Feed Efficiency and Sustainability of the US Dairy Industry

Educational Materials and Teachers’ Guide
For Grades K-12
**Educational Materials and Teachers’ Guide**

The teachers’ guide and educational materials have prepared to help teachers when they teach concepts of utilization of limited resources in the dairy industry, feeding dairy cows, efficient milk production, dairy sustainability, and compassion towards the dairy cows to school children. The guide is divided into 3 sections.

1). Early Elementary (Grades K-2)
   Teaching resources for kindergarten, Grade 1 and Grade 2

2). Late Elementary (Grades 3-5)
   Teaching resources for Grade 3 to Grade 5

3). Middle and High School (Grades 6-12)
   Teaching resources for Grade 6 to Grade 12

Each section will include objectives, reading materials, activity guide, and supporting materials.
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1). Early Elementary (Grades K-2)

A. Objectives of the educational materials prepared for Early Elementary (Grades K-2) students

The students will:

- Comprehend the materials using visuals/pictorials and learn to read the materials and write the words.
- Practice the basic mathematics: recognizing the numbers and counting
- Learn the basics of dairy farming: inputs (feeds), outputs (milk, manure), farmer, equipment, and animals
- Learn basic feed ingredients that cow would consume in a dairy farm
- Describe how cows help people and the environment.
- Learn to appreciate and show their compassion toward cows.

B. Reading Material: “Daisy the Dairy Cow-A story of a beautiful cow” - Series-I

Objectives: The students will:

Comprehend the materials using drawings and learn to read the material.

Learn basic feed ingredients that cow would consume in a dairy farm and in return cows produce milk for her calves and people.

Describe how cows help people and the environment.

Learn to appreciate and show their compassion toward cows.
The Story lines:

I’m a dairy cow. My name is Daisy. I live in a beautiful farm, Dairy Heaven.

My farmer is David. He and his family live close to the farm. They are kind to me and take care of me well.

I love when his daughter, Sara and son, Tom hug me. They are adorable kids.

I eat feeds that human cannot eat like grass, corn silage, alfalfa hay…. Also I love to eat delicious grains like corn, and barley.......... Everyday morning, David and his wife, Stacy feed me delicious feeds. They mix grass, corn silage, alfalfa, and grains together and give to me. I love to eat them........

I change all those feed into nutritious milk.......... I can make lot of milk........

Every day, I make lot of milk..... David's family love to drink milk. Sara and Tom enjoy drinking milk every day for their breakfast. Also they sell milk to his neighbors for cash. I’m very happy that I can help my family.....
People make lots of delicious food products for them out of my milk. Butter, cheese, curd, ice cream, and yogurt are their most favorite milk products.

I do not like to waste anything….. Do you know that my manure helps growing plants and vegetables? David and Stacy use my manure to their gardens……. David’s family is happy when they see their plants and vegetables are growing faster……. It is my great pleasure to see my family is happy!

C. Glossary

<table>
<thead>
<tr>
<th>Cow</th>
<th>Farm</th>
<th>Farmer</th>
<th>Family</th>
<th>Grass</th>
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<tbody>
<tr>
<td>Corn Silage</td>
<td>Alfalfa</td>
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<td>Share</td>
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<td>Garden</td>
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<tr>
<td>Plants</td>
<td>Vegetables</td>
<td>Grow</td>
<td>Happy</td>
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</tr>
</tbody>
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D. Procedure

1. **Introduce the topic of cows**
   
   Ask students the following questions?

   i) What do you know about cows?

   Write down the answers they provide in a white/chalk board.

   Ask them to imitate their sound.

   ii) What do you want to know about cows?

   Once they reply, tell them that you will be reading a book called “**Daisy the Dairy Cow-A story of a beautiful cow**”

2. **Apply a picture reading strategy**
Hold up the book, “Daisy the Dairy Cow- A story of a beautiful cow” or open the pdf file of the book in a computer and display in a big screen. Go through each page of the book. Ask students to tell the story by looking at the pictures of the book. This step helps to students to come up with creative ideas.

3. Read the text aloud
This step will be the next step of comprehending the book. Read the whole book to them. While reading, make sure to ask them whether story is related to what they imagined before listening to the story.

4. Ask students to recap the new information they have learned about dairy cows
Try to connect their previous answers on the white/chalk board. Ask them to compare what they learn new about dairy cows.

5. Ask them to follow the supporting materials given.
   i) The Dairy Activity Book
   ii) Dairy alphabet
   iii) Do you know about dairy cows?

6. Additional activities
Ask them to be part of the characters in the story.
Ask them to add more dialogues to the conversations.
2. Late Elementary (Grades 3-5)

2A. Objectives of the educational materials prepared for Late Elementary (Grades 3-5) students

The students will:

- Comprehend the materials using visuals/pictorials and learn to read the materials.
- Practice the basic mathematics: counting, adding, subtracting, multiplying, and dividing.
- Learn the details of the dairy farming: inputs (feeds), outputs (milk, manure), farmer, equipment, and animals.
- Learn basic feeding strategies used in a dairy farm (mixing feed ingredients) and concept of efficient utilization of feed to make more milk.
- Describe how cows help economy, people and the environment.
- Learn to appreciate and show their compassion toward cows.

2B. Reading Material: “Daisy the Dairy Cow-A story of an efficient cow” - Series-II

Objectives: The students will:

- Comprehend the materials by reading the material.
- Learn basic feeding strategies used in a dairy farm (mixing feed ingredients) and concept of efficient utilization of feed to make more milk.
- Describe how cows help economy, people and the environment.
• Learn to appreciate and show their compassion toward cows.

The Story lines:
Hi, Hope you can remember me..... I’m Daisy the Dairy cow from Dairy Heaven farm ......
Can you remember my story of making more milk from grass..... and use my manure to grow plants and vegetables faster!!!

Today I’m going to share you a story of an efficient cow! Do you know who is an efficient cow? Don’t worry right now if you do not know? I will tell you at the end.

One day, my farmer, David told me “Hi Daisy! You are doing a wonderful job. Make lot of milk for us every day! I would like to appreciate what you do! Do you want to join a competition?”

“Competition? What is that for?” I replied.

“Our city council is going to appreciate what you do and try to find the best cow that can make more milk in the region....”
I was happy but nervous. “I know that you can do it Daisy” David encouraged me.
Last week, David’s family and I went to the competition. There were so many farmers, cows, judges, kids....... Seemed like every one was busy..... That was my first time to be in a competition.
“What I have to do here?” I asked David. “You just have to do what you do every day.... Try to make more milk... They will feed you first and at the end of the competition they will record how much milk you make...If you make more milk you will win.”

“That is not difficult” I thought.

At the end of the competition.... There were two judges in front of everyone.

One of judges started “We are going to announce you the best cow today……”

“Do you know that there are two cows that made the most milk?
“One is Brownie, the cow from Dairyland farm and ......
Other cow is .......

“Who is the other cow? Am I the other cow?” I thought.

“Daisy, the cow from Dairy Heaven farm ............
Hurray.. Hurray...... Everyone was happy....
Then the send judge said that.......”

“But we want to select the best cow”....... 
Everyone was silent.

“Oh....no... how they are going to do that.......Both Brownie and I made same amount of milk.. How they are going to select the best cow......?” I thought.

The second judge continued.....

“We looked at how much feed they ate to make the milk.. The cow ate less and made more milk going to win today”

“Do you want to know who the champion cow is?
““Yes... Yes... “ everyone was excited.... But I was nervous......
“Today we declare the winner!...... The Champion cow is Daisy cow from Dairy Heaven farm! We love to give her the trophy “THE EFFICIENT COW”!

Brownie was the first one to greet and hug me. She was lovely. Everyone else followed Brownie and greeted me.

“This is great! Aha….This is a nice trophy. But I’m bit puzzled... What is EFFICIENT COW? I asked David.

“Daisy, look at your trophy” David said.

“THE EFFICIENT COW-THE COW MADE MOST MILK WITH LESS FEED”

DAISY FROM DAIRY HEAVEN FARM”

“I got it….Thank you David” He was very happy....

We all returned home happily in the night! That is my story of the efficient cow for you!

2C. Glossary

Milk Feed Efficient Competition Appreciate
Region Record Judge Amount Champion
Declare Trophy

2D. Procedure

1. Introduce the topic of cows

Ask students the following questions?

   iii) What do you know about cows?

Write down the answers they provide in a white/chalk board.
Ask them to imitate their sound.
iv) What do you want to know about cows?
Once they reply, tell them that you will be reading a book called “Daisy the Dairy Cow-A story of an efficient cow”.

2. Apply a picture reading strategy
Hold up the book, “Daisy the Dairy Cow-A story of an efficient cow” or open the pdf file of the book in a computer and display in a big screen. Go through each page of the book. Ask students tell the story by looking at the pictures of the book. This step helps to students to come up with creative ideas.

3. Read the text aloud
This step will be the next step of comprehending the book. Read the whole book to them. While reading, make sure to ask them whether story is related to what they imagined before listening to the story. Try to emphasize on the topics limited resources,

4. Ask students to recap the new information they have learned about dairy cows
Try to connect their previous answers on the white/chalk board. Ask them to compare what they learn new about dairy cows.

5. Ask them to follow the supporting materials given.
   i) The Dairy Activity Book
   ii) Dairy alphabet
   iii) Do you know about dairy cows?

6. Additional activities
Ask them to be part of the characters in the story.
Ask them to add more dialogues to the conversations.
3). Middle and High School (Grades 6-12)

3A. Objectives

3B. Reading Material: An American Success Story-The Dairy Industry of United States

An American Success Story-The Dairy Industry of United States

A Note to Teachers

The book is designed for the school children studying in middle and high schools (from grades 6-12) or anyone who is passionate to learn about the dairy industry in the United States. The book was prepared to give a broad understanding of how the dairy industry evolved in the United States, its significant improvements over the time, and sustainability of the dairy industry. It is written in a simple language with tables and figures to make their understanding easier.

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**Milk and our lifestyle**

Can you think of starting a day without drinking a glass of milk? Munching a cracker without a slice of cheese? Cooling off a hot summer-day without eating a delicious ice cream or a yogurt? These delicious and nutritious products made out of milk or commonly known as dairy products are an integral part of our lives and help to keep us stronger and healthier. It seems like we cannot live without them. Do you know who produce milk or have you ever thought of knowing the story behind producing milk?

**Who produce milk?**

Milk that we consume every day is produced mainly by dairy animals such as cows, goats, sheep and water buffaloes. In the United States, the majority of the milk is produced by dairy cows; hence, in this book we discuss about the milk produced by dairy cows.

**Why dairy cows are important?**

The human being recognized the importance of dairy cows since a long time ago as the connection between human and use of milk from cattle is as old as 9,000 years.

Dairy cows do not compete with human being for feed. They eat feed that human cannot eat and in turn, produce milk that human could consume. Simply, they convert less-valuable ingredients to a valuable food item for human.

Generally, they eat fresh grass, dried grass or legumes known as hay, fermented grasses, legumes or whole corn plants known as silage to get nutrients for their growth, maintenance of the body and produce milk. Also, they could eat leftovers or byproducts from food and other
industries such as beet pulp, citrus pulp, almond hulls, cotton seeds, soybean meal, and distillers grains.

Also, their manure or poop is rich in nutrients that plants could use to grown and bear fruits and farmers use manure as a good fertilizer for the crops that they cultivate.

Converting human inedible feed into to human edible milk and ability to use manure as a fertilizer helps recycling nutrients to keep the balance of the nutrients in the environment.

**Why we have to measure the performance of dairy cows?**

The milk production using dairy cows is an economic activity or an industry. In the dairy industry, major input is feed to dairy cows and major output is milk from dairy cows. Simply, dairy farmers spend money to feed the dairy cows and earn money by selling the milk. As in any other industry, the objective of the dairy production is to get more money from selling milk compared to money spend on feed the cows or earn a profit. As cows are producing milk as an output, measuring the performance or how many of pounds of milk they produce is important. Also, we need to know the amount of feed that they consume.

\[
\text{Profit} = \text{value of output} - \text{value of input}
\]

**How do we measure the performance of dairy cows?**

It is easier to measure how many pounds of milk produced by a dairy cow in a day. Generally, we prefer to see more pounds of milk being produced by a dairy cow. Also, it is important to know the how many pounds of feed they consume in a day. As we like to see less money spend on feed, we prefer to see less pounds of feed consumed by a dairy cow to produce milk. In the dairy industry, the performance of a dairy
cow could be calculated dividing the amount of milk produced by the amount of feed consumed by a dairy cow. This ratio is called “dairy efficiency” or “feed efficiency”. Simply, it is how many pounds of milk a dairy cow produce when you feed her a pound of feed.

\[
\text{Feed efficiency} = \frac{\text{Pounds of milk produced}}{\text{Pounds of feed consumed}}
\]

**What is dairy sustainability?**
Sustainability is a word that we hear more frequently in the present time. What is the meaning of sustainability and what is the connection with dairy industry?
Simply, dairy sustainability is the capability of the dairy industry to be continued for a long term. There are three basic requirements to fulfill to be able to sustain as an industry. As any other industry, if one or more requirements failed to accomplish, dairy industry would not be able to survive. The three basic requirements considered in the dairy sustainability are

1) Economic viability – ability of the dairy industry to make profits in a long run,
2) Social responsibility – ability to satisfy human food need and enhance the quality of life of the farmers and the society, and
3) Environmental friendliness – ability to operate the industry with a minimal negative impact on the environment.

**Dairy industry in the United States**

**History of the dairy industry**
Dairy industry in the United States started around early 1600’s when the migrants from Europe brought cattle to supply their families with
milk and meat. They imported different breeds of cattle such as Holstein, Jersey, Ayrshire, Durham, Guernsey, and Brown Swiss during the following centuries. The dairy cow population and number of dairy farms increased over the time and peaked around 1940’s. The dairy industry before 1940’s was characterized with many but small dairy farms with a few cows.

With the growth of human population of the United States over the time and the urbanization, the land availability for dairy industry declined. As a result, the dairy cow population and number of dairy farms started to decline from 1940’s till now. The dairy industry after 1940’s is characterized with less number of dairy farms with many cows. As the demand for milk grew from the beginning of the dairy industry, the total milk production of the country had to increase continuously up to now. As cows were selected based on their milk production, cows with a greater milk production resulted.

**Achievements of the dairy industry**

The demand for milk increased with the human population growth and urbanization. There was a need to increase milk production and dairy cows were selected and bred for higher milk production. As a result, the genetics of dairy cows improved over the time to produce more milk. Better feeding programs and management practices also helped to improve the productivity of a dairy cow (daily milk production per cow). Average dairy cow produced 11 pounds of milk per day in 1925 compared to 61 pounds of milk produced by an average cow per day in 2015.
Feed efficiency of dairy cows also increased over the time. It was 0.43 in 1925 and 1.20 in 2015. That means a dairy cow in 1900’s produced less milk when they fed a pound of feed compared to a dairy cow in 2015. Total milk production of the country also continuously increased as the productivity of cows improved over the time. As the number of dairy farmers decreased with increased total milk production, the productivity of the dairy farmer increase tremendously. Average dairy farmer in 1925 was responsible for producing 69 pounds of milk per day whereas an average farmer in 2012 was responsible for producing more than 8500 pounds of milk in a day.

**Dairy sustainability**

Dairy industry in the United States not just thrived since its beginning but achieved a tremendous success despite the various challenges posed at different times. Let’s look into how the dairy industry in the United States achieved three requirements to achieve sustainability.

1) Economic viability

   Generally, the price of the feed ingredients are highly variable and price of the milk sold is regulated in the United States, thus pose a greater challenge to maintain a profit margin. However, dairy farmers use strategies such as reduce cost of production, improved efficiency of dairy cows, and selling milk and milk products to other countries to maintain the profit margin.

2) Social responsibility

   The United States dairy industry is capable of producing high quality, nutritious milk and milk products to consumers for an
affordable price. It helps growing the kids and keeping the whole nation healthier.

As an industry, dairy sector provides jobs for thousands of people across the country and help feeding their families. Dairy industry is complex and there are many people involve making it a success. Crop producers, dairy farmers, veterinarians, nutritionists, researchers, dairy product manufactures, and industrialists who make equipment for the dairy industry are some of the jobs that depend on the dairy industry.

3). Environmental friendliness

**Dairy industry and the environment**

The dairy industry in the United States can affect the environment in several ways.

1) Removal of nutrients from soil
Production of pasture, and crops for the dairy cows could remove lots of nutrients from the soil.

2) Emission of greenhouse gasses

Greenhouse gases (GHG) are the gases that trap heat in the atmosphere and contribute to the global warming. There are mainly three gasses, carbon dioxide, methane, and nitrous oxide released during the process of milk production. Carbon dioxide is produced when dairy cows are breathing, respiration of the soil and burning fuel for equipment and for electricity.
Methane is mainly produced as a byproduct when dairy cows digest their feed in the digestive system and released to the environment by belching. Also, methane is produced when the manure from dairy cows are stored in manure lagoons. Nitrous oxide could be emitted by the commercial fertilizer or manure applied to soil.

3) Contamination of ground water, rivers, and reservoirs with nitrogen and phosphorus

The excess of nitrogen and phosphorus applied to the soil with commercial fertilizer and manure could leach down the soil to contaminate the ground water or contaminate the rivers or water reservoirs with runoff water.

The one of the objectives of dairy industry is to produce milk utilizing minimum inputs. The selection of dairy cows for greater milk production, better feeding and management practices have helped to achieve a greater milk production with minimal inputs or improved the efficiency of the nutrient utilization.

Use of feeding practices and use of better manure storage facilities have helped to reduce methane emission from the dairy industry.

**Summary**

The dairy industry of United States started when migrants from Europe brought the cattle in early 1600’s. The tremendous growth of the industry was observed since 1900 due to the selection of dairy cows for greater milk production, better feeding and management practices. Total daily milk production, daily milk production per cow, dairy
efficiency, and farm productivity increased over the time. However, number of dairy farms, total number of dairy cows, decreased over the time. Dairy industry in the United States not just thrived since its beginning but achieved a tremendous success despite the various challenges posed at different times and it is continue to grow with new challenges such as emission of greenhouse gasses from the dairy industry.

3C. Glossary

dairy products  greenhouse gasses  silage  manure
byproducts  environmental  industry  recycling
feed efficiency  nitrous oxide  social  methane
sustainability  carbon dioxide  productivity  economic