



LIVESTOCK WEIGHT MEASUREMENT USING COMPUTER VISION

A novel approach to minimize livestock input mismanagement using machine learning and low-cost smartphones for accurate service delivery



bhala



mPower

Project implemented by Acme AI, bhala Social Enterprises and mPower Social Enterprises under the Smart Farming Innovation for Small-scale Producers grand challenge by the Bill & Melinda Gates Foundation.

The Challenge

A substantial portion of rural households in Bangladesh are dependent on livestock farming – particularly cattle. Livestock intermediary groups support livestock farmers by providing inputs and management services – enabling livestock to improve productivity and/or fetch a good price

However, there are limitations in these services as calculating the ‘right’ amount of input is dependent on the accurate calculation of weight.

There are globally standardized methods to extract volumetric weight based on hearth/girth measurements – something that is also practiced in Bangladesh.

But the physical toil required for such a measurement often leads to service providers skipping this step and provide inputs based on estimations – leading to **mismanagements.**

About Consortium

Acme AI. Data annotation outfit and artificial intelligence (AI) solution development outfit based in Bangladesh with a strong portfolio in agriculture, robotics, healthcare, retail, manufacturing, spatial intelligence systems, among others.

bhalo Social Enterprises. bhalo was designed to bridge the gap between smallholder farmers and businesses and financial service providers. The idea of bhalo was developed in pursuit of finding a more effective and sustainable way of improving smallholder farmers' access to farm inputs, farm advisory and services, finance and markets. bhalo aims to become Bangladesh's largest farm inputs marketplace, impact millions of lives, and change the farm inputs industry.

mPower Social Enterprises. mPower is the social enterprise which is moving the development paradigm into the information age – building information technology solutions and strategies that maximise the impact on people's lives.

Measurement Process

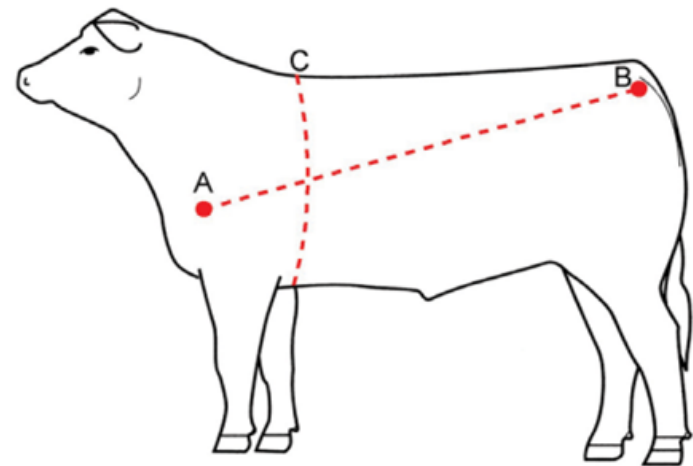
The standard volumetric measurement formula for beef cattle weighing is the following:

$$(\text{Heart girth} \times \text{heart girth} \times \text{body length}) \div 300 = \text{weight in pounds}$$

- 01** Measure the length of body, from the point-of-shoulder (A) to the point-of-rump or pin bone (B).
- 02** Measure the circumference or heart girth (C). Measure from a point slightly behind the shoulder blade, down the fore-ribs and under the body behind the elbow all the way around. After these measurements are made in inches – use the following formula.
- 03** $(\text{Heart girth} \times \text{heart girth} \times \text{body length}) \div 300$
= weight in pounds.

Example

Heart girth (76") X heart girth (76") X body length (66") divided by 300 = 1,270 pounds.



The Solution

So we have three actors



Smallholder Livestock Farmers

Seek to derive maximum value from their cattle



Intermediary Service Providers

Provide inputs and advisory services to farmers for a fee



Informal Rural Markets/ Bazaar

Avenues where livestock farmers sell their cattle or by-products

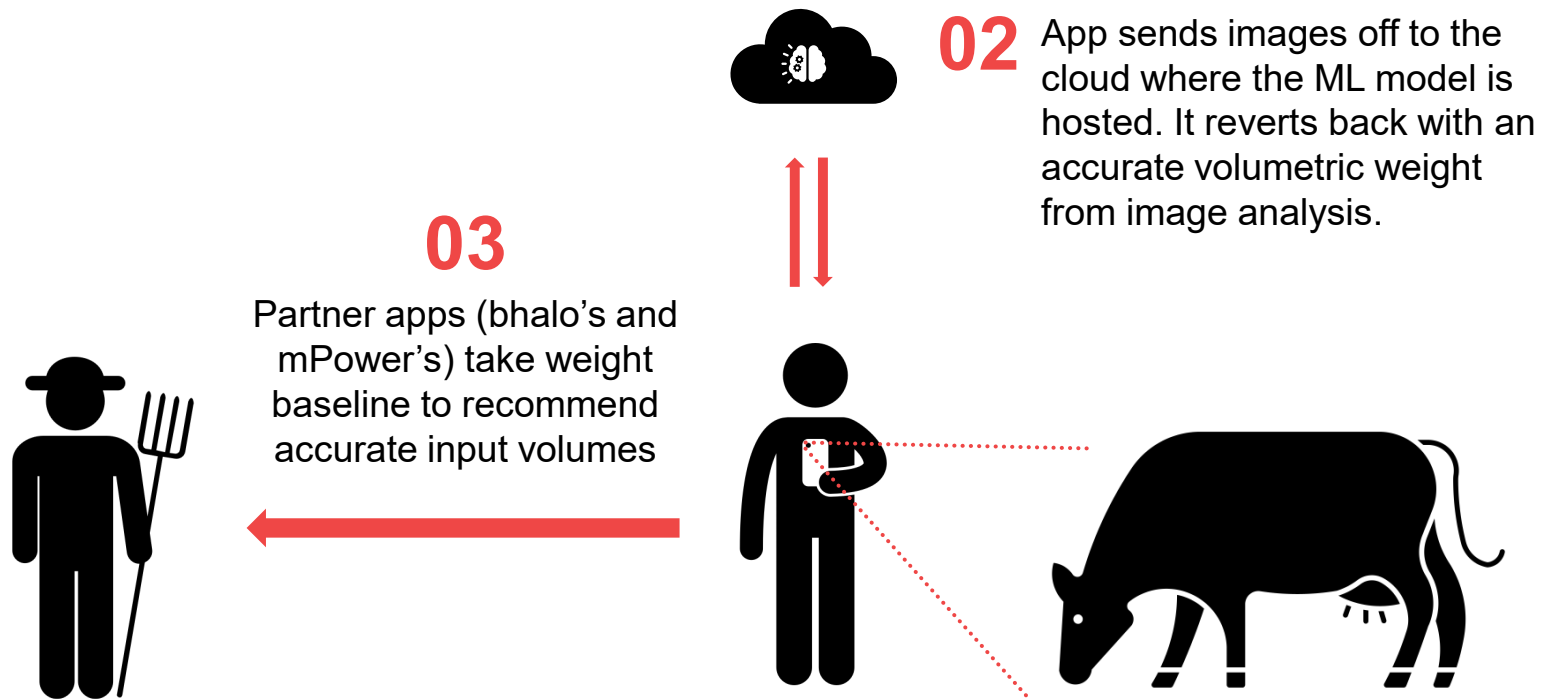
Lower livestock productivity equals lower market value – a bottleneck that intermediary service providers exist to solve. What we are doing is to help them **solve this challenge more efficiently**.

Bangladesh also has a **smartphone penetration of 50%** - ripe for scaling smart-device enabled solutions.

Given the recent strides in artificial intelligence and computer vision, we envisioned a **machine learning** model that works through a **smartphone** to detect weight from images – essentially **automating the hearth/girth measurement process** and making weight measurement ‘easier’.

The baseline weight then speaks to other platforms to provide accurate input recommendations.

How it Works?



Value

System translates to time-savings by livestock service providers as well as recommend optimum to improve livestock productivity and smallholder benefits – resulting in economic gains.

Two Types of Intermediaries



bhalo operates an agent network through which it provides curated care packages to smallholder farmers which include feed and nutrition products – who generally works with a farmer over a long period of time.



mPower runs one of the largest livestock service provider (LSPs) networks in Bangladesh – by the name of Sudokkho – housing over 4,000 livestock service providers who use digital tools to optimise livestock services. Services rendered by LSPs are generally one-off.

The app would serve as an enabler for bhalo Agents and the livestock service providers registered under Sudokkho to provide inputs in an accurate manner to maximise impact of their work.

The ML Model

Big problem

Mono-vision and depth sensing capabilities in low-cost smartphones

Workaround



Doesn't work in low-cost smartphones with the exception of a few Xiaomi models. Results were not very promising in terms of detection and parameter identification even on mid-range and flagship phones.



ARCore Depth Lab
Google AR Platform





Open-source vision model that works to create 3D render of objects using mobile video and photogrammetry. Cattle move around, albeit slowly, hence the renders came back with inconsistent (and often incomplete) results. Integrating the measurement formula would still be possible if not for the practical bottleneck of data requirement at the grassroots. It's just not feasible to send/receive off videos from the grassroots given the size of the data.





Standardised Reference Object

Two images, one from the side and another from the rear to isolate hearth-girth, body length, height, and use a reference object (a human or a cola bottle) to understand depth/distance.

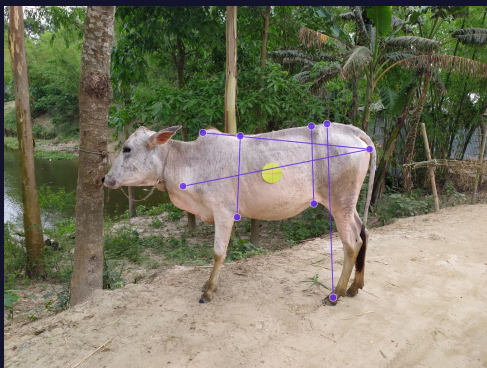


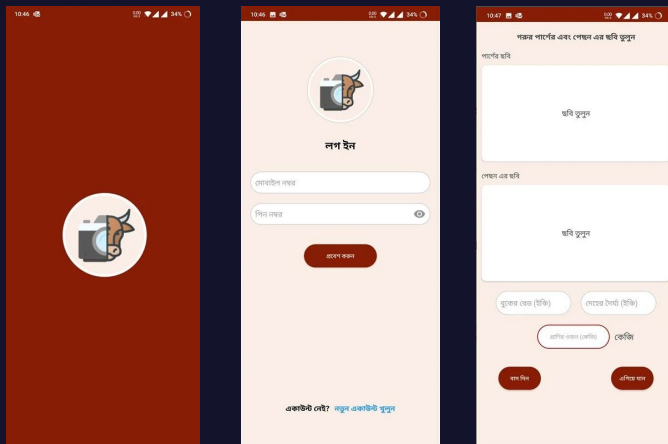
Outline Addon: Use outlines to force users to stand at specific distances to capture images.



**Can't expect
intermediaries to
carry Pepsi
bottles**

So we developed stickers as a low-cost alternative which can be put on a cattle body to make adjustments to depth deviations.





This is a feed calculator

1:14 65%

আইডি : 304



তারিখ : 2022-10-15

প্রাণির ওজন
506.50 কেজি

ফিড ক্যালকুলেটর

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**Achieved 92%~ accuracy
in volumetric cattle weight
detection under controlled
environments**



Stats + Findings

16,643

Total Weighing Session

Weighing sessions predominantly came from bhalo's and mPower's working areas in remote north and the climate impacted southern Bangladesh – specifically in districts of Kurigram, Jessore, and Barisal. We have also conducted a survey of 306 smallholder farmers to extract critical insights.

66%

Experienced weighing sessions and weight-based recommendations for the first time

29%

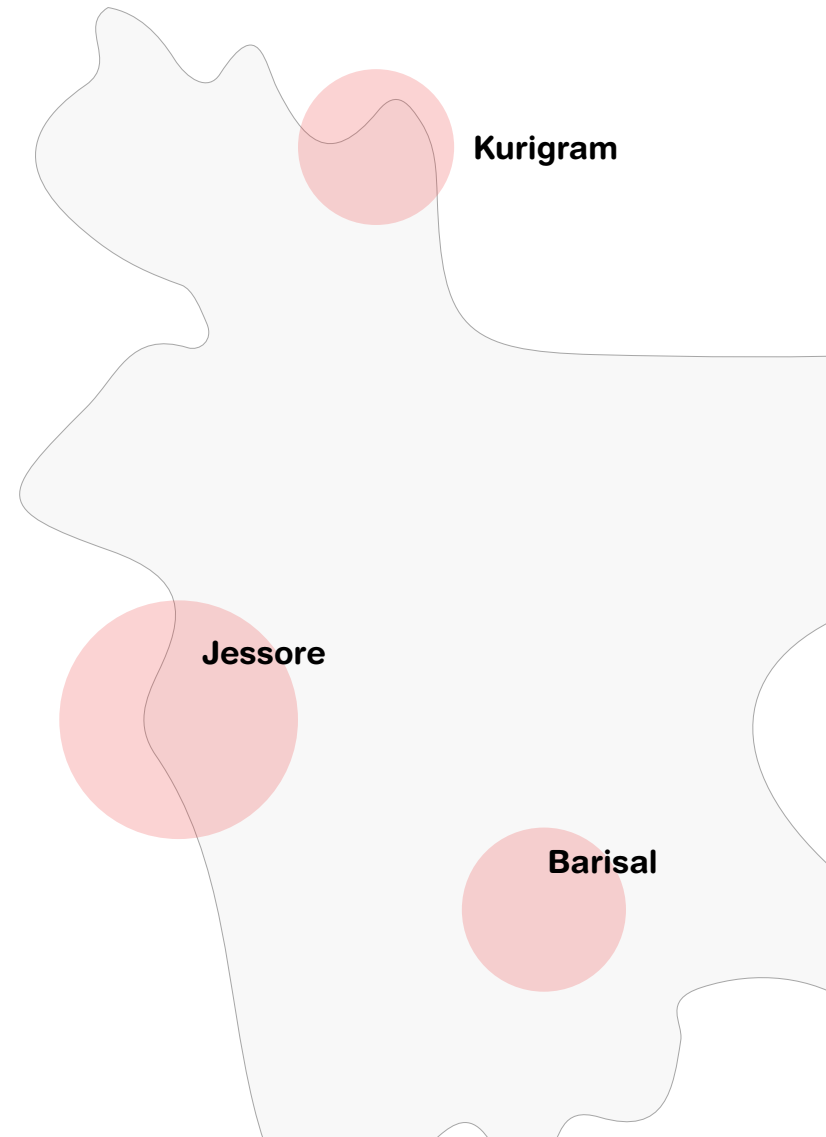
Expressed that weight-based feed provision improved feed management

33%

Expressed weight-based treatment/ medicine application yield positive results

3%

Realised cattle sales through measuring volumetric weight from the app



Practical Challenges

Adoption Challenges

- Bull weighing is a considerable use-case where the model falls short because of the practice of bulls being kept in small sheds mostly until they are sold. It is difficult to take images in those sheds and farmers are not keen on bringing them out.
- From our experience, most LSPs do not have smartphones.
- LSPs prefer to 'guesstimate' than spending time on weight measurement despite having an easier system.
- Resources are required for training, follow-up, and troubleshooting.
- Goat model did not inspire intrigue because of largely open-foraging practices.

Technical Challenges

- Volumetric weight is not the same as live weight.
- Dataset has an inherent bias towards a weight range. Because the dataset was collected from the grassroots, cattle weight, in most cases, ranged from 60 kgs to 450 kgs. There are cattle which weighs well over a ton which gives out incorrect results.
- Future dataset needs diverse range of classes inclusive of breed, age, teeth, species-based landmarks etc. for better accuracy and by-product estimation.
- Goat model yielded only 32% accuracy under controlled testing. Possible reasoning is that it worked through a single top-down image as opposed to a 2-image consideration. Difficult to collect goat dataset as well.

Opportunities

Explore independence from reference objects

Stickers are an archaic form of innovation which we would like to remove in future development. A substantial R&D work is required to do this.

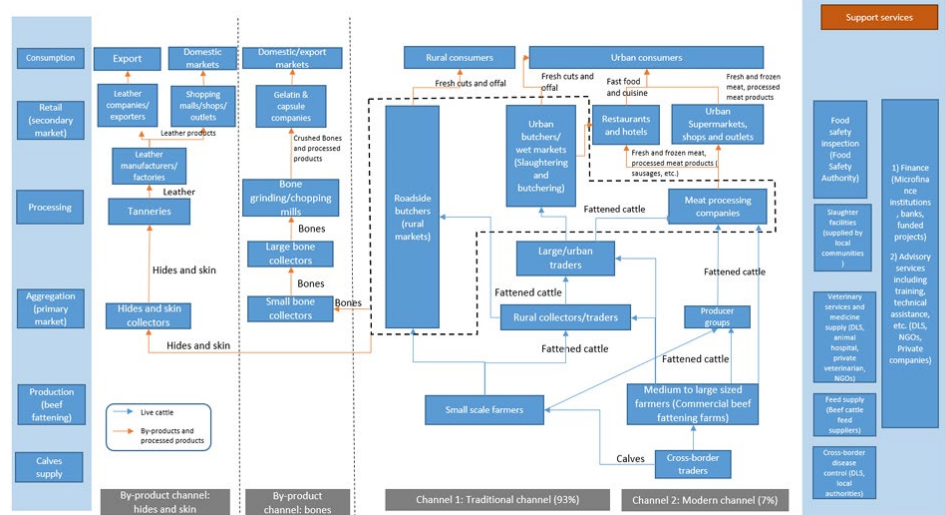
Value chain disruption

Connectivity into value chain actors (in both beef and dairy) can translate to greater economic gains for small-scale producers

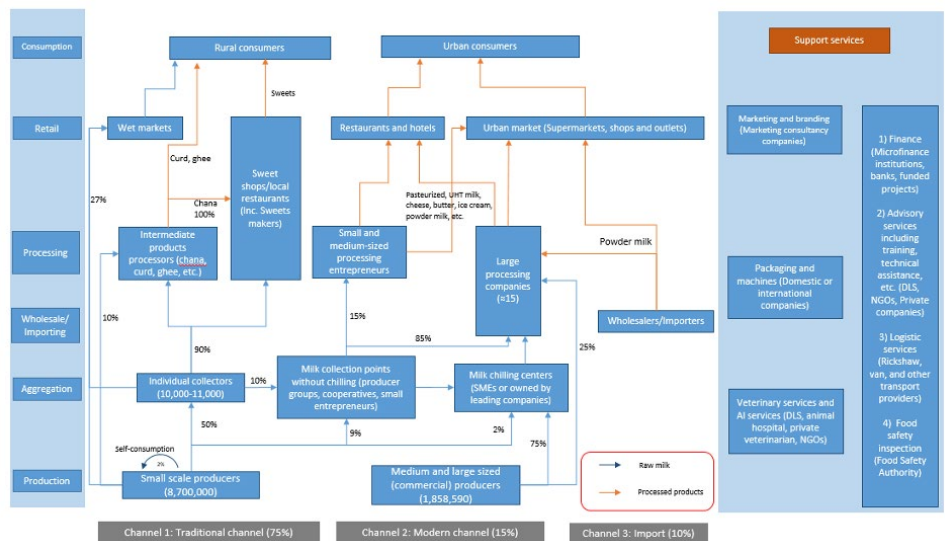
Stakeholder engagement

Deeper understanding and engagement with stakeholders (B2B, B2C, B2B2C, and B2G) to promote adoption in both ideal and variable market systems – a considerable area of work.

Beef value chain



Dairy value chain



Thank you.

