3.4 Action Plan for Technology 3: Boreholes/tube wells as a drought intervention for domestic water supply

3.4.1 Description of the Technology

Ground water is used as a drinking water source and also for back-garden agriculture and aquaculture primarily in the dry zone. Boreholes/Tube wells consist of a narrow, screened tube (casing) driven into a water bearing zone of the subsurface. The borehole efficiency (high efficiency means both high yield and high success rates) changes with the bedrock geology. One of the main reasons for selecting this technology is that, under surface water stress situation the ground water can be substituted for domestic purposes as it free of pollutants. The total cost of construction of a hand pump tube well (HPTW) and a production borehole are Rs. 193,920 – Rs. 210,080 and Rs. 198,550 – Rs. 219,450 respectively[26] out of which 50% is for drilling of the well, 20% is for screening, 15% is for testing of water quality and yield, 5% is for cleaning, communication and the balance is for demobilization[27].The total cost changes with the depth and the size of the borehole and investment cost is very high.

When the bed rock is igneous or metamorphic in formation and with no weathered zones and fractures, it would result in low yielding and less sustainable bore holes. Issues related to ground water quality are connected with natural geochemistry of the area and also with industrial or agricultural pollution of aquifers.
One could become self reliant and sufficient of water by having a borehole. Personal boreholes serve water which is pure and free of added chemicals at all times. Another advantage is that, there is no need to pay water bills. For women in rural areas, burden of carrying water from long distance is reduced because of boreholes, thereby saving their time. In addition to that, they can get water from these boreholes at odd hours, e.g. during night. The saved time can be utilized in doing several activities that would add to their earnings and so improve their socio economic conditions. On the other hand, water from these boreholes can be used for back yard gardens. Due to these boreholes one need not depend on rains for their irrigation purpose and get ample amount of water for all the construction purposes. Moreover, the energy required to extract water from them is less as compared to that in water purification plants.

3.4.2 Targets for technology transfer and diffusion

Target for the technology is introduction of 50 hand pump boreholes/tube wells in the dry zone where suitable hydro-geological conditions are available. The project will be completed within a period of eight

[26] US $ = SLRs. 135.00

[27] Personal communications – NWSDB, 2012

years. The overall target will be achieved by 2021 if the project is commenced in 2013. Main steps proposed to be adopted for technology transfer and diffusion is as follows;

Conduct an awareness program for decision/policy makers to facilitate securing funds on a priority basis; Preparation of a strong proposal with the assistance of stake holders to obtain additional funds from donor agencies; Financial incentives through loan schemes and import tax relief, build capacity of NWSDB/WRB; Amend the existing guidelines/laws for safe and sustainable use of groundwater: Formulate a protocol for prioritization of areas/sites; Collect data on highly vulnerable areas for climate change; Implement a method to register organizations having at least one person who has successfully completed the certificate course as tube well contractors at WRB/NWSDB, Create awareness; R&D on ground water availability/quality; Construct the first successful 25 boreholes from year–3 to year-5) and next successful 25 boreholes during year-5 to year-6; Introduce an annual license system for boreholes to prevent over extraction; Steps to prevent degradation of Ground water quality; Evaluation of success (year-3 to year-7).

3.4.3 Barriers to the technology's diffusion

Existing overall enabling framework: Water Supplies for towns such as Nuwara Eliya, Tangalle, Batticalo, Dambulla, Wennappuwa, Ahangama, Kataragama, Vavuniya, Puttalam, Chilaw, Anamaduwa, Nikaweratiya, Kuliyapitiya and Mihintale are being fully or partly operated by using groundwater from deep bore holes. At present, about 8% of the total population is benefited by this technology. Usage of ground water in the country is rapidly increasing leading to intensified smallholder cultivation thereby improving the standards of living of poor farmers in the dry zone.

Water Resources Board (WRB) is responsible for ground water resources (Act No. 42 of 1999). WRB, collects data and information on Water Resources for advisory purposes, and undertakes Hydro-geological investigation and Groundwater development projects.

In Sri Lanka, a land owner is regarded as owning the unreserved rights to water underneath his land and tend to extract all accessible water. Such unregulated activities results in drying up the aquifers by the end of the dry season and some communities are left without drinking water.

Identified barriers for transfer and diffusion of the technology:

Fourteen (14) key barriers have been and are comprised of two (2) economic & financial, three (03) institutional & organizational, four (04) policy, legal & regulatory, three (03) information & awareness and market failure, one (01) technical and one (01) "Other" barriers.

The list of key barriers and hierarchy classification for technology 3 is given in table 3.10.

Table 3.10: List of Key Barriers and Hierarchy Classification for the Technology 3

Technology Name: Boreholes/Tube wells as a drought intervention for domestic water supply			
No.	**Key Barriers Identified**	**Priority Rank**	**Category of Barriers**
1.	High capital cost	1	Economic and financial
2.	Inadequate funding allocation for this technology	11	Economic and financial
3.	Lack of technical assistance for physical investigations of the site, drilling of the well, screening, water quality testing and yield testing	4	Institutional and organizational capacity
4.	Lack of understanding on negative impacts of over extraction of ground water	10	Institutional and organizational capacity
5.	Lack of sustainability	3	Institutional and organizational capacity
6.	Lack of policies/laws/ by laws/ guidelines for safe and sustainable use of groundwater	5	Policy, legal and regulatory
7.	Lack of policies/laws to control drilling of boreholes affecting vulnerable aquifers	6	Policy, legal and regulatory
8.	High interest on loans for importers/producers of tube wells due to lack of policies/strategies to establish low-interest loan scheme	14	Policy, legal and regulatory
9.	High import taxes due to lack of policies/strategies to provide tariff relief	12	Policy, legal and regulatory
10.	Lack of information on ground water resources	7	Information and awareness/Market failures
11.	Lack of prioritization of areas to implement this technology	2	Information and awareness, market failures
12.	Lack of information on prices of equipment, loan schemes etc.	13	Informationand awareness, market failures
13.	Lack of R & D on ground water availability and hydrogeology	8	Technical
14.	Limitations of the technology due to poor quality of ground water	9	Other

3.4.4 Proposed Action Plans for the Technology

The Proposed Action Plan for Boreholes/Tube wells as a drought intervention for domestic water supply is provided in table 3.11.

WATER SECTOR

Action Plan for Technology 3

Table 3.11: Proposed Action Plan for the Technology 3: Boreholes/Tube wells as a drought intervention for domestic water supply

Action 1: Reduce high capital cost					
Justification for the action: The barrier related to this action is '*High capital cost*' 50% of the cost of construction of borehole is for drilling of the well and the drilling cost increases with increase in the depth.					
Sub Action No	**Priority Rank**	**Responsibility for Implementation**	**Time frame**	**Cost (US $) & Funding Source**	**Indicators**
I. Select sites having suitable hydro-geological conditions	V. High	• Dept. of Irrigation • NWSDB	2-3 years	----	(i) Reduced drilling cost
Action 2: Adequate funding allocation for diffusion of the technology-3 in prioritized areas (e.g. rural areas)					
Justification for the action: The barrier related to this action is '*Inadequate funding allocation for diffusion of the technology in prioritized areas (e.g. rural areas)*'**.** The government has not given priority in the annual budget, for the diffusion of the technology-3 in prioritized areas.					
Sub Action No	**Priority Rank**	**Responsibility for Implementation**	**Time frame**	**Cost (US $) & Funding Source**	**Indicators**
I. Advocacy of policy makers and legislators for implementation of adaptive measures with respect to climate change	V. High	• M/ Finance and Planning • M/ Irrigation and	0-1 years	0.01 M Domestic	(i) Awareness programs on possible socioeconomic benefits through the technology-3.

		Water Resources Management • M/ Water Supply & Drainage			(ii) Policy makers and legislators consider implementation of adaptive measures with respect to climate change as a priority area when taking policy decisions
II. Allocate sufficient funds from annual budget	V. High	• M/ Irrigation and Water Resources Management • M/ Water Supply & Drainage	0-1 years	----	(iii) 50% increase of funding in the annual budget within the second year for diffusion of technology 2.
III. Mechanism for additional funding from donor agencies		• NWSDB • WRB	0-1 years	0.01 M	(i) Completion of three stake holder meetings. (ii) Completion of a strong proposal for obtaining grants/loans by end of year -1.
Action 3 : Build capacity of relevant institutes to offer a certificate course to disseminate necessary knowledge and technical skills on construction of successful boreholes					
Justification for the action: The barrier related to this action is '*Lack of assistance for physical investigations of the site, drilling of the well, screening, water quality testing and yield testing'.* Poor hydro-geological conditions of the site can affect the sustainability of the borehole/tube well. Persons having necessary knowledge and technical skills for construction of successful boreholes is lacking due to inadequate capacity of relevant institutes to offer skill development training programmes.					
Sub Action No	**Priority Rank**	**Responsibility for Implementation**	**Time frame**	**Cost (US $) & Funding Source**	**Indicators**
I. Build capacity of NWSDB/WRB to offer a	V. High	• NWSDB	0- 1	0.5 M	(i) By end of year-1, adequate capacity of WRB

certificate course on construction of successful boreholes.		• WRB	years	Domestic and International	and NWSDB for successful implementation of technology-3.
II. Implement a method to register organizations having at least one person who has successfully completed the above certificate course as tube well contractors at WRB/NWSDB.	V. High	• NWSDB • WRB	1-2years	---	(i) Availability of a list of qualified borehole constructing organizations registered at WRB/NWSDB, by end of the year-2.
Action 4: Improve the knowledge on negative impacts of over extraction of ground water					
Justification for the action: The related barrier is *'Lack of understanding on negative impacts of over extraction of ground water'*. In certain areas in the country, rate of groundwater abstraction has exceeded the rate of recharge. One of the main reasons is lack of knowledge of consumers on negative impacts of over extraction of ground water.					
Sub Action No	**Priority Rank**	**Responsibility for Implementation**	**Time frame**	**Cost (US $) & Funding Source**	**Indicators**
I. Build capacity of NWSDB and WRB to create awareness on negative impacts due to over extraction of ground water. Include this under 3-I.	V. High	• NWSDB • WRB	0-1 years	Included under 3-I.	(i) Indicators given under 3-I.
II. Raise awareness at national and sub national level	V. High	• NWSDB • WRB	2-6 years	2 M Domestic and International	(i) From year 3, conduct awareness programmes annually on negative impacts of over extraction of ground water.
III. Publish guide books (in Sinhala/English/Tamil), leaflets, posters etc.	V. High	• NWSDB • WRB	0-1 years	0.05 M Domestic and	(i) By end of year-1, availability of 1000 guide books (60 % in Sinhala/10% in English/30%

				International	in Tamil media) by end of the third quarter of year-0.
Action 5: Diffusion of the technology by giving special attention to sustainability of boreholes					
Justification for the action: The barrier is '*Lack of sustainability'.* Many boreholes constructed in Sri Lanka have become failures due to poor hydrogeological conditions of the site, over extraction and poor water quality etc. Therefore special attention should be given to sustainability of boreholes.					
Sub Action No	**Priority Rank**	**Responsibility for Implementation**	**Time frame**	**Cost (US $) & Funding Source**	**Indicators**
I. Construct the first successful 25 boreholes according to the priority list. After installation, implement good Operation & Management practices.	High	• NWSDB • WRB • Registered organisations	3-5 years	6 M International	(i) Availability of 25 Successful boreholes in the dry zone by end of the fifth year.
II. Construct the next successful 25 boreholes.	High	• NWSDB • WRB • Registered organisations	5-6 years	6 M International	(i) Availability of another 25 successful boreholes by end of the sixth year.
III. Establish a periodic inspection scheme/Introduce an annual license system for boreholes to prevent over extraction.	High	• NWSDB • WRB	3-6 years	5000 International	(i) Annual license system from the year-3 (ii) Inspection reports available from the year-3
Action 6 : Revise existing guidelines for safe and sustainable use of groundwater					
Justification for the action: Barrier is *'Lack of Policies/ laws/ by-laws/ guidelines for safe and sustainable use of groundwater'.* At present, ground water is over-extracted by certain consumers in Sri Lanka due to lack of policy/strategy in the country to control over extraction. As a result, such					

boreholes have dried-out. In coastal areas, brackish water has entered in to such boreholes.					
Sub Action No	**Priority Rank**	**Responsibility for Implementation**	**Time frame**	**Cost (US $) & Funding Source**	**Indicators**
I. Amend the existing guidelines for safe and sustainable use of groundwater, developed for the regolith aquifer.	High	• M/Irrigation and Water Resources Management • M/Water Supply & Drainage	0-1 years	---	(i) Availability of revised guidelines for sustainable use of ground water
II. Dissemination of above guidelines through awareness programs. This will be included under Action 4-II.	High	• M/ Irrigation and Water Resources Management • M/Water Supply & Drainage	2-6 years	Included under 4-II	(i) See indicators given under 4-II.
Action 7 : Revise existing policies/ laws related to ground water in order to control drilling of boreholes affecting vulnerable aquifers					
Justification for the action: Barrier related to this action is ' *Lack of policies/laws to control drilling of boreholes affecting vulnerable aquifers'.* Depending on the site, drilling of boreholes can affect vulnerable aquifers.					
Sub Action No	**Priority Rank**	**Responsibility for Implementation**	**Time frame**	**Cost (US $) & Funding Source**	**Indicators**
I. Revise existing policies/laws.	High	• M/Irrigation and Water Resources Management • M/Water Supply & Drainage	0-1 years	---	(i) Availability of revised policies/laws by end of year 1.

Action 8 : Establish a mechanism for adequate availability of financial resources through a low-interest loan scheme

Justification for the action: Barrier – '*High interest on loans for importers/producers of tube wells.* Currently there is no mechanism in the country to establish low-interest loan system for purchasing of necessary equipment.

Sub Action No	Priority Rank	Responsibility for Implementation	Time frame	Cost (US $) & Funding Source	Indicators
I. Formulate financial incentives through loan schemes	V. High	• Central Bank • Treasury • Private sector	0-1 years	---	i) With effect from end of year-1, availability of financial incentives such as concessionary interest and longer grace periods for loans.

Action 9: Establish a mechanism for adequate availability of financial resources through an import tax relief

Justification for the action: Barrier related to this action is '*High import tax for importers/producers of tube wells due to lack of mechanism/strategy to establish import tax relief'.* Currently there is no mechanism in the country to establish an import tax relief for importing necessary equipment.

Sub Action No	Priority Rank	Responsibility for Implementation	Time frame	Cost (US $) & Funding Source	Indicators
I. Formulate financial incentives through import tax relief; Combine this to Action 8- I.	High	M/Finance and Planning	0-1 years	---	By end of year-1, implementation of import tax relief.

Action 10: Update information on status of aquifers in the dry zone of Sri Lanka by WRB/NWSDB

Justification for the action: '*Lack of information on ground water resources'* is the barrier related to this action.

There is no regular monitoring program to update the status of ground water resources in the country.

Sub Action No	Priority Rank	Responsibility for Implementation	Time frame	Cost (US $) & Funding Source	Indicators
I. Implement an annual monitoring program by WRB/NWSDB	High	• WRB • NWSDB	2-6 years	0.01 M International	Availability of annual data on ground water resources
Action 11: Develop a mechanism for prioritization of areas/sites for installation of boreholes and preparation of a priority list					
Justification for the action: Barrier related to this action is '*Lack of prioritisation of areas to implement this technology'* At present a prioritized list for the country for introduction of the technology 3 is not available.					
Sub Action No	**Priority Rank**	**Responsibility for Implementation**	**Time frame**	**Cost (US $) & Funding Source**	**Indicators**
1. Formulate a protocol/mechanism	High	• M/Irrigation and Water Resources Management • M/Water Supply & Drainage	0- 1 years	--	(i) Availability of a protocol for preparation of a priority list by end of year 1.
I. Collect data on highly vulnerable areas for climate change, need and urgency	Medium	• NWSDB • WRB	0-2 years	5000 Domestic	(i) Availability of data on highly vulnerable areas for climate change, need and urgency by end of year 2.
III. Preparation of a priority list	Medium	• NWSDB • WRB	2-3 year	---	(i) Availability of a priority list by year 3.

Action 12: Awareness campaigns on special facilities provided for tube well constructors

Justification for the action: Barrier related to this action is '*Lack of information on prices of equipment, loan schemes etc.'*

Certain tube well constructors/producers are not aware of special facilities provided to borehole constructors registered at WRB/NWSDB.

Sub Action No	Priority Rank	Responsibility for Implementation	Time frame	Cost (US $) & Funding Source	Indicators
(I). Create awareness on special facilities provided to constructors/producers especially in rural areas.	Medium	• NWSDB • WRB	2-6 years	5000 International	(i) Publicity on special facilities provided to constructors/producers through media.

Action 13: Promote R &D on ground water availability/quality and hydrogeology of various sites

Justification for the action: Barrier related to this action is '*Lack of R & D on ground water availability and hydrogeology'.* Above information should be monitored and updated by WRB/NWSDB.

Sub Action No	Priority Rank	Responsibility for Implementation	Time frame	Cost (US $) & Funding Source	Indicators
I. Monitor ground water availability/quality and hydro-geolological data in a systematic basis.	Medium	• NWSDB • WRB	2-6 years	--	

Action 14: Prevent degradation of Ground water quality

Justification for the action: *Barrier – 'Limitation of the technology due to poor quality of ground water'*

If the quality of ground water is poor, quality of borehole/tube well water will also be poor. Tube well water samples contaminated with *Escherichia coli,* Fluoride and nitrate ions, agrochemicals etc, have been reported. Therefore, it is necessary to ensure ground water quality required.

Sub Action No	Priority Rank	Responsibility for Implementation	Time frame	Cost (US $) & Funding Source	Indicators
I. Regular monitoring of quality of borehole water. This can be incorporated with present water quality surveying program.	Medium	• M/ Irrigation and Water Resources Management • M/Water Supply & Drainage	3-7 years	0.02 M International	(i) Availability of data on quality of borehole water.
II. Monitor health conditions of people consuming water from above boreholes and study whether there is a relationship between health issues and borehole water quality.	Medium	• Dept. of Health	3-7 years	0.05 M International	(i) Availability of data on health conditions of people consuming water from above boreholes. (ii) Results of statistical analysis
Total Cost of Technology 3					**Approx: US $ 14.67 million**

V. High = Very High