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Assessment of socio-economic viability of simplified hydroponics to improve the household food production and to develop a strategy for commercialization

Technology Grant No. TG/2012/Tech – D/07

**Final Report
Submitted to the**

**National Science Foundation
Sri Lanka**

By

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FR 1679

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Project Title: Assessment of Socio-economic viability of simplified hydroponics to improve the household food production and to develop a strategy for commercialization

Date the Project work commenced: 1st June 2013

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Date of submission of the final report: 12th August 2014

Total Allocation of Funds: Rs.593, 950.00

Total expenditure at the time of completion of the grant period: Rs.812,662

A) Details of Team Members

1. Team Member – Dr.Susil H.Liyanarachchi
Team member - Mrs. M.D.J.S.Saparamadu
2. Details of collaborators - None
3. Place where the project was carried out – Colombo and Kalutara Districts
4. Project personnel
 1. Number of personnel employed – 1
 2. Their status after the completion of the project – unemployed
5. Final Financial statement is attached – Yes

B) Executive summary of the project

Simplified hydroponics system is a low cost agriculture production system based on hydroponics principles. The system consists of three components – grow boxes, inert medium and the nutrient solution. We have developed a low cost nutrient solution for this system which has been patented nationally and numerous field investigations conducted demonstrated the feasibility of growing a vast array of vegetable species under this system.

The objective of the project was to assess the socio-economic viability of the simplified hydroponics system and to develop a market strategy for wider adoption of this system for household vegetable production. The project was carried out in Colombo and Kalutara Districts involving 20 households, 10 schools and 08 institutions.

Results of the pilot project revealed that the simplified hydroponics system is an appropriate and affordable technology for household vegetable production and is most suited for those households having limited land/space for conventional home gardening. However, fewer inputs required for crop production such as less labor, lesser amounts of water, lesser time for maintenance of the hydroponics gardens and absence of weed control makes this system attractive for anyone who is interested in home gardening. Main criteria for judging the effectiveness of the system is the yield obtained from crops and as mentioned above the levels of inputs required for household vegetable production. In

order for wider adoption of the technology all three components of the system needs to be available commercially.

Based on the experiences and insights gained from those participated in the pilot project, a commercializing strategy has been developed.

C) Report in Detail

Introduction/Background

Simplified Hydroponics is a low cost agriculture production system based on hydroponics principles. The system consists of three components – grow boxes, inert medium and the nutrient solution. We have developed a low cost nutrient solution for this system which has been patented nationally and numerous field investigations conducted demonstrated the feasibility of growing a vast array of vegetable species under this system.

National Science Foundation has approved a one year grant to implement a project on assessing the socio-economic viability of simplified hydroponics systems and to develop a market strategy for wider adoption of this system. The project was carried out in two districts, namely Colombo and Kalutara Districts involving 20 households, 10 schools and 08 institutions.

This report presents project end results which include the findings of the socio-economic assessment and the market feasibility study conducted. The findings are based on the experiences of and insights generated by those participated in throughout the project period.

Objectives

Overall objective of the project is to assess the socio-economic viability of simplified hydroponics technology for household vegetable production for consumption purposes and to develop a strategy for commercialization.

Activities and Outputs

Description of the work carried out during the reporting period against the work Plan

Activity	Progress
Output I. 10 number of community managed simplified hydroponics demonstrations gardens in selected schools, elderly homes, children's homes established and functioning in each District by the end of year one	
1.1 Selection of schools and public institutions	Completed
1.2 Initial visit to the places and induction	Completed
1.3 Sensitization program for AGA Offices in selected places including the GN officers and	Completed

also to key stakeholders. Agriculture officers , Education authorities etc.,	
1.4 Awareness Program on SH and technical demonstration	Completed
1.4 Setting up of the gardens	Completed
1.5 Design of formats for data collection and technical protocols	Completed
1.6 Procurement of chemicals	Completed
1.7 weighing and packaging	Completed
1.8 Monitoring the maintenance and record keeping on regular basis	Completed
1.9 Preparation of monthly reports	Completed
1.10 Preparation of quarterly reports	Completed
Output 2. Demonstration gardens established in 10 households of selected families in each of the two districts	
2.1 Selection of Households	Completed
2.2 Conduct awareness Programs	Completed
2.3 Setting up of demonstration gardens in Households	11 Households in Colombo District and 08 Households in Kalutara District
2.4 Regular monitoring and backstopping	Completed
Output 3. Social, economic and technical viability of simplified hydroponics in two Districts assessed	
3.1 Record observations and main findings from monitoring visits	Completed
3.1 Conduct individual interviews with beneficiary households using a structured questionnaire	Completed
3.2 Conduct focus group discussions to validate and triangulate the findings	This activity was combined with the activity 3.5.
3.3 Compilation and analysis of data from demonstration sites	Completed
3.4 Preparation of a draft report	Completed
3.5 Validation workshops with representative group of beneficiaries	Completed
3.6 Selection of 10 households for 2 nd crop cycle	Completed
3.7 Setting up the 2 nd crop cycle gardens	Completed
3.6 Preparation of the final report	Completed
Output 4. Demand for adoption of SH technology in urban areas of Colombo and Gampaha Districts Assessed	Completed ?
4.1 Identify a resource person/institution on market analysis	This activity has been changed in agreement with the NSF
4.2 Develop a methodology for demand analysis	Completed
4.3 Training of enumerators on the methodology	This activity has been changed in agreement with the NSF
4.4 Conduct the market survey	This activity has been changed in agreement

	with the NSF
4.5 Data analysis and report writing	Completed
4.6 Submission of the final report	Completed
Output 5. A potential strategy for scaling up and wider adoption of SH technology developed	
5.1 A consultative workshop with selected beneficiaries, CBOs and NGOs	This activity has been changed in agreement with the NSF
5.2 Consultation with a professional market institution	This activity has been changed in agreement with the NSF
5.3 Data analysis from all the reports available	Completed
5.4 Preparation of the strategy document	Completed

Description of the Work

Selection of households, institutions and schools

Households were selected from both the Colombo and Kalutara Districts - 10 from each district. Selection of households was conducted in collaboration with the Provincial Agrarian Service Agencies, the Kannanwila agriculture training center, Homagama agriculture training center and Maharagama Agriculture Training Center. Selection of the households was based on a number of criteria developed to select the most appropriate target group for the pilot project. Selection criteria included the interest and the past experience in maintaining a home garden, ability to find rice hull and sand as the growing medium and time for maintaining the hydroponics garden.

Government institutions were selected from the Kalutara District. Municipal Council, Electricity Board and the General Post Office showed a keen interest in participation in the pilot project. Open prison in Watareka was interested in participation mainly due to the potential of the technology for youth prisoners addicted to drug abuse. Altogether eight agencies including six government agencies, one private sector agency and one NGO have been selected to set up demonstration gardens.

Ten Public Schools have been selected for setting up demonstration gardens. Selection of schools were conducted in consultation with and recommendations made by the zonal education department. Before conducting the awareness programs, preliminary meetings were held with the school principal and the teacher in charge of agriculture with regard to the willingness and capacity of the schools to participate in the pilot project. All ten schools were selected from peri-urban areas of the Colombo District.

Awareness programs and Technical Sessions

Awareness programs which were followed by technical sessions were conducted to all participants. Objective of the awareness program was to provide participants with a general overview of hydroponics crop growing and introduce the objectives and expectations from the pilot project. Topics included in the general awareness program were 1) Global and local food security 2) Constraints and limitations in current agricultural practices 3) factors that need to be considered in developing new agricultural technologies 4) Principles of hydroponics and the history of hydroponics 5) advantages and disadvantages of hydroponics 6) principles and practice of simplified hydroponics and 7) setting up of gardens and nutrient management under simplified hydroponics.

Once the awareness programs were completed all participating families and agencies were requested to prepare the rice hull and river sand (growing media) as their counterpart contribution. Technical sessions were conducted only after the participants informed about their readiness with the growing media.

Objective of the technical session was to train participants on preparation of growing beds using rigidiform boxes, preparation of growing media, preparation of the hydroponics nutrient solution, application of the nutrient solution and nutrient management, planting the seedlings and seeds, maintaining hydroponics gardens and record keeping.

Delivery of materials and equipment

At the end of the technical training session individual participants and institutions were handed over the equipments and materials contributed through the project. It was ensured that the participating families and institutions have already prepared the growing medium in advance before the distribution of materials. Equipment and material included following items per person/institution. 1) 10 no. of rigidiform boxes 2) 10 hydroponics nutrient packs sufficient for 500 liters of nutrient 3) Black polythene to cover the inside the box 4) plastic tubing 5) 60 liter plastic barrel

Setting up of demonstration gardens and maintenance

Once the above steps were completed participating individuals and institutions were expected to set up the gardens in their localities. Setting up of and maintaining gardens included the preparation of grow boxes, transplanting the seedlings and nutrient management during the grow period and bloom and fruiting periods according the technical advice provided.

Monitoring

Maintenance of hydroponics gardens were regularly monitored to identify the issues and problems related to nutrient management and other aspects such as the quality of seedlings, pest and diseases and other technical assistance if required. Half year progress report was prepared based on the information generated from the monitoring activities. Further, some changes to the original proposal (without altering the original budget) have also been suggested based on the information gathered from monitoring activities. Difficulties were faced in monitoring the activities of the open prison and schools during the school holidays. Proper maintenance of records was also reviewed during the monitoring, and it had been a quite difficult task for most of the participants to keep proper records as instructed.

Assessment of socio-economic and technical viability of simplified hydroponics gardens

Based on the experience gained during the first half of the project cycle, it was decided to change the modality of the assessment proposed in the original project proposal. Accordingly, the external market survey to be conducted involving a random sample of respondents has been dropped. Instead, we employed the project participants themselves in socio-economic assessment and to study the market potential of the simplified hydroponics system. Almost all the project participants from households, schools and institutions were individually interviewed using a guided semi-structured questionnaire developed to elicit the required information. The questionnaire used and the list of participants interviewed is annexed. (See annexure I and II).

Information obtained from the individual interviews was further validated using a focus group discussion. List of participants of the focus group discussion is annexed (See annexure III)

Information gathered has been analyzed to identify strategies for developing a commercializing strategy to promote simplified hydroponics system.

Results and Findings

This section describes aspects related to the utility of the simplified hydroponics system and the enabling factors such as the effect of the climate, planting material, pest and diseases and impact of adaptive issues such as attitude, behaviors and practices of participants of the pilot project.

Simplified Hydroponics System

Simplified hydroponics system comprised of three main components; 1) Grow Boxes 2) Medium and 3) Nutrient solution.

Grow Boxes

The type of grow boxes used for the pilot project was commercially available rigid boxes of 15cmX 17cmX6cm size. Retail price of a box is Rs.300. There had been no major issues related to the durability and the utility of the rigid box for growing plants. It was revealed that the boxes can also be used without the black polythene cover which was meant for preventing algal growth by restricting the diffusion of sunlight inside the box. It has been observed that the plant leaves that touches black polythene tended to have scorching effects. Participants requested to have a choice of boxes of varying sizes having preference for 12 inches width.

The survey conducted asked participants to rate alternative materials that could potentially be used for grow boxes instead of rigid. Of the four alternative materials presented; low cost wood, plastic, cement and clay pots, most respondents preferred material was plastic due primarily to easy handling. Main issue for wood was its low durability and for using cement boxes the limiting factor was the weight. However, cost is the main determining factor and Rs.200-400 has been identified as the most feasible price range for a box. Therefore, a major consideration in commercializing the system and its popularization is the cost of the grow box. Another recommendation is to have boxes having sufficient space to grow a single plant. This will also make the cost of boxes more affordable.

Medium

The inert medium used for growing plants was a mixture of soaked rice hull and river sand at 3:2 ratio. The medium was to be prepared by the participants themselves according to the instructions given. However, most of the respondents were of the view that the process of medium preparation as cumbersome and it should be commercially available. A major impediment in preparing the medium was difficulty in soaking for a period of 5 days. Those who were selected from housing schemes and the elderly participants mentioned that they find it difficult to access and transport the rice hull in addition to lack of a proper place for soaking and mixing. Those who preferred preparing the medium on their own were limited. Cost of river sand per box was about Rs.450 excluding the transport cost and the cost of rice hull was about Rs.20 per gunny bag.

A major finding of the pilot project is that if this to be popularized among those who reside in housing schemes and high rise flats the medium need to be available in packs of appropriate size, the most preferred size being the amount sufficient for one rigid box, which is on average five numbers of four liter buckets. In addition to commercially available rice hull and sand mixture, the need for commercially available packeted rice hull alone has also been mentioned to replenish decomposed rice hull after about 10-12 months of use.

Nutrient Solution

Nutrient solution comprised of three components sufficient for the preparation of one unit of the nutrient solution of 50 liters. Three components of the total nutrient solution were pack A, pack BG (grow) and pack BF (bloom & fruiting). Almost all participants were of the view that preparation and the use of the nutrient solution is straightforward and no major difficulties encountered except the long time taken for the complete dissolution of the nutrients. In terms of application there had been some confusion with regard to the amounts used per box and the shifting from grow solution to the bloom & fruiting solution.

In regard to the amount of nutrient used per box the difficulty was due to the number of plants that were planted in a single box. Despite our recommendation of restricting two plants per box, many planted different numbers, on average 2-4 plants per box. An extreme case was planting six reddish plants in a box. However, it was found that one yoghurt cup (100ml) of nutrient solution per box per day at the grow stages and one yoghurt cup per plant after flowering was the optimum. 2 plants per box seem to be the most appropriate number of plants per box. However, this needs further research and confirmation. 4 sets of BG and 6 sets of BF were sufficient for a period of 5 months for 10 boxes.

Enabling factors

Climatic conditions

A major impediment for the project was the continuous heavy rainy season experienced due mainly to the impacts of climate change. While the system can withstand scattered rain, flash flooding that accumulate large amounts of water inside the boxes retard the plant growth. Therefore, the participants had to replant crops several times.

The main finding of the pilot project is that this system is more suited for dryer areas and if used in wet zone, protection of a simple shelter over the grow boxes seems to be the most appropriate measure to prevent crop damage from excess water, particularly as an adaptive measure to the climate impacts.

Planting material

While there were no major issues in regard to the access of planting material, there had been a number of cases in regard to the low quality of the commercially available seeds sold by private agencies having low germination rates and a considerable batch to batch variation. As observed by a participant a thorough washing of seeds before planting could increase the germination rate. The best seeds were those manufactured and sold by the Department of Agriculture. The findings revealed that more mature seedlings were best for the system. For example, when it

comes to chilies or tomatoes it is better to keep seedlings one week longer compared to the recommended length of seedlings in the nursery for replanting in soil. Some have used the grow bed as the nursery.

Pests and diseases

The simplified hydroponics system we promote is meant for producing food for household consumption. Given the heightened public concern on negative health effects of uncontrolled and abusive practices of pesticide use in commercial vegetable cultivation communities were more inclined to grow and consume vegetables free of pesticides. Therefore, the project encouraged the use of natural means for the control of pest and diseases instead of using chemical pesticides. (Since the system is free of weeds there is no need of using weedicides). However, pest and diseases control has been one of the major problems faced by the growers and was a key contributory factor in crop yield reduction. High intensity of pest attacks observed in recent times assumed to have some link to the effects of climate change.

Adaptive issues

Results of the pilot project clearly indicated a positive correlation between the interest and commitment of growers and the performance of the gardens. Most of the successful gardens were managed by those who had demonstrated commitment and interest towards home gardening. Most of those individuals and institutions already had well maintained gardens. Another important factor that contributed to the success/failure of project performance was the attitude of the individuals involved. This was clearly evident among the schools and institutions. A positive attitude of the leading individual always had a catalytic effect on the project and in addressing problems as and when they occur.

The next section present the overall performance of projects disaggregated into the types of institutions involved in the project.

Overall performance of the pilot project

The main criteria for measuring the performance of hydroponics gardens was the crop yield obtained at the end of the project. Accordingly, gardens were categorized into three groups; good, average and failed. The following tables summarize the findings disaggregated into Districts and institutional types.

Project end status of gardens – Households

Households		
District – Kalutara		
Good	Average	Failed

6	3	0
District - Colombo		
Good	Average	Failed
5	2	4
Total Households		
Good	Average	Failed
11	5	4



Project end status of gardens – Institutions

Institutions		
District - Kalutara		
Good	Average	Failed
3	0	2
District - Colombo		
Good	Average	Failed
0	0	4
Total Institutions		
Good	Average	Failed
3	0	6



Project end status of gardens – Schools

Schools		
District – Colombo		
Good	Average	Failed
5	2	4



Maximum Yields Obtained for Different Crops

crop	No. of plants/box	Yield/box Kg.
Veraniya Chillies	2	1.5
Cabbage	4	3.0
Chillies	2	1.6
Kno-kohl	6	2.0
Okra	2	2.0
Capsicum	2	1.0
Kochchi Miris	2	1.0
Cauliflower	2	0.5



Crop performance as experienced by the participants

Crop	Performance	No. of Plants/box
Veraniya Chilies	Good – maximum of 25-30 mature pods per plant	2
Kochchi Chillies	Good – no pest attacks	2
Cabbage	Good	2
Okra	Good	2
Leafy vegetables	Good	-
Tomatoes	Good	2
Kno-kohl	Good	4
Cauliflower	Good	1-2
Beans – bush type	Good	4
Salad leaves	Average	-
Brinjoles	Good	2
Carrot	Failed	2
Capsicum	Good	2
Green Chilies	Good	2

Summary findings of the socio-economic assessment and insights gained from the pilot study relevant to developing a market strategy for simplified hydroponics system

This section consolidates the findings of the monitoring visits, individual interviews with growers and the focus group discussions that were held under different topics.

- 1. Simplified hydroponics system is most appropriate for households with limited space. However, others who participated in the project having enough land for home gardening activities were of the opinion that due to less labor, less water and lesser time required for maintenance and absence of weed control and soil borne diseases in simplified hydroponics system make it attractive to anyone who is interested in vegetable production for home consumption.**
- 2. It is recommended that all three components of the simplified hydroponics system needs to be commercialized, preferably along with high quality planting material so that not only those who are interested in home gardening, but also those who are inclined but not fully committed could find all essential inputs to own an appropriate, affordable and accessible home garden which could be maintained without much hassle, even by those who are busy with other work. All of the respondents were of the view that once the simplified hydroponics garden is set up, the time required for daily maintenance which is primarily for applying the nutrients take no more than 15-20 minutes. In return the owner gets fresh vegetables free of pesticides and other harmful elements.**
- 3. It is important to maintain demonstration gardens in appropriate and relevant places for the public to view the operations, maintenance and the crop performance of simplified hydroponics systems.**
- 4. Success of simplified hydroponics gardens mainly depend on the interest, commitment and the attitude of the grower or the practitioner in home gardening. This may seem obvious. However, we found that targeting and working with those who are keen and interested in home gardening in initial stages of technology dissemination and adoption to make them convinced of the distinct advantages of the simplified hydroponics system would be an important first step towards popularization and facilitating wider adoption of this technology among the wider public. As we observed in the pilot study, those who are passionate about home gardening can act as catalysts to encourage those who get easily demotivated due to various problems one would face in crop growing in open environment. Those who are already accustomed to the vagaries of nature and the effect of numerous climate variables on crop production knows how to deal with those variables and find ways to overcome those obstacles through experience. This tacit knowledge and sharing of that is essential for the promotion of new technologies such as simplified hydroponics.**

5. Setting up of demonstration gardens in different agro-ecological zones would help generating interest on this technology and to see the advantages and also the limitations of the system. This will help communities to get a better understanding of the requirements and necessary adaptations to be made in respect to contextual specificities. This will also enable to identify specific crop varieties that are most suited to different climatic zones to plan the garden accordingly. Findings of the pilot study clearly showed the importance of holding an individual accountable for setting up of and managing the demonstrations gardens. One of the main reasons for failures of simplified hydroponics gardens set up at institutions levels is that there were no one designated to manage the project and there were management issues in regard to the maintenance.
6. Good quality planting material is a prerequisite for the success of hydroponics gardens. We found that seedlings are more appropriate compare to seeds. For simplified hydroponics gardens more mature seedlings are more suited.
7. The most preferred material for grow boxes are those made out of plastics. It is important that plastic containers are resistant to UV radiation to increase the durability. There seems to be containers made out of rubber based material being introduced to the market and this is an area that needs to be explored further. Other than plastics, there are other alternatives such as appropriate containers made out of clay, cement and low-cost wood.

Proposed Marketing Strategy

Based on the findings of the market research and observations made all three components of the simplified hydroponics system needs to be available on commercial basis. This include; the grow boxes, grow medium and the nutrient solution.

Capitalizing the strengths of different stakeholders in the industry the following has been identified as the most appropriate marketing strategy for the simplified hydroponics system.

1. To set up a company or a social enterprise managed by the developers of the nutrient solution to undertake the production of the simplified hydroponics nutrient pack ensuring the quality assurance of the product. The company will also undertake the setting up of demonstration gardens, technology training and dissemination and also get involved in research and development.
2. Grow medium will be manufactured by identified individual entrepreneurs from areas where the raw material for the production of medium, i.e. rice hull and river sand is available.

3. Identify suitable suppliers/manufactures of grow boxes made out of different material as identified in the market survey to have a wider choice in relation to the material and different sizes to suit differential requirement of communities.
4. Identify a private sector partner in the agro-enterprise field to market the all three components of the system having demonstration gardens. Selected private sector partner will use their existing market networks to distribute the product and for after sales services in consultation with other key stakeholders in the industry.
5. To mobilize and train a selected group of simplified hydroponics growers from among the grassroots communities as promoters of the technology and to provide extension services on simplified hydroponics. This group can also be linked up with the marketing company as agents of nutrient distribution for a commission.

Conclusion

Simplified hydroponics system has been proved to be an appropriate technology that is suited to produce vegetables for household consumption which is most suited for communities with limited space. Efficient use of water, nutrient, time and labor use are the distinct advantages of this technology which will suit busy professionals, women, elderly people and also people with disabilities. Results of the socio-economic assessment and market feasibility conducted involving community groups and institutions supported by the National Science Foundation revealed that for the successful adoption of the technology and for scaling up it is important to make all three components of the simplified hydroponics system to be available on commercial basis.

Deviations to the work plan when compared to the original proposal

Based on the findings of the half year evaluation findings and constraints in funding the external market survey proposed in the original submission was not done. Instead, we involved the project participants themselves in assessing the market feasibility of the system and to get insights in regard to developing a commercial zing strategy for simplified hydroponics system.

This change of activity was done without altering the original budget and the rationale for proposed changes were presented to the NSF project review committee and prior approval for the changes proposed changes were obtained.

Whether the work was on schedule? If not give reasons

The proposed time periods had to be adjusted due to the delays in receiving funding. As informed this was primarily due to the delays in releasing funds from the government

treasury. However, this did not affect the overall time required for the completion of activities proposed which was one year duration.

Major items equipments/consumables & material purchased during the reporting period

No equipments were purchased. Major consumables and materials purchased included;

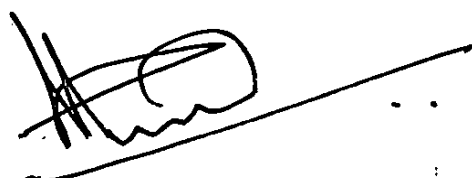
1. Chemicals for nutrient preparation
2. Grow boxes – Rigiform boxes
3. Plastic containers of 50 liter size
4. Black polythene
5. Gum tapes

Problems if any, encountered during the implementation of the project

The major problem encountered was the heavy and prolonged rain that might be due to climate shifts. This has affected the young seedlings and replanting of crops was necessary. One of the major recommendations to overcome this was to have a temporary shelter over the grow boxes during heavy rains.

Proposed follow up action regarding output

Follow up actions are explained under the proposed commercializing strategy



Signature of the Project Team leader

10. August. 2014

Date

Annexure I. Individual Interviews – List of Participants

1. Kannanwila Agriculture Training Center - Horana
2. Post office - Horana
3. **Ceylon Electricity Board – Horana**
4. P.Kumarasinghe
5. C.Perera
6. H.Ranasinghe
7. **A.Rodrigo**
8. **T.Ariyaratna**
9. A.Weeramuni
10. P.G.Sirisena
11. S.yatapatha
12. **H.A.D.Chandani**
13. Piyasoma Perera
14. A.D.Chitrananda
15. S.Priyangika
16. Sanjaya Mathota
17. **Matthegoda Vidyadeepa Vidyalaya**
18. Parakrama Maha Vidyalaya
19. Vijayagosha Vidyalaya
20. Homagama Maha Vidyalaya
21. Lenagala Maha Vidyalaya
22. **Maggamma Maha Vodyalaya**
23. P.Amaratunga

Annexure II. Market Feasibility Study – Questionnaire for Households

**Simplified Hydroponics – Market Feasibility Study
Questionnaire for Households**

General Information

1. Name :

Address:

2. Gender : Male

Age:

20-30	30-40	40-50	50-60	60-70	>70

Female

3. Working :

Non Working :

4. Crops & Yield

Crops Planted	Crop Yield

Seeds

5. How did you get the seeds? 1. Purchased 2. From others 3. From own plots

6. If purchased any difficulty you faced?

SH Technology

7. What are the main advantages of this technology? (Probe for details in regard to the specific advantages such as time, labor, water use, space, nutrients etc.,)

Labor	Hours/day –
Water (for 5 boxes)	Liters/day (convert buckets into liters) –
Nutrients (for 5 boxes)	Number of yogurt cups /day

When did you water – Time of the day	
Were there any missing days to put nutrients and reasons?	
Did your plants get diseased?	
If so what did you apply?	

8. Did you have a shelter over the boxes? Yes No:

9. If not how did you manage the rain?

10. Was it difficult to find and soak paddy husk?

11. Was it difficult to buy sand?

12. How did you apply nutrients?

No. of Plants/box	Grow Stage		Flowering & Fruiting	
	One cup	Two Cups	One Cup	Two Cups

Commercialization

13. Are you practicing soil based agriculture for home gardening?

14. How much is the investment in general per month/crop cycle? i.e. for fertilizer, labor, water etc.,

Input	Cost per crop cycle
1. Fertilizer	
2. Water	
3. Labor (hours of labor)	
4. Other (i.e. seeds, pesticides)	

15. Would you like to continue using this technology for home gardening?

16. Considering your present agricultural activities is the SH technology relevant or make sense? If so How it is relevant?

17. How many grow boxes are you willing to maintain and manage in future?

18. What is the maximum amount that you would like to spend on fertilizer per crop cycle for maintaining the number of boxes mentioned above?

19. Based on you experience in using this technology what are the innovations/additions/changes that you suggest that will further improve the utility/usage of this technology?

20. If this technology is to commercialize would you be willing to pay for the following items?
(We need to mention approximate prices per unit. Need to separate cost of capital items and the recurrent expenditure)

- | | | |
|--|-------------------------------|------------------------------|
| (a) Growing medium – (One year duration) | Yes: <input type="checkbox"/> | No: <input type="checkbox"/> |
| (b) Grow boxes – (Five year duration) | Yes: <input type="checkbox"/> | No: <input type="checkbox"/> |
| (c) Nutrient solution – 50 liters per crop cycle
(6 months) per 5 boxes | Yes: <input type="checkbox"/> | No: <input type="checkbox"/> |

21. Of the above items any items that you can make by yourself?

- | | |
|--------------------|--------------------------|
| (a) Boxes | <input type="checkbox"/> |
| (b) Growing medium | <input type="checkbox"/> |

22. What is your preference in regard to the grow boxes made out of the following material?

- | | |
|--|--------------------------|
| (a) Rigid boxes (2-3 year duration) | <input type="checkbox"/> |
| (b) Wooden boxes (1-2 year duration) | <input type="checkbox"/> |
| (c) Plastic boxes (about 10 years) | <input type="checkbox"/> |
| (d) Light weight concrete boxes (about 10 years) | <input type="checkbox"/> |
| (e) Any other preferences/suggestions | |

23. Do you need further training on simplified hydroponics?

24. If yes, please provide details on the type of information/specific skills that you would like to improve through training .
 25. Other than the inputs mentioned above what other support services that you require for effective hydroponics crop growing?
 26. Do you think this technology is also suitable for commercial agriculture?
 27. If yes, what are the changes/modifications that you think are needed?
-

Annexure III. Focus Group Discussion- List of Participants

1. P.H.kumarasinghe
2. T.Ariyaratna
3. H.ranasinghe
4. U.G.A.Rodrigo
5. P.Amaratunga
6. Sanjaya Mathotage
7. S.Priyangika
8. S.Perera
9. C.Perera
10. S.Liyanarachchi – Moderator
11. J.Saparamadu – Co-moderator

National Digitization Project
National Science Foundation

Institute : National Science Foundation

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