Bag Digester –
Test of a light Biogas Plant for Nepal

Implementation Report, Mai 2012

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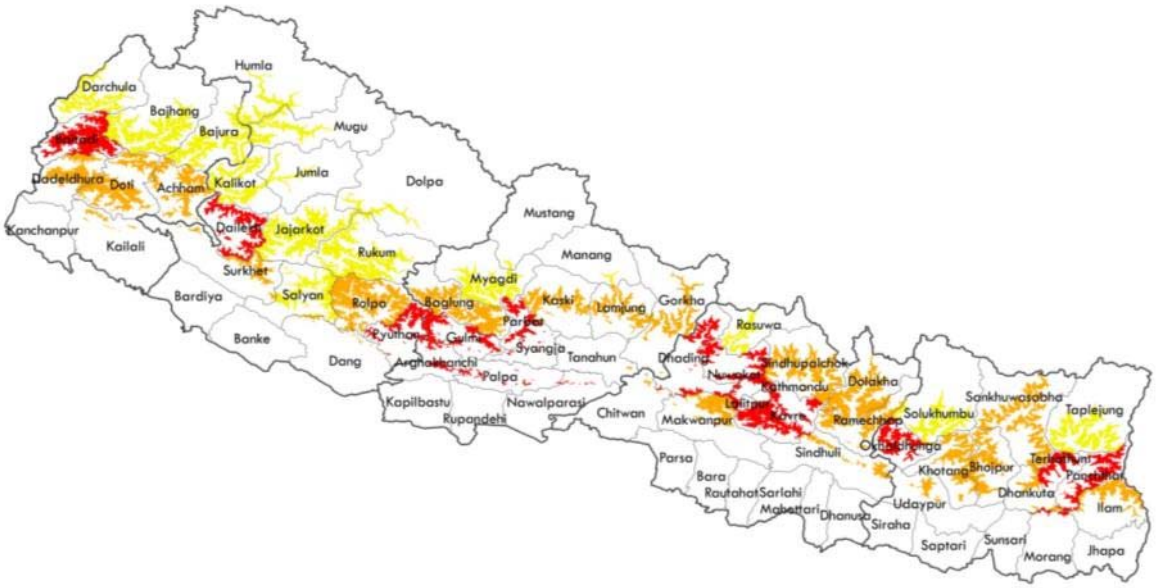


Executive Summary

Only about 2% of the households with cattle in the hilly and remote areas of Nepal possess a biogas plant - very few compared to the Terai. Since this is mainly caused by the high transportation costs of the common GGC2047 model, a light biogas plant is highly required to cover this market. Therefore the so called Bag Digester - a light biogas plant widely used in China - was tested by Nepal Biogas Promotion Association (NBPA) and the District Energy and Environment Unit Kaski of AEPC (DEEU Kaski), supported by GIZ.

Four Bag Digesters were installed by Manakanama Gobergas in different locations of Armala VDC, Kaski up to an altitude of 1'430 m above sea level in households without road access. Two plants were installed in the Chinese Design that was provided by the manufacturer and two plants were installed in an especially for remote areas designed Light Design.

The results of the test for the Bag Digester in the Light Design are:

- The total costs of the Bag Digester ($6m^3$) are around 34,000 NRs, 30% cheaper than a GGC2047 plant in Terai and hilly areas and up to 69% in very remote areas (cost calculations without subsidies)
- All the material for one Bag Digester can be transported by one taxi or carried by two persons.
- The installation of the Bag Digester is fast: Only approximately 5.5 person days are required for the installation (GGC2047 model around 27 person days).
- The plastic shed works as a greenhouse: It is expected that the Bag Digester has a higher performance than the GGC2047 model in the cold season.

The monitoring showed that the ratio of feeding material to hours of cooking is the same as the GGC2047 model. All the mentioned results lead to the conclusion that the Bag Digester in the light design is a very promising biogas plant for hilly and remote areas of Nepal.

It is recommended to introduce the Bag Digesters in the biogas market of Nepal. According to an estimation conducted in this study, around 170'000 Bag Digesters could be installed in Nepal[1]. To introduce this new biogas plant, the authors recommend to conduct an extended test for the implementation with minimal 10 Bag Digesters in every Regional Office of NBPA. In this project, also other stakeholders of the biogas sector should participate. Furthermore the conditions on the policy level for a further dissemination should be worked out. If subsidies are considered, the reduced lifetime of the Bag Digester should be taken into account, e.g. half of the GGC2047-subsidies.

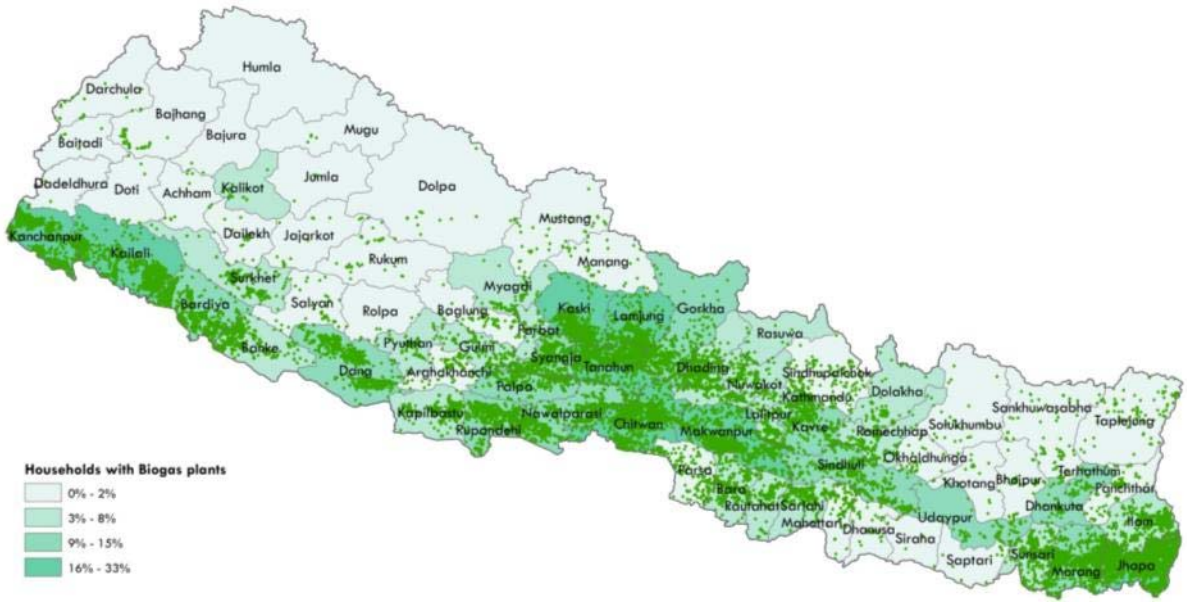
[1] Assumption: only remote areas between 1500m and 2500m and households with cattle but without a biogas plant are suitable, 40% of these households are potential buyers

Contents

1 Introduction

The penetration of biogas plants in the hilly and remote areas of Nepal is still quite low: Whereas in the Terai usually more than 10% of the households with cattle use biogas, in the remote and not central hilly districts the penetration is lower than 2%.

This is mainly caused by the high transportation costs for conventional biogas plants to these regions. Therefore Nepal Biogas Promotion Association (NBPA) and the District Energy and Environment Unit Kaski of AEPC (DEEU Kaski), supported by GIZ, tested a "Bag Digester" – Biogas plant.



Picture 1: Density of Biogas plants in Nepal

The idea of using plastic to produce biogas from dung is not new at all: More than 30 years ago, Bourdas et al. (1981) reported from a pilot PVC-biogas plant in the Dominican Republic. Bag Digesters are also very popular in Tanzania, China, Zimbabwe and Vietnam (Furze, 2002). It is estimated, that more than a million plastic digesters are in operation. A success is also the GIZ-supported program in Bolivia in high altitudes.

However, one has to keep in mind, that there are very different solutions with a wide range in terms of plastic quality (e.g. polyethylene vs. PVC), prices (from 30 US$ to 300 US$) and sizes (small-scale with a few m^3 to industrial plants with several 1000 m^3).

Picture 2: PVC-Bag Digester (Household Size)
Source: www.alibaba.com

Picture 3: PVC-Bag Digester (Industrial Size)
Source: www.alibaba.com

Picture 4: Tube digester (Polyethylene) in Bolivia (4000m)
Source: GIZ / EnDev

Picture 5: Tube digester (Polyethylene) in Kenia
Source: www.energypedia.info

Currently, PVC-Bag Digesters are a widely used technology in China and several manufacturers produce that type of biogas plants in China. One of these manufactures is Huamei International Green Energy Holding, a company based in Sheung Wan, China. After a visit of the company by representatives of NBPA, these PVC-Bag Digesters were found to be a potential product for the Nepali market. Therefore five Bag Digesters were imported to Nepal in July 2011.

The suitability of this biogas plant type was tested in the hills around Pokhara. The test should show the suitability regarding transport, installation, operation and maintenance.

This report summarizes the experiences made in all the four mentioned fields and gives recommendations regarding the further implementation of PVC-Bag Digesters in Nepal.

2 Implementation

The implementation was done in the following four steps:

- Site Selection
- Designing the installation
- Installation of 2 Bag Digesters according to Chinese design
- Installation[2] of 2 Bag Digesters in a cost-saving alternative

2.1 Sites

NBPA and DEEU defined jointly criteria for the site selection. These criteria are given in the table below:

Criteria	Value
Road-Accessibility (from Pokhara)	< 3 hours
Distance from drivable road	no direct road access, but < 1.5 hours (to test hilly / remote areas, but not too far for monitoring reasons)
Altitude	> 1,000 m (to test hilly / remote areas)
Read / write-ability	At least read and write numbers (for monitoring reasons)
Social status	Poor (Dalit, widows or others)
Water availability	> 20 - 30 liters/day
Number of cows or buffalos	1 - 3

Table 1: Criteria for the site selection.

According to the given criteria, DEEU Kaski proposed 5 installation sites. After a site visit of DEEU Kaski, NBPA and GIZ, four of the proposed sites were selected. The details of the sites are given in the following table:

	Plant 1	Plant 2	Plant 3	Plant 4
VDC	Armala - 4 Gorleng	Armala - 4 Gorleng	Armala -3 Nepanetok	Armala -3 Nepanetok
Driving Distance*	40 min	40 min	30 min	30 min
Walking Distance*	10 min	10 min	20 min	20 min
Name	Ram Krishna Pariyar	Kamal Pariyar	Buddhi Sharar Acharye	Shaanta Acharye
Mobil phone	9804171357	9806132914	9805847618	9805847618
Coordinates and Height	N 28°18'4.6" E83°58'51.9" 1'430 m	N 28°18'4.6" E83°58'51.9" 1'430 m	N 28°17'21.6" E83°57'59" 1'140 m	N 28°17'21.6" E83°57'59" 1'140 m
Family members	7	7	6	4
Read / write	yes	yes	yes	yes
Social status	Damahi	Damahi	Brahmin	Brahmin
Income	Not regular	Not regular	Not regular	Not regular
Land	2 Ropani	4 Ropani	1 Ropani	1 Ropani
Water availability	no shortage	no shortage	no shortage	no shortage
Cows	0	0	1	0
Buffalos	1	1	1	2
Other animals	1 goat	1 goat	1 goat	2 goats

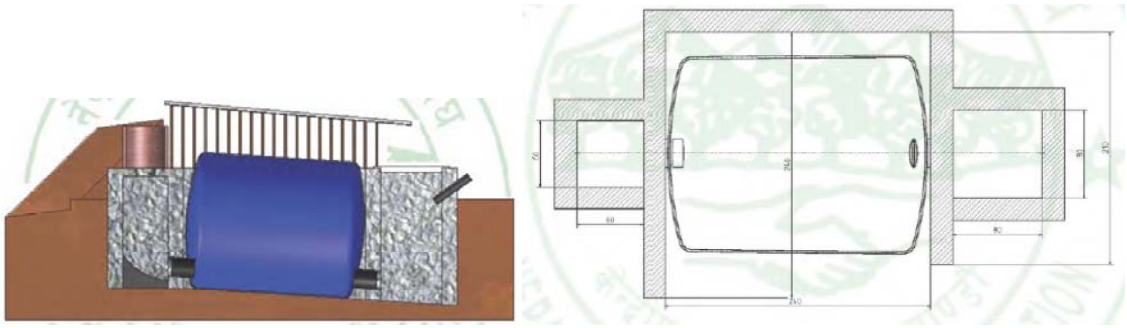
Table 2: Details of sites and users. * from Pokhara

[2] Implemented by Manakamana Gobargas Sewa Kendra, see annex for contact information

2.2 Designs

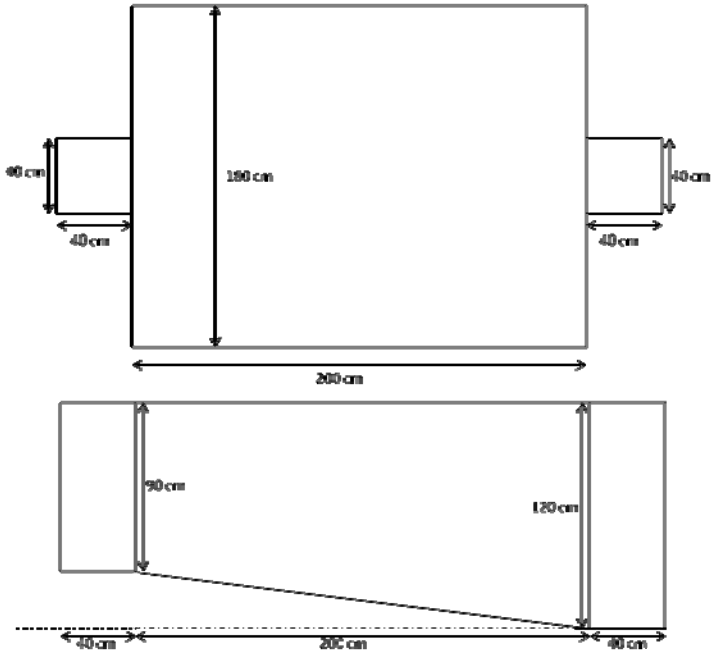
Two different designs for the installation of the Bag Digesters have been applied: the original Chinese Design and the Light Design.

Chinese Design: For the two first installations in Gorleng, the Chinese design originally delivered by the producer of the Bag Digester was implemented to gain experience with the installation. The Chinese design comprises an inlet and outlet chamber that is equal to the GGC2047 model. Therefore, the working principle is the same as a fix dome biogas plant (although there is not a fixed dome). The Bag Digester lies in a pit, which is fully cemented; the floor is covered with red mud. The site is additionally covered with a tin roof for the protection of the biogas plant (mechanical damages, UV).



Picture 6: Drawings of the Chinese design (front and top view).

Light Design: The Bag Digesters in Nepanetok were installed in a new, very light and cheap version. There are no inlet and outlet chambers, but only connecting pipes. The walls are not cemented, but smoothened with red mud. The gas pressure is not achieved by the level of slurry, but by weight on the Bag Digester (working principle of a floated drum plant). The Bag Digester is protected with a bamboo roof covered with high quality plastic (usually used for greenhouses).



Picture 7: Drawings of light design (front and top view).

2.3 Construction

The Bag Digesters were installed in two phases: In the first phase (August - September 2011) 2 Bag Digesters were installed according to the Chinese design in Gorleng. After gaining experience with this standard installation, 2 Bag Digesters in the light design were installed in Nepanetok (December 2011).

The construction steps of the light design are shown in the photo story below. The construction in the Chinese design is not documented in this report, since it is very similar to the construction of a GGC2047 model (besides the not needed dome).

Picture 8: Dig the pit and clean the surface with „Rato mato“

Picture 9: Start the mason work and connect the bucket to the white pipe and make hole with a hot metal pipe

Picture 10: Make the wall (pipe inserted) up to the ground level. Fill the outside with stones & soil up to 4 inches from the red bucket.


Picture 11: Connect the HDPE-Pipe for inlet/ outlet and fill the gap with liquid concrete (it must be watertight!)


Picture 12: Clean the surface and prepare the Bag Digester. Put the delivered glue on the last ring and attach the Bag.


Picture 13: Attach the blue drum as inlet. Construct a bamboo tent for protection.


Picture 14: Fill two bags with soil and attach them on a bamboo frame as a weight for the gas pressure.

3 Results

In this chapter the found characteristics of the Bag Digester - like costs, installation, operation and maintenance - are described and compared to the GGC2047 model.

3.1 Costs

The costs of a Bag Digester were calculated on the base of the spend materials and the current BSP-Quotation list of 2068/2069 (see Annex). All materials and transports are included, as well the appliances, ASS-charges and indirect costs of the biogas companies.

The total costs of a Bag Digester (6m³) in the light design[3] are 34,000 NRs. Therefore the Bag Digester is around 30% cheaper than a GGC2047 plant in Terai and hilly areas and up to 69% in very remote areas. For a fair comparison, the current subsidies for the GGC2047-model were not considered. Details are given in the table below.

	6 m3 GGC2047				6 m3 Bag Digester Light Design			
	Terai	Hill	Re-mote	V/Re-mote	Terai	Hill	Re-mote	V/Re-mote
Grand Total of Plant	46,680	48,830	59,590	195,815	33,633	34,298	37,947	61,039
Costs of Bag Digester compared to GGC2047	-	-	-	-	-28%	-30%	-36%	-69%

Table 3: Cost comparison between the GGC2047 and the Bag Digester Light Design. More details are given in the annex.

3.2 Weight and Material

In the picture below, all the materials for one Bag Digester are shown (additionally 1 bag of cement and 3 bags of sand are required). The material for 2 Bag Digesters can be transported in a normal taxi and from the road to the site by 2-3 persons per plant (see Picture 16)

Picture 15: All materials needed for the Bag Digester in the light design.

[3] The total costs of the original Chinese design are not mentioned in the table, as there are not significant advantages in terms of material or costs compared to the GGC2047 model: The costs for the two pilot plants in Gorleng were around 68'000 NRS per plant.

Picture 16: Transport of 2 Bag Digesters in one taxi and carrying of the material to the site (2-3 persons per plant needed).

3.3 Time Consumption for Installation

The time consumption for the installation differs highly between the Chinese and the light design. Whereas the construction works in the Chinese design nearly needs as much time as the GGC2047, the light design is half as time consuming (approximately 5.5 person days). In the table below, the needed installation time per plant is given.

Required time for activity	Chinese Design (Gorleng) [person days]	Light Design (Nepanetok) [person days]	GGC2047 in remote areas [person days]
Digging Pit	6	2	10
Transport Material	2	0.25	2
Masonry-Work	9	0.5	10
Connection Bag Digester	0.5	0.5	0
Connection Inlet and Outlet	0	0.5	0
Fill the plant and cast the dome	0	0	5
Piping	0.5	0.5	0.5
Shed Construction	0	1	0
Total Installation Days	18	5.25	27.5

Table 4: Installation Time for the Bag Digester Biogas Plant.

3.4 Challanges of Installation

In general the installation of the Bag Digester is easy. But there are some steps that have to be done carefully: For the connection of the Bag Digester to the inlet/outlet pipes three persons are needed who pull the rubber ring of the Bag Digester over the pipe simultaneously (see Picture 12). No tools should be used, since the rubber can be damaged (this happened in one plant). The cement filling around the inlet and outlet pipe has to be done carefully (see Picture 10) so that it is watertight.

3.5 Operation and Maintenance

The operation of the Bag Digester is exactly the same as the one of the GGC2047 model. In the last 5 month (since the installation), there was no special maintenance of the 4 Biogas Plants needed. As in the GGC2047 model, the water drain pipe has to be emptied every 2-3 weeks. Additionally a training regarding repairing the Bag Digester has been given to the users (see the manual in the Annex).

3.6 Performance

After six weeks, a steady cooking time and feeding could be observed in all 4 sites. According to the monitoring filled in by the users, the plants need 8 - 10 liters dung per cooking hour. For the GGC2047 6m³-plant a value of 11 kg dung per cooking hour is given by BSP (2009). This shows that the performance of the Bag Digester biogas plant is in the same range as the GGC2047.

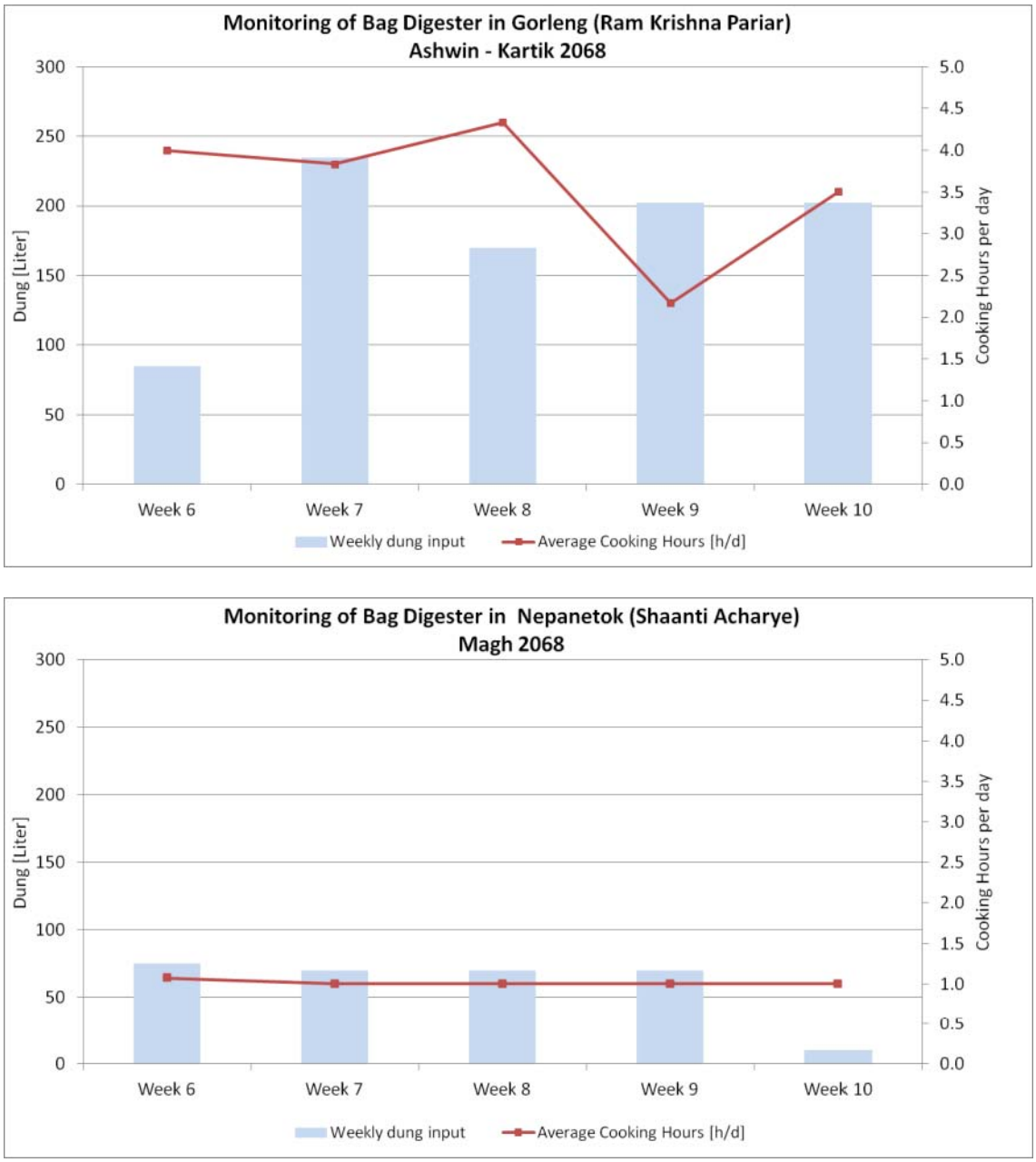


Figure 1: Weekly dung feeding and average cooking hours per day in 2 sites.

3.7 Lifetime

Obviously, there is no long-term experience in Nepal regarding the lifetime of the Bag Digester. Important factors are the protection from UV and mechanical damages (e.g. from children throwing stones). According to the manufacturer a minimum lifetime of 10 to 15 years can be expected with proper protection (as the bamboo shed). Mr. Mang mentioned a possible lifetime of 15 years with this kind of protection (during his visit on 12th of December 2011).

4 Conclusion

The Bag Digester, installed in the light design, is a very promising biogas plant for hilly and remote areas of Nepal. Compared to the GGC2047 type, it has the following advantages that are especially for difficult accessible places important:

- Very light: it can be transported by 1 taxi or by 2 porters
- Cheap: it is 30-69% (hilly – very remote areas) cheaper than the GGC2047 model
- Easy to install: since most parts are prefabricated, it is easy to install
- Easy to repair: since the plant is accessible, it can be easily repaired
- Fast: The masonry work for a Bag Digester can be done in half a day; the biogas plant is ready after 1 week
- Performance in winter: The Plastic shed works as a greenhouse and it is expected that this leads to a higher performance in the cold season

Like every technology, there are not only advantages, but also some disadvantages:

- More space needed: the plant can't be covered with a slab and needs therefore more space
- Shorter lifetime: The lifetime is expected to be shorter than the one of GGC2047 model
- Easier to damage: Since the plant is over ground the plant can be easier damaged

In respect to the extremely difficult access of many households of Nepal, a light and cheap biogas plant is very much needed to push the market also in these areas. The Bag Digester provides exactly these characteristics. The shorter lifetime probably has to be accepted, since it can't be expected that a light cheap plant is as durable as a cemented version.

5 Outlook for further implementation

With the pilot phase of 5 Bag Digesters, the principal suitability under Nepalese conditions could be shown. The planning of up scaling the use of Bag Digesters in Nepal requires on the one hand the estimation of the Bag Digester-Potential to set a vision, on the other hand a stepwise planning in order to reach this vision is needed. In this section, a rough potential estimation is conducted. The second part explains a possible way for up scaling the dissemination of Bag Digesters in Nepal.

5.1 Estimation of the potential for Bag Digester

In this section, the potential for Bag Digesters on district level is roughly estimated; in the annex additionally the potential on VDC-level for two districts is shown.

The Bag Digester is a suitable solution for areas with limited road access. Due to the limited data availability of the current road network, the following approach was chosen for the calculation of the potential:

- In the national census 2001, the number of households with cattle are given on district-level. The currently installed biogas plants (GGC2047 models) are subtracted from this number.
- It is assumed, that areas lower than 1500 m are connected with dirt roads and the transport is not so expensive. It is assumed that in these areas[4] the actual GGC2047 is installed. Areas

[4] It is possible, that also areas under 1500m are not accessible due to difficult topographic conditions.. However, most of the areas are connected with roads.

between 1500m and 2500m are therefore suitable for the Bag Digester. With GIS, an analysis of all districts was conducted and the respective share of areas between 1500m and 2500m was determined.

- The next step includes the multiplication of the potential households with the determined share of the area between 1500m and 2500m. This implicitly assumes that the density of households with cattle is equally distributed about the height of living.
- It was then assumed, that only 40% of these households are potential buyers of a Bag Digester.

$$Potential = HH\ with\ cattle_{District} \times \frac{Area_{1500m-2500m}}{Area_{District}} \times 40\%$$

In the map below, the areas between 1500 and 2500 meters above sea level are marked from yellow to red. The color indicates the density of potential Bag Digester: Yellow means an average of 0 to 4 plants per square kilometer, orange 4-10 plants / km² and red more than 10 plants per km². Five clusters with a high potential can be determined, in brackets the number of potential biogas plants.

- Baitadi, Dadeldhura and Doti (around 16'000 Bag Digester)
- Dailekh and Surketh in (around 7'000 Bag Digester)
- Rolpo, Baglung, Pyuthan and Gulmi (around 26'000 Bag Digester)
- Nuwakot and Kavre in Central Districts (around 14'000 Bag Digester)
- Ilam, Terhathun and Panchthar in Eastern-Districts (around 12'000 Bag Digester)

According to the made assumptions, the overall potential for Bag Digester in Nepal can be estimated to 170'000 Bag Digester biogas plants. The complete list is shown in the Annex.

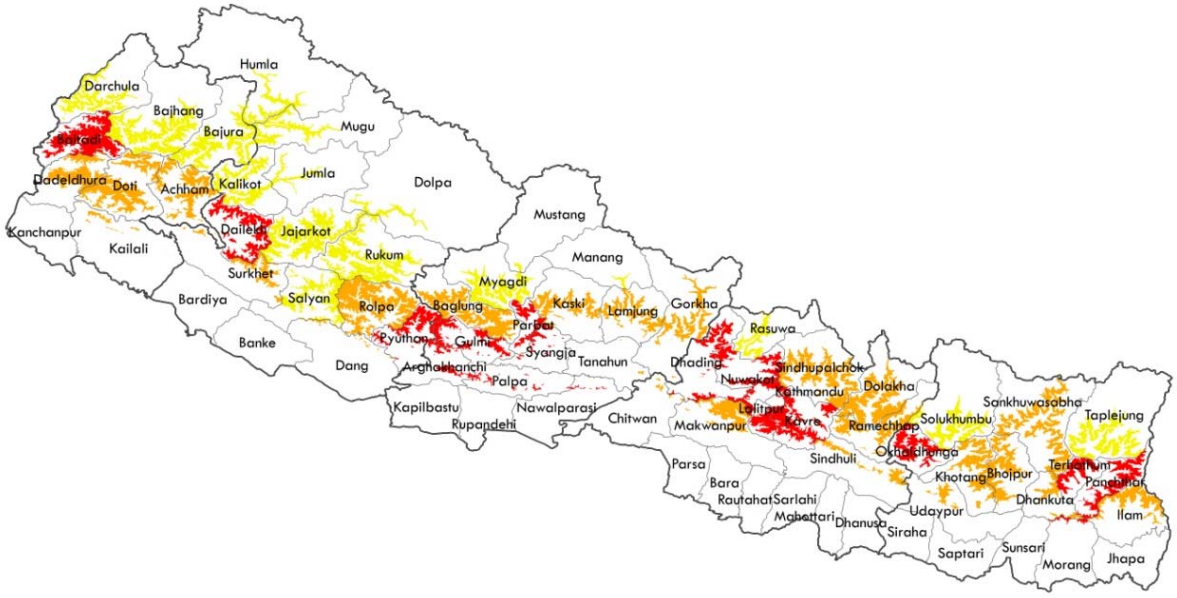


Figure 2: Potential areas for Bag Digesters (between 1500 and 2500 meters altitude).

5.2 Upscale the dissemination of Bag Digester in Nepal

The authors see three required steps for a successful dissemination of Bag Digesters in Nepal. First an extended test is required to examine different conditions and spread the knowledge. Second a desk-study should be undertaken to identify possible manufacturers. And third the required policies should be defined.

5.2.1 Extended test for implementation strategies

In an extended test, the implementation should be tested on a technical and organizational level with a higher number of plants distributed all over Nepal.

It is suggested, that the biogas companies of each NBPA-Regional Office receive at least 10 (partly subsidized) Bag Digesters for a broad dissemination. Every interested biogas company gets training in building the Bag Digesters with an official certificate. Then, the company will search for interested clients and build the plant. A visit by the technical units of NBPA after 6 months and 1 year provides the required monitoring data.

The authors suggest that interested stakeholders of the Biogas sector in Nepal participate in this extended test (e.g. NREDC, AEPC, BSP-N, GIZ, SNV, etc.). However, this next phase with around 60-100 plants should be defined in the next 1-2 months and should be implemented by NBPA and the biogas companies in the second half of the year 2012.

5.2.2 Search for alternative manufacturers

The Bag Digester type used in the pilot study is a high-quality product with prebuilt piping and appliances (but not the stove). Also the quality of the PVC is very high and all joints are double-sealed. Therefore, the price of the Bag Digester with around 190 EURO is higher than other products. To reduce the costs of the tested Bag Digester the prebuilt pipes and appliances could be used from the local market and not ordered from China.

5.2.3 Set the conditions on policy level for support

Parallel to the above activities, the authors suggest setting the conditions on the policy level for a further dissemination. If subsidies will be given, one should take the reduced lifetime of the Bag Digester into account (e.g. half of the GGC2047-subsidies). As the ownership of the farmer for this type of biogas plant has to be higher (due to the higher risk of damaging the plastic), the subsidies should not extend 25% of the total costs.

6 Comments from other Stakeholders

The report was sent for review to BSP, SNV, NBPA and other stakeholders in the biogas sector in other countries. The comments on the report are summarized below.

Technical Aspects

- The greenhouse seems to be a big advantage for the performance of the bag digesters. It is generally assumed that diurnal temperature change would affect bag digesters more than fix dome plants.
- Maybe the gas pressure will be too low for a gas lamp.

Quality and Lifetime

- One should be careful in looking for cheaper digesters, since the quality differs a lot.
- Reinforced PVC (material of the implemented bag digester in Nepal) should have a lifetime of at least 10 years.
- Geomembrane technology has a lifetime of 8-10 years in the case of Peru (if well-protected).
- It is crucial to have a standardized, validated technology with proven costs and benefits / duration of the material.
- Simple plastic bag biodigesters in Peru did not prosper due to bad quality of the plastic (duration: 0.5-1 year).
- In Bolivia a standardized package of good quality and resistant plastic on very low cost is available (duration: 4-5 years).

Costs

- In Laos the investment costs of the biodigester is one of the main constraints for mass dissemination. Furthermore the digesters are usually underfed. Therefore the implementation of 3 m^3 digesters is started - an approach that should also be considered for Nepal.
- The cost comparison between fix dome and bag digester should be undertaken in a long term analysis (including the lifetime and repairing costs).

Comparison Fix Dome and Tubular Digesters

- In Peru and Bolivia it was concluded that fixed dome and tubular digesters are adequate to be promoted, with a series of advantages and disadvantages attached to both.

7 Literature

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Furze. (2002): *TUBULAR PLASTIC BIO-DIGESTERS IN TANZANIA, VIET NAM, ZIMBABWE & CHINA* (Selection of verious reports). Ebeltoft, Denmark.

Annex

A1. Contacts for further information

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A2. Cost Comparison GGC2047 Model and Bag Digester

Biogas Support Programme (BSP)

Quotation for the Fiscal Year 2067/68 (2010/2011)

S. No.	Particulars	Unit	Bill of		Unit Rate in NRs				Quotation for Different Plant Sizes, in NRs.							
									6 cu m				6 cu m Bagdigester			
			6	6 (Bag)	Terai	Hill	Remote	V/Remote	Terai	Hill	Remote	V/Remote	Terai	Hill	Remote	te
1	**Materials to be Managed/Purchased by User**															
A	***Construction Material***								**24'903**	**25'707**	**32'421**	**147'560**	**1'696**	**1'661**	**2'118**	**9'962**
1	Stone/Brick*	PC	1'400	100	8	5	5	5	11'200	7'000	7'000	7'000	800	500	500	500
2	Sand	Bag	70	4	30	39	41	158	2'100	2'730	2'870	11'060	120	156	164	632
3	Gravel	Bag	35	2	40	101	110	180	1'400	3'535	3'850	6'300	80	202	220	360
4	Iron rods	Kg	15	0	77	80	95	308	1'155	1'200	1'425	4'620	-	-	-	-
5	Cement (Brick Masonry)	Bag	13	1	696				9'048	-	-	-	696	-	-	-
6	Cement (Stone Masonry)	Bag	14	1		803	1'234	8'470	-	11'242	17'276	118'580	-	803	1'234	8'470
	* brick is considered in terai and stone is considered for other regions															
B	***Unskilled Labour***	**Day**	**20**	**3**	**257**	**276**	**297**	**437**	**5'140**	**5'520**	**5'940**	**8'740**	**771**	**828**	**891**	**1'311**
C	***Multi Layer Pipe & Fittings***								**1'793**	**1'797**	**1'819**	**2'069**	**1'552**	**1'554**	**1'569**	**1'697**
1	½" GI Nipple (6" or 15 cm long)	PC	1	0	78	78	79	97	78	78	79	97	-	-	-	-
2	½" GI Pipe (20" or 50 cm long)	PC	1	0	89	91	95	171	89	91	95	171	-	-	-	-
3	½" GI Elbow	PC	2	0	37	37	38	52	74	74	76	104	-	-	-	-
4	½" 1216-Yellow Colour (C1216) (max. lengt	Metre	12	12	82	82	83	93	984	984	996	1'116	984	984	996	1'116
5	½" Male Straight Union (Brass)	PC	1	1	88	88	88	89	88	88	88	89	88	88	88	89
6	½" Female Tee F5-T1216*1/2F*1216|| A	PC	1	1	192	192	192	193	192	192	192	193	192	192	192	193
7	½" Wall-Plated Female Tee F5-T1216*1/2F	PC	1	1	275	275	276	277	275	275	276	277	275	275	276	277
8	½" GI Tee (for second stove)	PC			58	58	59	73	-	-	-	-	-	-	-	-
9	Teflon Tape	PC	1	1	13	15	17	22	13	15	17	22	13	15	17	22
2	**Appliances & Accessories Provided through Company**								**6'026**	**6'050**	**6'298**	**9'002**	**24'418**	**24'424**	**24'515**	**25'368**
1	Stove	PC	1	1	914	920	938	1'198	914	920	938	1'198	914	920	938	1'198
2	Mixture	Set	1	0	1'525	1'537	1'609	2'462	1'525	1'537	1'609	2'462	-	-	-	-
3	Emulsion paint	Litre	1	0	194	194	212	405	194	194	212	405	-	-	-	-
4	Inlet pipe		4	3	151	151	169	315	605	605	678	1'258	454	454	508	944
5	Dome gas pipe	PC	1	0	889	895	938	1'452	889	895	938	1'452	-	-	-	-
6	Main gas valve	PC	1	1	472	472	478	526	472	472	478	526	472	472	478	526
7	Water drain	PC	1	1	212	212	218	248	212	212	218	248	212	212	218	248
8	Gas tap (for stove and pressure meter)	PC	2	1	357	357	357	387	714	714	714	774	357	357	357	387
9	Nylon hose pipe (for stove and pressure mete	Metre	2	1	30	30	36	85	61	61	73	169	30	30	36	85
10	Pressure meter	PC	1	0	442	442	442	508	442	442	442	508	-	-	-	-
11	Drum for Inlet	PC	0	1	750	750	750	750	-	-	-	-	750	750	750	750
12	Bucket for Inlet & Outlet	PC	0	2	120	120	120	120	-	-	-	-	240	240	240	240
13	M-Seal	PC	0	1	60	60	60	60	-	-	-	-	60	60	60	60
14	Bamboo	Metre	0	12	15	15	15	15	-	-	-	-	180	180	180	180
15	Bagdigester	PC	0	1	19'500	19'500	19'500	19'500	-	-	-	-	19'500	19'500	19'500	19'500
16	Plastic	PC	0	1	1'200	1'200	1'200	1'200	-	-	-	-	1'200	1'200	1'200	1'200
17	Rubberstripes & Wire	Set	0	1	50	50	50	50	-	-	-	-	50	50	50	50
18	T-Pipe & Elbow (4 inch)	Set	0	0	300	300	400	500	-	-	-	-	-	-	-	-
3	**Other Wages and Charges**								**8'819**	**9'756**	**13'112**	**28'444**	**7'219**	**7'856**	**10'812**	**24'844**
1	Minimum Wages of Trained & Registered Mason								2'800	3'100	3'500	4'800	1'200	1'200	1'200	1'200
2	After Sale Service (Paid to Company Once After Sale Service is Carried out)								700	700	700	700	700	700	700	700
3	Participation Fee for Users' Training & Promotional Activities								125	125	125	125	125	125	125	125
4	Administrative Expenses of company (Rent,salaries-Allowances,Promotion exp.,Gurantee,etc)								5'194	5'831	8'787	22'819	5'194	5'831	8'787	22'819
	Grand Total of Plant (with Multi Layer Pipe & Fittings)								**46'680**	**48'830**	**59'590**	**195'815**	**35'656**	**36'323**	**39'905**	**63'182**
	Subsidy to be received by the biogas user (Including Transportation) in NRs.								**9'700**	**12'700**	**18'700**	**20'700**	**4'850**	**6'350**	**9'350**	**10'350**
	Additional Subsidy to be received by the biogas user in 40 LP Districts in NRs.								**700**	**700**	**700**	**700**	**350**	**350**	**350**	**350**
	Additional Subsidy for Poor/Janjati/Dalit/War Victims in NRs.								**2'000**	**2'500**	**3'500**	**3'500**	**1'000**	**1'250**	**1'750**	**1'750**

The above prices for the bagdigester are from 1st of June 2011 (1 US$ = 71 NRS), tha bagdigester itself costs 241 US$ in China, an additional 33 US$ was added as transport- and customs costs.

A3. List of Districts with a potential for Bag Digester

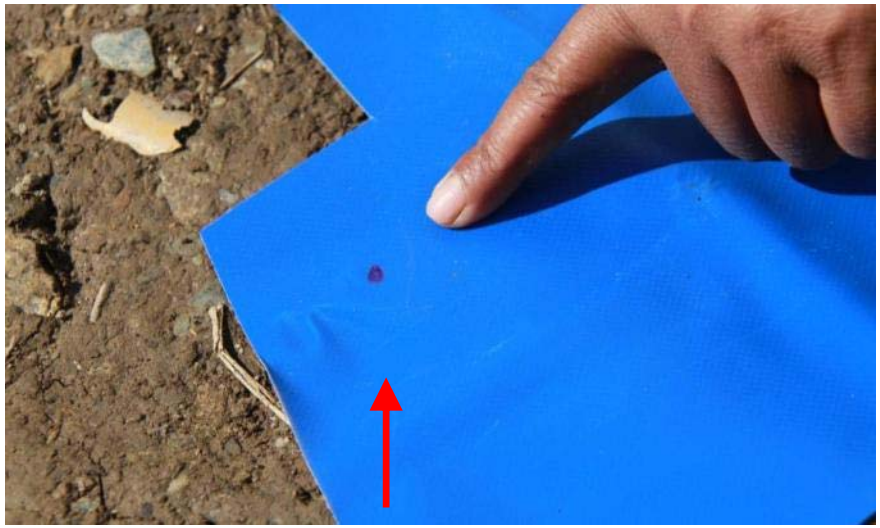
DISTRICT	HH	HH with Livestock	Existing GGC2047-Plants	Total Area of District [km2]	Area 1500m - 2500m [km2]	Potential Bag Digester [Number]	Density [Bag Digester / km2]
ACHHAM	44'002	38'555	17	1'715	552	4'965	9.1
ARGHAKHANCHI	40'866	37'222	662	1'109	147	1'941	12.9
BAGLUNG	53'555	45'521	618	1'844	850	8'280	9.7
BAITADI	40'375	38'193	32	1'486	842	8'649	10.3
BAJHANG	28'587	26'756	105	3'479	942	2'885	3.1
BAJURA	18'358	16'551	5	2'278	693	2'014	2.9
BHAKTAPUR	41'249	13'950	739	122	32	1'393	43.2
BHOJPUR	39'479	35'507	211	1'534	497	4'572	9.2
CHITAWAN	92'851	60'657	14'100	2'269	25	208	8.2
DADELDHURA	21'978	19'667	111	1'485	513	2'701	5.3
DANG	82'488	63'637	6'673	2'990	47	357	7.8
DARCHAULA	21'028	19'544	270	2'340	485	1'599	2.1
DHADING	62'709	56'081	4'252	1'910	327	3'552	11.1
DHANKUTA	32'540	27'051	2'273	906	164	1'793	6.7
DILEKH	41'139	36'795	83	1'505	561	5'470	10.1
DOLAKHA	37'291	31'573	934	2'180	750	4'216	5.6
DOLPA	4'412	3'609	4	7'918	162	29	0.2
DOTI	36'396	31'595	38	2'041	815	5'044	6.8
GORKHA	58'905	51'081	4'326	3'640	449	2'307	5.4
GULMI	59'181	52'060	1'445	1'120	336	6'068	18.0
HUMLA	6'952	6'209	1	6'017	311	129	0.4
ILAM	54'561	46'077	2'856	1'735	404	4'022	10.0
JAJARKOT	24'132	22'531	1	2'227	954	3'859	3.8
JUMLA	12'139	10'244	5	2'551	138	222	1.6
KAILALI	94'395	69'663	10'938	3'256	61	438	7.3
KALIKOT	2'024	1'506	60	1'637	516	182	0.4
KASKI	85'065	41'365	13'494	2'100	429	2'277	5.3
KATHMANDU	234'595	30'466	1'207	381	167	5'123	30.7
KAVRE	70'466	59'646	7'477	1'436	543	7'898	14.5
KHOTANG	42'859	39'980	28	1'615	515	5'096	9.9

DISTRICT	Households	HH with Livestock	Existing GGC2047-Plants	Total Area of District [km2]	Area 1500m - 2500m [km2]	Potential Bag Digester [Number]	Density [Bag Digester / km2]
LALITPUR	68'870	17'271	1'220	400	194	3'118	16.0
LAMJUNG	36'522	29'368	7'516	1'693	418	2'156	5.2
MAKWANPUR	71'069	53'151	15'854	2'419	420	2'589	4.7
MANANG	1'769	893	0	2'297	32	5	0.2
MORANG	167'856	100'560	10'446	1'848	45	883	19.5
MUGU	5'838	4'815	4	3'220	372	222	0.6
MUSTANG	3'241	2'074	12	3'564	19	4	0.2
MYAGDI	24'430	19'079	842	2'288	575	1'835	3.2
NAWALPARASI	98'336	70'459	8'812	2'160	15	175	11.5
NUWAKOT	53'163	47'428	2'282	1'175	369	5'673	14.8
OKHALDHUNGA	30'110	27'917	112	1'092	397	4'043	10.2
PALPA	49'937	42'178	5'047	1'437	63	648	10.2
PANCHTHAR	41'101	36'575	606	1'255	486	5'571	11.6
PARBAT	32'729	26'288	830	539	193	3'641	18.8
PYUTHAN	40'163	36'350	801	1'308	354	3'845	11.0
RAMECHHAP	40'384	36'999	1'014	1'475	447	4'366	9.7
RASUWA	8'689	6'784	227	1'521	255	439	1.7
ROLPA	38'503	35'342	3	1'890	1'111	8'310	7.5
RUKUM	33'500	30'397	34	2'922	957	3'974	3.6
SALYAN	10'913	9'583	133	1'892	534	1'066	1.6
SANKHUWASABHA	39'479	35'507	375	3'488	870	3'506	4.0
SINDHULI	47'703	42'359	4'771	2'509	189	1'136	6.1
SINDHUPALCHOK	57'617	49'975	846	2'493	818	6'444	7.9
SOLUKHUMBU	21'660	18'832	65	3'434	522	1'140	2.2
SUNSARI	120'185	66'315	4'297	1'264	2	32	18.9
SURKHET	50'658	40'004	2'140	2'463	274	1'684	6.2
SYANGJA	64'734	53'509	5'988	1'046	84	1'524	18.2
TANAHU	62'895	50'451	14'220	1'564	8	77	9.3
TAPLEJUNG	24'760	21'663	76	3'676	688	1'616	2.3
TERHATHUM	20'681	18'874	1'619	676	273	2'789	10.2
UDAYAPUR	51'586	41'961	3'909	2'070	106	780	7.4
Grand Sum					**24'316**	**170'580**	**7.0**

Repair of Bag Digester / ब्यागडाईजेष्टर

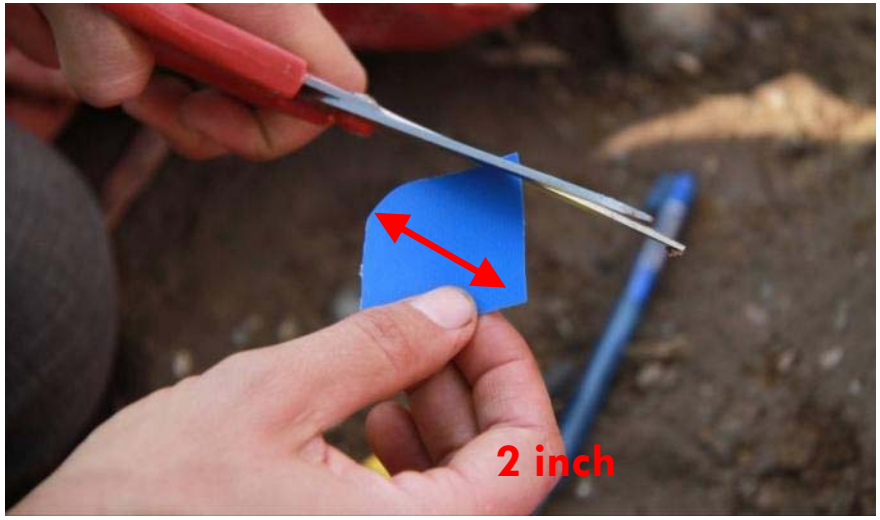
1. Search for the hole and mark it. Clean the surface with a fabric and let it dry

   प्वाल भएको ठाउँ पहिचान गरी गोलो चिह्न लगाउने र सफा गर्ने ।



2. Cut from the spare plastic a round shaped patch (2 inch bigger than the hole)

   प्वाल भन्दा २ ईन्च ठुलो लामो भएको प्लाष्टिको टुक्रा गोलो गरी काट्ने ।



3. Put “aceton” on a fabric.

   सरफ पानीमा सफा टालो भिजाउने ।

4. Clean both surface with “aceton”

   सरफले त्यो दुवै ठाउँमा सफा गर्ने ।

5. Mark the shape of the patch.
प्वालको नाप लिने ।

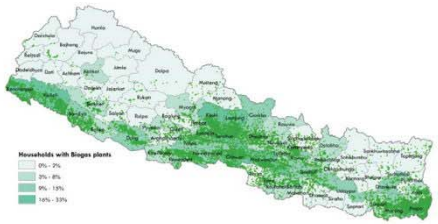
6. Add a layer of glue (PVC Seal) to the plastic
प्लको वरिपरि गम लगाउने ।

7. Add a layer of glue on the patch and distribute it with the finger. **Let it dry for 5 min.**
प्वाल टाल्ने प्लाष्टिकको टुक्रामा पनि गम लगाई ५ मी सुक्न दिने ।

8. Press the patch on the plastic
माथिवाट अर्को प्लाष्टिकको टुक्रा ले प्रेशर दिने ।

Flexprint for Training

Why Bag Digesters Biogas Plants in Nepal?
ब्याग डाईजेष्टर नेपालमा किन ?



The penetration of biogas plants in the hilly and remote areas of Nepal is low: Less than 2% of the households with cattle have a biogas plant. This is mainly caused by the high transportation costs for conventional biogas plants to these regions.

नेपालको पहाडी र दुर्गम भेगमा बायोग्यास प्लाण्ट कम संख्यामा निर्माण भएका छन् । २% भन्दा कम पशु पालेका घरधुरीमा मात्र बायोग्यास प्लाण्ट छन । यसको प्रमुख कारण भनेको GGC २०४७ मोडल बायोग्यास प्लाण्टमा लाग्ने सामानहरुको महङ्गो ढुवानी लाग्ने खर्च हो ।

What are the advantages of a Bag Digester?
ब्याग डाईजेष्टरका फाईदाहरु ?





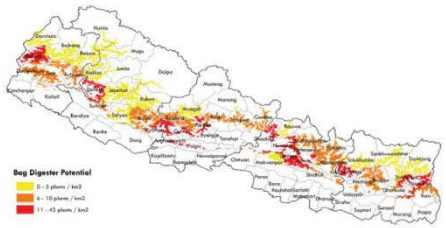

A cheap biogas plant. कम खर्चिलो बायोग्यास प्लाण्ट ।
The total costs of a Bag Digester is only 34,000 NRS. This is 30% - 69% cheaper than a conventional GGC2047 model without subsidies.
यस प्लाण्टको कुल खर्च रु ३४,००० हो, जुन बिना अनुदान ३०% – ६९% जी जी सी.२०४७ मोडल भन्दा सस्तो हुन्छ ।

Easy to carry. बोक्न लाई सजिलो ।
All the material for one Bag Digester can be transported by one taxi or carried by two persons.
यस प्लाण्ट निर्माण गर्न लाग्ने सबै सामग्री सजिलै एउटा ट्याक्सीमा लैजान सकिन्छ वा दुई जनाले बोकेर लैजान सकिन्छ ।

Fast installation. चाडो जडान हुन्छ ।
The installation of the Bag Digester is fast: Only 5 - 6 person days are required for the installation (GGC2047 model around 27 person days).
यस प्लाण्ट निर्माण भई जडान हुन कम समय लाग्छ एक जना मानिसले ब्याग डाईजेष्टर ५ - ६ दिनमा जडान गर्न सक्छ भने GGC २०४७ मोडल लाई २७ दिन लाग्छ ।

High performance. उच्च कार्यक्षमता
The plastic shed works as a greenhouse: Therefore the performance is as high as possible.
प्लाण्टको छानाले हरित गृहको काम गर्ने हुँदा यस प्लाण्टको कार्यक्षमता बढी हुन्छ ।

What is the potential of Bag Digester in Nepal?
नेपालमा ब्याग डाईजेष्टरको सम्भाव्यता ?



The potential for Bag Digester is estimated to around 170'000 plants in remote areas from 1500m to 2500m. (Assumption: 40% of the households with cattle). Several clusters have a high potential, e.g. Baitadi, Dadeldhura and Doti (16'000 plants), Rolpo, Baglung, Pyuthan and Gulmi (26'000 plants) and Nuwakot and Kavre (14'000 plants)

ब्याग डाईजेष्टरको प्रवलता नेपालमा करिब १७०००० प्लाण्ट दुर्गम क्षेत्रमा १५०० मि. देखी २५०० मि. सम्म हुने देखिन्छ । (अनुमानित ४०% घरधुरी पशु सहित) निम्न चार क्षेत्र अझ बढी प्रवल देखिन्छन:
१ बैतडी, डडेलधुरा, र डोटी (१६०००)
२ रोल्पा, बाग्लुङ, प्युठान र गुल्मी (२६०००)
३ नुवाकोट र काभ्रे (१४०००)

How to build a Bag Digester in 3 days?
ब्याग डाईजेष्टर कसरी ३ दिनमा जडान गर्ने ?


1) Measure the size with the template
१) टेम्पलेटको सहायताले नाप लिने ।

2) Dig the pit and check the form with the template.
२) खाल्डो खन्ने र टेम्पलेट संग जाँच गर्ने ।


3) Clean the surface and add „Rato mato"
३) खाडल सफा गर्ने र रातो मातोले लिप्ने ।

4) Start the mason work
४) मिस्त्री काम सुरु गर्ने ।


5) Make hole with a hot metal pipe in the bucket. ५) निलो बाल्टिनमा तातो फलामले दुलो पार्ने ।

6) Build the wall up to the ground level.
६) जमिन सतह सम्म पर्खाल निर्माण गर्ने ।


7) Fill the outside with stones & soil
७) पर्खालको बाहिर ढुङ्गा र माटोले पुर्ने ।

8) Connect the HDPE-Pipe for inlet & outlet
८) ईनलेट र आउटलेटसंग ज्म्ए पाईप जोड्ने ।


9) Fill in the liquid concrete for watertightness
९) चुहावट रोक्न तरल मसला प्रयोग गर्ने ।

10) Prepare the Bag Digester
१०) ब्याग डाईजेष्टर तयार गर्ने ।


11) Attach the Bag Digester to the pipes
११) ब्याग डाईजेष्टर लाई पाईप संग जोड्ने ।

12) Construct the bamboo tent for protection
१२) सुरक्षाको लागि बासँको छानो बनाउने ।


13) Fill two bags with soil and attach them on a bamboo frame. १३) माटोमा भरेका दुईवटा बोरा बाँसको फ्रेममा गासेर राख्ने ।
14) Do the piping and attach the stove
१४) सम्पुर्ण ग्यास पाईप जडान गरिसकेपछि अन्तमा चुल्हो जडान गर्ने ।

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