Chapter 24
Designing a Cow Lift for Downer Cow: Experience of Working on a Rural Technology

Prashant P. Tak, Tanmay K. Bhandakkar and Rupali S. Khanolkar

1 Introduction

'Downer cow syndrome' is a pathology in which cow is in sternal recumbency, i.e. being down, for a period longer than a day [1]. The reasons can be traumatic, metabolic, neurological and toxaemia. For instance, traumatic includes pelvic fractures, sacroiliac luxation and dystocia while the metabolic cause includes hypocalcaemia and hypomagnesaemia [2]. Figure 1 shows the distressing condition of animals that have suffered from downer cow syndrome.

Cow suffered from downer syndrome is treated with medicine for its initial cause, then with help of manual operation or machine animal is assisted to back onto its feet. Helping animal to stand regularizes the blood circulation. At many of places, manual method of lifting animal is employed which is not convenient also if animal not lifted properly animal can suffer more. Hence, it was necessary to design a machine which is easy to handle and can be easily manufactured at the local level. As this problem is not frequent, the machine cannot be used frequently so the machine designed must be portable so that it can be kept at community level to anyone can use it as per requirement. Hence while designing instrument, things mentioned earlier were taken care.

The current work documents the experience and methodology adopted during designing of a system/instrument to lift downer cow as a case study for understanding

P. P. Tak (✉) · R. S. Khanolkar
Rural Technology Action Group (RuTAG), IIT Bombay, Mumbai, India
e-mail: prashanttak1991@gmail.com; iitb.rutag@gmail.com

P. P. Tak
Centre for Technology Alternatives for Rural Areas (CTARA), IIT Bombay, Mumbai, India

T. K. Bhandakkar
Department of Mechanical Engineering, IIT Bombay, Mumbai, India

S. K. Saha and M. R. Ravi (eds.), *Rural Technology Development and Delivery*, Design Science and Innovation, https://doi.org/10.1007/978-981-13-6435-8_24

Fig. 1 Cows suffering from downer cow syndrome [3]

the constraints for development of rural technology and to set up a methodology and approach to solve the rural problem.

The outline of the paper is as follows. Introduction section is followed by the methodology adopted for solving the problem to lift downer cow and the technologies available in the market along with their pros and cons. The next section gives brief information about the development of the first and second prototypes and observations associated with it. Finally, the procedure for use of instrument is explained.

2 Methodology

The project started with a literature review to understand the causes and problems related to down cow syndrome. It was found that the available literature mainly focused on the causes of down cow syndrome and biological treatment given to the animal when it cannot stand up by its own. Comparatively, very limited literature concerning machines to lift the animal suffering from down cow syndrome is available. Literature survey also focused on the constraints for the development of machine/system.

In order to understand the practical difficulties in lifting downer cow, inputs were sought from Dr. R. V. Gaikwad, Bombay Veterinary Hospital. He explained the advantages and disadvantages of the existing technologies found during the literature survey. During the visit to Bombay Veterinary Hospital, the instrument used for lifting animal for treatment was studied and improved our understanding of the process, precautions to be followed and problems associated with the current operation of lifting animal.

The dimensions of the animal required for designing the cow lifting machine were obtained through fieldwork carried out at Bombay Veterinary Hospital and cow shed at Ghansoli, Navi Mumbai. Based on the literature survey, measured dimensions and observations, few ideas were proposed for the fabrication of prototype. From the pull of ideas, the design of instrument was finalized on the basis of different parameters which will be discussed in under the topic of constraints for developing technologies. The proposed design was finalized based on the inputs of fabricator regarding ease of fabrication.

All the operations and processes involved during the fabrication were documented. After fabrication, the prototype was tested with deadweight for 3 days and then trials were conducted at Gopal Goshala, Angaon near Bhiwandi on the live animal. The structure was helpful in lifting animal successfully without causing the injury to the animal but the height and weight of the structure was an issue. After three to four trials at Gopal Goshala, practical problems in the first prototype were identified.

After understanding the problems in the first prototype, alternative designs were discussed with Prof. Nishant Sharma, Industrial Design Centre, IIT Bombay. After suggestion and inputs, the second design was proposed. After finalizing prototype design fabrication was done. The fabricated prototype was tested in the lab and then taken to field for testing.

After successful trials and small changes, the prototype was handed over to the Goa Dairy, Ponda, Goa from where the demand for cow lifting machine had originated. At present, the prototype is being used by local farmers.

3 Available Technologies and Constraints for Development

A document published by Dairy Australia [3] gives information on nursing a downer cow, it includes biological treatment given to the downer cow and various technologies available for lifting of downer cow as given below:

The hip clamp is a method in which the animal is supported on its pelvic bone with help of metal clamp and lifted it with help of a crane or any other instrument. It is the easiest and most common method to treat downer cow. This method is considered ideal for quick lift and mostly used in simple cases such as simple milk fever. This method is not suitable for support due to trauma as it may lead to animal getting a fracture.

Sling method involves the use of slings and lifting device such as a crane to lift the animal. This method is difficult to execute and since the length of slings is fixed, is not flexible in terms of the size of animal. The animal can lean forward or backward and difficult to stabilize using slings.

Pelvic lift is an easier method consisting of hip clamp and seat. When the lift is engaged, the seat swings under the pelvis of cow. This method is suitable in case of pelvic fracture but supports only 40% of the weight of the animal.

In North America, floatation tanks are used whereby downer cows are supported by warm water in a tank to enable the animal to stand and improve blood circulation. The method has a good success rate, prevents secondary damage to the limbs and speeds up the animal recovery but it is very difficult to put the cow in the tank.

These technologies were discussed with Dr. Gaikwad and the problems, advantages and disadvantages of each option were identified through the discussion.

3.1 Constraints for Development

Size and weight bearing capacity: During the literature survey, it was found that there is limited availability of information regarding the dimension of cows in India. Hence, it was decided that the measurements will be taken from Bombay veterinary hospital and private cow sheds. As per dimensions, it was found that maximum width of the animal while standing is around 2 feet, while the length of the animal is 5–8 feet, which varies with the size of the animal. The stance, i.e. distance between front and rear legs, is 5–7 feet. The width of the animal while lying down is 3 feet excluding the length of the leg. The animal weight varies from 200 to 500 kg.
Portability: All the systems found during field visits were of stationary nature. But cow can suffer from syndrome at any place, and due to its weight and condition, it is not easy to carry animal to a medical facility centre. So the requirement of the system should be portability and quick assembly as per demand. The system should also be movable for animals to shift to other places within the shed or treatment centre.
Height and weight of structure: One of the likely locations where animal can suffer down syndrome is in and around cowshed. Since the average height of cowshed and dairy farm in Maharashtra is around 7–8 feet, the system height should be less than 7 feet. The weight of the structure should be low for easy portability.
Manufacturing: The bulk of the cow population and consequently the down cow syndrome issue are majorly concentrated in rural areas, where material and fabrication facilities may not be readily available. Hence, the design of structure should be such that it can be fabricated with use of commonly used fabrication machinery and operations.
Handling: Manual lifting of the animal requires six to eight people whereas the technologies available in Gopal Goshala and Bombay veterinary hospital requires two to three people to lift animal. Hence, the system needs to be designed for easy handling with minimum (two to three) people required for handling.

Based on the above discussion the objectives for the development of technology were identified as follows:

- To design portable and low-cost system to lift downer cow.
- System should lift animals weighing up to 500 kg for 30–45 min after every 6 h in a day.
- Easy to operate and handle without any special skills.
- Easy to maintain and repair.

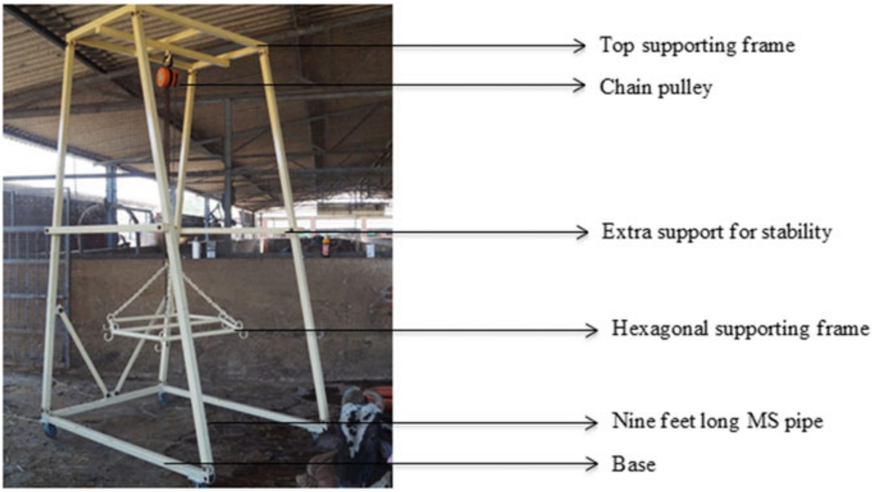

Fig. 2 First prototype

4 Design of Instrument

4.1 First Prototype

The first prototype was inspired by the existing instrument at Bombay Veterinary hospital, which was 10 feet high and fixed at one point. The canvas was narrow and can only support animal in its stomach region. Hence, it was observed that while lifting, the animal may lean forward or backward and chances of fatigue increases. To overcome the stability problem, the first prototype consisted of the following parts:

1. Superstructure with wheels.
2. Hexagonal supporting frame.
3. Supporting canvas for lifting animal.
4. Chain pulley block.

As shown in the figure below, a side at the bottom part of superstructure was removable allowing the superstructure to pull over the animal. Some of the important dimensions are given as below (Figs. 2 and 3):

1. Height: 9 feet.
2. Base: 4 feet * 3 feet.
3. Top supporting frame: 2 feet * 3 feet.
4. Weight: 140 kg.

Based on the tests conducted at Goshala, the following observations and problems associated with the first prototype are:

Fig. 3 Superstructure

- The structure is sturdier and more stable than existing system at Goshala.
- The dimensions of structure (length, width at base) and supporting structure (hexagon) are appropriate and no difficulty was faced while lifting the animal during trials.
- The social workers and other staff working on shop floor at Goshala recommended that the structure which is currently 9 feet should be reduced to around 7 feet.
- The design of canvas needs to be modified as it is unable to support the animal when it leans forward.

4.2 Second Prototype

Understanding the limitations of the first prototype, we did brainstorming and carried out discussion with Prof. Nishant Sharma (Industrial Design Centre, IIT Bombay). It was decided to use horse saw structure which provides stability as well as strength. After concept design, the prototype was fabricated and again tested at Gopal Goshala. The design worked well, and the staff working in Gopal Goshala was happy with the design. The second prototype consisted of the following parts as shown in Fig. 4:

1. Superstructure.
2. Elongated curve supporting frame.
3. Supporting canvas for lifting animal.
4. Chain pulley.

Some of the important dimensions are given below:

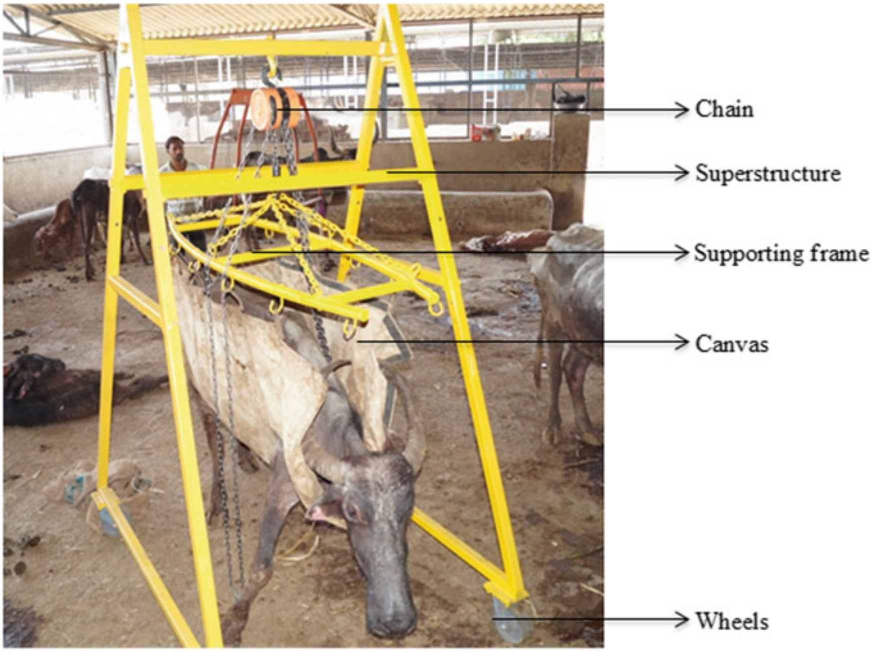

Fig. 4 Second prototype

1. Height: 6 feet 10 in.
2. Base: ~5 feet * ~3 feet.
3. Weight: 85 kg.

4.3 Parts of the Final Prototype

Superstructure: The superstructure consisted of M.S. square pipe of dimension 50 mm * 50 mm with 3 mm thickness, welded to each other to form a triangle on either side and connected with the help of top horizontal pipe using bolts. The superstructure also consists of wheels which can be rotated 360°, thus making it easier for handling.

The structure is supported with two additional horizontal bars to minimize the deflection of columns due to the weight of the animal.

Chain pulley: In view of the usage of the machine in rural areas, instead of the hydraulics or ratchet mechanism used in the existing designs, in this work, the lifting of animal is done through cost-effective, easily available and maintainable chain pulley mechanism. The chain pulley has the capacity to lift weight up to 1 tonne.

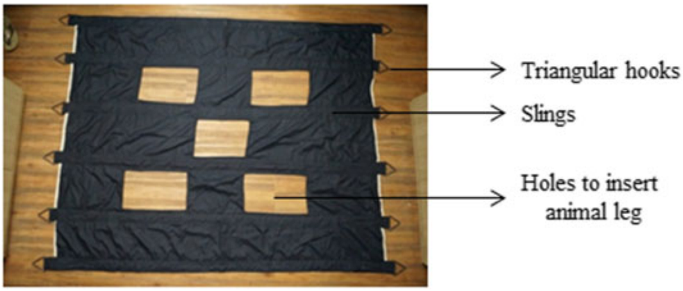

Fig. 5 Supporting canvas

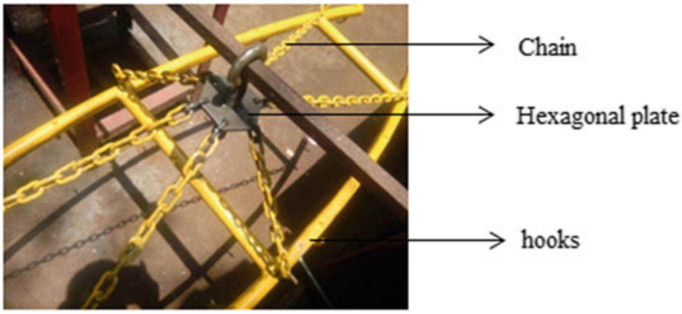

Fig. 6 Supporting frame

Supporting canvas: It is used to steadily lift the animal with help of superstructure. The canvas is made up of Gwalior cloth and is 5 feet long and 6 feet wide. The horizontal sling of width 3 in. are triple folded, made with the same material and stitched over the canvas as shown in Fig. 5. At the end of the slings, the triangular hooks of side 3 in. were stitched to help it attach to the hooks on the supporting frame. In order to improve the comfort level of the animal, an extra layer of cotton fabric is stitched at the inner side of the canvas. Four holes are given to insert the legs of animal into it and hole in the centre is given for udder as well as for the animal pee to go out without spoiling the canvas.

Supporting frame: The supporting frame is used for connecting the supporting canvas and chain pulley and helps in maintaining the shape of the animal. The supporting frame is wider in the middle confirming to the contour of the animal. On the outer edges of the supporting frame, hooks are welded to connect to the triangular hooks of the sling on canvas. The frame is connected to the hexagonal plate through the chain as shown in Fig. 6. The hexagonal plate is further attached to the chain pulley through a round hook.

4.4 Procedure to Use the System

Following process was carried out during the trials of prototype at Gopal Goshala. All the tasks involved below were conducted in presence of veterinary doctors, and informed consent was obtained to perform the trials.

Step 1: Assemble the superstructure as per the directions given in the assembly of part as superstructure (refer to Fig. 3). Figure 7 shows the assembly of superstructure on the field. All the bolts should be tightened properly to prevent disassembly and bolt failure.

Step 2: Chain pulley should be installed in the hook provided on the topmost horizontal pipe of the superstructure. The other end of the chain pulley should be kept facing the ground for connecting it to supporting frame.

Step 3: Canvas should be inserted into the animal legs ensuring that the hooks are on the top side.

Step 4: The superstructure is then pulled carefully over the animal without affecting it.

Step 5: All the hooks of the canvas should be joined with the hooks of supporting frame.

Step 6: After hooks are properly inserted in the supporting frame, the chain of the chain pulley block is pulled to help the animal to stand on its leg.

Step 7: It may happen that animal leg may not come out of canvas on its own and so it is necessary to help the animal to takeout his leg through the holes on the canvas. Keep the animal in the standing position for 30–45 min and then lower down the chain of chain pulley to keep the animal in the clean and dry area.

5 Conclusions

The system/instrument developed by RuTAG IIT Bombay is helpful for the individual farmers, veterinary doctors, dairy farms and organizations working for animals. This instrument can be kept at gram panchayat level or any cooperative level for use of larger community. The total cost of the instrument is nineteen thousand (19,000) rupees only.

The present work is a valuable experience and case study for RuTAG in understanding the procedure to be adopted for developing rural technology.

Acknowledgements The authors are grateful for funding and support from Office of Principal Scientific Advisor to the Government of India, for giving the opportunity to work on the project under RuTAG IIT Bombay. Authors would like to thank Dr. Ketaki Bapat for her support and Dr. Sudhir Ranade, Yogesh Patil from Gopal Goshala for their help in conducting trials. We are also thankful to Dr. Mahendra Bale and Dr. Dhuri from Goa Dairy without whom the trials could not be conducted in Goa.

Fig. 7 Steps included in lifting animal [4]

Compliance with Ethical Standards All procedures performed in studies involving human participants were in accordance with the ethical standards of the institutional and/or national research committee and with the 1964 Helsinki declaration and its later amendments or comparable ethical standards. Also all applicable international, national, and/or institutional guidelines for the care and use of animals were followed for the purpose of studying animals suffered from the abovementioned diseases and testing the prototype developed. Informed consent was obtained from all authorities where the study has been conducted to include animals in the study.

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