

# HUB-168



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**SENIOR MATHS**  
**BALVIGYAN 2019-20**

***FOOD SECURITY AND  
WASTE MANAGEMENT  
FOR  
SMART CITY***

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**Submitted by:**

- **Choithram School, Manik Bagh**
- **Indore Public School (Eastern Campus)**
- **Ryan International School, Indore**
- **Shri Agrasen Vidyalaya**



# INDEX

<u>Sr.no.</u>	<u>Topic</u>	<u>Page no.</u>
<u>1</u>	Approval Certificate	
<u>2</u>	An Insight	
<u>3</u>	Introduction	
<u>4</u>	Present Scenario	
<u>5</u>	Our Survey	
<u>6</u>	Escape Clauses	
<u>7</u>	Our Solution	
<u>8</u>	Dakshata	
<u>9</u>	Mechanism	
<u>10</u>	Rooflaps®	
<u>11</u>	Cost estimation	
<u>12</u>	Conclusion	
<u>13</u>	Thank You Note	



# *Certificate*

This is to certify that Choithram School (Manik Bagh), Indore Public School (Eastern Campus), Ryan International School and Shri Agrasen Vidyala of hub 168 has successfully completed the project work under the sub theme **Food security and waste management for smart city** based on Community based Sahodaya Project in the year 2019-2020. It is further certified that this project is a collaborative work of the participant schools. All research and findings have been done on the field and are original work of students.

Signature:

Principal

Date: 04/01/2020



# *AN INSIGHT*

“A grain saved is a grain produced.”

India has become the second largest producer of food grains after the green revolution. We produced sufficient food products but we are presently not provided sufficient food and nutrition for the growing population. Despite the huge production the per capita availability is low in India because of the increasing population and high losses of produce. The production of food grains and agricultural products is not enough to provide nutritional food security to growing population.

Food and agricultural organization estimated that more than 225 million undernourished people reside in India, which constitute about 21% of the national population.



# INTRODUCTION

## USE OF MATHEMATICS IN STORAGE

Within the broad concept of farming, there are two essential elements: time and money. The base of both of them is Mathematics. Mathematics has enabled farming to be economically efficient and has increased productivity. Farmers though unaware of the concepts, use mathematics as a system of organization to effectively utilize their time and manage money. Farmers use numbers daily for a variety of tasks, from measuring and weighing, to land marking. Farmers need to consider all aspects of their farming operation to make it successful farmers create mathematical systems of equations and inequalities to help them make decisions about which crop to plant in which field. The system of organisation is commonly referred to as linear programming. We, in our project, intend to use mathematics as a measure to bring about sustainable development for farmers wherein they make a cost-effective warehouse to prevent spoilage of food grains, thus increasing their quality in terms of nutrition. Our aim is to use mathematics as a medium to design and implement our ideas about construction of an economical and



efficient warehouse. Mathematics has also served as a criterion for comparison between the pre and post scenario of storage of horticulture crops. Statistics, also a branch of mathematics also guided us in our surveys to gather fruitful information. To get a deeper look into the problems faced by warehouse-keepers in the process of grain storage, leaving the hypothetical world of facts and figures, we visited the warehouses to experience the real life issues concerning storage of grains and we came to know about the following problems :-

- Pests attacking grains.
- Intermixing of different types of grains.
- Poor ventilation which affects germination of grains.
- No fire extinguishers.
- Poor quality of sacks.
- Generally, upraised platforms are absent. So when excessive rains occur, the grains become wet and are rendered useless.
- No provision for regular fumigation of grains which causes fungi to grow and spoil the grains.
- Generally grains are not covered while they are being transported. So if rains occur during the transport, the grains get spoiled.



# PRESENT SCENARIO

“What night is in the relation to stars,  
Hunger is in the relation to food, Child in is  
relation to mother,

Like This growth of futuristic and activist farmer is in  
relation to cost effective warehouses.”

1. A study once represented that quantity of wheat equivalent to the entire production of Australia goes waste each year in India.
2. India is one of the largest food producers in the world. But still 61,824 tons of food grain has been damaged and 194 million people go to sleep hungry everyday.
3. India ranked 100 among 119 countries in the 2017 Global hunger Index with 14.5% of the population under-nourished.
4. Sharad Pawar, former agricultural minister, stated that most crops are left to rot in the sun because of absence of appropriate transportation and storage facilities or are eaten by insects.





5. The under 5 Mortality rate is 4.8% in India particularly because of inadequate nutrition and unhealthy environment.
6. About 40% of the 57,676 tons of food grains stored in FCI warehouses have got damaged or become useless for human consumption.
7. Food Grains worth US\$ 14 billion are wasted every year in India.
8. We see daily prints about “Grain Drains”, we see people criticizing, we hear voices sympathizing yet a few have come to a solution.
9. Labour in warehouse are often not treated properly and given the right working conditions. Machinery is not used to support them and they often get injured owing to this.

***The farmers have given this country surplus food with their sweat. Time has come that we bring advancements in the agricultural sector.***





## OUR SURVEY

Someone has rightly said that we get to understand the reality when we experience it ourselves. In this course of time, along with going on through facts and figures governing food security, we also visited currently existing warehouses to understand the problems faced by concerned authorities of those storage houses in their day to day jobs. Mankind is something which has always found a solution to every problem. Isaac Newton was once unable to solve an equation of gravitation with existing maths so he invented some math with a new set of operations called calculus. And today as we are facing the adverse problem of food grain wastage, we as representatives of mankind came up with a solution to various problems that caught our eye on our visit to warehouses of Chhawani. Talking to the caretakers of residents, we surveyed and concluded that because of inadequate entry of sunlight, moisture content in surroundings, improper material of storage sacks, carelessness of distributors and local transporters cause a large amount of food grains to be wasted that could satisfy hunger of vast population of our country.



# ESCAPE CLAUSES OF STORAGES IN INDIA

1. Based on Preliminary study done by Engineering Division of Headquarters, it was found that most warehouses have outlived their life span and are still in use. Such Sorts of Warehouses pose a lot of problems of storage, including storage losses.
2. Investment in structures had increased multiple times but returns are still quite low.
3. The maintenance costs are exorbitant while a chain of low returns continues, which highlights the failure of the warehouses.



4. The pest control and favourable climate conditions required by different crops are either absent or inadequate for storage, which deteriorates the yield, both in quantity and quality.

5. Only certain crops like rice and wheat are the main concern of the Government Structures. Other crops like beverages and those of horticulture are ignored.

6. Lastly, labour security is ignored totally in warehouses, both government and private. They often get injured during the tedious and time taking process of arranging the stacks at great heights and carrying them manually to these heights.





## “DAKSHATA”

“If the challenge exists, so must the solution.”

We kept an apprehensive vision to lay foundation of substantial and significant grain storage facilities in India to ignite a spark for tremendous progress and development.

We came up with an innovative concept, altering the deformities and reforming the present warehouses. Our evaluation, research and exploration led us to a facility which promotes efficiency and productivity,

“Dakshata” is an approach which maximizes the output of effective food production and storage. The essence of “Dakshata” is proficiency and high yielding. “Dakshata” is not only cost effective but also a realistic approach towards modern development in warehousing.



# *DAKSHATA:* *THE FEATURES AND DIMENSIONS*

## **Dimensions:**

Height- 6m

Length- 20m

Breadth- 15m

Raised Platform- 1.5m

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## **1. ELEVATED PLATFORMS**

It prevents accumulation of rainwater and due to its upraised structure it declines the rate of pest attack.

## **2. TRANSPARENT COVERING**

This ensures that adequate amount of sunlight penetrates within so they that neither excessive light can bur the crops nor the presence of moisture can lead to spoilage.

## **3. ROOFLAPS®**

These opening flaps on the roof of our storage house is an innovative solution to ensure that proper amount of sunlight enters the room at different timings of the day.

It is a motor based mechanism that will be controlled once programmed to work.





## 4. FUMIGATING PIPES

Fumigation is a widely used process for insect control. Generally two types of fumigants are available for this purpose in grain storage program.

1. Methyl Bromide: Highly toxic, has residual effect on grain and accumulates in the Human body
2. Aluminum phosphide: Again this fumigant has more hazardous effect than its use.

Neem pest fumigants are available in gaseous state and are used as a pesticide and disinfectant. It assumes more importance in developing countries where millions of deaths are reported every year due to the accidental intake of synthetic pest fumigants.

## 5. JACK-IT

Safety does not favour luck, it favours preparation. We worked upon the problem of labour security which we found to exist upon surveying the Central Warehouse in Chhawani and came up with an ingenious solution to reduce the risk of labour getting injured while climbing tall columns of sacks to place other sacks. The way devised by us is such that labour would only have to climb sacks to a height without carrying sacks on their shoulders. The sacks would be elevated to the required

height by being vertically displaced using the Jack-It so that the labour can simply place it onto the column.

The Jack-It combines Creativity and Innovation to make way for development.





# *BENEFITS OF NEEM PEST FUMIGANTS*

1. Very strongly pest repellent.
2. Eco Friendly
3. Pest does not develop resistance to it.
4. This natural product does not leave any residue on plant.
5. Non Toxic.
6. It does not contaminate terrestrial and aquatic environment.



# MATHEMATICAL CONCEPTS

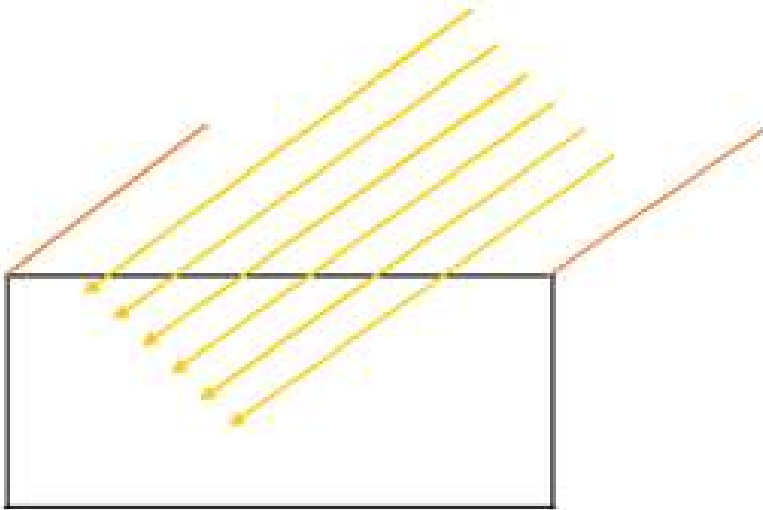
Our Dakshata is wholly based on Mathematics to maximize its efficiency. Some of them are specified below:-

## **1. Trigonometry:**

On the roof of Dakshata, there are two movable flaps attached. Their purpose is to allow only the required amount the sunlight to pass through the transparent roof. Their working relies upon the angle of elevation of the sun at various times of the day. The concept is, that during early morning hours, the flaps would coincide with the line of sight from the roof to the sun and the angle of the flaps with the roof should be equal the angle of elevation of the sun. As the day progresses and the intensity of sunlight starts to increase considerably (i.e. around 10:30 AM), the flap nearer to the sun would begin to close. After some time, the other flap would begin to close as well. Thus, both flaps would be completely closed by noon, when sunlight strikes normally. Now the process is followed in the reverse order, that is, the flaps begin to open and by 5:45 PM, they again start to follow the angle of elevation of the sun. We did this so that



the grains receive adequate sunlight and the required moisture content in them also remains preserved. This would also prevent the grains to be attacked by microbes and further reduce the amount of spoilt grains.



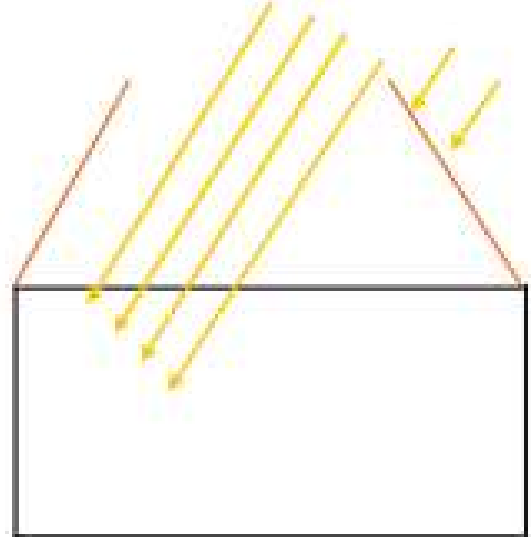
#### EARLY MORNING

- Sunlight from the east
- Slant Sunlight received by Left half of Dakshata
- Both flaps follow angle of elevation of sun



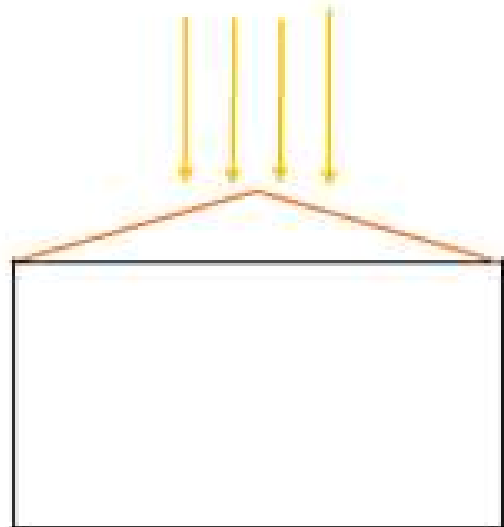
## LATE MORNING

- Sunlight from the east
- Slant Sunlight received by Left half of Dakshata
- First flap starts to close



## NOON

- Sunlight from above
- No direct sunlight received
- Both flaps close completely





# *Trigonometric Formula to determine the Angle of the Flaps:*

Let 'a' be the number of degrees from the currently sub-solar latitude.

Suppose 't' to be the current time (in 24 hour format), 'x' to be the time of sunrise (in 24 hour format), and 'y' to be the time of sunset (in 24 hour format):

Then, the angle of the flaps shall be:

$$\theta = \cos \left( \frac{t - x}{y - x} \times 180 \right) + \frac{a}{2}$$



## 2. Surface Area and volume:

The concept of Surface area and Volume helped us to design our Dakshata in such a way that there is an ideal space for the storage of grains which is not too much neither less. If the space for storage is too much, then more and more of new grains are brought in and in the process the old ones are neglected and get spoilt. If the storage space is too low, then the warehouse is rendered useless as it cannot even store grains for calamities in advance. Therefore, an ideal storage space had to be determined according to several factors.





### 3. Cost Estimates

Construction costs :

Cost per m<sup>2</sup> = Rs. 3000

Dimensions of Warehouse: 20m × 15m × 6m

Cost = (300 + 180 + 240) × Rs.3000

= Rs. 21,60,000 approx.

Items	Rate	Quantity/Area	Cost
Fumigating pipes	Rs.1300	6	Rs.7800
Exhaust Fan	Rs.1300	1	Rs.1300
Rooflaps®	Rs.46/sq.ft.	350sq.m	Rs.16100
Neem Extracts	Rs.1000 each pipe	6	Rs.6000
White Wash	Rs10/sq.m.	290sq.m	Rs.2900
Motors	Rs.8000	2	Rs.16000

Items Total Cost – Rs 50,100

Total cost= Rs 22,10,100 approx.

# Project Report





## Identification of Problem

**Choithram School, Manik Bagh:** Identified the central problem that warehouse development in our nation needed a boost for better food security in rural and urban areas after observing that the rate of wastage of foodgrains in India is among the highest in the world due to several reasons like spoilage of grains due to deluge, extreme heat, and pest attacks.

**Shri Agrasen Vidyalaya:** Threw light on the fact that wastage of foodgrain in India in the present time period accounts for a waste of about US\$ 14 billion per year and needs to be controlled for securing a proper future for the nation.

**Indore public school:** Stressed on the point that the farmers of our nation work very hard for hours in extreme temperatures for producing grain and hence countering grain wastage must be a priority, unlike the present



scenario where over 40% of the grains produced by farmers do not reach the final consumers.

**Ryan International School:** Focused on labour security in the warehouses by throwing light on the fact that warehousing has taken the form of a ‘capitalist’ sector where interests of labour are not taken into account by the people in charge of the operations, especially in government warehouses.



## Data Collection

### **Choithram School, Manik Bagh:** Central Warehouse Indore III

- Aimed at identifying the drawbacks of the infrastructure of the warehouse so that effective solutions could be drawn for them.

### **Shri Agrasen Vidyalaya:** Central Warehouse Indore I

- Focused on questioning labour regarding the problems faced by them in the warehouses as they worked and control of pests in the warehouse.

### **Indore public school:** Madhusudan Warehouse

- Questioned warehouse owners on how the nutritional value of the grains was kept intact for longer periods and what measures were taken for the same.

### **Ryan International School:** Sanket Warehouse

- Ensured whether the structure of the warehouse was such that it could remain standing in the event of a deluge or any other disaster alongside fire safety equipment present there.



## Analysis of data

**Choithram School, Manik Bagh:** Calculated the dimensions which would be ideal for the warehouse; made the warehouse more creative and unique by giving the idea of Rooflaps® and conducting mathematical calculations based on modeling.

**Shri Agrasen Vidyalaya:** Threw light on the problems encountered in the current warehouses; gave the idea of pyramid/pulley to ease the work of labourers and facilitate the process of arrangement of sacks in stacks in the warehouse.

**Indore public school:** Calculated an approximate for the cost of the warehouse; gave ideas to make the warehouse as economically feasible as possible.

**Ryan International School:** Contributed to the process of making the warehouse more socialist by suggesting measures for safety and security of the labourers.



## **Research for Smart Solution-Methods and Tools**

**Choithram School, Manik Bagh:** Collected an abundance of data regarding the root of most problems faced in warehouses, that is, adequate moisture, heat, and sunlight required in warehouses and the adverse effects of these conditions not being met adequately.

**Shri Agrasen Vidyalaya:** Researched regarding effect of use of chemical pest- repellents on the nutritional value of the grains stored in the warehouses and health of workers as well as consumers during the long run.

**Indore public school:** Found the trends and patterns followed in the data provided for wastage of foodgrains in India and the world over the past few decades and projections for future wastages in accordance with regular warehouses which are being used today.

**Ryan International School:** Conducted thorough research on the arrangement patterns of sacks in warehouses alongside the importance of labour security in these warehouses, while also searching about the current type and form of infrastructure present in warehouses across India and the world.



## Smart Solutions Suggested

**Choithram School, Manik Bagh:** In order to make the warehouses more advanced, we suggest the construction and implementation of Roof flaps and transparent roof.

**Shri Agrasen Vidyalaya:** Strongly suggested the implementation of fumigating pipes which would use neem gas as a pest repellent.

**Indore Public School:** Safety is more important than convenience. We suggest the construction of elevated platform. Also, fire extinguishers and proper ventilation are to be taken care of.

**Ryan International School:** To avoid the injuries caused to the labours while arranging the sacks of grains we have suggested a machine. The machine will help to lift the sacks and will be called the “JACK-IT”





## Effective Implementation of Solutions – Means and Ways

**Choithram School, Manik Bagh** has come across the solution of rotating roof flaps .these flaps are used for regulating the amount of sunlight entering the warehouse. These are rotating flaps which can be changed by us according to the direction of sun.

**Ryan International School** has given the solution for fumigation. We are using neem extract instead of the typical chemicals used . This extract will be in the form of compressed gas, under the warehouse which would pass through the pipelines and would spread as gas in the warehouse.

**Shri Agrasen Vidyalaya** came with the solution for grain safety- installation fire extinguishers and sand buckets in various places in warehouse. the warehouses would be build on an appropriate height so that flood waters will not enter the warehouse. For ventilation, we have positioned exhaust fans and windows.

**Indore public school** has given solution of a machine that would work as a jack and is manually operated this machine will help in lifting the sacks in which many labourer get injured. It is cost efficient with low maintenance.

*We have also planned to spread awareness about these solutions amongst warehouse owners.*



# Problems Encountered During Implementation and Resolution

**Choithram School, Manik Bagh:** Faced a major problem in ensuring that the cost required to make Dakshata a reality stayed below a specified limit.

**Shri Agrasen Vidyalaya:** Problems were faced regarding the working of the management during the transition period where already constructed warehouses are renovated to turn them into Dakshata.

**Indore public school:** Faced problems in convincing warehouse owners to make this small investment to secure the future of the country by achieving the goal of 100% food security.

**Ryan International School:** Problems were encountered as it was observed that it would take time for warehouse keepers and labour to adapt to the new methods presented by Dakshata® as they would require training to deal with them.

# *Miniature of Project*

**Topic:** Smart City “Indore”

**Theme:** Working towards special needs of the city

**Sub-Theme:** Food Security and Waste Management for smart city

**Name of Lead School:** Choithram School, Manik Bagh

**Participant School 1:** Ryan International School

**Participant School 2:** Shri Agrasen Vidyalaya

**Participant School 3:** Indore public school, Eastern Campus

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## **Data Collection: The Building Blocks Leading Up to Dakshata**

**Case Study:** The students of all participating schools as well as the lead school visited different warehouses in Indore to get an idea about the problems faced by warehouse-keepers and the labour working there.

**Observation:** On observing the situation in the warehouses and the condition of the labour, it was observed that the following problems exist in warehouses:

- Pest attacking grains.
- Absence of upraised platforms
- 0% Labour Security
- Labour and officials are not trained to use fire extinguishers

**Survey:** A number of warehouse labour, keepers, and officials were surveyed alongside the labour from transport companies. Their answers mostly revolved around those provided in the questionnaire-cum-interview provided below.

**Questionnaire-cum-Interview:** The following questions were asked at the warehouse. The answers given by the keepers, labours and officials mostly revolved around these answers given to us by Mr. Kamal Singh Rana of the Chhawani FCI Central Warehouse. Some extracts (clubbed with some answers from the labour) are as follows:

**Q.1 How are grains brought to the warehouse?**

**Ans.** Grains are brought to the warehouse by the means of tractors, trucks, loading rickshaws and bullock carts.

**Q2. How grains are stored to the warehouse?**



**Ans.** Grains are placed in the warehouses in the horizontal and vertical stacks to minimise the space occupied according to the name and issue date of the farmers.

**Q.3 What are the difficulties faced in storing the grains?**

**Ans.** 1. Since they are provided very less area to store the sacks so they are bound to increase the height of the piles of the sacks which is a very risky task. They might get injured.  
2. Also, there is no electricity as there is a risk of short circuit. So, they work only in daytime.  
3. If a sack accidentally gets opened, the whole arrangement gets disturbed.

**Q.4: What measures are taken to prevent grains from pests?**

**Ans.** In order to protect the grains, the workers spray DDVP on floor and Malathion on sacks weekly and for more protection plastic covers are used to cover sacks and these sacks are not sold for 1 week. Zinc Phosphide is also sprayed to protect the grains from rats.

**Q.5: How the nutritious value of grains is maintained?**

**Ans.** By applying the above measures, the nutritious value of the grains is also conserved also, ware house keeper makes sure that preservatives are organic in nature and are effective and pesticides are used minimum.

**Q.6: What measures are taken to prevent grains from climate change?**

**Ans.** According to them, the measures taken to prevent grains from pests are enough to protect grains from climate change.

After applying the measures, climate change does not cause any harm. Instead the weight of the sacks increases which is profitable for its owner.

**Q.7: What are the basic problems faced by ware house keepers?**

**Ans.** a. Light  
b. Risky Task of arranging sacks  
c. If a sack gets accidentally opened whole arrangement gets disturbed  
d. Workers face Skin allergies and infections.



**Q.8: What are your suggestions for the betterment of warehouses?**

- Ans. 1) Availability of light must be there after daytime.  
2) Facilities should be provided to make the task of workers less risky.  
3) Machines can be used to lift and drop the sacks.  
4) Computerized entry system should be there.  
5) Machines should be used to stich the mouth of the sacks in order to avoid waste.  
6) Latest Moisture absorption technique should be used

**Q.9: What support warehouse keepers expect from public and the government?**

Ans. Workers expect medical insurance from the government and co-operation from public



## *Facts and Figures*

Today, we have seen a considerable increase in the food production quantities across the whole nation, especially after the green revolution, however, the amount of food which reaches our plates is considerably less.

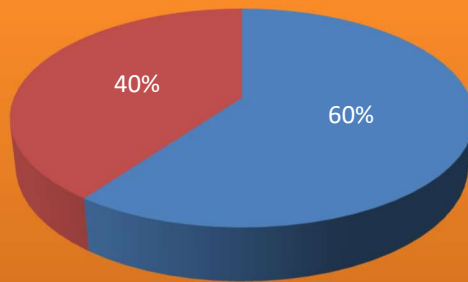
The warehouse keepers gave us information such:

- According to the UN's Food and Agriculture Organization, one-third of the total global food production is wasted, costing the world economy about \$750 billion. Annually, close to `31 million (70-75%) of waste is dumped into open landfill sites.
- Globally, India currently ranks second in terms of overall foodgrain wastage.
- Approximately food grains worth INR 50000 crores are wasted every year in India in warehouses of the food corporation of India.
- This amounts to approximately US\$ 14 billion, which is more than the amount initially planned for expenditure on the International Space Station, one of the world's most expensive projects



# A GRAPHICAL REPRESENTATION OF DAKSHATA'S CAPABILITY TO REVOLUTIONIZE THE INDIAN GRAIN STORAGE SECTOR

**Food Security Statistics- Without Dakshata**



**Source:**  
Food Corporation of India

**Time Span:**  
Past Decade

■ Grain Used ■ Grain Wasted

**Food Security Statistics- With Dakshata**



**Estimated Data**

**Anyday, Anytime**

**Dakshata's Efficiency is Clearly Seen Here**

■ Grain Saved ■ Grain Lost





# CERTIFICATE

It is to certify that our project titled “Grain Storage”, presented by the students of Choithram School(ManikBagh),Indore Public school(Eastern Campus), Ryan International School ,and ShriAgrasenVidyalaya appearing for **Senior BalVigyan Mathematics**, under the aegis of Sahodaya Schools Complex under the theme “Innovative Solutions for Problems of Today and Tomorrow” and the Sub-Theme “Food Security and Waste Management” visited **Central Warehousing Corporation,Indore** to conduct a case study regarding “Grain Storage”.

कमलशेखर  
ॐ

Concerned Authority

Central Warehousing Corporation Warehouse



## CONCLUSION

Conclusion as Google says, has two meanings. One is an opinion that you reach after thinking about something carefully; or second, an end to something. The difference is created when we act on our research. So we try to create an opinion to resolve the problem of grain storage faced by India today by innovation and correction in our storage practices. Innovations that are guided by smallholder farmer, adapted to local circumstances and sustainable for the economy and environment will be necessary to ensure food security in future with extensive research, we delved into greater depths of problems faced by them and tried our best to overcome them in our ideal warehouse for efficient storage.