CDM Feasibility Study (FS) 2012
Final Report

Energy Efficiency Improvement Program for Textile dyeing Process in Bangladesh Textile and Garment Industry

—Implemented by PEAR Carbon Offset Initiative, Ltd.—

FS Partner(s)	Green Project W.S.T
Location of Project Activity	Bangladesh
Category of Project Activity	Energy Efficiency
Targeted GHG	CO_2
Description of Project Activity	The PoA will reduce energy and water consumption in textile dyeing and finishing process through optimizing dyeing process from yarn to fabric including promoting high quality yarns and introducing direct dyeing, new generation reactive dyeing and other new dyes according to factories and buyers requirements. The technologies and know-hows will be introduced and promoted by Green Project Water Saving Technology (W.S.T), voluntarily as the W.S.T was established with a vision of promoting the water and energy saving technologies in Bangladesh Textile and Garment industry. The PoA is a voluntary action promoted by the W.S.T. The W.S.T is the coordinating/managing entity (CME) of the PoA and responsible for overall supervising and managing the PoA. PEAR is the PoA developer and CER buyer. The PEAR also supports the W.S.T on their management.
Methodology to be applied	AMS-II.D (Energy efficiency and fuel switching measures for industrial facilities, version 12)
Baseline Scenario	In the absence of the CDM project activity, the factories would continue to apply the current conventional dyeing practices to consume energy at historical average levels, until the time at which the dyeing practices would be likely to be replaced by the energy and water saving technologies in the absence of the CDM project activity.
Monitoring Plan	The W.S.T will act as the overall supervisor and prepare a monitoring report periodically (typically annually) to the DOE by using the reports by factories. The CPA implementers will undertake the monitoring (especially preparing the monthly and annual status report) based on the operation and monitoring manual prepared by The W.S.T. The WST has the responsibility to manage and operate all of the CPA. The monitoring parameters and monitoring frequency of them are given as follows. ・ Number of batches for the project（monthly aggregation） ・ Water consumption per batch for the project（per batch） ・ Steam consumption per batch for the project（per batch） ・ Electricity consumption per batch for the project（per batch） ・ Electricity production and fuel consumption of generators that provide electricity for the factory (yearly)

Estimation of GHG Emission Reductions	Estimated GHG emission reduction is 1,627 ton CO2/year.
Duration of Project Activity/ Crediting Period	The duration of the PoA is 28 years and the crediting period of each CPA is 10 years
Environmental Impact Analysis	As the PoA focuses on process change or process optimization in the existing textile and garment factories that have had environmental clearance certificates and the PoA is seen as no any negative environmental impacts then an additional environmental impact assessments for PoA is not required.
Demonstration of Additionality	The CPA additionality is stipulated as one of the eligibility criteria of the PoA. As for the additionality of the PoA, the PoA is additional if the each CPA under the CPA is additional. The CPA additionlaity is demonstrated through “GUIDELINES FOR DEMONSTRATING ADDITIONALITY OF MICROSCALE PROJECT ACTIVITIES, version 04”.
Project Feasibility	As the PoA almost does not require any additional investment and the technology the W.S.T introduced is not a new technology, the feasibility of the project is not seen as a problem.
Contribution to Sustainable Development in Host Country	The contribution of the PoA to sustainable development of Bangladesh is attributed to the environmental positive impacts of the PoA explained as below. The project will contribute to ensure future water security in Bangladesh. The underground water is the main source of drinking water in Bangladesh. However, for textile dyeing in Bangladesh garment industry, underground water also has been used dominantly. It has been figured out that the heavy lifting of underground water on a regular basis in so many places including Dhaka city is causing the underground water levels to dry up faster than is normal. The project promises to reduce underground water consumption for textile dyeing process significantly. The project will contribute to ease land subsidence having occurred. It is reported that there are too many places in the country where the heavy withdrawal of underground waters have disturbed the soil layers and caused land subsidence. Even in the capital city and other cities of the country that depend disproportionately in the lifting of underground water for household and other uses, land subsidence is noted to be a serious consequence of the practice. Thus, from the preventing the disfigurement of land and its calamitous effects, a reducing consumption of underground water is an indispensable way.

FS Title: CDM Feasibility Study on "Energy Efficiency Improvement Program for Textile dyeing Process in Bangladesh Textile and Garment Industry"

FS Entity: PEAR Carbon Offset Initiative, Ltd.

1. FS Implementation Scheme

W.S.T: The CME of the PoA
JTCC (Japan Textile Consultant Center): Subcontract entity for conducting energy saving audit in target factories.

2. Outline of CDM Project

(1) Description of Project:

The PoA will reduce energy and water consumption in textile dyeing and finishing process through optimizing dyeing process from yarn to fabric including promoting high quality yarns and introducing direct dyeing, new generation reactive dyeing and other new dyes according to factories and buyers requirements. The technologies and know-hows will be introduced and promoted by Green Project Water Saving Technology (W.S.T), voluntarily as the W.S.T was established with a vision of promoting the water and energy saving technologies in Bangladesh Textile and Garment industry.

The PoA is a voluntary action promoted by the W.S.T. The W.S.T is the coordinating/ managing entity (CME) of the PoA and responsible for overall supervising and managing the PoA. PEAR is the PoA developer and CER buyer. The PEAR also supports the W.S.T on their management.

The PoA also aims to contribute to environment and resources conservation significantly through water saving and CO2 emission reductions.

The first CPA of the PoA targets the Textile and Garment factory of the Grameen Knitwear, Ltd. which supports and closely works with the CME.

(2) CDM Methodology to be applied to the Project:

AMS-II.D (Energy efficiency and fuel switching measures for industrial facilities, version 12) is applied for CPAs under the PoA.

3. Study Contents

(1) Issues to be Addressed in FS:

The FS mainly has observed and discussed the following issues during the survey.

a. Understand the technologies promoted

In order to implement the project, it is important to understand the water and energy saving technologies, current actual condition and needs of Bangladesh textile and garment industry.

Therefore, the FS has conducted data and information collection through reviewing related references and site visits.

b. Issues related to CDM

The PoA applies the AMS-II.D (ver.12) and the methodology seems to be very flexible and leaves very wide rooms for application. However, the PoA covers all textile and garment

factories and situations of the factories vary especially as for monitoring that becomes a main issue on CDM development. Therefore, the study observed the feasible way of monitoring based on the real condition of factories.

(2) Process to Solve the Issues in FS:

Regarding the issues mentioned, the following surveys were conducted to determine solutions for the issues.
Domestic survey: for understanding the technologies, data collections through reviewing of references, research papers and reports were conducted. Consultation with Japan Textile Consultant Center (JTCC) was conducted and an outsourcing contract with them for auditing energy saving potentiality of target factories (Grameen Knitwear and Landmark) was done.
Three time of site visits were conducted with the following schedule and contents.
From 31 August 2012 to September 15, the first site visit was conducted. During the visit the two factories, Grameen Knitwear (CPA1) and Landmark (CPA2), were visited for understanding the existing situation and auditing energy saving potentiality. At the same time confirmation and discussions on baseline setting and monitoring were conducted. As a result, it was clear that the factories have energy saving potentiality in both dyeing process and facilities and ex-ante baseline survey for baseline setting was decided.
From November 3 to November 8, the second site visit was conducted. During the site visit, Local stakeholder consultation meeting was held to collect comments from varies stakeholders on sustainable development impacts of the project. During the site visit, discussions with experts from dyeing machine manufactories on calculation of water and steam consumption based on the dyeing curves. As a result, no negative opinions from stakeholders were found and sustainable development contribution of the project was confirmed.
From January 5 2013 to January 11, the third site visit was conducted as the validation site visit. The DOE visited the factories and related stakeholders and organizations were interviewed. The results of the survey are given as follows. The baseline can be set based on analyzing the historical record of dyeing recipes that indicate dyeing charts for corresponding dyeing technologies. The conservative (short time) dyeing chart for each type of dyeing (color, material and machine wise) should be determined as a baseline. CO_2 emission factors for boiler and electricity consumption efficiency of pumps are calculated as for specifications of boilers and pumps as parameters ex-ante determined. As it became clear that energy saving from most factories is under the limit (60 GWh_{th} per year) of micro scale CDM project, the additionality of CPAs under the PoA is demonstrated by "GUIDELINES FOR DEMONSTRATING ADDITIONALITY OF MICROSCALE PROJECT ACTIVITIES".

4. Results of CDM FS
(1) Application of CDM Methodology:

The methodology of AMS-II.D (Energy efficiency and fuel switching measures for industrial facilities) is applied for CPAs under the PoA and a justification of applicability of the methodology is given in the table below.

No	Applicable conditions of the Methodology	Conformity of CPAs
1	This category comprises any energy efficiency and fuel switching measures implemented at a single or several industrial or mining and mineral production facility/ies. This category covers project activities aimed primarily at energy efficiency;	Each CPA will promote energy efficiency improvement for textile dyeing and finishing process of a textile and garment factory by targeting dyeing machine and other machines.
2	This category is applicable to project activities where it is possible to directly measure and record the energy use within the project boundary (e.g., electricity and/or fossil fuel consumption).	The electricity and fossil fuel consumption for textile dyeing process can be measured or calculated through directly measured value by meters installed at corresponding points of energy an water supply lines.
3	This category is applicable to project activities where the impact of the measures implemented (improvements in energy efficiency) by the project activity can be clearly distinguished from changes in energy use due to other variables not influenced by the project activity (signal to noise ratio).	Each CPA under the PoA focuses on optimizing or changing textile dyeing process in dyeing machines or other machines. Then the target of the measures is clear; the impacts of the measures are controllable, distinguishable.
4	The aggregate energy savings of a single project (inclusive of a single facility or several facilities) may not exceed the equivalent of 60 GWh_e per year. A total saving of 60 GWh_e per year is equivalent to a maximal saving of 180 GWh_{th} per year in fuel input.	For every year during the crediting period, the aggregate energy savings of each CPA under the PoA will not exceed 180 GWh_{th} per year. If during implementation and monitoring of each CPA goes beyond 180 GWh_{th} in any year of the crediting period, the GHG emission reductions that can be claimed during this particular year shall be capped at the maximal saving of 180 GWh_{th} estimated in the registered CPA-PDD for that year during the crediting period.

(2) Baseline Scenario and Project Boundary:

As per the methodology AMS II.D./version 12, the baseline scenario for the PoA is demonstrated as follows.
In the absence of the CDM project activity, the factories would continue to apply the current conventional dyeing practices to consume energy at historical average levels, until the time at which the dyeing practices would be likely to be replaced by the energy and water saving technologies in the absence of the CDM project activity.
The PoA targets textile and garment factories in Bangladesh and each CPA targets one factory. The sources of GHGs and GHGs considered in CPAs under the PoA are explained in the table below.

Source		GHGs	Included?	Justification/Explanation
Baseline	Electricity consumption of dyeing machines	CO_2	Yes	Major Source of emissions
		CH_4	No	Minor Source and thereby neglected
		N_2O	No	Minor Source and thereby neglected
	Steam consumption of dyeing machines	CO_2	Yes	Major Source of emissions
		CH_4	No	Minor Source and thereby neglected
		N_2O	No	Minor Source and thereby neglected
	Electricity consumption for pumping up water that used in dyeing processes for textile dyeing	CO_2	Yes	Major Source of emissions
		CH_4	No	Minor Source and thereby neglected
		N_2O	No	Minor Source and thereby neglected
Project	Electricity consumption of dyeing machines	CO_2	Yes	Major Source of emissions
		CH_4	No	Minor Source and thereby neglected
		N_2O	No	Minor Source and thereby neglected
	Steam consumption of dyeing machines	CO_2	Yes	Major Source of emissions
		CH_4	No	Minor Source and thereby neglected
		N_2O	No	Minor Source and thereby neglected
	Electricity consumption for pumping up water that used in dyeing processes for textile dyeing	CO_2	Yes	Major Source of emissions
		CH_4	No	Minor Source and thereby neglected
		N_2O	No	Minor Source and thereby neglected

(3) Monitoring Plan:

The W.S.T will act as the overall supervisor and prepare a monitoring report periodically (typically annually) to the DOE by using the reports by factories.
The CPA implementers will undertake the monitoring (especially preparing the monthly and annual status report) based on the operation and monitoring manual prepared by The W.S.T.
The WST has the responsibility to manage and operate all of the CPA.
The monitoring parameters and monitoring frequency of them are given as follows.

- Number of batches for the project（monthly aggregation）
- Water consumption per batch（per batch）
- Steam consumption per batch （per batch）
- Electricity consumption per batch（per batch）
- Electricity production and fuel consumption of generators that provide electricity for the factory (yearly)

Monitoring equipment or meters are installed to dyeing machines in the case of there are no measuring equipment on the machines. The meters include electric power meter, steam and water flow meters. In the case of dying machines have monitoring functions; the recorded data in the memory is used for calculation of the monitored parameters.
Based on orders, factories have to prepare dyeing recipes; a sample is decided from the number of recipes with 90/10 statistical conditions.

(4) GHG Emission Reductions:

For ex-ante calculation of emission reduction from the CPA, the following assumptions are considered with the data in hand at the moment.

- Number of batches 4000
- All cotton
- 95% fabric load
- Among the batches 80% dark, 10% medium and 10% light color

Baseline emission：

$$BE_y = (EC^{BL}_{Dyeing,y} + EC^{BL}_{Water,y}) \times EF^{BL,elec}_{CO2} + SC^{BL}_y \times EF^{BL,steam}_{CO2} \quad (1)$$

where,

BE_y	Baseline emissions in a year *y* (CO_2 ton/year)
$EC^{BL}_{Dyeing,y}$	Baseline electricity consumption by dyeing machines to which the water and energy saving technologies will be introduced by the CPA in year *y* (kWh/year)
$EC^{BL}_{Water,y}$	Baseline electricity consumption by pumping of fresh water that used in dyeing machines in year *y* (kWh/year)
SC^{BL}_y	Baseline steam consumption by dyeing machines to which the water and energy saving technologies will be introduced by the CPA in year *y* (ton-steam/year)
$EF^{BL,elec}_{CO2}$	CO_2 emission factor of electricity generation for the factory (ton CO_2/MWh)
$EF^{BL,steam}_{CO2}$	CO_2 emission factor for the steam generation for the factory (ton CO_2/ton)

BE_y = (713,920+58,576)* 0.483/1000+ 19,374*0.139 = 3,066 ton CO_2/year

According to the survey of the W.S.T, it is said that the technology proposed will contribute to reducing 75% of electricity consumption and 50% of steam and water consumption.

Therefore the project emission is

$$PE_y = (EC^{PJ}_{Dyeing,y} + EC^{PJ}_{Water,y}) \times EF^{PJ,elec}_{CO2} + SC^{PJ}_{y} \times EF^{PJ,steam}_{CO2} \quad (2)$$

where,

PE_y	Project emission in a year y (CO_2 ton/year)
$EC^{PJ}_{Dyeing,y}$	Project electricity consumption by dyeing machines to which water and energy saving technologies introduced by the CPA in year *y* (kWh/year)
$EC^{PJ}_{Water,y}$	Project electricity consumption by pumping of water that used in dyeing machines in the factory in year y (kWh/year)
SC^{PJ}_{y}	Project steam consumption by dyeing machines to which water and energy saving technologies introduced by the CPA in year *y* (ton-steam /year)
$EF^{PJ,elec}_{CO2}$	CO_2 emission factor of electricity generation for the factory (ton CO_2/MWh)
EF^{steam}_{CO2}	CO_2 emission factor for the steam generation for the factory (ton CO_2/ton)

PE_y = (713,920+58,576)* 0.483/1000*0.25+ 19,374*0.139*0.5 = 1,439 ton CO_2/year

Emission reduction:

$$ER_y = BE_y - PE_y - L_y \quad (3)$$

= 30,66 – 1,439 – 0 = 1,627 ton CO_2/year.

The estimated emission reduction is shown in the table below.

	2013	**2014**	**2015**	**2016…**
Energy saving	1,627 tCO2	1,627 tCO2	1,627 tCO2	1,627 tCO2
Total	1,627 tCO2	1,627 tCO2	1,627 tCO2	1,627 tCO2

(5) Duration of Project and Crediting Period:

The duration of the PoA is 28 years and crediting period of each CPA is 10 years.

(6) Environmental Impact Analysis:

As the PoA focuses on process change or process optimization in the existing textile and garment factories that have had environmental clearance certificates and the PoA is seen as no any negative environmental impacts then an additional environmental impact assessments for PoA is not required.

(7) Stakeholder Consultation:

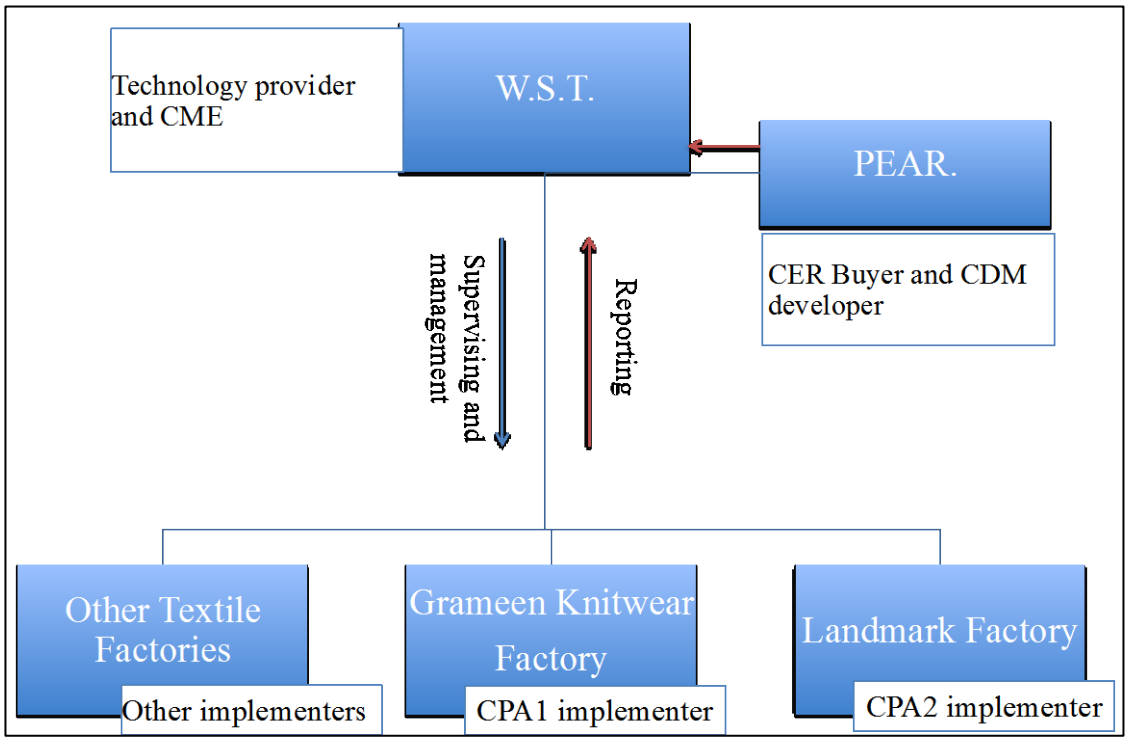
The Local stakeholder consultation meeting was conducted at the PoA level as social and environmental impacts of the CPAs are seen to be identical regardless of target factories. The PoA level Local Stakeholder Consultation Meeting was held at Uttara Club (Lotus Hall), Dhaka on 5th of November 2012 for having comments and opinions from local stakeholder from various sectors.

Around 50 participants including Mr. Faruque Hassan, Vice President, BGMEA, delegates from Textile and Garment Factory and experts from Machinery Manufacturer were present in the meeting.
All questions and comments are responded to increase stakeholders understanding of the project.

Some factories' requirements of conducting audits on their factories for joining the project are accepted.
Some stakeholder's requests to complete the sustainable development matrix after the meeting are accepted also. Please refer to the table above for detailed responds for corresponding questions and comments.

(8) CDM Project Implementation Scheme:

W.S.T is responsible for collection of all necessary information from target factories directly and responsible for defining and inclusion of each CPA supported by PEAR.
Textile and Garment factories who voluntarily participate in the PoA have responsibility to provide necessary information for management of the PoA.
The factories will sign agreements (using a specific format) with the W.S.T to promise providing all the relevant information and undertaking the monitoring. The managing and reporting structure of the PoA is depicted as follows.



(9) Financial Plan:

The PoA does not change any existing system and equipment in factories and almost does not require any additional investment for the technology itself besides CDM related investments. The CDM related additional investment such as transition costs and costs for monitoring equipment will be adjusted by factories.

(10) Analysis of Project Profitability:

In order to demonstrate economical feasibility of the project, the costs of one batch for dyeing black cotton that require most dyestuffs and dyeing time in Grameen Knitwear factory was taken.
The benefits for the factory are the cost reduction benefits from saving water, energy and dyestuffs. On the other hand, the cost is the additional invests for the some chemicals, high quality low twist cotton yarn and for monitoring equipment required.
For dyeing 40 kg black cotton in Grameen Knitwear factory, it is estimated that the saving cost from changing from conventional reactive to direct dyeing is 0. 34 US$/40kg[1].

The following assumptions are applied for the economical analysis and index of net benefit is used instead of IRR while there is no initial cost is needed. The price of CER is assumed as 9 EUR/t CO_2e (assuming that current (almost priceless) CER price will increase in the future. W.S.T is incentivized by the "high-quality environmental certification" nature of CDM).

- Average number of batches is 4,000
- All are 100% cotton
- Load capacity is 95% for all machines
- Among the batches 80% is for black color, 10% for medium color and 10% for light color

Moreover, for monitoring one electricity meter, one steam flow power and one water flow meter for each machine is installed.

Economical Benefits

Scenario	Net benefit (Thousand US$)
Without CEE	7,450
With CER	7,477

1 EUR = 1.31868 USD

(11) Demonstration of Additionality:

The CPA additionality is stipulated as one of the eligibility criteria of the PoA. As for the additionality of the PoA, the PoA is additional if the each CPA under the CPA is additional. The CPA additionlaity is demonstrated through "GUIDELINES FOR DEMONSTRATING ADDITIONALITY OF MICROSCALE PROJECT ACTIVITIES, version 04", paragraph 3 as follows.

3. Energy efficiency project activities[2] that aim to achieve energy savings at a scale of no more than 20 gigawatt hours per year are additional if any one of the conditions below is satisfied:
(a) The geographic location of the project activity is in an LDC/SIDS or special underdeveloped zone of the host country identified by the government in accordance with the paragraph 2 (a) (i) above;
(b) The project activity is an energy efficiency activity with both conditions (i) and (ii) below satisfied:
(i) Each of the independent subsystems/measures in the project activity achieves an estimated annual energy savings equal to or smaller than 600 megawatt hours;
(ii) End users of the subsystems or measures are households/communities/SMEs.

[1] This figure varies by dyeing machine, material and time (market).
[2] All technologies/measures included in approved Type II small-scale CDM methodologies are eligible to be considered. Further, the Board at its fifty-seventh meeting clarified that all CDM project activities that meet the criteria specified in the guidelines are eligible to apply the guidelines irrespective of the scale of the approved CDM methodology applied to the project

As Bangladesh is the least developed country (LDC), any CPA can be additional if the total energy saving from the CPA does not exceed 60 $GWh_{th.}$
For example, in the case of CPA1, the energy saving per year is 8.8 GWh_{th} and below the criteria of the micro scale CDM projects.
Furthermore, it is believed that the most factories satisfy the condition, if energy saving from any CPA exceeds the 60 GWh_{th}, the CPA claims only the CER equivalent to energy saving below than the 60 GWh_{th}.

(12) Project Feasibility:

The technology in PoA does not require any additional investment and the technology is not a new technology. With the effort of W.S.T, already 15 factories have showed their interests and related instructions, auditing and data collections are on going. Therefore, the feasibility of the project is not seen as a problem.

(13) CPA Promotion under PoA:

The data collection for CPA2 that targets Landmark factory was already completed and another 15 factories are under auditing by W.S.T. It is planned to include 30 factories by 2015.

5. Contribution to Sustainable Development in Host Country

The contribution of the PoA to sustainable development of Bangladesh is attributed to the environmental positive impacts of the PoA explained as below.

(1) The project will contribute to ensure future water security in Bangladesh.
The underground water is the main source of drinking water in Bangladesh. However, for textile dyeing in Bangladesh garment industry, underground water also has been used dominantly. It has been figured out that the heavy lifting of underground water on a regular basis in so many places including Dhaka city is causing the underground water levels to dry up faster than is normal. The project promises to reduce underground water consumption for textile dyeing process significantly.

(2) The project will contribute to ease land subsidence having occurred.
It is reported that there are too many places in the country where the heavy withdrawal of underground waters have disturbed the soil layers and caused land subsidence. Even in the capital city and other cities of the country that depend disproportionately in the lifting of underground water for household and other uses, land subsidence is noted to be a serious consequence of the practice. Thus, from the preventing the disfigurement of land and its calamitous effects, a reducing consumption of underground water is an indispensable way.