or water content is reached (more typically at around -2 to -5 bars) because the rate of water movement to the roots decreases and the stomata tend to lose their turgor pressure and begin to restrict transpiration. This water is strongly retained and trapped in the smaller pores and does not readily flow. The volumetric soil moisture content at the wilting point will have dropped to around 5 to 10% for sandy soils, 10 to 15% in loam soils, and 15 to 20% in clay soils.

Available Water Capacity

The ***total available water (holding) capacity*** is the portion of water that can be absorbed by plant roots. By definition it is the amount of water available, stored, or released between field capacity and the permanent wilting point water contents. The average amount of total available water in the root zone for a loam soil is indicated by the area between the arrows in the table 1.

The soil types with higher total available water content are generally more conducive to high biomass productivity because they can supply adequate moisture to plants during times when rainfall does not occur. Sandy soils are more prone to drought and will quickly (within a few days) be depleted of their available water when evaporation, transpiration rates are high. For example, for a plant growing on fine sand with most of its roots in the top foot of soil, there is less than one inch of readily available water.

A plant transpiring at the rate of 0.25 inches per day will thus start showing stress symptoms within four days if no rainfall occurs. Shallow rooted crops have limited access to the available soil water, and so shallow rooted crops on sandy soils are particularly vulnerable to drought periods. Irrigation may be needed and is generally quite beneficial on soils with low available water capacity.

Soil Type	Total Available Water, %	Total Available Water, in/ft
coarse sand	5	0.6
fine sand	15	1.8
loamy sand	17	2.0
sandy loam	20	2.4
sandy clay loam	16	1.9
loam	32	3.8
silt loam	35	4.2
silty clay loam	20	2.4
clay loam	18	2.2
silty clay	22	2.6
clay	20	2.4
peat	50	6.0

Texture	FC (v%)	PWP (v%)
Sand	10	5
Loamy sand	12	5
Sandy loam	18	8
Sandy clay loam	27	17
Loam	28	14
Sandy clay	36	25
Silt loam	31	11
Silt	30	6
Clay loam	36	22
Silty clay loam	38	22
Silty clay	41	27
Clay	42	30

Soil Water Storage

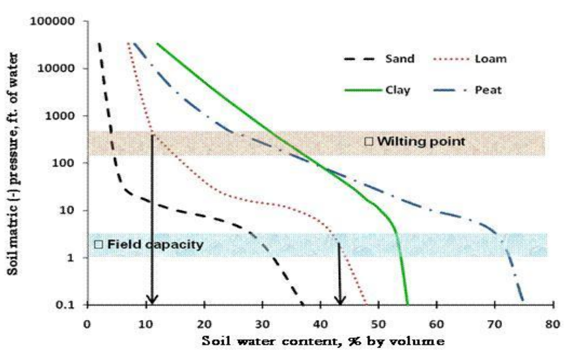
The soil water storage or soil water content can be quantified on the basis of its volumetric or gravimetric water content. The ***volumetric water content*** is the volume of water per unit volume of soil, expressed as a percentage of the volume. The ***gravimetric water content*** is the mass of water per unit mass of dry (or wet) soil. The volumetric water content is equal to the gravimetric water content times the soil's bulk density (on a dry soil basis).

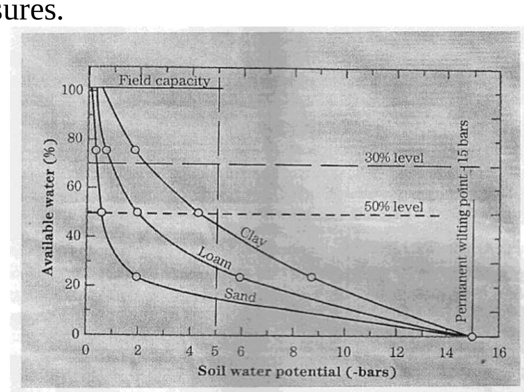
Factors that affect the soil water storage are:

- Total Porosity or Void Space
- Pore-size and Distribution and Connectivity
- Soil Water Pressure Potential or Energy Status of the Soil Water

Differences in soil water pressure potentials from one point to another in the soil and throughout the larger landscape determine how water will move. For water movement in soil, the water table is used as a convenient reference because below the water table the total porosity of the soil is saturated, and above the water table, the soil porosity is unsaturated (the soil water content is less than the total porosity).

The ***water table*** is defined as the upper surface of groundwater (saturated zone) or that level in the ground below the soil surface where the water is at (and in equilibrium with) atmospheric pressure. At the water table reference, the pressure potential is set equal to zero. Thus, below the water table, the pressure potential becomes positive, and above the water table the pressure potential becomes negative. This negative pressure in unsaturated soil is termed matric, tension or suction pressure potential so as not to confuse it with positive pressures.





1.3 Related Works

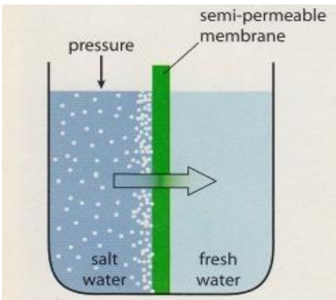
1.3.1 WA Economics Salt water potato farming

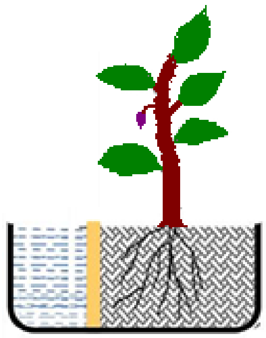
It is tested and implemented in Netherland that the potatoes can grow in salty condition. This one was grown with 40% of sea water and -40% sea water. It shows that the potatoes membrane has the ability to absorb water from salt water. [4]

Compared to regular irrigation system;

- No need to use much fresh water.
- Salt water/ Sea Water/ Saline Water can be used with fresh water for potato farming.
- No mulching process is needed.

1.3.2 Semi permeable membrane watering system





Using semi permeable membrane, salt water uses for irrigation by using reverse osmosis process to get efficient fresh water. As shown in the figure using this membrane salt water (sea water) can be used for irrigation by introducing high pressure in salt water side. [5]

Compared to regular irrigation system;

- High cost.
- Must attach to the plant.
- No possibilities to use for higher yields.

1.3.3 Bottle Watering System [6]

This device improves the soil moisture content by root irrigation using minimum water amount. The specific objective is to develop a small watering system using waste plastic bottles for root irrigation to improve soil moisture using even high saline water.

Once the sun light falls, water in the small bottle evaporates and condenses on the outer bottle wall which then flows down to the soil. This is directed to the plant root. Water is delivered below the often hard and dry soil surface direct to the plant roots. This prevents water being lost though evaporation or runoff. As the plants develop, their roots wrap around the bottle and only take as much or as little water as they require.[6]

1.4 Objective of the research

The main goal of this project is to use saline water (Sea water) for irrigation by introducing a novel method using localized irrigation method to the root zone of crops. The specific task is to introduce a new watering system to the root zone that capable of using saline water and any type of water.

2.0 Materials and Methods

2.1 Materials

2.1.1 Watering Units

- Evaporation Set – Mirror/Transparent Material
- Oil Can
- 5L water bottle
- Coconut Fibers
- Saline Water/ Sea Water
- Saline tubes

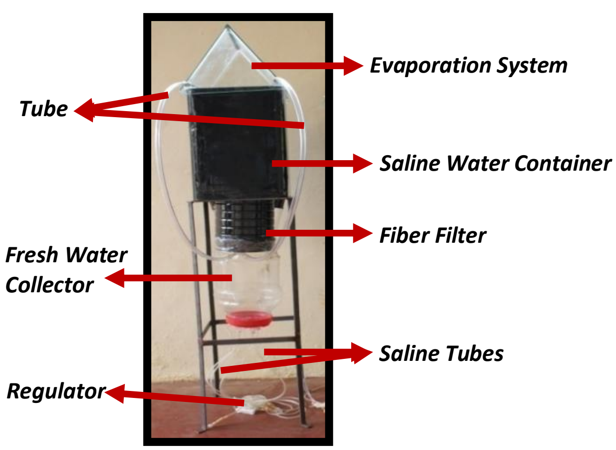
Fig.5.The Watering System.
Fiber, Semi permeable membrane, Evaporation System.

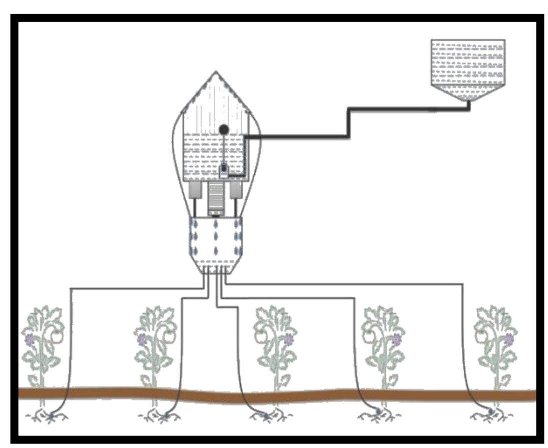
2.1.2 Other materials used

- Tensio meter (Soil Moisture meter)
- Thermometer
- Measuring tape
- Volumetric flask – 500ml
- Nursery plants
- Water, Fertilizers

2.2 Experiment Method

2.2.1 Watering Device



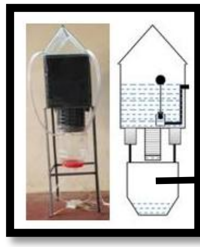


This watering device designed with two methodologies (Evaporation & Coconut fibers) used to convert saline water into fresh water; to achieve the maximum benefit.

2.2.2 Function of the System

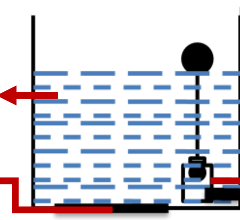
Step: 01

The mirror set for evaporation is kept on the top of the saline water container. The fiber filter is connected to the bottom of the saline water container. Each system is connected via a tube to collect the purified water to the water container.



Step: 02

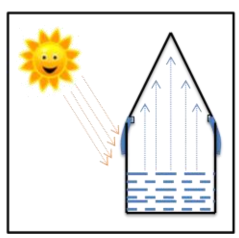
The saline water filled in the black container in the System.

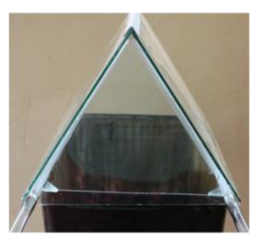


Step: 03

The Evaporation part in the System.

The saline water filled in the container evaporates and condense in the mirror set and flows down to the purified water container through the tube connected once the sunlight falls in the black container.





Step: 04

The fibers filter part in the system.

It is placed in the bottom of the black container. This filter consists layers. They are; Red fibers, White Fibers, Activated Fibers. The fiber particles can absorb Na ions. This Low cost material could be found in all parts of Sri Lanka.

The Saline Water is tested in different condition with different type of fibers mixture. The concentration of Saline Water Solution is tested with pH paper and seems 9.0 and after filtered it was 7.5. The Conductivity of the saline water was 4.5 and after filtered it tested to 1.2. Though the percentage of Na ions removed it seemed that it could not be drinkable and can be used for irrigational purposes as plants need some ions for its growth and food production.

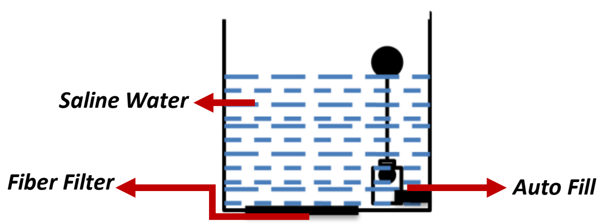
The Following Na ions removal capacity measurements were done by the Thailand Team for SJWP 2013 and the Na ions removal Capacity in Saline Water done by us.

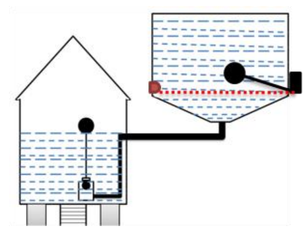
Type of Coconut Fiber	Na ions removal Capacity	Na ions removal Capacity in Saline Water
Red Fiber	30%	25%
White Fiber	25%	20%
Pith removed Fiber	40%	33%
Activated Fiber	42%	45%
Mixed Fiber	90%	60%

Step: 05

Automatic Saline Water Filler

The automatic filler ([fig.8] mechanical part) connected to the black container to automatically fill the saline water once its get empty through the system which is connected to the main tank supplier. Also, the main tank supplier is connected with a mechanical system to alert the farmer that the saline water is empty and it should be filled by making an alarm system.

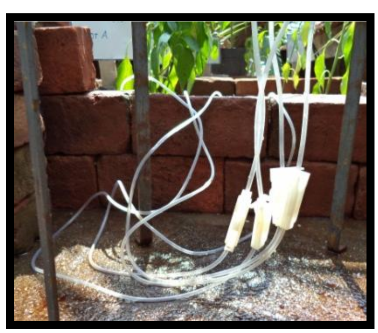


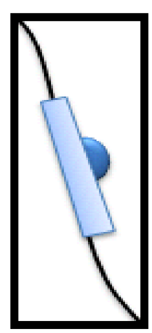


Step: 05

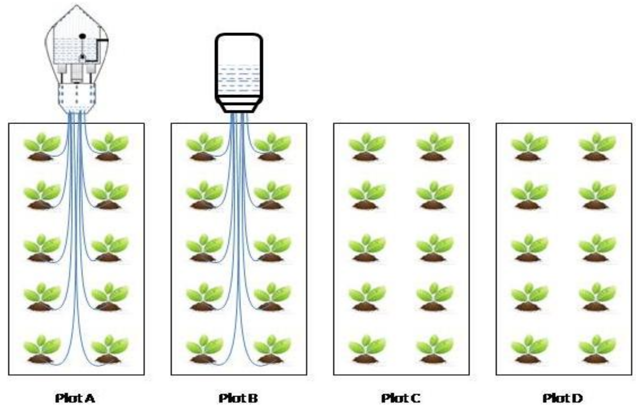
Regulator part in the system.

The regulator is connected to the saline tube which carries water to the root zone of the plant. The function of the regulator is to control the water flows to the root zone. The water drips forever but during the rain it is not necessary. Therefore, through this regulator it is able to stop the water flow by adjusting it.





2.2.3 Experimental Plots

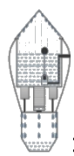


Plot A : Plants with the gadget using saline water.

Plot B : Plants with regular traditional dripping irrigation system using normal water.

Plot C : Plants with surface watering technique using normal water

Plot D : Plants with surface watering technique using high saline water

 : Plant  : Gadget  : Traditional dripping System

Four plots were prepared to get the normal condition of plant growth by digging, ploughing, harrowing, watering, etc.

- Ten plants were planted in each plot in 2 rows; 5 plants in a row.
- The plot A watered using the gadget innovated using high saline water and plot B watered using the traditional drip irrigation system using normal water.
- The plot C watered with surface irrigation system using normal water and plot D watered using high saline water with surface irrigation system.
- In addition, a gadget was used for experiment to measure the amount of saline water evaporated. It was measured for every 24 hours [Moring 6 a.m to next day morning 6 a.m].
- The soil moisture was measured in Plot A, Plot B, Plot C. Also the growth of the plant and the amount of water irrigated measured in the plots.
- The Soil type also considered; Loam, Sandy & Clay.

2.2.4 Experiment on Large Scale

The gadget was used in the yield for a section to experience the effectiveness of the gadget. The gadget was tested on Chile, Brinjals & Tomato crops.

2.2.5 Measurements

2.2.3.1 General measurements

The following were measured as traditional general measurements during the period of experiment.

1. Temperature : For evaporation testing.
2. Humidity : to monitor the level of transpiration and evaporation.
3. Wind Speed : to monitor the effect on transpiration.
4. Height of a plant : to measure the growth of plant.
5. Amount of Water Poured : to measure the amount of saline water used.
6. Area of Plot and
   Distance between each plant : 4 plots, 3x7 feet each; 1.4 feet distance between each plant.
7. Depth of root system : Avg. 8 cm each plant.

2.2.3.2 Scientific measurements

Scientific measurements were taken during the unit testing and experiment on the following details using the scientific methods and equipments.

1. Salt concentration on Saline Water
2. Moisture content at the depth of around 8 cm
3. The amount of evaporated water fed
4. The amount of water filtered using the fiber filter
5. The concentration of salinity in the water after filtered
6. Amount of water fed to normal plots.

3.0 Results

1.1 General measurements

1. Area of each plot
2. Average level of water fed to each bottle – 10 L
3. Time duration for one measurement - 24 hours (6 a.m. to 6 a.m. next day)
4. Duration of Experiment : 08 weeks
5. Age of the plant : 48 days
6. Height of a Plant : Avg. 28.8 cm
7. Temperature : Avg. 34^0C
8. Humidity : Avg. 51%

9. Salinity of normal water: 8 parts per thousand (Constant)
10. Salinity of high saline water: 54 parts per thousand (Constant)
11. Average wind : 7 - 12 kmph

1.2 Measurements of Water Usage and Soil Moisture

The usage of water measured by calculating the amount of water evaporated and the amount of water filtered in all 4 plots. The water fed by evaporation and filter system measured every 24 hours by disturbing the testing gadget which is not connected with the plot.

Water evaporated and filtered in Plot A – Average Data for the Month March			
Duration (In Week)	Water collected through Evaporation (ml)	Water collected through Fiber Filter (ml)	Total
1st Week	575ml	26,480ml	27,085ml
2nd Week	600ml	26,680ml	27,280ml
3rd Week	590ml	26,270ml	26,860ml
4th Week	585ml	26,710ml	27,295ml
Total Amount of Water per month	**2350ml**	**106,120ml**	**108,470ml**

Table 1

Time	**Temperature (*C)**	**Soil Moisture (Centibars) Available Water for Plant (%)**		
		Plot A	**Plot B**	**Plot C**
06.00 a.m	28.5*C	0.3 Centibars	0.3 Centibars	0.2 Centibars
07.00 a.m	32*C	0.3 Centibars	0.3 Centibars	0.2 Centibars
08.00 a.m	33*C	0.3 Centibars	0.3 Centibars	0.2 Centibars
09.00 a.m	37*C	0.3 Centibars	0.4 Centibars	0.2 Centibars
10.00 a.m	37*C	0.4 Centibars	0.4 Centibars	0.2 Centibars
11.00 a.m	36*C	0.4 Centibars	0.4 Centibars	0.2 Centibars
12.00 p.m	39*C	0.4 Centibars	0.4 Centibars	0.3 Centibars
01.00 p.m	35*C	0.5 Centibars	0.4 Centibars	0.3 Centibars
02.00 p.m	34*C	0.5 Centibars	0.5 Centibars	0.3 Centibars
03.00 p.m	32*C	0.5 Centibars	0.5 Centibars	0.3 Centibars
04.00 p.m	31*C	0.5 Centibars	0.5 Centibars	0.4 Centibars
05.00 p.m	31*C	0.5 Centibars	0.5 Centibars	0.4 Centibars
06.00 p.m	28*C	0.5 Centibars	0.5 Centibars	0.4 Centibars

Table 2

Week	Temperature (*C)	Plot A		Plot B		Plot C		Plot D	
		Soil Moisture (Centibars)	Water Fed (L)	Soil Moisture (Centibars)	Water Fed (L)	Soil Moisture (Centibars)	Water Fed (L)	Soil Moisture (Centibars)	Water Fed (L)
1	32.70	0.33	22.09	0.34	21.50	0.20	105	0.28	105
2	33.10	0.34	22.28	0.33	21.69	0.26	105	0.26	105
3	33.10	0.36	21.86	0.38	21.27	0.24	105	Plants Started Wilting	
4	33.00	0.39	22.30	0.37	21.71	0.22	105		
5	33.00	0.40	22.16	0.39	21.57	0.27	105		
6	33.40	0.42	21.95	0.41	21.36	0.28	105		
7	33.00	0.40	21.81	0.43	21.22	0.25	105	Plants Died	
8	33.10	0.43	22.61	0.36	22.02	0.23	105		
9	33.00	0.38	21.99	0.35	21.40	0.22	105		
10	31.20	0.35	22.71	0.38	22.12	0.24	105		
11	33.00	0.34	22.35	0.34	21.76	0.27	105		

Table 3

Weeks	Temperature (*C)	Plants Height			
		Plot A (c.m)	Plot B (c.m)	Plot C (c.m)	Plot D (c.m)
1	32.70	30.8	30.8	30.8	30.8
2	33.10	34.2	34.3	34.2	34
3	33.10	36.7	36.7	36.7	Plants Started Wilting
4	33.00	39.4	39.3	39.5	
5	33.00	42.6	42.4	42.8	
6	33.40	45.8	45.2	45.9	
7	33.00	49.4	49.2	49.6	Plants Died
8	33.10	53.8	53.7	53.9	
9	33.00	57.5	57.2	57.4	
10	31.20	60.5	60.5	60.9	
11	33.00	65	64	64.8	

Table 4

4.0 Discussion

The world population is 'exploding', the common estimation being around 10 billion people by 2050 with most of the growth in poor developing countries. Food production requires irrigation. It is obvious that more land will have to be allocated to grow crops and this land will need more water. Irrigation has by far the largest share of the world's water consumption. About 250 million hectares are irrigated worldwide today, nearly five times more than at the beginning of the 20th century.

As the human population grows, notably in the tropics and subtropics (where many rural people live in poverty), the difficulties of increasing food production also increases. In these areas, average crop yields are in gradual decline. In spite of improved plant breeding, the rates of rise in potential yield are slowing down. Problems caused by erosion and lowland flooding are more frequent, providing evidence of ecological instability in upland areas. Water tables are falling as a result not only from drought, but also from over use.

Soil moisture is often neglected, but improved soil moisture management is crucial for sustainable improvement of food production and water supply. A wider perception of soil productivity and the reasons for soil erosion and runoff will contribute to achieving higher, profitable and sustainable plant production and to improve the regularity of stream flow.
Scientific Endeavour should continue to increase our knowledge of the components of these problems and offer partial solutions. However, unraveling details of problems will not automatically result in workable means of solving them. Conventional approaches to crop production with minimum water quantity for watering offer limited scope for future progress. There is a need to think laterally, to see if there are other ways of looking at old assumptions to identify new ways forward.

This research, intended for farmers, aims to provide a solid basis for sound, sustainable soil moisture management with minimum water quantity at the time it required.

The filter can purify water. It means that the water removes the dust particles, and other things. Using such filter to purify saline water is a simple theory we studied to forward the project. Through our study we discovered that the coconut fibers could remove the Na ions in salt water. The coconut fiber is available at low cost and it is natural filter material available in the environment. By incorporating the different types of fibers, a filter made to optimize fresh water from saline water. The percentage of removal of sodium ions by the coconut fiber is not sufficient for drinking purposes but it could be used for irrigation and other related purposes.

Heat from the sun causes water at the surface of oceans, lakes and rivers to change into water vapour in a process called evaporation. Using this simple theory, in a green house, we produce water to evaporate and condense to the root level of the plant to make the soil moisture level high. This condenses water, once it gets mixed with the soil, does not get evaporated again to the environment [6].

By incorporating the evaporation part in the device gives maximum efficiency of water for irrigation. The following graphs show the difference between plot A and C contrast the height of the plants and the amount of water fed for the plants growth;

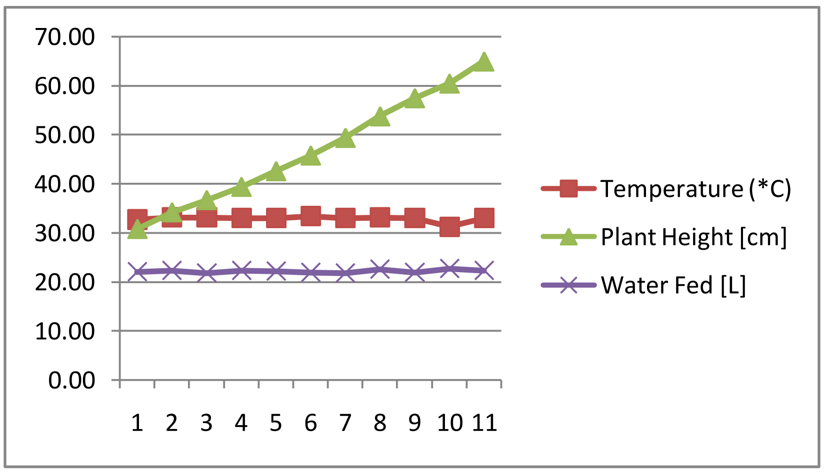


Chart 1. Plot A. The Plant Height and Amount of Water fed.

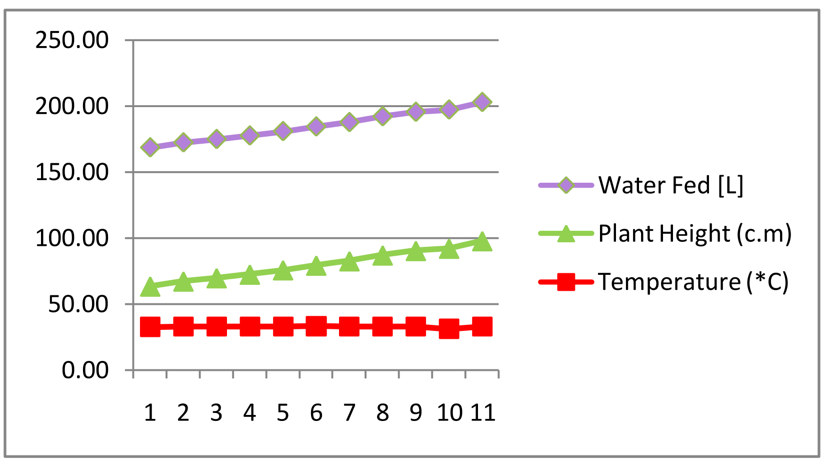
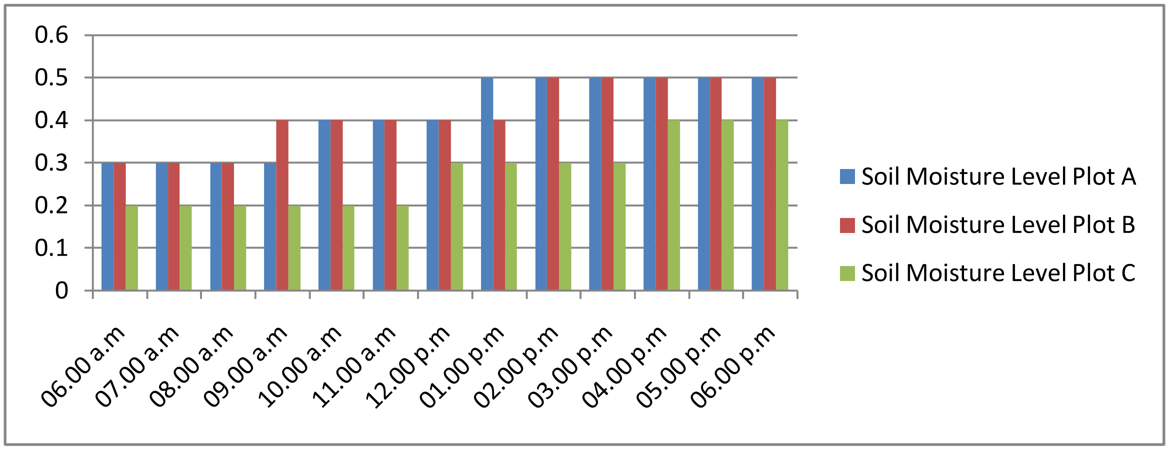


Chart 2. Plot C. The Plant Height and Amount of Water fed.



From the graph it shows that the soil moisture in Plot A and Plot B are nearly same and the moisture in Plot C is high but the level of the plant height and growth is differs though a huge amount of water is fed for Plot C than compared to Plot A and B. Also the state of Plot D is dead as the saline water is directly fed to the surface area of the plot and plants.

5.0 Conclusion

1. This device uses saline water for irrigation and it saves the amount of fresh water uses in irrigation for agricultural purposes.
2. The Coconut fiber has the capacity to remove Na (Sodium) ions in Salt water. It is found in our experiment that the different types of coconut fiber like red, white, pith removed and especially activated fibers has the highest percentage of Na ions removal capacity than the activated carbon.
3. Using the coconut fibers filter significant amount of water filtered as fresh water and low cost than compared to other filtering devices.
4. Application of this device to the farming area to optimize the soil moisture level could successfully prevent the water waste by feeding water to the surface soil layer using any watering techniques.
5. By supplying only the required amount of water at the roots with this controlling device, significant amount of water can be saved during the period in which heavy quantity of water is used in any cultivation.
6. This device could save nearly 50% of water per acre of brinjal, chilli or similar plantation compared to normal watering methods.
7. Using the regulators control the filtered water not to flow during the rain time.
8. Using the alarm system the farmer knows that the main tank is empty.

9. This device is being as a companion to the farmers not to be with the farming plot as this automation of irrigation and gives warning to the farmer once the saline water tank empty.
10. This efficient and novel device could achieve following environmental and social benefits;
    - Improvement of productivity of farmers due to less involvement of watering plants in regular intervals.
    - Prevention of Soil erosion.
    - Increase of yield due to prevention of flushing off the fertilizer from plots.
    - Reduced water pollution due to not allowing water to flow to the environment.

6.0 Suggestion for further researches

1.1 The Fiber filter should be modifying to achieve the maximum removal of Na ions and other ions to use it for the drinking purposes.

1.2 The alarm system which is connected to the main saline tank should be modify to a mobile SMS or alert app system as nowadays all farmers uses mobile phones.

1.3 Using Semi permeable membrane should be considered for the filtration..

1.4 The anti fungal effect and the life time of the fiber should be investigated.

1.5 Try the system for different types of crops.

1.6 Further improvements to increase the efficiency and effectiveness of the proposed device.

7.0 Reference

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