FINAL REPORT

ON

Conduction of a study on biogas appliances workshop and organizing a workshop for Enhancing efficiency of biogas stoves in Nepal

SUBMITTED TO

National Rural and Renewable Energy Programme (NRREP)

Alternative Energy Promotion Center (AEPC)

Khumaltar, Lalitpur

Submitted by

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July 2014

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Annexes

1. BACKGROUND

Alternative Energy Promotion Centre (AEPC) was established in 1996 under the Ministry of Environment with the objectives of popularizing and promoting the use of renewable energy technology to raise living standards of the rural people, protecting the environment and developing commercially viable alternative energy industries in Nepal.

BSP Nepal was started in July 1992 by (DGIS) of Netherland all the district 75 out of 75 reach the biogas programme with 3915 VDCs 2800 village have biogas. Its main office is located in Baagdole, Lalitpur. BSP- Nepal was established as an NGO in 2003 to take over the implementation responsibility of BSP, which manage directly by Netherland development organization. Similarly CDM has been successful in Nepal biogas program and this successful start issuance of carbon credits has secured a flow of revenue to biogas program of Nepal which helps in financial self reliant.

The biogas plant construction under BSP-Nepal is fixed dome type (GGC Model 2047) and the size ranges 4, 6, 8 and 10 cubic meters. Those are generally individual house hold plant and the installation of them is feasible up to 2100 meter altitude in Nepal. To get the subsidy one should adopt the standard GGC Model 2047.

Biogas Support Programme (BSP) started in July 1992 with funding from Directorate General for International Cooperation of Netherlands (DGIS) of the Netherlands Government through the SNV/N. Government of Nepal (GON) and the German Development Bank (KFW) also started funding the BSP from the Phase-III, which started in March 1997 and lasted till June 2003. Until the phase-III, BSP was directly implemented by SNV/N.

BSP Phase-IV (July 2003-2010) was implemented after successful completion of first 3 phases. As a substantial amount of the DGIS fund was being left unspent, a budget neutral extension (BNE) was made earlier- and phase IV was carried out until December 2010. The BSP is currently in operation under the interim phase for the period from January 2011 – July 16, 2012. Currently, biogas program is being implemented under NRREP/AEPC from July 2012 and support by the government of Nepal. DANIDA, the Norwegian Government, KFW, WB, SNV and DFID. The Government Of Nepal (GOV) and External Development Partners supporting Nepal's rural and renewable energy sector have designed national rural and renewable energy programme (NRREP) to be implemented by AEPC for five years mid- July 2012 to mid-July 2017 in a single programme modality. The biogas energy sub-

component of NRREP covers biogas (household, intuitional, community and large sized) technologies (BTs). NRREP targets to install 130,000 household biogas plants, 1000 institutional biogas plant (large sized) and 200 community biogas plants throughout the country.

Biogas is a high grade fuel that can be used both thermal and electricity generation purposes. So, far biogas up to 10 cu. m capacities is supported by the government to meet the household/ domestic thermal cooking needs. The large capacity plants are also in the use for the public institution as (such as schools, hospitals, prisons), community groups and especially for commercial and industrial purposes. Given the possibility of use of waste generated in public/private entities in the relation to the electricity scarcity, especially in urban and semi-urban areas, the proper management of waste can also generate biogas which is economically competent with the existing fuels, electricity, LPG and kerosene.

A Biogas Coordination Committee (BCC) under the Executive Director of AEPC as a chairperson ensures overall coordination, guidance, and monitoring of programme and activities of the Biogas Support Programme (BSP). The BCC is supported by the Component Support Team (CST) chaired by representative from AEPC with members from implementing agencies and relevant external donor representatives in the matters relating to issues arising in the program and its analysis.

AEPC provides subsidy to the biogas users through the biogas companies. B**iogas** S**ector** P**artnership- Nepal (BSP-N)** and NBPA are the implementing agencies for biogas support program under AEPC. Recognized Biogas Companies construct the biogas plants for the biogas users.

2. OBJECTIVES

To find out the hindrances leading to low efficiency of the appliances of individual appliance manufacturing workshops, present and orient them.

- Study the stove efficiency test result reports conducted by at least AEPC/NRREP and SNV and summarize the outcomes of the study.
- Based on the results produced study on the existing situation and draw out the hindrances leading to low efficient appliances focusing on stoves.
- Conduct a workshop and present the result and orient the appliance manufacturing workshop.

3. SCOPE

The scope of work shall include, but shall not necessarily be limited to, the following:

- Conduct a thorough study on the deviated dimensions of the appliances (focusing on stoves) manufactured by each workshop with respect to the approved designs.
- Document each and every deviation and prioritize according to the severity of impact of the deviations of the parts of appliances leading to low efficiency for each manufacturer.
- Visit to at least two manufacturing workshops and monitor the process flow and draw out the results.
- Present the result organizing a workshop inviting at least two staffs of the manufacturing workshop from all the workshops including the owner, NBPA and BSP-N representatives.

4. METHODOLOGY

The orientation-training programme is grouped into four phases as follows:

a. Inception/ desk study
b. Finalization of training course and participants
c. Conduction of training programme
d. Reporting

The methodology to be followed in the above-mentioned phases is presented below:

5.1 PLANNING AND PREPARATION

The study related to this subject commences immediately after the signing of the contract with AEPC/NRREP.

Prior to the training following activities have been carried out:

- Relevant documents/information including different biogas appliances standard values have been collected from AEPC/NRREP, Biogas workshop, different manufacturer companies. After the thorough revision of the documents, a draft training design –with defined course modules and detailed course contents- have been prepared and it has been further refined in consultation with AEPC/NRREP professionals.

- The training team has developed a structured training programme schedule to meet the specific objectives. The training guidelines with specific course contents, training schedule and detailed handouts have been generated.
- There have been interaction with AEPC for the selection of training participants among the existing companies, finalizing the dates and venue, and providing the support facilities as well as conducting the training.
- The complete program have been executed sequentially in different phases as presented in flow chart and their detailed methodology is listed below.

5.2 COMPANY VISIT

- Two workshops/ appliances manufacturer have been visited in Rastriya Gobar Gas Chitawan and Nilkamal Gobargas Company. During visit manufacturing flow process has been analyzed.
- Checking of different parameters/drawings/standard developed in appliances of different workshop
- Quality control process, Manufacturing difficulties and Management system have been analyzed during visit

A glimpse of activities and steps of the tasks to conduct this training programme is presented in flow chart

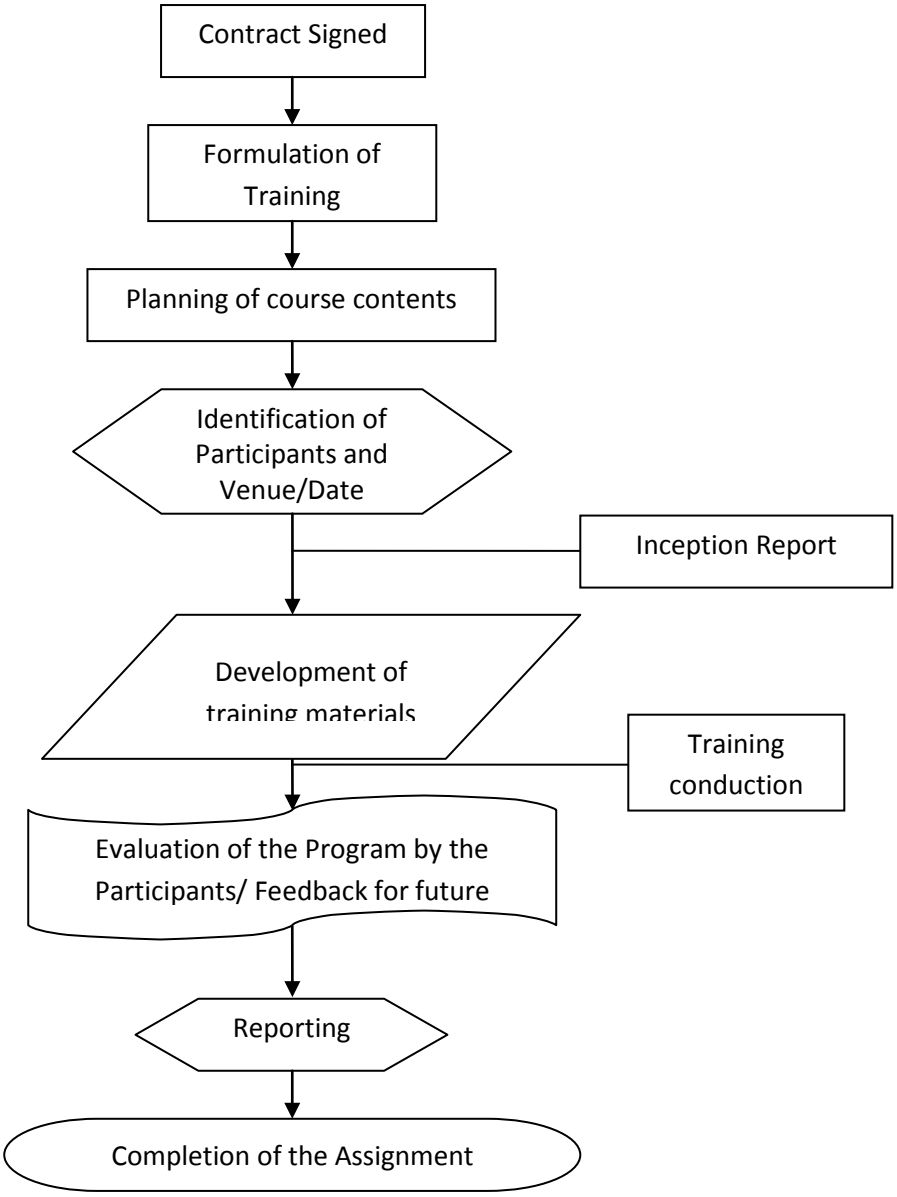


Figure 1: Flow Chart for the Training Programme

5.3 TRAINING PHASE

Training programme for the companies from listed biogas stove manufacturing companies. The duration of training programme have been of 2 days and the program has been conducted in Gaidakot Nawalparasi.

TRAINING METHODOLOGY

The methodology of the training has been presentation of the lecturers, distribution of the handouts, discussions and solving sample questions. The medium of instruction was Nepali/English language for all the classes. Sufficient time for the questions and their

solutions have been discussed thoroughly in theory classes to give the trainees clear understanding of the subject matters. This has not only helped the participants for better understanding of the deliberations during training but also has become an asset for future consultation purposes.

i) Theory Class

a. Instruction Method

- Lecturers
- Group discussions/Interaction
- Solving sample questions

b. Language of Instruction: Nepali/English

c. Instructional Aids:

- Overhead projector,
- Multimedia Presentation
- White Board

d. Course Material:

- Distribution of handouts/Leaflets
- Posters/Photograph/Drawing

ii) Demonstrational Session:

a. Instruction Method:

- Company visit

A combination of training methods have been used to conduct the proposed training packages. The training techniques selected and adopted will lead towards increasing and strengthening the knowledge, skills and attitude change for promotion and dissemination of biogas stove.

- **Lecture cum Discussion**

  This method has been used while dealing with the theoretical aspect of the course contents. Participatory discussions have been encouraged in this method. It will focus on manufacturing guidelines for the biogas stove, standard method and dimensions, deviation on product of individual company, potential correction, and process flow of the company and potential correction on it.

- **Group Discussion**

  For the active participation in sharing the ideas and experiences, this has also been adopted in almost all the training packages.

- **Field visit**

  A company has been visited for the detail monitoring product and process during training. For the demonstration, a nearest site from the training venue have been identified and visited by all participants.

TRAINING AIDS AND MATERIALS

Teaching aids and materials are to be selected on the basis of the training methods used. The following training materials have been used in the training sessions.

a) Multimedia Projector with Laptop Computer
b) Handouts, Posters/ Photographs/ Drawings
c) Pamphlets/leaflets of different RETs
d) White Board including marker pens and duster
e) Others as suggested by the resource persons and authorities of AEPC.

MONITORING AND EVALUATION

The training programme has been monitored and evaluated during at the completion of the program. Differences in the knowledge, skill and attitude of the participants before and after the course have been determined by undertaking.

5.4 REPORTING

Upon completion of programme at two different regions, a draft report has been submitted to the AEPC/NRREP.

FINAL REPORT

After the submission of the draft final report, AEPC has reviewed and issued certain comments. The consultant has thoroughly incorporated all the comments and suggestions. The report is finalized by adding the necessary information.

6. PROGRAMME SCHEDULE

The schedule of the orientation-training programme that have been followed at presented below:

Conduct a study on biogas appliance workshops and organize a workshop for Enhancing efficiency of biogas stoves in Nepal

Proposed date: 5 July to 6 July
Proposed venue: Gaidakot, Nawalparasi
Organized by:
National Rural and Renewable Energy Programme (NRREP)
Alternative Energy Promotion Centre (AEPC)
Conducted by:
Multiscope Consultancy Pvt. Ltd.

Day	Time	Session	Resource Person
Day one	9:30- 10:00	Registration / Tea & Snacks	Staff
	10:00 -11:30	Opening Ceremony: Welcome Speech to the Chief Guests, Guests and Participants and Speeches	HBD/AKJ/AEPC.NRREP officer
	10:30 -11:00	Introduction to the objectives, Rules and Regulation, scheduling and conduction of Pre-training Test	HBD/AKJ/AEPC.NRREP officer
	11:00-12:00	Familiarization with the course content and biogas production technology, appliances for the biogas production and their standard	AKJ
	12:00-13:00	Lunch	
	13:00-14:00	Presentation of measured parameters of individual company, deviation from standard and their effect on efficiency and potential improvement	HBD

	14:00-15:00	Process flow of the company and discuss about result and potential improvement	AKJ
	15:00 –onward	Tea and company visit for the observation production process and process monitoring	HBD/AKJ/AEP C.NRREP officer
Day Two	8:00- 8:30	Breakfast	Participants
	8:30 -9:00	Recalling the previous session by at two to three participants	
	9:00 – 10:00	Presentation from AEPC/NRREP regarding work performance of existing companies, potential improvement and support from own organization	AEPC.NRREP officer
	10:00 – 11:00	Evaluation of the training Programme (Feedback from trainees) and post evaluation	AKJ/HBD/ staff
	11:00 – 12:00	Closing Ceremony (Speeches, certificate distribution etc.)	AKJ/HBD/ staff
	12:00 onwards	Wrap Up; Lunch	

AKJ- Dr. Ajay Kumar Jha, HBD- Er. Hari Bahadur Darlami

7. **PARTICIPANTS OF THE PROGRAMME**

There were 28 participant from 14 companies are as follows

S.N.		**Name of Workshop**	**Address**	**Phone no**
1	Ms. Hari Kala Paudel	Asian Bio-gas Products	Butwal, Rupandehi	9817512960
2	Mr. Chandra Bahadur Kharti	Asian Bio-gas Products	Butwal, Rupandehi	9857026079
3	Mr. Rishiram Timilsian	Nilkamal Engineering	Bharatpur-10, Chitawan	9855064358
4	Mr.Kamal Dahal	Shikhar Biogas Product	Butwal, Rupandehi	9847025711
5	Mr. Bimal Dahal	Shikhar Biogas Product	Butwal, Rupandehi	9847025883
6	Mr. DB Gurung	Gharelu Gobar Gas & Prabhidi Bikash Company Pvt.Ltd.	Milan road, Butwal, Rupandehi	9857020852
7	Mr. Shyam Sundar Rana	Gharelu Gobar Gas & Prabhidi Bikash Company Pvt.Ltd	Milan road, Butwal, Rupandehi	9847478021

8	Mr. Sudip Paudel	Rastriya Gobar Gas	Bharatrapur, Chitawan	9845091199
9	Mr. Deepak Gautam	Nepal Urja Engineering	Banepa-10, Kavre	9841104407
10	Mr. Rewati Kumar Dahal	Nepal Urja Engineering	Banepa-10, Kavre	9751046509
11	Mr. Kamal Prasad Chaulagain	All Nepal Biogas Company (PVT)LTD	Hetauda-4, Kantirajpath, Makawanpur	9845149288
12	Mr. Harka Bahadur B. K.	National Iron & Alternative Power Development Company P.Ltd.	Bharatpur-10, Chitawan	9845163643
13	Mr. Santa Bahadur Gurung	National Iron & Alternative Power Development Company P.Ltd.	Bharatpur-10, Chitawan	9845153571
14	Mr. Prakash Jha	Galaxy Engineering Works	Bharatpur-10, Chitawan	9858422663
15	Mr. Gaurab Rana	Galaxy Engineering Works	Bharatpur-10, Chitawan	985842263
16	Mr. Baharthi Karn	Galaxy Engineering Works	Bharatpur-10, Chitawan	9807412537
17	Mr. Mulin Adhikari	Galaxy Engineering Works	Bharatpur-10, Chitawan	9807412537
18	Mr. Raman KC	Nawa Durga Engineering Workshop	Dhadwar-3, Katarniya	9858022388
19	Mr. Munna Ali Khan	Nawa Durga Engineering Workshop	Dhadwar-3,katarniya	
20	Mr. Prakahs Chandra Subedi	Pragati Bio Energy	Damauli, Tahanun	065560573
21	Mr. Niraj Paudel	Pragati Bio Energy	Damauli, Tahanun	9851045892
22	Mr. Ram Bahadur Gurung	Pokharel Biogas Products & Industries	Butwal, Rupandehi	071542665
23	Mr. Bijay Pokharel	Pokharel Biogas Products & Industries	Butwal, Rupandehi	071542665
24	Mr. Narayan Prasad Bhattarai	Narayan Metalcast	Butwal, Rupandehi	9857025942
25	Mr. Binod Shrestha	Siddha Baba Metalcast	Butwal, Rupandehi	9803885575
26	Mr. Basudev Chaudhary	Agni Engineering Workshop	Biratchowk,Morang	9804329642
27	Mr. Krishna Achaya	Agni Engineering Workshop	Biratchowk,Morang	9852057303

List or resource person from consultancy, AEPC/NRREP and other institutions

S.N	Name	Institution
1	Mr. Uttam Kumar Jha	AEPC/NRREP
2	Mr. Suraj Regmi	AEPC/NRREP
3	Mr. Saroj Karki	AEPC/NRREP
4	Mr. Prakahs Lamichhanbe	BSP
5	Mr. Prakash Khadka	Nepal Biogas Promotion Association
6	Mr. Hari Bahadur Darlami	Multiscope Consultancy
7	Dr. Ajay Kumr Jha	Multiscope Consultancy
8	Top Bahadur Darlami	Multiscope Consultancy

8. ACTIVITIES DURING THE PROGRAMME

Day first

Opening Session

Our program started with the registration of the participants from different districts and distribution of material to them. It then followed on with the introduction among participants and resource persons. Expectations of the participants were collected in written form as a questionnaire. Team leader Mr. Hari Bahadur Darlami expressed the highlights of the training program whereas program schedule was made clear to the participants by Mr. Hari Bahadur Darlami, Managing Director of the Multiscope Consultancy with a brief introduction of Multiscope Consultancy. The session followed by a welcome speech from Mr. Suraj Regmi from AEPC/NRREP and the objective of workshop, rule and regulation has been conducted by Mr. Hari Bahadur Darlami. During opening session, Mr. Prakash Lamichane, Director of BSP, also expressed few words about importance of training program. At the mean time, there was class and field monitor was selected. Mr. Rishi Ram Timilsina has been selected as class and field monitor.

Lecture Session

Lecture Session went according to the program schedule (attached with this report). The lecture session started with biogas production technology, appliances for the biogas production and their standard by Dr. Ajay Kumar Jha. Team Leader of resource persons, Mr. Hari Bahadur Darlami has been presented on measured parameters of individual company, deviation from standard and their effect on efficiency and potential improvement. In between these sessions, some leisure time was given for the participants to raise questions regarding the topic so that discussions could be done. Meanwhile, Mr. Suraj Regmi and Mr. Prakash Lamichhane was also highlighting on the points regarding the policies of AEPC/NRREP and subsidies accordingly.

Apart from the regular schedule, participants were also given ample opportunity to enjoy by making some jokes and other entertainment activities along the queries.

Demonstration Session

During the first day of the training program the participants were taken to biogas appliances manufacturing workshop at Rastriya Biogas at Bharatpur Chitawan. During workshop visit, Mr. Sudeep Paudel of has explained the process in the company, process of biogas appliances production. Mr. Hari Bahadur Darlami and Dr. Ajay Kumar Jha also highlighted process flow of the workshop.

Day two

During the second day, Mr. Hari Bahadur Darlami has been presented on factors that affects the quality of the product. During the session Mr. Suraj Regmi, Mr. Prakash Lamichhane and Uttam Kumar Jha also added the technical, managerial and other factors that affecting quality product.

Mr. Uttam Kumar Jha was given presentation the way forward to improve the quality of biogas appliances. He also highlighted the importance of layout, process of work, quality control etc.

Discussion session

Floor was opened for the discussion focusing current status of workshop, potential practice, improvement option, potential barriers etc.

Closing session

During closing session, program was conducted by Mr. Suraj Regmi. From participant, Rishi Raj Timilsina expressed his views about the experience of the training program. Mr. Uttam Kumar Jha expressed his kind words on the closing ceremony of the program. He also expressed thanks to all who helped to complete the workshop program successfully.

9. CONCLUSION

Following conclusions has been drawn from the study on performance of stove, study of process flow of workshop and the workshop program with biogas companies.

- Physical dimension of standard parameters of biogas stove have been deviated from standards.
- Efficiency ranges from 30 % to 36% and average efficiency is 32.73%. There is still room for efficiency improvement by controlling standards.
- Technical reason of the deviation in parameters due to lack of proper machine, improper manufacturing process, lacking of qualified man power and quality control system.
- Managerial cause of lacking of quality product due to lagging on purchase of high tech equipment, high staff turnover, lack of lack quality conscious.
- External factors such as lack of training program for the workshop technician, uncertainty of biogas promotion, lacking of quality control system from concern bodies.
- Work process flow of the workshop company is running traditional way.
- Most of the workshop owner are feeling to improve their physical parameter after workshop.

10. RECOMMENDATION

Following recommendation has been drawn from study of biogas stove, work process flow and workshop interaction:

- Research and development should be conducted to increase the efficiency of biogas stove
- Standard should be revised on the basis of social expectation, raw material availability and increased efficiency
- Quality control mechanism should be developed

- Assurance for workshop should be developed for the quality product and economic product
- Training should be provided for technical man power of the workshop
- Energy audit should be done.

Annexes

Annex-1: Photographs

Group photos of participants and resource persons

Participants and resource persons attending the workshop

Participant during workshop visit

Mr. Uttam Kumar Jha and other participants during workshop visit

Mr. Hari Bahadur Darlami during program

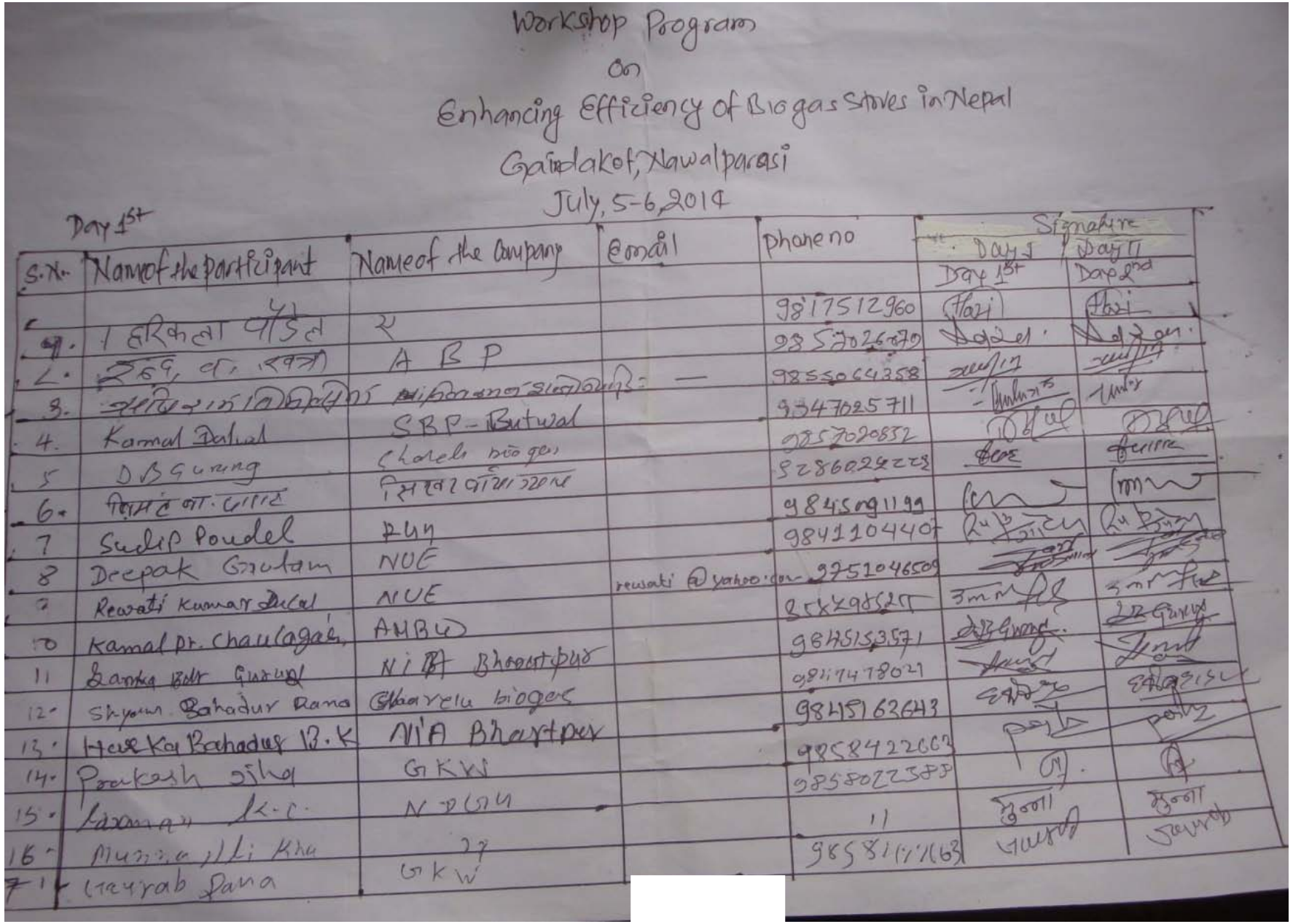
Mr. Suraj Regmi during program

Mr. Uttam Kumar Jha During Program

Mr. Uttam Kumar Jha During Program

Participant during program

Annex 2: Attendance sheet



Workshop Program

On

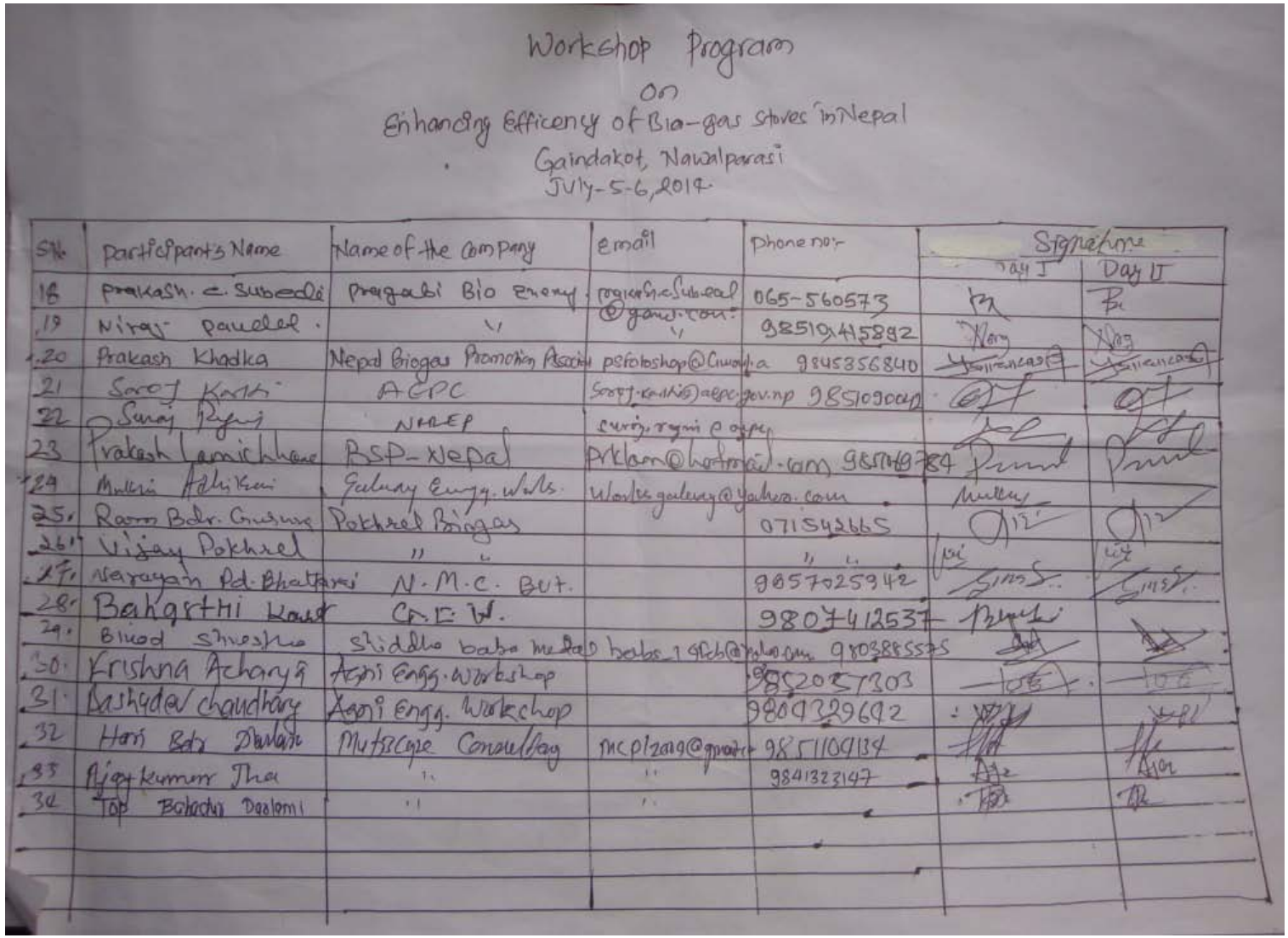
Enhancing Efficiency of Biogas Stoves in Nepal

Gaindakot, Nawalparasi

July, 5-6, 2014

Day 1st

S.N.	Name of the participant	Name of the Company	Email	phone no	Signature Day I Day 1st	Day II Day 2nd
1.	हरिकला पौडेल	ए		9817512960		
2.	[illegible]	A B P		9857026870		
3.	[illegible]	[illegible]	—	9855044358		
4.	Kamal Dahal	SBP-Butwal		9547025711		
5	D B Gurung	Chaleb biogas		9857020832		
6.	[illegible]	[illegible]		9828029223		
7	Sudip Poudel	BSP		9845091199		
8	Deepak Gautam	NUE		9841104407		
9	Rewati Kumar Dahal	NUE	rewati@yahoo.com	9752046509		
10	Kamal Pr. Chaulagain	AMBU		8[illegible]9852[illegible]		
11	Sanka Bdr Gurung	NIDT Bharatpur		9845153571		
12	Shyam Bahadur Rana	Bharelu biogas		9[illegible]7478021		
13	Hasta Kaji Bahadur B.K	NIA Bhartpur		9841516343		
14	Prakash Jha	GKW		9858422063		
15	[illegible]	NDBU		9858022383		
16	Muniraj Li Kha	11		11		
17	Nayrab Rana	GKW		9858[illegible]163		



Workshop Program

on

Enhancing Efficency of Bio-gas Stoves in Nepal

Gaindakot, Nawalparasi

July-5-6, 2014

S.N.	Participants Name	Name of the company	email	Phone no:-	Signature	
					Day I	Day II
18	Prakash C. Subedi	Pragabi Bio energy	pragatic.subedi@gmail.com	065-560573		
19	Niraj Paudel	"	"	9851041589 2		
20	Prakash Khadka	Nepal Biogas Promotion Assoc.	pcfotoshop@live.com	9845356840		
21	Saroj Karki	AEPC	saroj.karki@aepc.gov.np	9851090040		
22	Suraj Rijal	NRREP	suraj.rijal@gmail.com			
23	Prakash Lamichhane	BSP-Nepal	prklam@hotmail.com	9851087784		
24	Muktiram Adhikari	Galaxy Engg. Works	Workshop.galaxy@yahoo.com			
25.	Ram Bdr. Gurung	Pokhrel Biogas		071542665		
26	Vijay Pokhrel	"		"		
27.	Narayan Pd. Bhattarai	N.M.C. But.		9857025942		
28.	Bhagirathi Kandel	C.E.W.		9807412537		
29.	Binod Shrestha	Siddha baba metal	babas_1976@yahoo.com	9803855575		
30.	Krishna Acharya	Agni Engg. Workshop		9857057303		
31.	Bishnudev Chaudhary	Agni Engg. Workshop		9804329692		
32	Hari Bdr. Dahal	Mutsepe Consultancy	mcplzng@gmail.com	9851109134		
33	Ajay Kumar Jha	"	"	9841323147		
34	Top Bahadur Daulami	"	"			

Annex-3: Hansout

TRAINING MATERIAL

ON

Conduct a study on biogas appliance workshops and organize a workshop for Enhancing efficiency of biogas stoves in Nepal

ORGANINZED BY

NRREP/AEPC

Khumaltar, Lalitpur

CONDUCTED BY

Multiscope Consultancy Pvt. ltd.

Sankhamul, Kathmandu

June 2014

Contents

1. BSP STANDRAD MADE FOR BIOGAS APPLIANCES

Biogas Support Programme has been developed Quality Standards biogas Appliances for the quality and efficient product. Standard has covered in following parameters

- Specification
- Material
- Manufacturing Process
- Workmanship and Finish
- In Process Quality Control
- Performance
- Sampling
- Marking
- Packing
- Reference List

Following appliances have to follow above standard parameters

1.1 BSP STANDARD FOR BIOGAS STOVE

It consists following parts

- Air Regulating Ring - A metal ring provided to cover the air holes at the Burner Pipe near the Burner Nozzle. The Air Regulating Ring controls the flow of air in to the burner pipe and thus controls the gas/ air ratio. By proper adjustment of this ring suitable gas/ air ratio can be obtained for efficient heating.
- Burner- A device for the final conveyance of the gas, or a mixture of gas and air to produce a suitable flame.
- Burner Clearance - Distance between the burner cap centre and maximum height of the prongs of the pan support. This clearance determines effective distance between the gas flame and the cooking pot.
- Burner Cap - Head of the burner, which remains just beyond the outlet end of the mixing chamber and contains a number of ports for gas burning. This can be de-attached for cleaning of the burner assembly.
- Burner Cup - Mixing chamber of the burner assembly. This is immediately below the burner cap and attached to the burner pipe at the outlet end.
- Burner Pipe - Main body of the burner, which holds the gas inlet nozzle at the inlet end and Burner cup on the outlet end. Burner Pipe provides structural support to the

Burner Assembly and also provides means for gas conveyance from nozzle to burner port. It also holds air hole for obtaining suitable gas/ air ratio.

- Burner Nozzle- An small orifice of pre-determined diameter which allows entry of gas in to the burner assembly under pressure and high velocity.
- Pan Support - The assembly, which is meant to support the vessels. Prongs are parts of pan support.
- Prongs - That part of pan support, which actually supports the vessels.
- Stove - An assembly of burner/s forming a separate unit allowing direct contact between the flames or hot gases from the burner/s and the vessel above it/ them.
- Support Frame - Main structure of the stove including legs. This is the main structure of the stove on which pan support rests.

Specification

- Size: Standard size of BSP approved stove is 200mm. That is, the size of the pan support shall be 200 X 200 mm.
- Biogas Stoves shall have only one burner
- Burner clearance shall be strictly between 25 to 30 mm to ensure efficient heating performance of the stove
- The burner shall be in the centre and level position of the Stove assembly.

Type

There may be two types of Biogas Stoves depending upon the use of type of Pan Support:

- Fixed Pan Support Type (Type A): In this type of stove the all 4 Prongs are welded directly on the frame of the stove and can not be de-attached later on.
- Loose Pan Support Type (Type B)- In this type of stove the pan support, normally made of cast iron including prongs and square, can be de-attached from the frame of the stove.

Material

- Quality and quantity should be as per standard

Construction

General

- The stove, including all component parts, shall be easy to clean and maintain in good working order.
- Frame, Pan Support and other parts of the stoves shall be so constructed that they are secured against displacement, distortion, warping, or other damage, and shall be

supported to maintain a fixed relationship between essential parts under normal and reasonable condition of handling and usage so as to assure continued compliance with requirements.

- The stoves shall be so designed that it remains stable and shall not be easily over turned.
- The stove legs shall be level and shall not rock when placed on a level surface.
- Loose pan supports shall be so designed that it is not possible to place them firmly in other than proper position.
- Prongs of the Pan Support shall have suitable taper to accommodate round bottom pans.

Burner

- Burners and parts of the burners (Burner caps in most cases) shall be interchangeable or replaceable without difficulty and affecting the performance of the burner.
- Burner Nozzle and Burner Pipe shall be jointed by two good quality tack welding applied at opposite sides of the pipe The tack welding also keeps the air regulating ring from slipping out.
- The parts of the burner shall not become disconnected during operation of the stove.
- Air regulating ring shall be smooth and easy to operate, with no excess gap between two pipe for effective adjustment or regulation of air.
- The jointing of Burner Pipe and Burner Cup shail be very strong, air tight and by means of araldite.

Recommended Manufacturing Process

Burner Assembly:

- Cut the G. I Pipes and M. S. Rods to the required lengths
- Drill a side hole of 8 mm diameter at a distance of 18 mm from one end of ½”G I Pipe.
- Reduce the outside diameter of G. I. Pipe to 20 (+0, -0.2) mm up to 20 mm from the other end to fit the burner cup.
- Machine the M S. Rod in a Lathe Machine to meet the dimensional requirements. Drill the inside bore of the rod to the required diameter. Cut the step for gripping Rubber Hose Pipe.

- Drill the Nozzle Hole. This operation is critical and the Nozzle jet diameter and width of the hole shall be maintained
- Insert the Burner Nozzle inside the Burner Pipe and tack weld the part at top and bottom of the circumference.
- Insert the Air Regulating Ring from the other end of the Burner Pipe.
- Insert the other end of the Burner Pipe in the Burner Cup. Make a strong bond between the Burner Pipe and the Burner Cup by means of Araldite. Let the Araldite dry.
- Place the Burner Cap in its place.

Workmanship and Finish

- The finish of exposed parts shall be durable, easy to clean and not subject to excessive deterioration in normal use..
- The welding joint shall be of good and sound quality. The joint shall be properly cleaned.
- The Air Regulating Ring shall be smooth and easy to operate.
- All the exposed surfaces shall be smooth, without any blur, projections or protrusion. Any sharp edge shall be suitably removed.

In Process Quality Control

The manufacturer shall consistently check the quality of the product during various stages of its manufacturing. Quality control at following points are recommended, however depending upon the procedure followed the manufacturer may include other suitable points also

- Raw Material: Raw Material shall be checked to ensure that they conform to the requirements.
- Dimension: The dimensions of the finished product shall be strictly controlled and regularly checked
- Machining: Quality of the machining of the parts shall be checked immediately after each machining process.
- Internal boring/ drilling shall be checked for diameter as well concentricity of the hole.
- Side boring shall be checked for their position as well as their intersection with the main axis of the part.
- Welding: Quality of the welding joint shall be checked after each welding process

- Quality Plan: The supplier shall prepare a quality plan describing exactly how the specification and other quality requirements specified in this standard will be met. The plan shall clearly specify different inspection/ control points. The supplier shall maintain records of dimensional checks, visual inspection and other tests carried as a proof of conformance of the product to the requirements of this standard- The supplier shall preserve and present these records to BSP representative/ s when visits for quality checking are made.

Performance:

Burner when in complete assembly with the burner and stove shall pass the following performance tests'

- Ignition and Flame Travel: There shall be easy and safe access for lightening and re-lightening of the burner by a matchstick. With the vessel placed on the burner, if the flame is applied to the burner port and the gas is turned on. flame travel shall be complete
- Flame Stability: It shall be possible to operate the burner with gas inlet pressure of 747 N/m^2 (762 gf/cm2) without the flame extinguishing, blowing or striking back.
- Flash Back: The burner shall conform to the flash back test when tested as per the test method.

Sampling

This sampling plan shall be followed for any lot wise inspection of the products for the purpose of lot acceptance.

- Batch: All of the products made from one source of raw material and made at the same time shall constitute a batch.
- Lot: A number of products offered for inspection at one time and manufactured from the raw material from same source shall constitute a lot. Maximum and recommended lot size shall be 500 sets of Biogas Stoves.
- Defective Sample: Any sample not conforming to any one or more of the Specified requirements.
- Random Sampling: A random sampling method ensuring that every piece of products offered for inspection shall have equal probability for being selected as a sample shall be followed. Either of the two random sampling method shall be followed:
  i. Systematic Sampling:

ii. Use of Random sampling table:

- Sampling Plan for Visual Inspection and Dimensional Check:

i. Sampling Plan

Lot size	Sample Size	Acceptance	Rejection
1-15	3	0	1
16-90	13	1	2
91-150	20	**2**	3
151-280	32	**3**	4
281-500	50	5	6

ii. Criteria for conformity: For the lot size specified in column (a) of the above table sample size specified in column (b) shall be inspected for visual and dimensional requirements If the number of defected samples is less or equal to the number mentioned in column c then the lot shall be considered conforming to the requirements of this standard in visual and dimensional requirements, if the total number of defective samples is equal to or more than the number mentioned in column d then the lot shall be considered not conforming to the requirements of this standard.

- Sampling Plan for Performance Tests:

  1 sample per 100 completed Burner Assembly shall be tested

Marking

Every piece of Siogas Stove shall permanently be marked with the following information:

- Manufacturers Name/ or logo/ or any other identification.
- Batch No.
- Approved Colour Code.

Packing

Biogas Stoves shall be suitably packed inside a cardboard box to prevent damage during transportation from the manufacturer's workshop to other storage.

Reference List

- BSP Standard for Burner Cup and Cap.
- IS; 6480- 1971, Indian Standard - Glossary of Terms Relating to Domestic and Commercial Gas- burning Appliances.

- IS. 8749- 1988, Indian Standard - Specification for Biogas Stove
- BSP drawing
- Other BSP Publications.

1.2 Biogas Tap (With Varying Knob)

Gas Tap - A device used to regulate the flow of gas. This device is attached at the end of gas line and just before the gas stove/ or lamp.

The Piston of the test piece shall be closed air-tight. The open end of the G. I. Pipe shall be connected to a device (for example air compressor) for applying an air pressure. The sample then shall be applied to a minimum internal air pressure of 0.5 Kg/ cm2 {49 x 103 N/m2). The test piece shall not show any sign of air leakage from any part, surface or mating surfaces during the test.

The air leakage can be tested by any suitable means such as by immersing the sample completely inside a water bath or by applying soap/ shampoo solution.

1.3 Biogas Water Drain

Water Drain -A device used to remove water precipitated from gas at the gas pipeline.

1.4 BSP Standard for Burner Cup & Cap

Burner - A device for the final conveyance of the gas, or a mixture of gas and air to produce a suitable flame.

Burner Cap - Head of the burner, which remains just beyond the outlet end of the mixing chamber and contains a number of ports for gas burning. This can be de-attached for cleaning of the burner assembly.

Burner Cup - Mixing chamber of the burner assembly. This is immediately below the burner cap and attached to the burner pipe at the outlet end.

Burner Port - An opening in a burner head through which gas or air- gas mixture is discharged for ignition.

Flash Back - Transfer of combustion from a burner port of an aerated burner into the burner cup. Burner pipe and finally to the burner nozzle.

1.5 Dome Pipe

Dome Pipe - A pipe fitted at the centre of Dome of the biogas plant. This is permanently fitted to the concrete structure of the dome and acts as inlet of the gas at the gas pipeline.

1.6 Gas pipe line adaptor

Gas Pipeline Adapter - A device which can be fitted at an appropriate place to enable attach an external device in the gas pipeline.

1.7 Mixer Installation and Manufacturing

Mixture - A device used to agitate the dung and water into the inlet pit of a biogas plant. The mixer after proper agitation of the dung and water shall make effective mixing.

Vertical Mixer Bracket - A device used to support the Vertical Mixer Machine in the inlet pit. Vertical Mixer Bracket is permanently fixed in the concrete structure of the inlet pit,

Vertical Mixer Machine - A device with fins of predetermined profile used to churn the dung and water in the inlet pit.

1.8 Biogas lamp

- **Air Sleeve** - This contains a number of Air holes, which can be rotated to adjust and vary the gas and air ratio in the mantle holder.
- **Lamp**- A device used to generate light by combustion of the gas
- **Mantle Holder**- A part of the lamp, which is fitted with the carborendom Ventury where a mantle can be fitted. The holder consists of gas nozzle for the flow of the gas for combustion and air holes for proper mixing of gas and air.
- **Reflectors** - These are heat and light reflectors fitted on top of the lamp so that heat and light produced at the mantle is reflected below and the flow of heat through the lamp top is retarded.

1.9 Pressure test

Pressure test will be done for the following appliances

- **Biogas tab**
- **Water drain**
- **Gas pipeline adaptor**

Procedure pressure test

The Piston of the test piece shall be closed air-tight. The open end of the G. I. Pipe shall be connected to a device (for example air compressor) for applying an air pressure. The sample then shall be applied to a minimum internal air pressure of 0.5 Kg/ cm2 {49 x 10^3 N/m^2). The test piece shall not show any sign of air leakage from any part, surface or mating surfaces during the test.

The air leakage can be tested by any suitable means such as by immersing the sample completely inside a water bath or by applying soap/ shampoo solution.

Now, this standard parameter has to fulfill the entire requirement below for quality standard which is describe in detail below;

Table : Standard for stoves

S.N.	PARAMETRE	STANDARD
1.	Burner cap centre and pan base (burner clearance)	25-30 mm
2.	Size of hole on burner cap	Not defined
3.	No. of hole on burner cap	Not defined
4.	Size of stove	200*200 mm/250*250 mm
5.	Burner nozzle air (M.S)	16 mm
6.	Inner diameter of Burner pipe (G.I)	17 to 17.4 mm
7.	Angle of Pronge	Not defined
8.	Side hole for air	8 mm dia
9.	Distance of side hole from one end	18 mm
10.	Angle between burner holes and burner axis	45^0
11.	Location of burner	Centered
12.	Pan support	20*6*125
13.	Burner pipe length (G.I)	150 mm
14.	Burner material	Aluminum
15.	Height of stove	20 mm
16.	Frame size of stove	25×6 mm
17.	Color of burner pipe	Black
18.	Type of fit in burner cap and burner base	Tight/ push type
19.	Air regulating ring	¾ inch inner dia / Black

There are some other parameters that need to be taken into mind for quality control like surface finished of burner, leakage from joints, welding quality, tolerance of the above parameter, weight per length of materials.

Actually, the study was confined for the calculation of efficiency of existing stove from certain sample so, the parameter that directly or in directly affect efficiency and performance were only taken into consideration for study.

2. Observed parameters of biogas stoves of different companies

Study report of different workshop regarding different stove parameters

1. Agni Engineering Workshop

S. N.	Parameters	BSP standard	Observed value			Deviation
			Set A	Set B	Average	
1.	Burner cap centre and pan base , burner clearance (in mm)	25-30	28.08	32.70	30.39	0.39
2.	Size of hole on burner cap (in mm)	Not defined	3.10	3	3.05	-
3.	No. of hole on burner cap (in mm)	Not defined	32	32	32	-
4.	Size of stove (in mm*mm)	250*250	247*247	248*242	247.5*244.5	-3.5 * -5.5
5.	Burner nozzle air, M.S (in mm)	16 mm	15.04	15	15.02	0.98
6.	Inner dia. of burner pipe (in mm)	17 to 17.4	15.36	14.7	15.03	1.7
7.	Angle of Pronge	Not defined	5^0 uniform	10^0 not uniform	7.5^0	-
8.	Dia. of side hole (in mm)	8	7.40	7.45	7.43	0.57
9.	Distance of side hole from one end (in mm)	18	19	19	19	1
10.	Angle between burner holes and burner axis	45^0	35^0	40^0	37.5^0	7.5^0
11.	Location of burner	Centered	Centered	Not centered	-	-
12.	Pan support (in mm*mm*mm)	20*6*125	21*5*120	20*5*117	20.5*5*118.5	0.5*1*6.5
13.	Burner pipe length, G.I, (in mm))	150	155	153	154	4
14.	Burner material	Aluminum	Aluminum	Aluminum	-	-
15.	Frame size of stove (in mm)	25×6	24.62*3.66	24.74*3.72	24.68*3.69	0.32*2.31
16.	Color of burner pipe	Black	Not black	Not Black	-	-
17.	Type of fit in burner cap and burner base	Tight/ push type	Loose fit	Loose fit	-	-
18.	Inner dia of air regulating ring (in mm)	19.0, Black	21.32 , black	19.94 , black	20.63	1.58
19.	Efficiency		35.27 %	33.88 %		

Photograph of Agni stove	Major findings	Improvement
	• Size of stove smaller than standard • Inner diameter of burner pipe larger than standard • Deviation on angle between burner holes and burner axis is large • Location of burner not consistent • Variation in burner pipe length • Pan support are larger that reduce efficiency	• Make as per standard • Make as per standard • Make as per standard • Check center location after manufacturing • Make as per standard • Make it as per standard

2. Shiva Engineering Workshop

S.N.	Parameters	BSP standard	Observed value			Deviation
			Set A	Set B	Average	
1.	Burner cap centre and pan base , burner clearance (in mm)	25-30	36.04	35.08	35.56	5.56
2.	Size of hole on burner cap (in mm)	Not defined	3	3	3	-
3.	No. of hole on burner cap (in mm)	Not defined	36	36	36	-
4.	Size of stove (in mm*mm)	200*200	200*195	201*202	200.5*198.5	0.5*1.5
5.	Burner nozzle air, M.S (in mm)	16	14.06	16	15.03	0.97
6.	Inner dia. of burner pipe (in mm)	17 to 17.4	15.64	15.5	15.57	1.43
7.	Angle of Pronge	Not defined	0^0	0^0	0^0	-
8.	Dia. of side hole (in mm)	8	7.76	7.71	7.73	0.27
9.	Distance of side hole from one end (in mm)	18	20	17	18.5	0.5
10.	Angle between burner holes and burner axis	45^0	44^0	43^0	43.5^0	1.5^0
11.	Location of burner	Centered	Not Centered	Centered	-	-
12.	Pan support (in mm*mm*mm)	20*6*125	20*6*100	22*5*100	21*5.5*100	1*0.5*25
13.	Burner pipe length, G.I, (in mm)	150	155	152	153.5	3.5
14.	Burner material	Aluminum	Aluminum	Aluminum	-	-
15.	Frame size of stove (in mm)	25×6	25.32*3.46	25*3.44	25.16*3.45	0.16*2.55
16.	Color of burner pipe	Black	Not Black	Not Black	-	-
17.	Type of fit in burner cap and burner base	Tight/ push type	Loose fit	Loose fit	-	-
18.	Inner dia of air regulating ring (in mm)	19.0, Black	20.72 /black	20.82 /black	20.77	1.72
19.	Efficiency		36.06 %	37 %		

Photograph of Shiva stove	Major findings	Improvement
	• Burner clearance are large • Deviation on angle between burner holes and burner axis is small • Location of burner not consistent • Variation in burner pipe length • Air ring regulator size are large	• Make between 25-30 • Make as per standard • Check center location after manufacturing • Make as per standard • Make as per standard

3. All Nepal Biogas Company

S. N.	Parameters	BSP standard	Observed value			Deviation
			Set A	Set B	Average	
1.	Burner cap centre and pan base , burner clearance (in mm)	25-30	30.75	29.07	29.91	-
2.	Size of hole on burner cap (in mm)	Not defined	4.12	4.18	4.15	-
3.	No. of hole on burner cap (in mm)	Not defined	20	20	20	-
4.	Size of stove (in mm*mm)	250*250	252*251	250*248	251*249.5	1*-0.5
5.	Burner nozzle air, M.S (in mm)	16	15.06	15	15.03	0.97
6.	Inner dia. of burner pipe (in mm)	17 to 17.4	16.52	15.9	16.21	0.79
7.	Angle of Pronge	Not defined	10^0 uniform	10^0 uniform	10^0	-
8.	Dia. of side hole (in mm)	8	7.72	8	7.86	0.14
9.	Distance of side hole from one end (in mm)	18	19	19	19	1
10.	Angle between burner holes and burner axis	45^0	42^0	43^0	42.5^0	2.5^0
11.	Location of burner	Centered	Not Centered	Centered	-	-
12.	Pan support (in mm*mm*mm)	20*6*125	21*5*117	21*5*115	21*5*116	1*1*9
13.	Burner pipe length, G.I, (in mm)	150	158	156	157	7
14.	Burner material	Aluminum	Aluminum	Aluminum	-	-
15.	Frame size of stove (in mm)	25×6	24.24*4.32	24.06*4.24	24.15*4.28	0.85*1.72
16.	Color of burner pipe	Black	Not Black	Not Black	-	-
17.	Type of fit in burner cap and burner base	Tight/ push type	Loose fit	Loose fit	-	-
18.	Inner dia of air regulating ring (in mm)	19.0, Black	22.36 mm/ black	22.60 mm/ black	22.48 mm	3.43 mm
19.	Efficiency		32.40%	29.83%		

Photograph of All Nepal stove	Major findings	Improvement
	• Burner clearance are large • Deviation on angle between burner holes and burner axis is large • Location of burner not consistent • Variation in burner pipe length • Air regulating ring dia are large	• Make as per standard • Check perfect inclination during manufacturing • Make it centered • Make as per standard • Make as per standard

4. Neelkamal Engineering

S. N.	Parameters	BSP standard	Observed value			Deviation
			Set A	Set B	Average	
1.	Burner cap centre and pan base , burner clearance (in mm)	25-30	26.06	27.04	26.55	-
2.	Size of hole on burner cap (in mm)	Not defined	5.06	5	5.03	-
3.	No. of hole on burner cap (in mm)	Not defined	20	20	20	-
4.	Size of stove (in mm*mm)	250*250 mm	249*247	249*249	249*248	-1*-2
5.	Burner nozzle air, M.S (in mm)	16 mm	15.38	15	15.19	0.81
6.	Inner dia. of burner pipe (in mm)	17 to 17.4	15.64	16.18	15.91	1.09
7.	Angle of Pronge	Not defined	5^0 uniform	5^0 uniform	5^0	-
8.	Dia. of side hole (in mm)	8	7.09	7.14	7.11	0.89
9.	Distance of side hole from one end (in mm)	18	18	19	18.5	0.5
10.	Angle between burner holes and burner axis	45^0	50^0	50^0	50^0	5^0
11.	Location of burner	Centered	Not Centered	Not Centered	-	-
12.	Pan support (in mm*mm*mm)	20*6*125	17*6*111	16*5*112	16.5*5.5*111.5	3.5*1*13.5
13.	Burner pipe length, G.I, (in mm)	150	160	160	160	10
14.	Burner material	Aluminum	Aluminum	Aluminum	-	-
15.	Frame size of stove (in mm)	25×6	25.32*4.22	25*4	25.16*4.11	0.16*1.89
16.	Color of burner pipe	Black	Not Black	Not Black	-	-
17.	Type of fit in burner cap and burner base	Tight/ push type	Loose fit	Loose fit	-	-
18.	Inner dia of air regulating ring (in mm)	19.0, Black	21.32 /black	22 /black	21.66	2.61
19.	Efficiency		28.59%	29.07%		

Photograph of Neelkamal Stove	Major findings	Improvement
	• Deviation on angle between burner holes and burner axis is large • Location of burner not consistent • Variation in burner pipe length • Air regulating ring dia are large • Pan support pronged are larger	• Make as per standard • Check center location after manufacturing • Make it centered • Make as per standard • Make prong smaller as per standard to increase efficiency

5. Galaxy Engineering Workshop

S. N.	Parameters	BSP standard	Observed value			Deviation
			Set A	Set B	Average	
1.	Burner cap centre and pan base , burner clearance (in mm)	25-30	27.68	30.07	28.87	-
2.	Size of hole on burner cap (in mm)	Not defined	4.14	4.14	4.14	-
3.	No. of hole on burner cap (in mm)	Not defined	20	20	20	-
4.	Size of stove (in mm*mm)	250*250	250*250	250*247	250*248.5	0*-1.5
5.	Burner nozzle air, M.S (in mm)	16	15.73	15	15.36	0.64
6.	Inner dia. of burner pipe (in mm)	17 to 17.4	16.68	16.2	16.44	0.56
7.	Angle of Pronge	Not defined	10^0 uniform	10^0 uniform	10^0	-
8.	Dia. of side hole (in mm)	8	7.12	7.13	7.13	0.87
9.	Distance of side hole from one end (in mm)	18	20	21	20.5	2.5
10.	Angle between burner holes and burner axis	45^0	45^0	45^0	45^0	0
11.	Location of burner	Centered	Not Centered	Centered	-	-
12.	Pan support (in mm*mm*mm)	20*6*125	18*5*128	20*5*127	19*5*127.5	1*1*2.5
13.	Burner pipe length, G.I, (in mm)	150	157	156	156.5	6.5
14.	Burner material	Aluminum	Aluminum	Aluminum	-	-
15.	Frame size of stove (in mm)	25×6 mm	23.88*3.42	24*3.30	23.94*3.36	0.06*2.64
16.	Color of burner pipe	Black	Not Black	Not Black	-	-
17.	Type of fit in burner cap and burner base	Tight/ push type	Loose fit	Loose fit	-	-
18.	Inner dia of air regulating ring (in mm)	19.0, Black	21.98/ black	21.82 / black	21.9	2.85
19.	Efficiency		32.43%	32.80%		

Photograph of Galaxy Stove	**Major findings**	**Improvement**
	• Deviation on angle between burner holes and burner axis is large • Location of burner not consistent • Variation in burner pipe length • Distance of side hole are far • Air regulating ring dia are large	• Make as per standard • Check center location after manufacturing • Make it centered • Make as per standard • Make as per standard

6. National iron and Alternative Power Development of Company

S. N.	Parameters	BSP standard	Observed value			Deviation
			Set A	Set B	Average	
1.	Burner cap centre and pan base , burner clearance (in mm)	25-30	27.11	27.40	27.25	-
2.	Size of hole on burner cap (in mm)	Not defined	5	5	5	-
3.	No. of hole on burner cap (in mm)	Not defined	20	20	20	-
4.	Size of stove (in mm*mm)	250*250	247*247	247*247	247*247	-3*-3
5.	Burner nozzle air, M.S (in mm)	16	14.39	14	14.19	1.81
6.	Inner dia. of burner pipe (in mm)	17 to 17.4	16.86	16.44	16.65	0.35
7.	Angle of Pronge	Not defined	0^0 uniform	0^0 uniform	0^0 uniform	0
8.	Dia. of side hole (in mm)	8	8	7.69	7.85	0.15
9.	Distance of side hole from one end (in mm)	18	19	19	19	1
10.	Angle between burner holes and burner axis	45^0	45^0	45^0	45^0	0
11.	Location of burner	Centered	Centered	Centered	-	-
12.	Pan support (in mm*mm*mm)	20*6*125	16*5*116	17*5*117	16.5*5*116.5	3.5*1*8.5
13.	Burner pipe length, G.I, (in mm)	150	157	155	156	6
14.	Burner material	Aluminum	Aluminum	Aluminum	-	-
15.	Frame size of stove (in mm)	25×6	25.64*3.80	25*3.80 mm	25.32*3.80	0.32*2.2
16.	Color of burner pipe	Black	Not Black	Not Black	-	-
17.	Type of fit in burner cap and burner base	Tight/ push type	Loose fit	Loose fit	-	-
18.	Inner dia of air regulating ring (in mm)	19.0, Black	21.38 /black	23.44 /black	22.41	3.36
19.	Efficiency		35.21%	35.14%		

Photograph of national Iron Stove	Major findings	Improvement
	• Size of stove smaller than standard • Variation in burner pipe length • Distance of side hole are far • Air regulating ring diameter are large	• Make as per standard • Make it centered • Make as per standard • Make as per standard

7. National Biogas Construction and Service

S. N.	Parameters	BSP standard	Observed value			Deviation
			Set A	Set B	Average	
1.	Burner cap centre and pan base , burner clearance (in mm)	25-30	29.09	29.03	29.06	-
2.	Size of hole on burner cap (in mm)	Not defined	2.16	2.18	2.17	-
3.	No. of hole on burner cap (in mm)	Not defined	32	32	32	-
4.	Size of stove (in mm*mm)	250*250	247*247	248*247	247.5*247	-2.5*-3
5.	Burner nozzle air, M.S (in mm)	16	15	15	15	1
6.	Inner dia. of burner pipe (in mm)	17 to 17.4	16.3	16.38	16.34	0.66
7.	Angle of Pronge	Not defined	5^0 uniform	5^0 uniform	5^0	-
8.	Dia. of side hole (in mm)	8	7.72	7.79	7.75	0.25
9.	Distance of side hole from one end (in mm)	18	18 mm	18 mm	18 mm	0
10.	Angle between burner holes and burner axis	45^0	35^0	35^0	35^0	10^0
11.	Location of burner	Centered	Not Centered	Not Centered	-	-
12.	Pan support (in mm*mm*mm)	20*6*125	19*5*124	20*5*123	19.5*5*123 .5	0.5*1*1.5
13.	Burner pipe length, G.I, (in mm)	150	160	158	159	9
14.	Burner material	Aluminum	Aluminum	Aluminum	-	-
15.	Frame size of stove (in mm)	25×6	25.16*4.16	25*4	25.08*4.08	0.08*1.92
16.	Color of burner pipe	Black	Not Black	Not Black	-	-
17.	Type of fit in burner cap and burner base	Tight/ push type	Loose fit	Loose fit	-	-
18.	Inner dia of air regulating ring (in mm)	19.0, Black	22.72 /black	22.16 /black	22.44	3.39
19.	Efficiency		35.58%	34.80%		

Photograph of National Biogas Stove	**Major findings**	**Improvement**
	• Stove size smaller than standard • Deviation on angle between burner holes and burner axis is small • Location of burner not consistent • Variation in burner pipe length • Air regulating ring dia are large	• Make as per standard • Make as per standard • Check center location after manufacturing • Make as per standard • Make as per standard

8. Gharelu Gobar gas and Prabidhi Bikash Company

S.N.	Parameters	BSP standard	Observed value			Deviation
			Set A	Set B	Average	
1.	Burner cap centre and pan base , burner clearance (in mm)	25-30	30.10	32.04	31.07	1.07
2.	Size of hole on burner cap (in mm)	Not defined	4.14	4.12	4.13	-
3.	No. of hole on burner cap (in mm)	Not defined	20	20	20	-
4.	Size of stove (in mm*mm)	250*250	247*246	247*247	247*246.5	-2.5*-3.5
5.	Burner nozzle air, M.S (in mm)	16	14.41	14	14.20	1.80
6.	Inner dia. of burner pipe (in mm)	17 to 17.4	15.56	16.62	16.09	0.91
7.	Angle of Pronge	Not defined	5^0 uniform	5^0 uniform	5^0 uniform	-
8.	Dia. of side hole (in mm)	8	7.42	7.10	7.26	0.74
9.	Distance of side hole from one end (in mm)	18	19	19	19	1
10.	Angle between burner holes and burner axis	45^0	35^0	41^0	38^0	7^0
11.	Location of burner	Centered	Centered	Centered	-	-
12.	Pan support (in mm*mm*mm)	20*6*125	18*5*120	18*5*116	18*5*118	2*1*7
13.	Burner pipe length, G.I, (in mm)	150	155	164	159.5	9.5
14.	Burner material	Aluminum	Aluminum	Aluminum	-	-
15.	Frame size of stove (in mm)	25×6	24.28*4.12	24*4	24.14*4.06	0.86*1.94
16.	Color of burner pipe	Black	Not Black	Not Black	-	-
17.	Type of fit in burner cap and burner base	Tight/ push type	Loose fit	Loose fit	-	-
18.	Inner dia of air regulating ring (in mm)	19.0, Black	22.28 /black	22.26 /black	22.27	3.22
19.	Efficiency		29.36%	30.86%		

Photograph of Gheralu Stove	**Major findings**	**Improvement**
	• Size of stove smaller than standard • Burner clearance are large • Deviation on angle between burner holes and burner axis is small • Variation in burner pipe length • Distance of side hole are far • Air regulating ring dia are large	• Make as per standard • Make it between 25-30 • Make as per standard • Check dimension during fabrication • Make it optimized as per standard • Make as per standard

9. Nepal Urja Engineering

S.N.	Parameters	BSP standard	Observed value			Deviation
			Set A	Set B	Average	
1.	Burner cap centre and pan base , burner clearance (in mm)	25-30	35.72	33.04	34.38	4.38
2.	Size of hole on burner cap (in mm)	Not defined	5	4.10	4.55	-
3.	No. of hole on burner cap (in mm)	Not defined	21	20	20	-
4.	Size of stove (in mm*mm)	250*250	253*253	250*250	251.5*251.5	1.5*1.5
5.	Burner nozzle air, M.S (in mm)	16	14.09	14	14.04	1.96
6.	Inner dia. of burner pipe (in mm)	17 to 17.4	16	15.94	15.97	1.03
7.	Angle of Pronge	Not defined	15^0 not uniform	15^0 uniform	15^0	-
8.	Dia. of side hole (in mm)	8	7.05	7.06	7.05	0.95
9.	Distance of side hole from one end (in mm)	18	18	20	19	1
10.	Angle between burner holes and burner axis	45^0	45^0	43^0	44^0	1^0
11.	Location of burner	Centered	Not Centered	Not Centered	-	-
12.	Pan support (in mm*mm*mm)	20*6*125	22*5*145	20*5*126	21*5*135.5	1*1*10.5
13.	Burner pipe length, G.I, (in mm)	150	168	164	166	16
14.	Burner material	Aluminum	Aluminum	Aluminum	-	-
15.	Frame size of stove (in mm)	25×6	24.18*3.34	24.12*3.22	24.15*3.28	0.85*2.72
16.	Color of burner pipe	Black	Not Black	Not Black	-	-
17.	Type of fit in burner cap and burner base	Tight/ push type	Loose fit	Loose fit	-	-
18.	Inner dia of air regulating ring (in mm)	19.0, Black	22.88 / black	22.94 / black	22.91	3.86
19.	Efficiency		32.22%	32.13%		

Photograph of Nepal Urja Stove	Major findings	Improvement
	• Burner clearance are large • Location of burner not consistent • Variation in burner pipe length • Distance of side hole are far • Air regulating ring diameter are large	• Make as per standard • Check center location after manufacturing • Make it standard length • Make as per standard • Make as per standard

10. Pokharel Biogas Product and Industries

S.N.	Parameters	BSP standard	Observed value			Deviation
			Set A	Set B	Average	
1.	Burner cap centre and pan base , burner clearance (in mm)	25-30	28.10	29.41	28.75	-
2.	Size of hole on burner cap (in mm)	Not defined	5	5	5	-
3.	No. of hole on burner cap (in mm)	Not defined	20	20	20	-
4.	Size of stove (in mm*mm)	250*250	253*251	252*252	252.5*251.5	2.5*1.5
5.	Burner nozzle air, M.S (in mm)	16	14.04	15	14.52	1.48
6.	Inner dia. of burner pipe (in mm)	17 to 17.4	16.66	15.92	16.29	0.71
7.	Angle of Pronge	Not defined	5^0 uniform	5^0 uniform	5^0 uniform	-
8.	Dia. of side hole (in mm)	8	8	7.42	7.71	0.29
9.	Distance of side hole from one end (in mm)	18	17	17	17	1
10.	Angle between burner holes and burner axis	45^0	45^0	42^0	43.5^0	1.5^0
11.	Location of burner	Centered	Centered	Centered	-	-
12.	Pan support (in mm*mm*mm)	20*6*125	22*5*123	20*5*121	21*5*122	1*1*3
13.	Burner pipe length, G.I, (in mm)	150	157	157	157	7
14.	Burner material	Aluminum	Aluminum	Aluminum	-	-
15.	Frame size of stove (in mm)	25×6	24.22*3.90	24*3.82	24.11*3.86	0.89*2.14
16.	Color of burner pipe	Black	Not Black	Not Black	-	-
17.	Type of fit in burner cap and burner base	Tight/ push type	Loose fit	Loose fit	-	-
18.	Inner dia of air regulating ring (in mm)	19.0, Black	21.68 /black	22.32 /black	22	2.95
19.	Efficiency		32.51%	33.39%		

Photograph of Pokhrel Stove	Major findings	Improvement
	• Size of stove larger smaller than standard • Deviation on angle between burner holes and burner axis is small • Variation in burner pipe length • Distance of side hole are far • Air regulating ring dia are large	• Make as per standard • Make as per standard • Make it centered • Make as per standard • Make as per standard

11. Rural and Alternative Energy Service Center

S.N.	Parameters	BSP standard	Observed value			Deviation
			Set A	Set B	Average	
1.	Burner cap centre and pan base , burner clearance (in mm)	25-30	33.77	34.73	34.25	4.25
2.	Size of hole on burner cap (in mm)	Not defined	4.16	4.14	4.15	-
3.	No. of hole on burner cap (in mm)	Not defined	20	21	20	-
4.	Size of stove (in mm*mm)	250*250	240*242	246*246	243*244	-7*-6
5.	Burner nozzle air, M.S (in mm)	16	15.04	15	15.02	0.98 mm
6.	Inner dia. of burner pipe (in mm)	17 to 17.4	16.72	16.48	16.60	0.4
7.	Angle of pronge	Not defined	5^0 not uniform	5^0 uniform	5^0	-
8.	Dia. of side hole (in mm)	8	7.40	7.11	7.25	0.75
9.	Distance of side hole from one end (in mm)	18	19 mm	20	19.5	1.5
10.	Angle between burner holes and burner axis	45^0	45^0	45^0	45^0	0
11.	Location of burner	Centered	Not Centered	Centered	-	-
12.	Pan support (in mm*mm*mm)	20*6*125	22*5*125	21*5*124	21.5*5*124.5	1.5*1*0.5
13.	Burner pipe length, G.I, (in mm)	150	162	160	161	11
14.	Burner material	Aluminum	Aluminum	Aluminum	-	-
15.	Frame size of stove (in mm)	25×6	26.54*3.64	26.50*3.52	26.52*3.58	1.52*2.42
16.	Color of burner pipe	Black	Not Black	Not Black	-	-
17.	Type of fit in burner cap and burner base	Tight/ push type	Loose fit	Loose fit	-	-
18.	Inner dia of air regulating ring (in mm)	19.0, Black	22.08 mm/black	21.68 mm/black	21.88 mm	2.83 mm
19.	Efficiency		34.42%	35.22%		

Photograph of Rural & Alternative Stove	Major findings	Improvement
	• Size of stove smaller than standard • Burner clearance are large • Location of burner not consistent • Variation in burner pipe length • Distance of side hole are far • Air regulating ring diameter are large • Burner pipe length are long	• Make as per standard • Make as per standard to increase efficiency • Check center location after manufacturing • Make it standard length • Make as per standard • Make as per standard • Make it in standard length

12. Shikhar Biogas Product

S. N.	Parameters	BSP standard	Observed value			Deviation
			Set A	Set B	Average	
1.	Burner cap centre and pan base , burner clearance (in mm)	25-30	33.06	34.72	33.89	3.89
2.	Size of hole on burner cap (in mm)	Not defined	5	5.04	5.02	-
3.	No. of hole on burner cap (in mm)	Not defined	20	20	20	-
4.	Size of stove (in mm*mm)	250*250	248*247	247*247	247.5*247	-2.5*-3
5.	Burner nozzle air, M.S (in mm)	16	15.04	15	15.02	0.98
6.	Inner dia. of burner pipe (in mm)	17 to 17.4	16.36	16.20	16.28	0.72
7.	Angle of Pronge	Not defined	0^0 uniform	0^0 uniform	0^0	-
8.	Dia. of side hole (in mm)	8	7.70	7.39	7.54	0.46
9.	Distance of side hole from one end (in mm)	18	18	18	18	0
10.	Angle between burner holes and burner axis	45^0	45^0	45^0	45^0	0
11.	Location of burner	Centered	Centered	Not Centered	-	-
12.	Pan support (in mm*mm*mm)	20*6*125	20*5*117	20*5*117	20*5*117	0*1*8
13.	Burner pipe length, G.I, (in mm)	150	155	155	155	5
14.	Burner material	Aluminum	Aluminum	Aluminum	-	-
15.	Frame size of stove (in mm)	25×6	25.62*3.58	25.54*3.44	25.58*3.51	0.58*2.49
16.	Color of burner pipe	Black	Not Black	Not Black	-	-
17.	Type of fit in burner cap and burner base	Tight/ push type	Loose fit	Loose fit	-	-
18.	Inner dia of air regulating ring (in mm)	19.0, Black	21.94 /black	21.72 /black	21.83	2.78
19.	Efficiency		35.21%	33.98%		

Photograph of Shikhar Stove	**Major findings**	**Improvement**
	• Burner clearance is large • Size of stove smaller than standard • Location of burner not consistent • Variation in burner pipe length • Distance of side hole are far • Air regulating ring dia are large	• Make in between 25-30 mm • Make as per standard • Check center location after manufacturing • Make it centered • Make as per standard • Make as per standard

13. Arun Mechanical Works

13.	Arun					
S.N.	**Parameters**	**BSP standard**	**Observed value**			**Deviation**
			Set A	**Set B**	**Average**	
1.	Burner cap centre and pan base , burner clearance (in mm)	25-30	28.46	29.06	28.76	-
2.	Size of hole on burner cap (in mm)	Not defined	4.14	4.18	4.16	-
3.	No. of hole on burner cap (in mm)	Not defined	20	20	20	-
4.	Size of stove (in mm*mm)	250*250	250*249	249*249	249.5*249	-1.5*-1
5.	Burner nozzle air, M.S (in mm)	16	15.73	15.73	15.73	0.27
6.	Inner dia. of burner pipe (in mm)	17 to 17.4	16.48	16.50	16.49	0.51
7.	Angle of Pronge	Not defined	15^0 uniform	15^0 uniform	15^0 uniform	-
8.	Dia. of side hole (in mm)	8	7.76	7.72	7.74	0.26
9.	Distance of side hole from one end (in mm)	18	19	19	19	1
10.	Angle between burner holes and burner axis	45^0	45^0	45^0	45^0	0
11.	Location of burner	Centered	Not Centered	Centered	-	-
12.	Pan support (in mm*mm*mm)	20*6*125	16*5*119	19*5*125	17.5*5*122	22.5*1*3
13.	Burner pipe length, G.I, (in mm)	150	155	154	154.5	4.5
14.	Burner material	Aluminum	Aluminum	Aluminum	-	-
15.	Frame size of stove (in mm)	25×6	23.56*3.22	23.72*3	23.64*3.11	1.36*2.89
16.	Color of burner pipe	Black	Not Black	Not Black	-	-
17.	Type of fit in burner cap and burner base	Tight/ push type	Loose fit	Loose fit	-	-
18.	Inner dia of air regulating ring (in mm)	19.0, Black	20.40 /black	21.64 /black	21.02	1.97
19.	Efficiency		30.98%	Not burning		

Photograph of Arun Stove	**Major findings**	**Improvement**
	• Location of burner not consistent • Variation in burner pipe length • Distance of side hole are far • Air regulating ring diameter are large • Frame size of stove are large to decrease efficiency	• Check center location after manufacturing • Make it centered • Make as per standard • Make as per standard • Make it in standard size

14. Public Biogas and Urja Bikash Company

S. N.	Parameters	BSP standard	Observed value			Deviation
			Set A	Set B	Average	
1.	Burner cap centre and pan base , burner clearance (in mm)	25-30	34.38	30.42	32.40	2.40
2.	Size of hole on burner cap (in mm)	Not defined	4.16	4.14	4.15	-
3.	No. of hole on burner cap (in mm)	Not defined	20	20	20	-
4.	Size of stove (in mm*mm)	250*250	248*247	249*249	248.5*248	-1.5*-2
5.	Burner nozzle air, M.S (in mm)	16	14.40	15	14.70	1.30
6.	Inner dia. of burner pipe (in mm)	17 to 17.4	15.76	16.18	15.97	1.03
7.	Angle of Pronge	Not defined	0^0 uniform	0^0 uniform	0^0 uniform	-
8.	Dia. of side hole (in mm)	8	7.09	7.12	7.10	0.90
9.	Distance of side hole from one end (in mm)	18	19	19	19	1
10.	Angle between burner holes and burner axis	45^0	45^0	44^0	44.5^0	0.5^0
11.	Location of burner	Centered	Not Centered	Not Centered	-	-
12.	Pan support (in mm*mm*mm)	20*6*125	21*5*117	21*5*119	21*5*118	1*1*7
13.	Burner pipe length, G.I, (in mm)	150	159	157	158	8
14.	Burner material	Aluminum	Aluminum	Aluminum	-	-
15.	Frame size of stove (in mm)	25×6	26.52*3.54	26.28*3.62	26.40*3.58	1.40*2.42
16.	Color of burner pipe	Black	Not Black	Not Black	-	-
17.	Type of fit in burner cap and burner base	Tight/ push type	Loose fit	Loose fit	-	-
18.	Inner dia of air regulating ring (in mm)	19.0, Black	22.32 /black	22.64 /black	22.48	3.43
19.	Efficiency		Not Burning	30.28%		

Photograph of Public Stove	Major findings	Improvement
	• Burner clearance are too high • Deviation on angle between burner holes and burner axis is small • Location of burner not consistent • Variation in burner pipe length • Distance of side hole are far • Air regulating ring dia are large • Frame of prong are long	• Make it between 25-30 mm • Make as per standard • Check center location after manufacturing • Make it dimensioned • Make as per standard • Make as per standard • Make it as per standard

15. New Nava Durga Engineering Workshop

S.N.	Parameters	BSP standard	Observed value			Deviation
			Set A	Set B	Average	
1.	Burner cap centre and pan base , burner clearance (in mm)	25-30	27.03	26.42	26.72	-
2.	Size of hole on burner cap (in mm)	Not defined	5	5.08	5.04	-
3.	No. of hole on burner cap (in mm)	Not defined	20	20	20	-
4.	Size of stove (in mm*mm)	250*250	247*246	248*248	247.5*247	-2.5*-3
5.	Burner nozzle air, M.S (in mm)	16	14.70	14	14.35	1.65
6.	Inner dia. of burner pipe (in mm)	17 to 17.4	15.36	15.88	15.62	1.38
7.	Angle of Pronge	Not defined	5^0 uniform	5^0 uniform	5^0 uniform	-
8.	Dia. of side hole (in mm)	8	7.72	7.21	7.46	0.54
9.	Distance of side hole from one end (in mm)	18	20	19	19.5	1.5
10.	Angle between burner holes and burner axis	45^0	44^0	45^0	44.5^0	0.5^0
11.	Location of burner	Centered	Centered	Not Centered	-	-
12.	Pan support (in mm*mm*mm)	20*6*125	19*5*117	20*5*117	19.5*5*117	0.5*1*8
13.	Burner pipe length, G.I, (in mm)	150	158	153	155.5	5.5
14.	Burner material	Aluminum	Aluminum	Aluminum	-	-
15.	Frame size of stove (in mm)	25×6	24.26*4.22	24.32*4	24.29*4.11	0.71*1.89
16.	Color of burner pipe	Black	Not Black	Not Black	-	-
17.	Type of fit in burner cap and burner base	Tight/ push type	Loose fit	Loose fit	-	-
18.	Inner dia of air regulating ring (in mm)	19.0, Black	21.84 / black	22.18 /black	22.01	2.96
19.	Efficiency		31.70%	31.42%		

Photograph of New Nava Durga Stove	Major findings	Improvement
	• Size of stove smaller than standard • Location of burner not consistent • Variation in burner pipe length • Distance of side hole are far • Frame size of stove are large	• Make as per standard • Check center location after manufacturing • Make as per standard • Make as per standard • Make it in standard sized

16. Asian Biogas Product

S. N.	Parameters	BSP standard	Observed value			Deviation
			Set A	Set B	Average	
1.	Burner cap centre and pan base , burner clearance (in mm)	25-30	26.04	27.09	26.5	-
2.	Size of hole on burner cap (in mm)	Not defined	5.02	5	5.01	-
3.	No. of hole on burner cap (in mm)	Not defined	20	20	20	-
4.	Size of stove (in mm*mm)	250*250	246*247	245*245	245.5*246	-4.4*-4
5.	Burner nozzle air, M.S (in mm)	16	14.71	15	14.85	1.15
6.	Inner dia. of burner pipe (in mm)	17 to 17.4	16.34	16.82	16.58	0.42
7.	Angle of Pronge	Not defined	5^0 uniform	5^0 uniform	5^0 uniform	-
8.	Dia. of side hole (in mm)	8	7.06	7.10	7.08	0.92
9.	Distance of side hole from one end (in mm)	18	18	18	18	0
10.	Angle between burner holes and burner axis	45^0	42^0	43^0	42.5^0	2.5^0
11.	Location of burner	Centered	Not Centered	Not Centered	-	-
12.	Pan support (in mm*mm*mm)	20*6*125	20*5*121	20*5*117	20*5*119	0*1*26
13.	Burner pipe length, G.I, (in mm)	150	161	158	159.5	9.5
14.	Burner material	Aluminum	Aluminum	Aluminum	-	-
15.	Frame size of stove (in mm)	25×6	23.72*3.32	23.64*3.44	23.68*3.38	1.32*2.62
16.	Color of burner pipe	Black	Not Black	Not Black	-	-
17.	Type of fit in burner cap and burner base	Tight/ push type	Loose fit	Loose fit	-	-
18.	Inner dia of air regulating ring (in mm)	19.0, Black	22.9 / black	22.04 / black	22.47	3.42
19.	Efficiency		31.85%	32.40%		

Photograph of Asian Stove	Major findings	Improvement
	• Stove size smaller than standard • Deviation on angle between burner holes and burner axis is small • Location of burner not consistent • Variation in burner pipe length • Distance of side hole are far • Air regulating ring dia are large	• Make as per standard • Make as per standard • Check center location after manufacturing • Make it in dimensioned • Make as per standard • Make as per standard

3. Results from observation

Following parameters are found more deviated in major companies

- **Burner cap centre and pan base**: Few company have deviation in burner clearance which effecting efficiency of the stove
- **Hole on burner cap**: Hole of the burner is not in equal spacing and center of the hole not lying in the same circle for the most of the company.
- **Size of the stove**: In most of the companies size of the stove is not as per standard which is ultimately affecting center location of burner.
- **Burner nozzle air:** there is few deviation in burner nozzle air for the most of the companies
- **Inner dia. of burner pipe** : it is almost considerable range for all the company
- **Angle of Pronge**: it is uniform for almost companies but there is not uniform for few companies.
- **Dia. of side hole** : there is few deviation in side diameter of hole for almost companies.
- **Distance of side hole from one end** : there the deviation of hole for almost companies.
- **Angle between burner holes and burner axis**: Drilling process of most of the companies is not perfect. It is deviating upto 10 º. It directly affecting the efficiency of the stove.
- **Location of burner:** Due to deviation of size in stove, length of burner pipe and assembly defect. burner location of the various companies not in center.
- **Pan support**: Pan support size is not as per standard but most of the companies pan support size are shorter than standard which is not affecting efficiency of the stove.
- **Burner pipe length**: Length of the burner pipe of most of the company are larger than standard.
- **Burner material**: Material of the burner material of all companies as per standard.
- **Frame size of stove**: There are few deviation in frame size but it not affecting efficiency of the stove.
- **Color of burner pipe**: Color of burner pipes of all companies are other than black.
- **Type of fit in burner cap and burner base**: Almost companies have loose fit.
- **Inner dia of air regulating ring** : There is deviation of inner diameter of almost companies
- **Efficiency**: There is possibility to increase efficiency of most of the companies.

4. Quality work during processing

For quality product (Technical aspect)

• Quality of raw material • Trained man power • Machine required		• Layout of the equipment • Equipment working condition • Process used • Motivation of manpower • Power supply condition • Monitoring of work		• Quality control system • Precision required
Input		Process		Output

For quality product (Managerial aspect)

• Economic order quantity • Location of raw material stock • Work environment • Hygiene of work place • Training of skill man power • Less turnover		• Layout of the equipment • Punishment and award for the work • Processing time		Quality control system Award for quality work
Input		Process		Output

Quality affecting factors

Technical factors

- Area and Layout of the workshop
- Machine and tools
- Quality of raw material
- Trained man power
- Manufacturing process
- Finishing on assembly
- Quality controls system

Managerial factors

- Economic order quantity of raw material
- Cost allocation for technical training
- Cost allocation quality control

- Scheduling for the production of multiple biogas appliances
- Reduce stock time and processing time
- Reduce turnover of staff
- Hygiene of work place

Other factors

- Research and development and technology transfer
- Training program
- Monitoring and quality control mechanism
- Provision for loan facility
- Cooperation from government side
- Punishment and award system

5. Case study of for process

This is case study of the biogas appliances manufacturing company based on their company status, available equipment , manufacturing technology, pool of human resources , machining equipment available, quality control etc.

General Information of Workshops

Having bank account	Yes
Loan from financial institutions	Yes
Total asset	15 lakh
Annual Turnover	9 lakh
Toilet facility	Yes
Workshop area	Around 3600 ft^2
Products	Cooking Stove
Agreement with clients (Biogas companies)	No
Payment in advance from clients	No
Payment timing	When Biogas Companies get subsidy amount

Various produced appliances

Products	**Current rate of production (per month)**	**Maximum capacity (per year)**
Stove	820	15000
Gas tap	1500	30000
Gas pipe	700	10000
Mixture	500	7000
Water drain	600	10000

Equipments of the workshop

Equipments:
Lathe machine turret lathe

Arc welding machine-5
Grinder-2
Drilling machine: radial-1, bench-2, hand-1
Power hacksaw-1
Bending machine /Power press-1
Shearing /Cut off machine-2
Rolling machine-1
Hand press bend-1

Position of tools and materials: Satisfactory

Manufacturing processes

Products	**Processes**
Stove	Cutting(straight and angle), welding, lathe work, painting
Gas tap	Cutting, machining, soldering, fitting, air pressure testing, painting
Gas pipe	Parting, threading, rod welding, elbow fitting, air pressure test, number coding, painting
Mixture	Cutting, rolling, welding, galvanizing, painting
Water drain	Cutting, machining, threading, soldering, air pressure testing

Type of workshop layout	process
Precision in manufacturing process	Precise as per drawing
Process done for finishing products	Grinding, sandpaper smoothening, primer painting, enamel painting
Has followed any management system and quality assurance	No
Other services provided by the workshop	Yes, e.g. Solar water heater

Poll of human resources

Technical			**Non-technical**		
Staffs	Male:8	Female: 0	Staffs	Male:1	Female:1
Ethnicity	Brahmin/Chettri:2	Others:8	Ethnicity	Brahmin/Chettri:1	Others:
Trained staffs	0		Trained staffs	0	
Level			Level		
Years of experience	Staffs	Experience	Years of experience	Staffs	Experience
	4	17-18 yrs.		1	10-15 yrs.
	2-4	5-7 yrs.			
	Others	1-2 yrs.			

Raw material order quantity:

Raw material	**Order quantity**	**Order time**
Iron	1350 kg	Monthly
Brass	75 kg	Monthly
Aluminium	15000 pieces	Monthly
Nylon washer	1250 pieces	Quarter yearly
Rubber washer	3750 pieces	Quarter yearly
GI pipe ½ inch	45 pieces	Monthly
GI pipe 1 ½ inch	45 pieces	Monthly
Angles	500 kg	Monthly

Raw material storage/ Distance of production site and store: workshop

Cautionary notices in main machine/area: No

Production information:

Product	**Quantity produced**	**Time duration (hours)**
Stove	1	1
Gas tap	1	1
Gas pipe	1	0.5
Mixture	1	2.5
Water drain	1	1

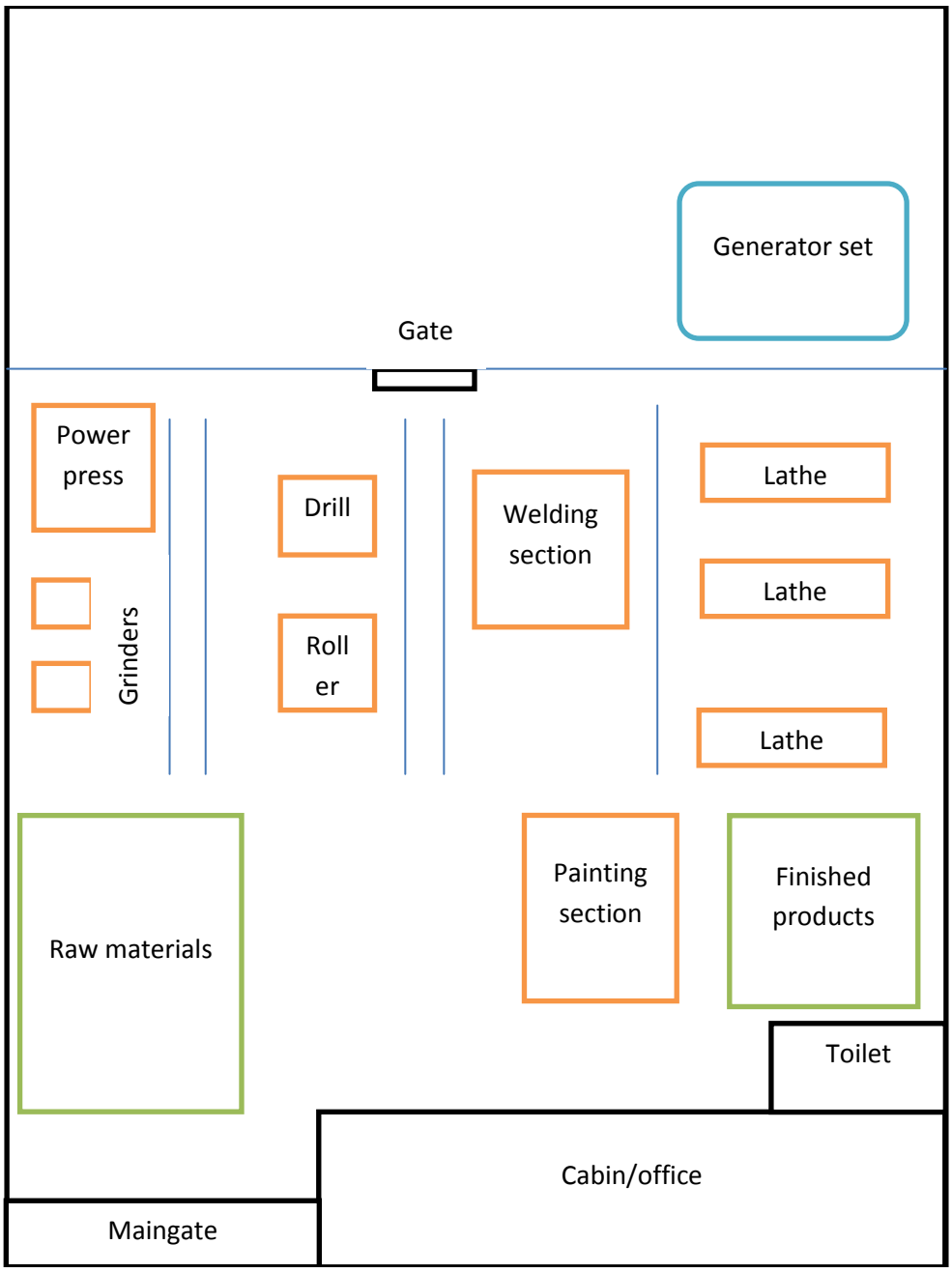
Selling of product quantity

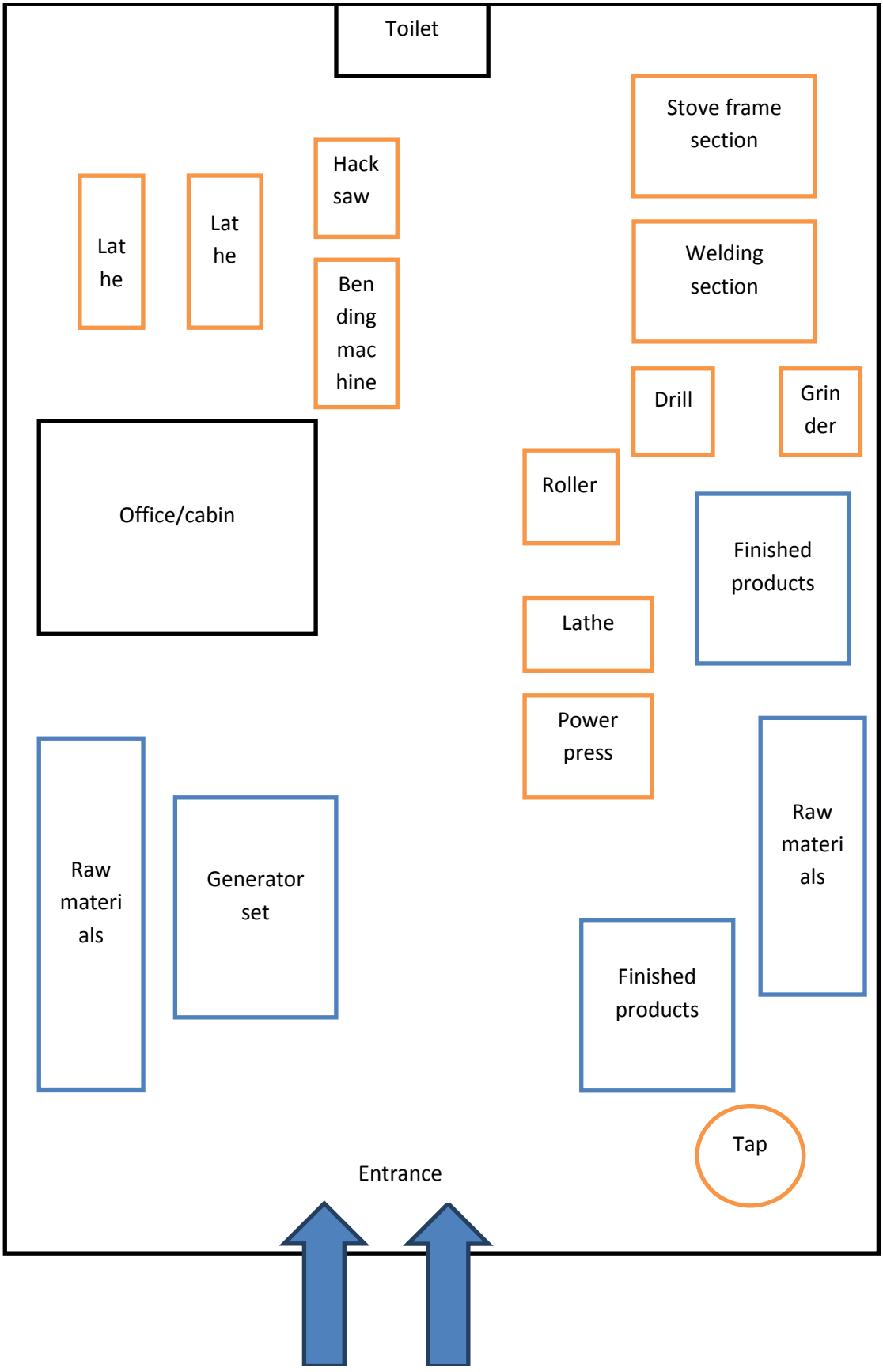
Product	**Stove**	**Gas tap**	**Mixture**	**Water drain**	**Gas pipe**
Average sell yearly	7000	12000	5000	5000	5000
Stock time	15-20 days to 2 months	15-20 days to 2 months	15-20 days to 2 months	15-20 days to 2 months	15-20 days to 2 months
Market demand	high				

Major problems

- Uncertain subsidy program
- Lack of training and field visit
- Lack of flexibility in cost minimization

Layout of one of the workshop




Toilet
Stove frame section
Hack saw
Lat he
Lat he
Welding section
Ben ding mac hine
Drill
Grin der
Office/cabin
Roller
Finished products
Lathe
Power press
Raw materi als
Generator set
Raw materi als
Finished products
Tap
Entrance