INTRODUCTION

Green fodder plays a major role in the feed of milk animals, thereby providing the required nutrients for milk production and the health of dairy animals. In the state of Goa, feed cost per litre of milk is 75% of the total milk cost, where in green fodder contributes 30% of the value. Rapid urbanisation and mining areas have caused shrinkage of grazing and fodder-producing lands. Due to non-availability of quality green fodder throughout the year, milk producers are forced to utilise extra concentrates for optimum milk production. On account of this, the cost of milk production is higher in the state as compared to neighboring states.

Non-availability of irrigated lands for fodder production, higher labour cost, and small land holdings have left dairy farmers with many challenges for milk production in Goa. It is quite evident that with decreasing cultivable land and depleting natural resources, sustainable technology would be the key driver of the dairy industry in the years to come.

NEED OF HYDROPONICS TECHNOLOGY IN STATE OF GOA.

Hydroponics technology is required to overcome following constraints during conventional green fodder production in the state:

1) Small land holdings amongst dairy farmers
2) Non-availability of fertile land for fodder production
3) Irrigation, fencing, land preparations resources are limited.
4) Mining and coastal belt has limited area for fodder production.
5) Destruction of fodder by stray cattle’s and wild animals.
6) Higher cost of labour for cultivation practices.
7) Poor participation of educated unemployed youths for fodder farming.
8) Demand of green fodder is very high against existing availability of the fodder.
HYDROPONICS TECHNOLOGY

It is a science of growing plants in nutrients rich solutions instead of soil and can be efficiently used to take pressure off the land to grow green feed for the livestock. Plants require three things to flourish, water, nutrients, and sunlight. Hydroponics is a straightforward way of providing all these nutrients without the need of soil under controlled environment conditions to optimise the growth of plants. Technology has been tested on various crops as Maize, Sorghum, Barley, Oats for producing high quality of nutritious green fodder for dairy animals. Beside this hydroponics can be used for growing wheat grass, paddy saplings etc in seven days of time for optimum growth. Fodder obtained from hydroponics consists of grass with grains, roots, stem and leaves as compared to only stem and leaves part in conventionally grown fodder.

HYDROPONIC INNOVATIVE TECHNOLOGY FOR DAIRY BUSINESS

- To grow green fodder at wider temperature (15° - 32 °C) and humidity (70 -80 %) range without fungal growth.
- Environmental friendly.
- Contamination free fodder.
- Saves water and labour
- Fodder grown is highly palatable and nutritious
- Fodder improves animal health and reproductive efficiency.
**ADVANTAGES OF HYDROPONICS**

1. **Conservation of water**: It requires just 2-3 ltrs of water to produce one kg of lush green fodder, as compared to 60-80 lts to conventional system of fodder production. Water left over in hydroponics is recycled to grow the fodder.

2. **Land**: Hydroponics green house requires marginal land to erect the system ie 10 mts x 4.5 mts land for 600 kg green fodder / day/ unit, in comparison to one hectare land for conventional green grass field. Reduction in the amt of land required for maximum fodder production is an asset for both regions where agriculture is difficult and densely populated areas that lacks sufficient growing space.

3. **Reduced labour requirement**: In conventional fodder production requires continuous intense labour for cultivation to harvesting of the grass, but in hydroponics labour required is 2-3 hours / day only.

4. **Reduction in growth time of green fodder**: To obtain nutritious fodder requires just over 7 days from seed germination to fully grown plant of 25 – 30 cm height. Biomass conversion ratio is as high as 7-8 times to traditional fodder grown for 60-80 days.

5. **Green fodder round the year**: technology is capable to make provision for the green fodder round the year, as per demand. Constant supply can be organised irrespective of rain, storm, sunshine or drought.

6. **Increasing of nutritive value of fodder**: through hydroponics it is possible to enhance the nutritive value by adding additional growth promoters, nutrients, etc to have quality milk from the dairy animals.

7. **Natural feed for animals**: growing of green fodder through Hydroponics is completely by natural source. No pesticides are used in green fodder production that could contaminate milk and milk products.
8. **Enhancement of milk production:** by providing green fodder to milch animals it can compensate the concentrate feed so as to have economically viable milk producing industry.

9. **Minimising loss of fodder:** Green fodder produced from hydroponics will be fully utilised as there won’t be loss of the fodder during feeding as compared to wastages of chopped traditional grasses during consumption by the animal.

**NEED BASED TECHNOLOGY TRANSFER**

Considering the various difficulties and constrains put forward by the dairy owners and traditional green fodder growers it was decided to have suitable technology for green Fodder production through Hydroponics in the Dairy Co-operative Societies which will over come the constraints in traditional fodder production and meet the growing demand of the fodder in the state. Project proposal was forwarded to Rashtriya Krishi Vikas Yojana to set up Hydroponics Systems purely on pilot basis in the state of Goa in 2011-12.

As per the project proposal Hydroponics Units were considered in DCS areas.
- Where there no sufficient land available for conventional fodder production.
- Mining area having milk production potential.
- DCS with minimum 50 milch animals who can produce at least 250 lts milk per day.
- Dairy Co-operative Society supported by ST / SC / OBC milk producers having milk production as sole enterprise.
- Coastal belt DCS having no sufficient land for fodder production.
- Hydroponics unit will produce Green fodder per day which is sufficient to provide nutrient rich fodder required for at least 40 – 50 milch animals per day by community efforts.
- Institute where required research can be under taken on Hydroponics Technology to provide sustainable need based technology to the milk producers.
PILOT PROJECT IMPLEMENTATION

With financial support of Rashtriya Krishi Vikas Yojana (GOI), Dept. Of Agriculture Govt of Goa as nodal agency and Goa State Co-operative Milk Producers' Union Ltd Curti Ponda as implementing agency, eleven units are erected and commissioned in ten Dairy Co-operative Societies and one Unit at ICAR Complex Old Goa in 2011-12. Units are on pilot basis having Maize Green Fodder production capacity of 600 kg fodder / day.

LOCATIONS OF THE HYDROPONICS UNITS IN THE STATE

<table>
<thead>
<tr>
<th>SLNO</th>
<th>DAIRY CO-OPERATIVE SOCIETY</th>
<th>TALUKA</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Kapila SDVS - Curti ( demo Unit )</td>
<td>Ponda</td>
</tr>
<tr>
<td>2</td>
<td>Ramprasad SDVS Khadki</td>
<td>Sattari</td>
</tr>
<tr>
<td>3</td>
<td>Rudrakksh SDVS Nagve</td>
<td>Sattari</td>
</tr>
<tr>
<td>4</td>
<td>Vithalapur Karapur SDVS Karapur</td>
<td>Bicholim</td>
</tr>
<tr>
<td>5</td>
<td>Bhagavati Sapteshwar SDVS Mandre</td>
<td>Pedne</td>
</tr>
<tr>
<td>6</td>
<td>Orlim SDVS Orlim.</td>
<td>Salcet</td>
</tr>
<tr>
<td>7</td>
<td>Mallikarjun SDVS Caure</td>
<td>Quepem</td>
</tr>
<tr>
<td>8</td>
<td>Cacoda SDVS Cacoda</td>
<td>Quepem</td>
</tr>
<tr>
<td>9</td>
<td>Gananath SDVS Nirankal</td>
<td>Ponda</td>
</tr>
<tr>
<td>10</td>
<td>Gosamvardhan SDVS Priol</td>
<td>Ponda</td>
</tr>
<tr>
<td>11</td>
<td>Dir. ICAR ( ICAR Complex Old Goa )</td>
<td>Tiswadi</td>
</tr>
</tbody>
</table>
ERRECTION OF HYDROPONICS GREEN HOUSES

PREPARATION OF BASEMENT OF GREEN HOUSE
HYDROPONICS GREEN HOUSE

GREEN HOUSE INSIDE VIEW
GREEN FODDR GROWTH CYCLE IN HOUSE

GREEN HOUSE WITH FULLY GROWN MAIZE FODDER OF 7 DAYS
INAUGURATION OF 1ST HYDROPONICS GREEN HOUSE AT ICAR COMPLEX
OLD GOA

HYDROPONICS GREEN FODDER DISTRIBUTION TO BENEFICIARIES IN HANDS OF
HON. MLA MR. SUBHASH PHAL DESAI.
RELEASE OF HYDROPONICS FODDER PRODUCTION TECHNICAL BULLETIN IN HANDS OF CHAIRMAN GOA MILK UNION

HYDROPONICS GREEN FODDER READY TO FEED
After erecting and commissioning of the units at different location in Goa yellow maize seed from Karnataka state was made available to the beneficiaries for fodder production. Routine monitoring was under taken to assess the performance of seed germination, green house management, fungal growth and other related problems at beneficiary level.

As far as researchable issues are concerned, as per the project were under taken for complete study at ICAR institute under the guidance of Scientists with constant interaction between farmers, fodder users and technology providers. Within three month of time period following observations were reported by the beneficiaries

1. formation of black dots on the surface of the green houses
2. Germination of yellow maize seed was not satisfactory.
3. water management was not up to the mark by the beneficiaries
4. Clogging of foggers in few green houses.
5. Effect of light on colour of fodder leaves.

To overcome the issues training programme and technical discussion was under taken to resolve the issues under guidance of Sr. Scientist (Animal Nutrition) from ICAR institute Goa.
Important suggestions made by the experts helped to overcome the problems

- In order to avoid fungal growth in the green houses fungicidal solution like EM (Effective micro organism) to be used.
- White maize seed was found to have better germination rate to yellow maize.
- Water in green house tank should be replaced in every three days.
- Seeds should be free from impurities to avoid clogging of foggers.
- Green fodder leaves have yellow appearance due to excessive sunlight outside of green house.

**RESEARCHABLE ISSUES AND STANDERDIZATION OF THE HYDROPONICS TECHNIQUE**

Various researchable issues under project were taken for study at hydroponics unit at ICAR, ICAR complex old Goa.

- Estimation of germination rate based on seed soaking time.
- Evaluation of nutrient contents in maize hydroponics green fodder
- Digestibility and feeding practices in Maize hydroponics fodder
- Use of EM (effective micro organism solution in green houses
- Standardisation of maize seeds used for Green fodder production in hydroponics house.
- Production cost of hydroponics maize green fodder through hydroponics technology.

Beside above studies other issues pertaining to effect of hydroponics fodder on milk production, fertility, weight gain in calves will be under taken in due course.

Based on beneficiary feedback and studies under taken by scientists below mentioned facts have been proved at initial stage of project implementation.

### COMPARISON - CONVENTIONAL FODDER PRODUCTION V/S HYDROPONICS MAIZE FODDER PRODUCTION (600 KG /DAY/UNIT)

<table>
<thead>
<tr>
<th>SI No</th>
<th>Attributes</th>
<th>Conventional Green fodder</th>
<th>Hydroponics Green fodder</th>
<th>Savings on</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Area</td>
<td>10000 sq.mts.</td>
<td>50 sq. mts.</td>
<td>Land</td>
</tr>
<tr>
<td>2</td>
<td>Fodder production in days (growth period)</td>
<td>60-70 days.</td>
<td>7 day.</td>
<td>Time saved on growth period.</td>
</tr>
<tr>
<td>3</td>
<td>Water and electricity requirement</td>
<td>Very high</td>
<td>Very low</td>
<td>Water and power saving</td>
</tr>
<tr>
<td>4</td>
<td>Land fertility</td>
<td>Essential</td>
<td>Not essential</td>
<td>Soil conditioning.</td>
</tr>
<tr>
<td>5</td>
<td>Fertilisers</td>
<td>Required</td>
<td>Not required</td>
<td>Saving on fertilisers</td>
</tr>
<tr>
<td>6</td>
<td>Fodder yield dependency</td>
<td>On climate rain, water, etc</td>
<td>In controlled environment</td>
<td>No dependency</td>
</tr>
<tr>
<td>7</td>
<td>Fodder utilisation by animals</td>
<td>Partial</td>
<td>complete</td>
<td>Reduction in fodder waste</td>
</tr>
<tr>
<td>8</td>
<td>Labour requirement</td>
<td>More</td>
<td>Less</td>
<td>Saving on labour</td>
</tr>
<tr>
<td>9</td>
<td>Fencing and protection</td>
<td>Required</td>
<td>Not required</td>
<td>Saving on fencing cost</td>
</tr>
<tr>
<td>10</td>
<td>Fodder feeding practices</td>
<td>By chopping</td>
<td>Not required</td>
<td>Saves chopping time and labour</td>
</tr>
</tbody>
</table>
### NUTRIENTS COMPARISON

**CHEMICAL COMPOSITION (ON % DRY MATTER BASIS) OF MAIZE GREEN FODDER.**

<table>
<thead>
<tr>
<th>NUTRIENTS</th>
<th>CONVENTIONAL GREEN FODDER (MAIZE)</th>
<th>HYDROPONICS GREEN FODDER (MAIZE)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Protein</td>
<td>10.67</td>
<td>13.57</td>
</tr>
<tr>
<td>Ether Extract</td>
<td>2.27</td>
<td>3.49</td>
</tr>
<tr>
<td>Crude Fibre</td>
<td>25.92</td>
<td>14.07</td>
</tr>
<tr>
<td>Nitrogen Free Extract</td>
<td>51.78</td>
<td>66.72</td>
</tr>
<tr>
<td>Total Ash</td>
<td>9.36</td>
<td>3.84</td>
</tr>
<tr>
<td>Acid Insoluble Ash</td>
<td>1.40</td>
<td>0.33</td>
</tr>
</tbody>
</table>

### BENEFICIARIES PREFERENCE FOR HYDROPONICS TECHNOLOGY OF GREEN FODDER PRODUCTION

End user beneficiaries and other milk producers opted for green fodder production through hydroponics technology offered their experiences.

- Hydroponics unit at Mandrem DCS members said that due to hydroponics technology they could save time and money on production of green grass by way of traditional method there by utilising same land for cultivation of other crops.

- Milk producers at Ramprasad SDVS khadaki expressed that hydroponics is a magic box, our worries in production of conventional fodder by spending money, labour, and dependency on rain, irrigation has reduced.

- Member of vithalapur DCS karapur claimed that there was 8 % hike in milk production was observed in their milch animals. They were happy to note that due to hydroponics fodder feeding enhancement of fertility (oestrus and conception) rate has also increased.

- Traditional milk producers at Ansole DCS were happy to run the unit as community Unit. They work together and generate fodder from the unit as one family. This has set a good example of Green fodder production through Community efforts.
✓ Orlim DCS members on coastal belt felt that this is the right technology to adopt as fodder generated through hydroponics could save higher cost on concentrate feed to reduce cost of milk production in Goa.

✓ Members of Mallikarjun DCS Caure were proud to state that Hydroponics technology in miming area is real asset to their society, which caters fodder need to other DCS members and generate daily income to the unit handling family.

✓ Cacoda DCS members reported that Hydroponics Unit is working as fodder factory in the urban area which serves the nutritious fodder to those animals who generally depend on vegetable and paper waste in the city.

✓ Visitors across the country visited to the demo unit at kapila DCS Curti Ponda expressed the need of hydroponics technology for green fodder production in other states also to have sustainable dairy business with lowered cost of production.

ACHIEVEMENTS

✦ Successful transfer of Hydroponics technology for green fodder production amongst milk producers.

✦ Generation of 600 kg maize green fodder per day per unit through hydroponics technology.

✦ Appx. seven kg hydroponics green fodder can replace one kg concentrate feed there by reducing cost of milk production.

✦ Seven day Hydroponically grown maize fodder has proved to be more nutritious as compared to conventional fodder of 60-80 days.

✦ Standardization of hydroponics technology in terms of seed usage, green house maintenance cost, production cost of fodder in Goan condition.

✦ Successful usage of nutritional benefits of hydroponics green fodder for enhancement of productivity, reproductive efficiency and health in milch animals.

✦ As an income generating source to the hydroponics fodder growers.

✦ Hydroponics Technology a handy tool to unemployed youths who are unwilling to take up agriculture in fields.
Hydroponics technology could work as beneficial tool to have paddy sapling nursery, flowers and other vital plant propagations beside fodder production for animals.

Conservation of environment and land saving.
आता गुरांना वर्षभर हिरवागार चारा
हायप्रोपोनिक तंत्रज्ञानाने वाढणार गोव्यातील दूषउतपादन!

चाराचारणाऱ्याने वनस्पतीजन्य प्रधानांचे प्रमाण तसेच कृषीतीन या हरितद्वाराचा साथा भरपूर असतो, शिवाय तंतुम्य व विश्वासबांधणी करून देऊन, विविध प्रकाराची खिंचवाहीची जनवरीने संभाजित. त्यानुसार ही चारा दुनियातील जनवरीने २० कंप्रणा दुर्धारात दोनों सावधान चाराचित्रात मोडी बाढ होते. पायातपरंपरातून प्राप्त ६०० किलो हिरवार चारा उत्तमतत्त्व करण्याचे उद्देश ठेवले तर किमान ७० हजार चौ.मी. सुपीक जमीन आवश्यक असते. शिवाय रासायनिक उत्तर, अधिक संकटांचे भंडार, डंपर, गावत कामगी नंतर आढ़ी बाबी आवश्यक उत्तर. तसेच एकदा शिवाय फेरीवित्तीय रूपात चाराची सुरंगांत होणारातील ६५ ते ६० दिवस लागतात. पण एखादा चारा हायप्रोपोनिक तंत्रज्ञानाने निम्ने कारण चाराच्या आत्मविरोध ५० चौ.मी. जाणा पुस्ती उद्द्वोधन आणि चाराच्या उत्तराचे देखील ७० दिवसांत! शिवाय असा चारा पार्श्विक चाराशाखा सर्व असून त्यातील रासायनिक गुणधर्म दूष उत्पादनासाठी फायदेशी आहेत. हायप्रोपोनिक चारा अर्थव्यवस्था हिरवागार आणि तंत्रज्ञान असल्याने पुरस्कर तो आवर्तने खेळात. एका दुष्याचा जनवरीचा दिवसकाळी ५५ किलो हायप्रोपोनिक चारा पुस्ती उत्तराचे. गोव्यात आतापर्यंत प्रायोगिक तंत्रज्ञान फरव्ह १९ टक्केनं हायप्रोपोनिक हिरवार चारा उत्तराचा संघकास आहे. पण गोव्याची दृष्टीय गरज पाहता दुष्ठताच्याचा वाढवित्त्वाहून हायप्रोपोनिक तंत्रज्ञान सर्वसामान्य दूष उत्तराच व्यावसायिकपणे पौष्पित विविधाचारी सरकारने पाहते उचलली तर युवा आणि मोठ्या प्रमाणात दुष्ठताच्या व्यवसायाचे बनवले, अशा आशा व्यक्त होत आहे.
CONCLUSION

Natural green fodder is the key to decreasing feeding cost during milk production. However due to climatic conditions, non availability of land succulent grass is available for shorter period in year and not available at all in many regions of Goa. Due to non availability and higher land costs, minimum Utilisation of fodder producing areas to feed livestock, could intern provide more acreage for other crop production, there by improving the economy and sustainability of land. This system also eliminates additional pressure on already over worked irrigation system. The process of growing green fodder Hydroponically allows the control of climatic conditions for optimum growth with guaranteed output per day. In current scenario it is the demand of the dairy owners in the states, were there is low land holdings, scarcity of water, saline water, higher labour and land cost. It has proved that Green fodder production through Hydroponics technology can be a real alternative source to over come the fodder deficiency in the state.

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