**Case 4:** To create a load distribution bag that increases efficiency and reduces body pain of labourers (of any age or gender) while collecting cotton and vegetables in a cost-effective manner.

**Team Members:** Drishti Baid, Md Zisan Khan, Prashant Nahar, Uday Agrawal

**INTRODUCTION**

Initially, we picked the problem of traditional cotton picking and were determined to make a product which increases the efficiency of labourers and also reduces the problems faced thereof. As we delved further, we realised that carrying heavy bags of cotton (10-20 kg while picking) by the traditional method is as big a problem as is cotton picking done by hands at present. We decided to work on cotton carrying only after studying all the stages of cotton growth in as much detail as we could and found it to be the most interesting and challenging one. Thus, we ended up making a load distribution bag which distributes weight throughout the body. The same product can be used for vegetable picking and its use can further be extended to any and every type of farming.

**GOALS**

1. The first goal was to observe the cotton picking process in great depth and identify all the problems that trouble the labourers and farmers. After such identification, the aim now was to develop solutions that solve the majority or all of these problems and are long lasting, cost effective and easy to make by at home while also ensuring that labour remains intact and their productivity increases.

2. The second aim was to identify all other areas that may be worth considering. These may be as specific as those related to cotton or other crops or may as well be social or community level problems.

3. The third goal was to take feedback of Natubhai’s machine from the people and provide review about the changes that can be made in order to reduce its weight and cost. (After the visit to Natu Bhai’s village, Ervada, we dropped the idea of reviewing his village and instead focused on areas we found to be more troublesome.)

**SECONDARY RESEARCH**

Cotton is used for making textile products like socks, underwear, towels and most of the T-shirts. Making of all these materials involves the following steps:
Hand picking of cotton is still practiced in some parts of the world. Most of the modern countries have machinery for picking the cotton. Cotton picking is often done by women in India. They do this work by bare hands. It requires a lot of time picking one ball at a time.

**PRIMARY RESEARCH – OBSERVATIONS**

**Observations Related to Cotton**

- Traditional cotton is mainly grown and nurtured in Ervada & Dasada as opposed to BT Cotton which requires more water, insecticides and pesticides. While in Viramgam, farmers have switched from traditional cotton to BT cotton due to the abundance of water now available because of the canals built. Further, traditional cotton is of three types: V 797, Gujrati Ekvee and Trepan Ten.
- A community based spinning and ginning machine is set up where all the produce is sold. The same setup provides them with the cotton seeds for next season. These seeds are to be mixed with soil for easy germination and so that seeds don’t mix with each other.
- Traditional cotton is picked just once. This, however, does not mean that the entire process of cotton picking takes place in one go. Due to asynchronous growing patterns, it is possible that some balls are picked first and sold immediately to fetch better price and some are picked
later as and when they mature. So, farmers just pick the cotton bolls that have ripened. This requires attentiveness and hence it's not just a mechanical job.

- 1 biga gives around 40-50 mand of cotton (1 mand =20kg) and roughly requires 6 workers to be picked in 1 day. 1 male worker can pick 5 mand in day and 1 female worker can pick 4-5 mand.

- Some people were working in the industries nearby but they said that farming is a better profession as people have more control and more chances of profit. In service, they only get a fixed amount every month.

- The labourers go through a lot of pain while picking cotton as it involves carrying heavy load and repetitive movement through the day. (Please find detailed explanation of the same in the “Brainstorming” section)

Other Observations

- Jeera has more risk because of optimum water and seeds requirements. Anything less than optimum will only lead to entire harvest getting ruined.

- We came across a new type of chuhla which was made up of mud and horse excreta. They used cow dung as fuel. They have to but horse excreta which are expensive, however, the chuhlas made only fetch Rs. 10 once ready.

- The benefit of LPG subsidy has done more harm than good as these people do not have enough money to buy LPG cylinders and cannot buy kerosene as well.
INSIGHTS

Field Visit 1 & 2 (Farmers’ Perspective) - Ervada, Dasada & Viramgam
As we majorly interacted with farmers who owned big pieces of land. We started seeing things from their perspective. According to them, finding labour was a difficult task as the labourers chose to work in the industries nearby. They constantly stressed on the respect and money farmers earn in foreign countries only made possible by big machines and autonomy.

They even accused the government of not providing enough support in case of need and not being farmer friendly. They also mentioned that children of big farmers do not want to pursue agriculture as their profession and how they might be the last generation doing so.

There was a clear divide among farmers on whether they would be willing to purchase equipment for their workers. The observation which forced us to dig deeper was that the daily wage of a farm worker is comparatively lower than what the government prescribes even when the demand is high. According to basic principles of Economics, if demand is greater than supply (as suggested by big farmers in case of labour), then the daily wage should rise which clearly wasn’t the case back then.

Field Visit 3 (Labour Perspective) - Panchasar & Jahurpura
After interacting with the labour, our opinion changed 180 degrees. The small farmers work as labourers on each other’s fields and have a very community cohesive approach towards farming. Those who do not own any land still wish to pursue agricultural labour work as their profession because of the expertise they have gained over the years. Clearly, lack of labour supply wasn’t the problem as pointed out by the big farmers.

While interacting with these labourers, they suggested that it is very difficult to make a machine for cotton picking because of asynchronous growth patterns. Instead, they suggested that if something is made to reduce their body load and movement, then it could be a viable solution. They would be willing to invest in anything that it improves their quality of life, is low cost and durable.

PROBLEMS
The following is the list of problems we came across during the three field visits. These are as follows:

1. Drift of labourers from traditional agricultural occupation to jobs in nearby factories.
2. The weeds have to be handpicked as no machine can differentiate between weeds and cotton plant.
3. The cotton is handpicked causing injuries to their eyes and hands. It also employs children leading to child labour. Some of the labourers buy gloves which cost 50 but last only for about 8 days.
4. Nilgai have grown in number in recent years and have been a headache for farmers as they eat up the entire cotton plant. They have the power of destroying up to 80 percent of the entire harvest.
5. The canals are not present everywhere and the places where they are, huge investment is required to be made on transportation of water through pipes due to improper contour mapping.
6. The traditional method of cotton picking and carrying puts a lot of pressure on the shoulders. The cotton pickers pick the cotton bolls and put them in the bag behind them. The movement is repetitive and leads to fatigue. The cotton pickers usually carry a load of up to 10 kgs, and then empty it on a sheet and resume. The cotton pickers have to bend a lot while collecting cotton which leads to back pain.

7. In jowar and bajra farming, till date, sickle is used which makes an individual prone to injuries, sweat and back ache. After the harvest, sometimes scorpions and snakes also bite them. In case of jeera, only hands are used (not even a sickle).

8. The farmers sprinkle water at night due to lower electricity cost at night. It is difficult to navigate at night without carrying a torch which occupies one hand while the pipe remains in the other.

9. The tractor leads to body pain as they have to remain seated in the same position for hours. Also, the entire working takes a lot of attention. The tractor vibrates a lot as they have no shock absorbers. It is very difficult to steer the tractor in the right direction. The direct effect of this is on eyes, neck and back.

**PROBLEM STATEMENT**

“How might we reduce body pain of labourers, regardless of age or gender, while ensuring a better collecting approach which minimises hand movements and stress on the shoulders and back while collecting cotton, in a cost effective manner.”

**BRAINSTORMING**
After the three field visits, we sat down to brainstorm. We identified the various problems faced by these labourers and started discussing the possible solutions for each one of them.

**Body load**

The heavy weight of bags clearly rests on shoulders, back and chest. The maximum pressure is on shoulders also causing rashes as they do not use any padding in the traditional method.

The voluminous bag creates an impact on the back as can be explained by the pendulum effect. All the things which are away from the stationary position want to attain one and the same thing is happening in this case.

Due to the cross knot tied in the traditional method, the knot puts pressure on the chest which magnifies with weight.

**Body Movement**

The body movements are bending and hand movement. The workers bend only when the dry cotton balls on the ground (roughly 5-10 % fall on the ground. They rarely bend to pluck cotton balls as they are at a height of 2 feet.

As the bags in the traditional method is at the back, they have to twist their wrists multiple times throughout the day to put the cotton plucked into the bags. Repetitive movement of wrists makes it extremely painful for them.

**Injuries**

While collecting cotton, the farmers either pluck the cotton one by one or pull all the cottons at once right from the bottom of the plant. The branches and dry leaves pierce into their hands - fingers and palms.

The tall branches also sometimes get into the eyes of the labourers with a chance of causing permanent damage.

**Collecting Approach**

The movement is repetitive in the traditional method causing fatigue. The bag has a limited space and sometimes these people carry heavy load which is voluminous as well. The present method largely restricts free movement of the workers.

**Cost Effective**

The aim is to make something durable, sustainable and should be easily made up from locally available materials. The objective will be achieved only if our prototype can be a DO IT YOURSELF product.
First Prototype

After discussing various ideas, we decided to go ahead with the load distribution idea as discussed below.

The prototype we have built is made up of simple mechanics of load distribution in which we have considered two things to reduce the load effort which are:

1. To minimize the distance between the centre of gravity of the human body and the centre of gravity of load.
2. To divide one type of stress into multiple components. In the traditional approach, there was only a single tensile component, thus the point of load falls on the particular point on the shoulders. Now, our prototype divides this component into three components and four directions.

To deal with the above mentioned points, we have made a universal load distribution and movement reducing bag which is made up of a waist belt and two straps for the shoulders for the proper distribution among the waist and the shoulders. To deal with the buckling problem, we have used foam as a reinforcement.

Shortcomings & Challenges

1. The first shortcoming is the storage issue. Our prototype could carry only 4 kg of weight in total while these individuals carry roughly 10 kg in total using traditional method.

   "The challenge is to increase the volume of the bag while ensuring that the weight gets redistributed over all the pain points instead of just falling on shoulders."

2. The carrying bags of the prototype currently get in the way while walking. The knees collide with the bags, thus restricting free movement.

   "The challenge is to design the bag such that it does not hinder leg movement and there is a slope such that the balls roll at the back instead of accumulating at one place."

3. The stitching of the first prototype was not perfect and thus it took them some time to wear. Also, the weight falls on the waist right now as opposed to equitable distribution over all the pain points.

   "The challenge is to improve the present design and make it less cumbersome to wear."

4. The idea of the unloading mechanism was appreciated but it would be difficult to untie and open it with weight as bags will become voluminous.

   "The challenge is to provide unloading mechanism is such a way that labourer does not have to bend to open it or depend on anyone else."

5. The problem that labourers pointed out was that two bags may disrupt the balance between the two sides. Also, due to asynchronous cotton picking process, there is a chance that one bag fills faster than the other hindering the natural movement of the hands.
“The challenge is to make a single large bag with two intels while also ensuring they do not accumulate at a single place again making one side of the bag heavier.”

SECOND PROTOTYPE

1. Keeping in mind the traditional idea, the aim was to redistribute the weight. While the carrying capacity of the traditional method is massive, the problem is that all the weight falls on the shoulders. Thus, we built a large bag which has the capacity of carrying as large as 15 kg.

2. To ensure that the bags do not hinder the knee movement, we have such a shape to the bag that the ends of it are on that part of the waist which is parallel to the knee. In such a way, it doesn’t hinder both the forward and the backward movement as balls won’t accumulate in the front or sideways.

3. We have made a belt which is easier to wear with minimum tightening and loosening mechanisms. Also under the current system, the straps were very long thus creating the need of cloth unnecessarily. As we plan to make it “Do It Yourself “product, the labourers can make it according to their physique eliminating all the extra material.

4. We have provided a knot mechanism which when untied emptyes the entire collected material. Several changes can be made like using a button or buckle instead of simply tying a knot.

5. We removed the concept of two bags and instead made one single large bag with two inlets open on both sides. Also, as needed, irrespective of the side from which the balls are put into the bag, the balls would go and collect at the same place at the back.

6. The biggest advantage of our prototype is its “Do It Yourself” nature. It can be easily made at home using any cloth of 1 metre length. It can be made a minimal cost of Rs. 150 and thus will cost very less and is durable.
RESPONSE TO SECOND PROTOTYPE

To test our second prototype, we went to Chhatrot and Panchasar. We received an overwhelming response which can be seen from the following:

“Manne saru lagiu chhe. Mara deerka upyog kre chhe to saru chhe.”

“I liked this product. If my kids use it, then it is good.”

- Chanchi Ben, 55 years old

“Pehla ae loko jaahre cotton ball leta tha tyaare tyoni kamar dukhti thi ane vadi jati thi parantu aa product thi tem ne tem na kamar na dukhama ane wahana dukhama ghado fer chhe.”

Earlier using traditional method, our back use to hurt a lot as we used to bend so often but with your prototype, our pain will be reduced.”

- Bachu Bhai, 60 years old

“Pehlani prakriya ma gaanth khuli jata baddi kapas dhodai jati parantu aa design ma tyone dori howana li the tenu bhayi rehto na thi.”

“In the traditional method, one knot puts a lot of pressure on the abdomen and if that know open us, the entire cotton can fall. In your product, two knots will provide double safety.”

- Rasik Bhai, 35 years old
“Aa vastu saaru chhe. Shaheer mein koi dird na thaaye ae na mate bahu saaru chhe. Jo ame pehla upyog krta hata, te pachedi krta aa vastu saari chhe.”

“This prototype is very good. This will not cause any kind of body pain and is really good. Your prototype is better than our traditional method.”

- Suresh Bhai, 24 years old

“Aa vastu ma sagvarta saari chhe. Hu darzi kaam kru chhu, hu pan aa vastu banavi ne aa loko ne aapis.”

“This product has more space. It can carry greater volume of cotton. I work as a tailor and I will make more like these and give people for use.”

- Rasu Ben, 47 years old

1. Our prototype is not restricted to picking of traditional cotton balls.
2. It can be used for picking vegetables and fruits that grow at heights like Apple Gourd (Tinda), Mangoes (Aam) & Ivy Gourd (Kundru).
3. It can also be used for picking tea leaves which will reduce constant hand movements to the back.
CONCLUSION

As mentioned, the second prototype was a success. We received amazing response from the beneficiaries. We also suggest the future teams to work on inbuilt torch head gear and ripstop gloves to further improve the lives of these workers. We have planned to distribute manuals with instructions on how to stitch the prototype and its advantages over the traditional approach. We are deeply indebted towards our mentors at SRISTI, especially Prof. Anil K Gupta, Alzubair Sir and Mr. Sagar Panchal for providing us with the opportunity to work on such an interesting issue and for their constant guidance and support.