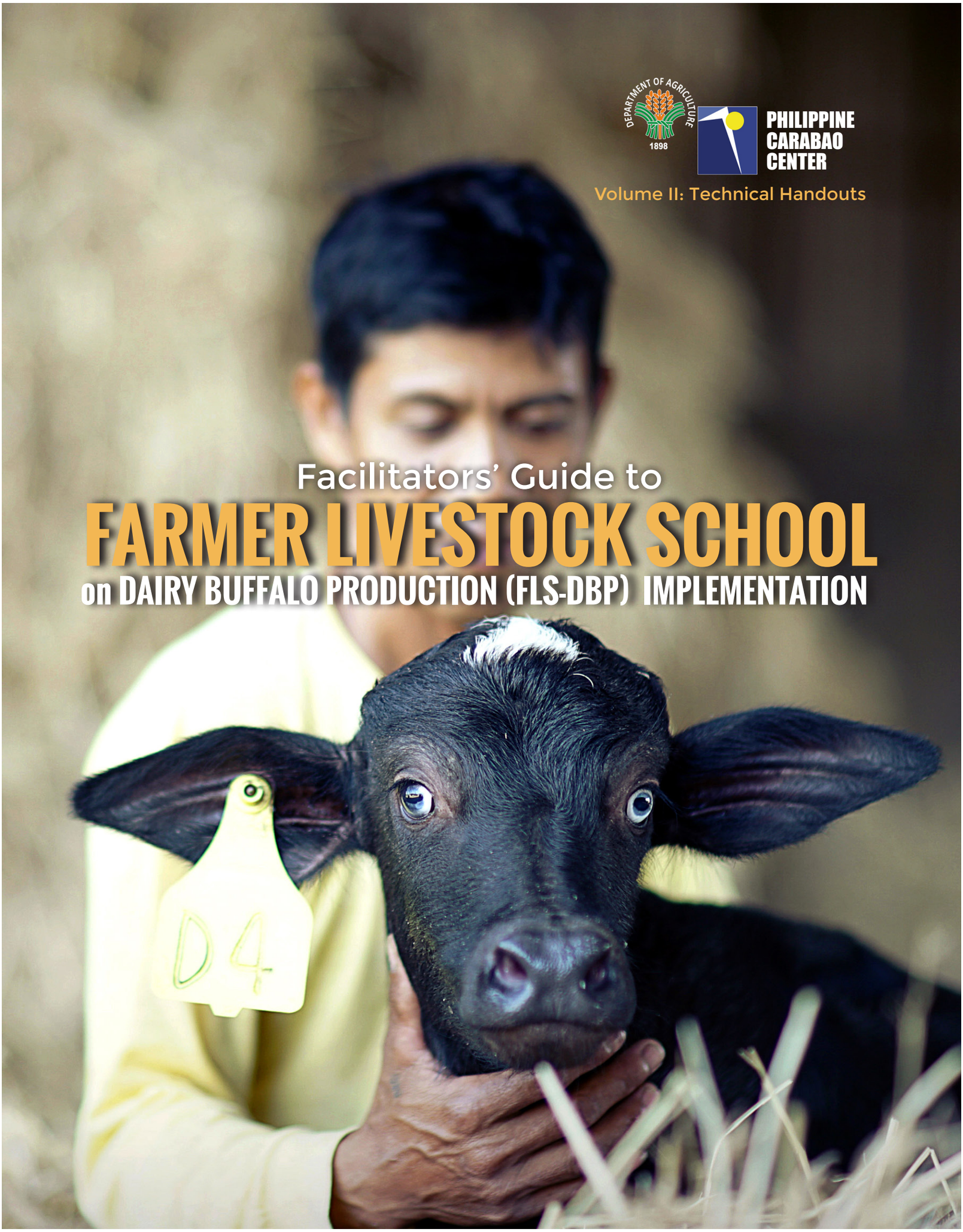

PHILIPPINE CARABAO CENTER

Volume II: Technical Handouts

Facilitators' Guide to

FARMER LIVESTOCK SCHOOL

on DAIRY BUFFALO PRODUCTION (FLS-DBP) IMPLEMENTATION

Produced and packaged by the Knowledge Management Division-Learning Events Coordination Section

EDITOR
Eric P. Palacpac

MANAGING EDITOR
Charlene P. Corpuz

TECHNICAL COMMITTEE
Ms. Mina P. Abella
Dr. Nancy S. Abes
Ms. Anna Marie P. Alo
Dr. Daniel L. Aquino
Ms. Phoebe Lyndia T. Llantada
Dr. Cyril P. Baltazar
Dr. Meriam M. Cabling
Ms. Wilma T. del Rosario
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Dr. Ester B. Flores
Ms. Rovelyn T. Jacang
Mr. Francisco G. Gabunada, Jr.
Dr. Renelyn M. Labindao
Dr. Rosalina S. Lapitan
Dr. Eric P. Palacpac
Ms. Grace Marjorie R. Recta
Dr. Annabelle S. Sarabia
Mr. Erwin M. Valiente

FLS FACILITATORS
Erwin M. Valiente
Rovelyn T. Jacang

PHOTOGRAPHERS
Erwin M. Valiente
Rovelyn T. Jacang
Charlene P. Corpuz

ILLUSTRATIONS AND LAYOUT
Khrizie Evert Marcelo-Padre

EDITORIAL ADVISER
Arnel N. Del Barrio

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Department of Agriculture
PHILIPPINE CARABAO CENTER
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ABOUT US

The Philippine Carabao Center, an attached agency of the Department of Agriculture created by virtue of Republic Act 7307, is mandated to conserve, propagate and promote the carabao as a source of milk, meat, draft power and hide to help achieve better nutrition, higher levels of income and improved general well-being of the rural farming families.

The PCC mandate is pursued through the implementation of the following major services:

- Artificial Insemination
- Bull Loan Program
- Frozen Buffalo Semen Distribution
- Provision of Superior Breeding Animals
- Training of Technicians and Farmers
- Technical and Extension
    - a) Animal Reproduction
    - b) Animal Nutrition
    - c) Animal Health
    - d) Forage Production and Improved Feeding System
    - e) Cooperative Development
    - f) Dairy Production and Processing
- Analysis of milk samples
- Nutrition Laboratory Services
- Biosafety and Environment Laboratory Services
- Information and Library
- Visitors' Assistance
- Marketing Assistance

PREFACE

Farmer Livestock School on Dairy Buffalo Production (FLS-DBP), which started in 2015 as initiated by the Department of Agriculture-Philippine Carabao Center (DA-PCC) in partnership with the Livestock Research Division of Department of Science and Technology-Philippine Council for Agriculture, Aquatic, and Natural Resources Research and Development (DOST-PCAARRD), aims to improve the management of dairy buffaloes in the country by way of technology options for the dairy buffalo farmers.

The FLS-DBP is a modality that lasts for about 34 weeks with bite-sized topics and lessons for farmers. Likewise, it offers a separate intensive capability enhancement platform for facilitators, which lasts for two to three weeks, involving participants from the Local Government Units (LGUs) and Provincial Veterinary Offices (PVOs), farmer-cooperatives, and DA-PCC. It also includes a short exposure trip or immersion in a progressive dairy buffalo farmers' abode and farm.

The first FLS-DBP facilitator's learning workshops happened in Nueva Ecija and Ilocos Norte in 2015 followed by pilot classes of FLS-DBP in Guimba, Talugtog and San Jose in Nueva Ecija and Marcos and Batac in Ilocos Norte from 2016 to 2017. Since then, FLS-DBPs and facilitator's learning workshops were facilitated by PCC in partnership with LGUs and other government agencies.

A team of module developers from DA-PCC worked together to prepare this session guides, which we dedicate to the furtherance of human capital among our farmer-clientele and partner program-implementers.

ARNEL N. DEL BARRIO
Executive Director III

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The Department of Agriculture-Philippine Carabao Center (DA-PCC) expresses its sincerest appreciation to all the contributors, module developers, evaluators, photographers, and reviewers of this facilitators' guide to Farmer Livestock School on Dairy Buffalo Production (FLS-DBP). This instructional material is a compilation of the knowledge, skills and experiences of the agency experts that seek to complement further enhance the knowledge and practices of its farmer-clientele.

With deepest gratitude, the DA-PCC also extends its appreciation to Ms. Ana Marie P. Alo of the Livestock Research Division of DOST-PCAARRD, one of the pioneers of FLS modality in the country, for sharing her expertise in helping develop the FLS-DBP curriculum.

To all those who committed their efforts and resources in preparing this session guide, we dedicate utmost respect and thanksgiving.

FLS-DBP GUIDE COMMITTEE

Ms. Mina P. Abella
Supervising Science Research Specialist
National Headquarters and Gene Pool,
Philippine Carabao Center

Dr. Nancy S. Abes
Project Evaluation Officer III
National Headquarters and Gene Pool,
Philippine Carabao Center

Ms. Anna Marie P. Alo
Supervising Science Research Specialist
Livestock Research Division,
PCAARRD

Dr. Daniel L. Aquino
Agricultural Center Chief IV
Philippine Carabao Center at
Central Luzon State University

Dr. Cyril P. Baltazar
Farm Superintendent
National Headquarters and Gene Pool,
Philippine Carabao Center

Dr. Meriam M. Cabling
Science Research Specialist II
Philippine Carabao Center at
Central Luzon State University

Ms. Wilma T. del Rosario
Senior Science Research Specialist
National Headquarters and Gene Pool,
Philippine Carabao Center

Dr. Peregrino G. Duran
Scientist I
National Headquarters and Gene Pool,
Philippine Carabao Center

Dr. Ester B. Flores
Supervising Science Research Specialist
National Headquarters and Gene Pool,
Philippine Carabao Center

Ms. Rovelyn T. Jacang
Science Research Specialist I
National Headquarters and Gene Pool,
Philippine Carabao Center

Dr. Renelyn M. Labindao
Science Research Specialist II
Philippine Carabao Center at
Central Luzon State University

Dr. Rosalina S. Lapitan
Scientist I
Philippine Carabao Center at University of the
Philippines, Los Baños, Laguna

Ms. Grace R. Recta
Agricultural Center Chief IV
Philippine Carabao Center at
Mariano Marcos State University

Dr. Annabelle S. Sarabia
R&D Division Chief
National Headquarters and Gene Pool,
Philippine Carabao Center

Mr. Erwin M. Valiente
Science Research Specialist I
National Headquarters and Gene Pool,
Philippine Carabao Center

Ms. Phoebe Lyndia T. Llantada
Science Research Specialist II
National Headquarters and Gene Pool,
Philippine Carabao Center

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CONTENTS

Understanding Adult Audiences: First Step in Facilitating Adult Learning Processes in the FLS

(Adapted from the Facilitators' Guide to Farmer Livestock School on Goat Enterprise Management Implementation, PCAARRD 2013)

Anna Marie P. Alo
Supervising Science Research Specialist
Livestock Research Division, PCAARRD

1. What are the characteristics of adult learners that can guide us in the FLS implementation?

a. Adult learners have a self-image of being self-directed; they therefore learn what they want to learn, see what they want to see, and hear what they want to hear.

b. Unlike children, adults define themselves by their experiences. When in a situation where their experiences and achievements are not being recognized, they feel rejected.

c. Adult are always ready to learn not only because they are physically capable, but because they are psychologically mature to make decisions and face up to greater challenges.

d. Because adults have accumulated experiences and have a well-pronounced self-image of autonomy, they tend to view learning as an immediate solution to their problems or a process that will help them improve their ability to cope with present problems.

e. Adult learners remember:

- 10% of what they read
- 20% of what they hear
- 30% of what they see
- 50% of what they hear and see
- 70% of what they say and write
- 90% of what they say as they do the thing

2. What learning principles apply to adult learners?

a. Principle of Association

"Experiences that occur together tend to recur together—like thunder and lightning."
Implications:
Aim at desirable associations and make sure that experiences are happy and positive.

b. Principle of Contrast

"We tend to remember those things that are in sharp contrast to one another."
Implications:
Always present two important situations with significant differences.

c. Principle of Guidance and Feedback

"A learner must be guided in the performance of a desired behavior. He/She must also be given feedback on how he/she performed."
Implications:
Provide opportunities where the learner can demonstrate his/her understanding of the message.

d.Principle of Practice and Repetition

"An activity participated in many times by a learner tends to be remembered easily."
Implications:
Involve learners in all activities if possible and repeat the same lesson through different drills and exercises.

e. Principle of Reward and Reinforcement
"Correct behavior must be rewarded to make learning permanent. Reward may be intrinsic or extrinsic."
Implications:
Give reinforcements in the form of positive comments and certificates, and reinforce as soon as possible.

3. In summary, based on adult characteristics, how should we facilitate participatory learning in the FLS?

- Build on the participants' existing knowledge and experiences (Let learning be experience-based);
- Let participants learn by doing (experiential);
- Offer opportunities for direct application (use-driven);
- Divide learning content into sequential bits of information (cumulative);
- Stimulate multi-sensory capabilities of participants (multi-sensory);
- Approximate the actual environment for application of knowledge (field-based);
- Encourage participants to find answers by discovery (self-discovery);
- Let there be two-way communication (interactive);
- Provide time to digest, synthesize, and assess learning (reflective); and
- Play the role of a facilitator rather than an expert teacher (be facilitative rather than authoritative).

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Facilitating Adult Learning in the FLS: The Necessary Skills

(Adapted from the Facilitators' Guide to Farmer Livestock School on Goat Enterprise Management Implementation, PCAARRD 2013)

Francisco G. Gabunada Jr.
Assistant Professor
Ecological Farm and Resources Management Institute,
Visayas State University
and
Anna Marie P. Alo
Supervising Science Research Specialist
Livestock Research Division, PCAARRD

1. Introduction

- The aim of a farmer livestock school (FLS) is to facilitate participatory adult learning by:

  - Building on participants' existing knowledge and experiences
  - Encouraging participants to find answers by discovery
  - Creating atmosphere for interaction
  - Assuming the role of a facilitator rather than an expert teacher

In any human interaction, there are two basic ingredients, namely content and process. The first, which is often the focus of attention, deals with the subject matter. "Process" deals with what happens between and among the interacting individuals. When this part is not given the needed attention, communication can break down and the task objective may not be met.

- Facilitation can enable people to work together to achieve objectives.

2. What is facilitation?

- It comes from "facilitate", to make easy
- A facilitator is someone who stands neutral while assisting and guiding his/her audience through the use of listening and probing skills and by understanding verbal and non-verbal language, norms, and emotional behaviors.
- Therefore, learning in the FLS is not based on the knowledge of the facilitators or resource persons; rather, learning comes from the whole group's effort of joint analysis, as well as sharing of each member's knowledge. To attain this attitude in the FLS, facilitators will need to be equipped with the following communication skills:

  - Expressing neutrality
  - Listening skills
  - Questioning skills

3. What is neutrality?

- Neutrality is the condition of being impartial or of not being engaged in taking sides or positions (Lambio, 2002).
- In the FLS, the aim is to let the farmers express their feelings, ideas, or opinions without being inhibited by thinking that what they express is wrong.

4. Why is neutrality important when communicating with farmers in the FLS?

- Farmers know their circumstances better than anybody else (including the facilitators).
- Most often, farmers tend to please the facilitators by telling what they think the facilitator wants to hear.
- If the facilitator fails to impart to the farmer that he/she wants to know the farmers' real feelings or opinions, the validity of the succeeding parts of the discussion (especially analyses) will be affected.
- Neutrality boosts a farmer's confidence to do the analysis based on his/her knowledge; without being concerned that the facilitator or other farmers will look down at him or prove that he/she is wrong. This will create an ambiance of open discussion in the FLS, thus, leading to a mode of openness to learn from one another.
- Neutrality is very important in getting the farmers into more active analysis of their situation and not relying on the FLS facilitator. Getting farmers to analyze their situation as well as plan and implement activities to improve is the main aim of FLS.
- Neutrality is critical in getting the farmers to understand that the FLS aims to increase their expertise in making informed decisions by themselves based on their analysis of their situation.

5. How can facilitators practice neutrality?

- Neutrality is expressed in both words and action. Facilitators need to appreciate and be aware of the need to conduct themselves in a manner that conveys value and respect for farmers' ideas. To some, this can come naturally; to others, this will require a change in attitude. This change in attitude comes only after the facilitator is aware and appreciates the need for neutrality.
- Below are some tips on ensuring neutrality. Facilitators must remember to:
- Pose questions in such a manner that the farmers will understand that their points of view (whether positive or negative) are being sought. In some cases, introductory statements posing alternative opinions may be needed.
- Example: "I've had several interesting discussions with local farmers about using raincoats for buffaloes in the rainy season. Some say this is good; others say there are other better ways of managing the buffaloes. What do you think?"
- Ask open questions instead of questions answerable only by yes or no; or leading questions (questions loaded with possible answers), which may condition their answers.
- Listen carefully to the answer of the farmer and endeavor to clarify and expound it by asking questions to probe deeper into his/her answers (asking for reasons why he/she takes such opinions).
- Encourage farmers to speak; do not interrupt them as they speak unless it is to clarify their points.
- Give information as needed, but do not recommend or impose opinion – as much as possible, these information should come in the form of basic principles (answers to "why"); not packages (answers to "what" or "how"). These principles will help lead farmers to appreciate the need for being analytical and reflective of their situation.

6. How will facilitators state their questions in a neutral way?

- Leading questions must be avoided at all times for they condition the farmers to say only what the development workers want to hear.

  "This type of feed is not suitable for your carabao, is it?"

- To transform this question into neutral statements, it can be stated as:
  "What do you think of this type of feed? Then follow-up with: "Why do you think so?"
- Another type of leading question is one that is loaded with options for answers. If this cannot be avoided, present the question in such a way that the farmer still has an option, which will express his/her own response.

  Wrong: "Which do you think is the best forage for buffalo, napier or kakawate?"
  Better: "Which forage do you think is best for your buffalo?" Then follow up with, "Why?"

7. What is the importance of active listening in the FLS?

- To build on farmers' existing knowledge and experiences, FLS facilitators should not only ask the right questions; they should also be able to understand the farmers' answers. This can only be gained through active listening.
- Listening should be used to understand what the speaker is saying. More often, this is not attained because of the tendency of listeners to succumb to common blocks. Often, these blocks do not lead to understanding the message; rather this leads to manipulation of information towards that is desired by the listener (Covey, 1996).
- With effective listening skills, development workers will be able to understand clearly the needs and opinions of farmers. This will likewise help them build with the farmers a better relationship based on trust.
- The following are the common blocks, which listeners should avoid:

  (1) Comparing – listener always tries to assess who is smarter, more competent, more emotionally healthy, or who's a bigger victim.

  (2) Mind reading – paying less attention to words than to intonations and subtle cues in an effort to see the truth. Listener tries to rely on intuition, hunches, and vague misgivings.

  (3) Rehearsing – the whole attention of the listener is on preparing and crafting the next comment rather than on what the speaker is actually saying.

  (4) Filtering – listening to some things but not to others, especially if it appears threatening, negative, critical, or unpleasant.

  (5) Judging – prejudging the speaker when he/she does not fall within the listener's standard of approval; as a result, he/she closes the mind or simply ceases to listen.

  (6) Dreaming – half-listening to something the speaker says suddenly triggers a chain of memories that causes the listener to shift the focus on what he/she had experienced rather than what the speaker is saying.

  (7) Identifying – the listener takes everything the speaker says, and then refers it back to his/her (listener's) own experience. The listener then launches to his/her own story before the speaker can finish.

  (8) Advising – listener acts as a problem-solver, ready with help and suggestions. However, the listener is so focused on giving immediate advice that he/she fails to acknowledge the needs and feelings of the speaker.

  (9) Sparring – listener argues and debates with the speaker. The speaker never feels heard because the speaker is so quick to disagree.

  (10) Being right – listener goes to any length (twist the facts, start shouting, make excuses or accusations, recall past sins) to avoid being wrong.

  (11) Derailing – listener derails topic when he/she gets bored or uncomfortable with the topic. This is accomplished by suddenly changing the topic or by joking it off.

  (12) Placating – listener wants people to like him/her by agreeing with everything the speaker says. Listener may half listen, just enough to get a drift, but is not really involved.

8. How does one listen effectively?

- Covey (1996) describes the result of succumbing to these obstacles to listening as autobiographical response. When people listen, they tend to filter what they hear through their own experiences. People tend to translate other's words and feelings according to their own opinions and experiences. He mentioned four main autobiographical responses, as follow:

  (1) We tend to **evaluate** the statements of others by agreeing or disagreeing with them. This can be expressed verbally or non-verbally. However, we tend to evaluate through our own experiences and not really based on the present moment or the reality of the person we are speaking to.

  (2) We also tend to **probe.** This appears to be a tool to seek to understand but the questions that we usually ask may come from experiences, not from the present moment. This is then used to lead the conversation towards the things that matters to us because of our experiences.

  (3) Even if not asked, most of us have the tendency to **advice**. When we give advice, we generally mean well but they come from our biases.

  (4) We also tend to **interpret** the statements of others. When we interpret, we explain their behavior in terms of our motives. The danger of interpreting is that we may make others feel manipulated, insulted, and psychoanalyzed.

- These autobiographical responses are not wrong per se. They can be helpful as long as we have a clear understanding of the situation. In other words, we have to diagnose or try to understand the situation first.

- Diagnosing to completely understand others would require the highest form of listening, which is called **emphatic** listening. It is listening not only with your ears, but also with your eyes and hearts. It is getting into the frame of mind of the other person by listening beyond words but more of feelings, meanings, and behavior.

9. How do you develop emphatic listening?

Developing the skill of emphatic listening progresses through five stages (Covey, 1996):

- Mimic content – repeat what is said (words only, not feelings), not probing, or evaluating or interpreting; just repeating some words that were said to indicate to the other person that you are paying attention.

- Rephrase content – put the other person's meaning into your own words.

- Reflect feeling – capture the feelings of the other person; you reflect whether the person is upset, disoriented, angry, etc.

- Reflect content and feeling – express both the words and the feelings.

- Learn when not to reflect - discern if reflection is necessary or silence or just a hug is what is needed while listening.

10. Use of questions to stimulate discovery-based learning: Learning to answer questions with other questions (based mostly from FAO, 2001)

- Discovery-based learning aims to provide an enlightened educational opportunity for participants.

- The idea is to promote learning by discovery and to lead a person towards his or her own analysis. Most of the time, people know the answer of their question; they just need to be guided to it.

- The method involves getting the facilitator to answer the question with another question.

  Example : For most people, the natural response to the question, “What is this?” is, “This/That is a _____.” The result of this answer is that the education process has been stopped.

  A better way to answer the question is to answer it with another question: Where did you find it? What was it doing? Were there many of them? Have you seen this before?

- In applying this method, it is important to use only open questions. These questions do not suggest an answer.

  Examples of Open Questions that stimulate farmers’ ideas:

  - Can you tell me more about this?
  - What would be an example of that?
  - What makes you see it that way?
  - What are some reasons for that?
  - Could you help me understand this better?
  - Have you any other ideas about this?
  - How do you feel about that?
  - How do you think other farmers would feel about this?
  - How would you describe this?
  - Why is that important?
  - Do you see any advantages or disadvantages to this (referring to an observation made by the farmer)?
  - How do you think this compares with your current practice?

- Probing must also be used to follow-up and clarify the answers of the farmers. Probing is a technique aimed to gain more insights or details into what the farmer says (“probing” means “to dig deeper”).

  Examples of Probes:

  - Restate what the farmer just said: “so, this breed of buffalo is not very much affected by parasites . . .”
  - Repeat the remark that has just been said in the form of a question. Doing this invites the farmer to expand on this particular theme: “This breed resists parasites?”
  - Ask the farmer to clarify: “Could you tell me more about this?”
  - Summarize in your own words what you understand the farmer has said, and ask: “Do I understand correctly?”
  - Remain silent (5-second pause) keeping eye contact. This encourages the farmer to keep talking.
  - Encouraging the farmer to continue by making affirmative sound, like: “Yes, I see”, or “Right”, or “Uh-huh”.

  Example Dialog 1:

  Farmer: What is this?
  Technician: Where did you get it?
  F: From my neighbor’s feed garden.
  T: How was it being used?
  F: Chopped and fed to buffaloes.
  T: How much of it was fed to animals?
  F: It was being fed in small quantities, added to the Napier grass.
  T: What is its effect on their buffaloes?
  F: My neighbors said their animals grew better even in the dry season. Moreover, the calves seldom get sick or die.
  T: Did your neighbor plant it on his/her farm or did the plant just grow by itself?
  F: He/She planted it.
  T: Have you seen a similar plant in your farm?
  F: It looks like desmodium but with bigger leaves.

T: This is called Arachis pintoi. This forage is high in protein, is easily digested and grows well even in the dry season. Thus, it helps animals grow better.
F: So, is it good for carabao?
T: Are you going to plant it?
F: If I get the planting materials.
T: Where are you going to get it from?
F: I will try to borrow from my neighbor.
T: Thank you, I will visit you next time.
F: Thank you very much for your visit and assistance. Hope for your next visit.

Example 2:

F: What is this?
T: Looks like an insect.
F: Is it a bad insect?
T: Yes, and even more so if they are many. Where did you find it?
F: On the ear of my carabao.
T: Do you see them throughout the year?
F: No, only in the wet season
T: What are they doing?
F: They were many and some were swollen.
T: What do they eat?
F: They suck blood.
T: Is your buffalo all right?
F: It is ok, but sometimes when there are many insects, some of my animals get sick.
T: Can they be removed easily?
F: Not really, but we don't know of anything else to do, so we pick them out by hand.
T: When did you last do it?
F: A month ago
T: Did you see other insects like that on you buffalo?
F: I looked only in the ears.

The technician could check the buffalo with the farmer and show other ticks hidden in other part of the body.

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Taking Cue from Adults' Non-Verbal Gestures

Anna Marie P. Alo
Supervising Science Research Specialist
Livestock Research Division, PCAARRD

1. What are messages and how are messages conveyed?

- Behavioral events related to the internal status of people intended to produce effects
- Set of symbols, which have the same meaning for the source and the receiver of the message, expressed by using codes.
- Composed of verbal and non-verbal (NV) exchanges.

2. What is NV communication?

- It is the transmission of messages by means of visible codes and bodily actions that are bound to the situation.
- To understand the correct meaning of NV language, codes must be read as clusters not as individual cues.
- To Sigmund Freud, it is the reaction of the unconscious of one human being upon that of another without passing through the conscious state (e.g., when we subconsciously conceive some unfriendly gesture, we react with some hostility without conscious control).
- Observing and becoming aware of gestures is simple; but interpreting them is something else (Nierenberg and Calero, 1973).
- NV feedback can warn us that we must change, withdraw or do something different to bring about the results we desire.

3. What are some of the categories of NV cues?

a. Physical appearance and artifacts

- The use of clothing, ornaments or adornments, hairstyles, cosmetics, and automobiles hold communicative value that expresses age, gender, status, role, socioeconomic class, group membership, and personality.
- The face is the most powerful channel of all messages—we encode messages in our facial expressions and decode the faces of people around us.
- One's wardrobe—one of the most influential artifacts.

b. Proxemics—people's use of space

- Public space—12-25 ft.
- Social space—4-10 ft. communication among business associates, strangers; the higher the status, the greater the distance.
- Personal space—2-4 ft. for friends and family members; used for most conversations.
- Intimate space--<2ft for whispering, embracing, with high probability of touching.

c. Vocalics—NV aspects of the voice; sounds that have no meaning, but can indicate emotions

- Vocal characterizers—indicate if individual has a cold, is tired (i.e., thru heavy and deep breathing), sleepy (yawning), nervous, or bored.
- Vocal segregates—interjections such as "um", "uh", "ah-ah", that signal the source to stop, pause, or continue.
- Voice qualifiers—extremely high pitch or slow speech (to show anger or calmness)

d. Kinesics—body movements and gestures

- Emblems--gestures with one-to-one correspondence to verbal codes (e.g., waving of hands to greet; pointing of finger; or shoving of lips to show direction)
- Illustrators—primarily hand and arm movements to accent speech (e.g., use of finger to show how small an object is or arms to show length and width)
- Regulators—maintains conversational coherence (e.g., head nods, eye contact)
- Adaptors—unintentional NV displays, often in response to some source of emotional discomfort (e.g., head scratching, clenching of fist, nail biting)
- Affect displays—NV presentations of emotion, communicated through facial expressions

4. Understanding some kinesic materials

Situation:

Suppose you find yourself listening to a farmer who suddenly starts to speak with one hand partly covering his mouth, would you consider him lying? Unsure? Doubting? Distorting the truth?

Understanding the gesture:

He/She may possibly be expressing any of the above. But before jumping to a conclusion, recall if that person has previously spoken in that manner. Analyze the circumstances. He/She may have had a recent dental work out that may cause him/her to be self-conscious when talking, or that someone had told him/her he/she has bad breath. If he/she really has a track record of covering his/her mouth while speaking, test him/her. Ask him/her if he/she is sure of what he/she said. Such question may be answered by a simple yes. It can also make him/her defensive, making you know that he/she is unsure of himself/herself. Gesture analysts recommend that we should always consider gestures in context. Experience, alternative verification, and congruency with verbal message are important ingredients in understanding gestures.

5. Some positive gestures and their general meaning

5.1. Open and ready

- Sitting at the edge of a chair, with one hand in mid-thigh and leaning slightly forward;
- Open hands--signals sincerity and truthfulness and a welcoming desire;
- Hands-on-hips (standing) with feet apart—shows not only readiness to take part but also desire to achieve goal;
- Hitching up of trousers;
- Uncrossing of legs (when seated) or relaxing folded arms (when standing) and focusing on speaker.

5.2. Interested

- The THINKER pose—body forward, head slightly tilted and supported by one hand in cheek;
- “I’m available” look—eye contact maintained 60% of the time with constant winking or flickering of the eye.

5.3. Pensive and pausing-for-thought

- Removing glasses and cleaning of lenses even if they do not need cleaning—signals procrastination;
- Removing glasses and putting earpiece in mouth—implies gaining time to evaluate;
- Pinching bridge of nose accompanied by closed eyes—communicates great thought and concern about decision being made;
- Let me consider” look -- Eyes looking at speaker for several seconds with a one-sided smile, which may become cynical;

- Cynical pose—hand on face, chin in palm with index finger along cheek, remaining fingers below mouth;
- Preoccupied walk—head down, hands clasp behind back, walking pace is slow and may kick a stone or two;
- Pacing—walking back and forth and contemplating on a difficult decision (Don't talk to a pacer so as not to interrupt his/her thought process).

6. Some negative gestures and their meaning

a. Uninterested, displeased, and antagonistic

- "I'm not interested" look—eyes downcast, face turned away;
- Tightened jaw muscles, eyes squinted, lips pursed;
- Walks with hands in pockets while looking down (also dejected or secretive).

b. Rejecting, defensive, disagreeing, or holding back

- Folded arms and/or crossed legs;
- Nose-or eye-rubbing (also sign of negation or doubt).

c. Frustrated

- Running fingers through hair, rubbing back of neck;
- Short spurts of breaths similar to snorting;
- Tsk sound.

d. Bored

- Crossed legs with foot in constant kicking motion;
- Tapping of the fingers;
- Turning body to the exit;
- Arranging things and keeping table neat to go.

e. Insecure

- Nail, pencil, paperclip biting gestures;
- Cuticle pinching (also a sign of nervousness);
- Hand touching the throat (for women: a sign also of uncertainty);
- Self-pinching.

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Village Characterization Using Storymaps and Graphical Calendars

Anna Marie P. Alo
Supervising Science Research Specialist
Livestock Research Division, PCAARRD

Using storymaps for FLS

- Maps in the FLS are generally used to know WHAT is present and available in a village or farm.
- As a general procedure, walk with the farmers not just to have an ocular view of the area but more so to understand relationships of farm components, talk about their problems, and concerns of the other villagers.
- After the walk, sit down with the key informants or people who have been in the village for a long time, and ask them to draw the map by using brown paper and pen.
- Some of the mapping tools for participatory diagnosis and evaluation are the following:

(1) Community map---this shows the boundaries of a community as well as important physical characteristics such as landmarks, markets, roads, and water systems. It is primarily used to locate households and farms of buffalo raisers, especially those participating in the FLS. At the end of the school, it can be used again to know the location of additional buffalo farms that were established because of the FLS.

Let the farmers draw the spot where you are currently located. Then let them add other elements, based on need. The following are some elements that you may require:

= Roads and other infrastructures
= Farms of each of the buffalo raisers
= Landforms, such as mountains, hills, valleys
= Bodies of water like rivers, streams, creek, falls, coast lines
= Pasture areas, whether privately-owned or communal
= Crops planted

(2) Transect map—this is a cross-section of a community. It is used to compare spatial relationships of the various community resources, cropping patterns, community services, and problems of the major land use zones.

Let the farmers who went on a walk divide the brown paper into distinct geographical areas, such as coastal, lowland, upland, or into specific land use such as grazing area, crop lands, homestead, etc. Under each column, let them write the indicators for comparing each area. These may include:

= use of area
= vegetation growing (include food, feed, and useless plants)
= livestock raised
= constraints

Then let them compare each area by using the indicators set.

(3) Resource flow/farming system maps---this shows the input-output flows of the different resources and subsystems within the farm (e.g., crop and animals) or outside the farm (marketing, external inputs).

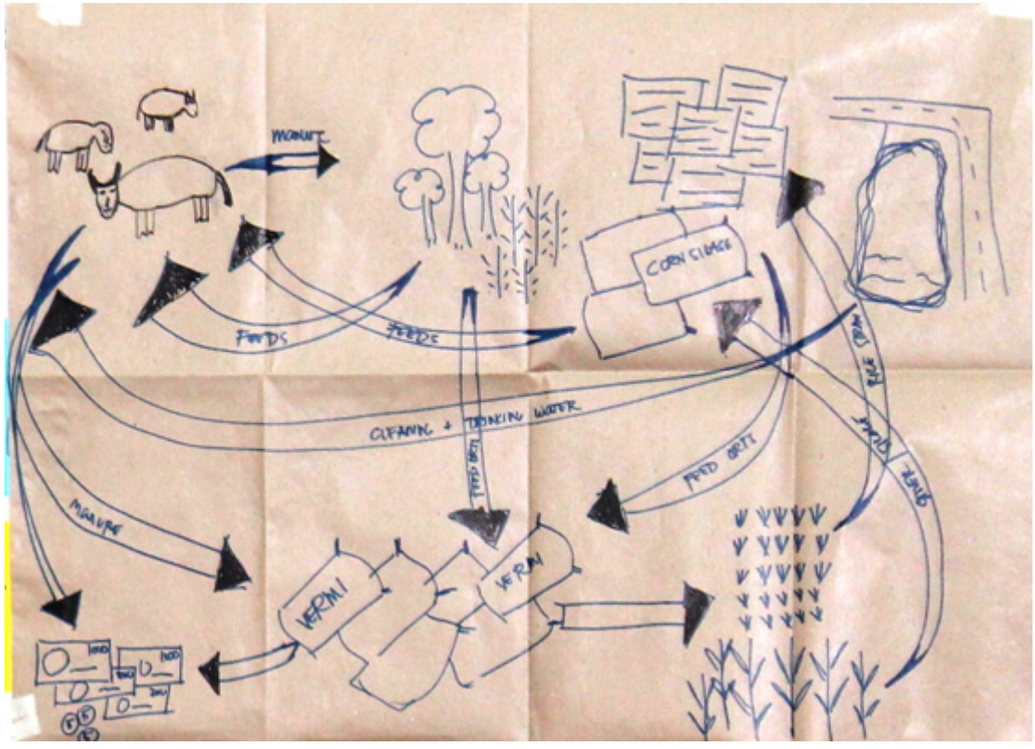
Facilitating the production of this map requires that you know all the resources available in a farm, such as the different livestock species raised aside from buffalo, the different crops planted and all their by-products. Once these have been identified, instruct the farmers to draw these elements and show their relationships by using forward and backward arrows. This will the give a picture of what each element gives to the other and vice-versa.

(4) Farm layout/sketch - a flat representation of a farm meant to specify location of farm components e.g., the various crops planted, livestock raised, fishery resources in relation to homestead, and other farm facilities. Preparation of this is similar to a community map, except that this is smaller, as it pictures only a specific farm.

Sample maps

Community map drawn by participants during the conduct of FLS-DBP, May 2017.

Transect map drawn by the participants during the conduct of FLS-DBP, May 2017.



Bio-resource flow map made by participants during the conduct of FLS-DBP, September 2017.

Sketch made by the participants during the conduct of FLS-DBP, May 2017.

Characterization Using Graphical Calendars

- Calendars are generally used to know WHEN activities are being done in a village
- Some of the calendars crucial to the FLS are:

  (1) Rainfall calendar---shows rainfall pattern in a year in an area that can be used to plot the start, peak, and end of rainy months

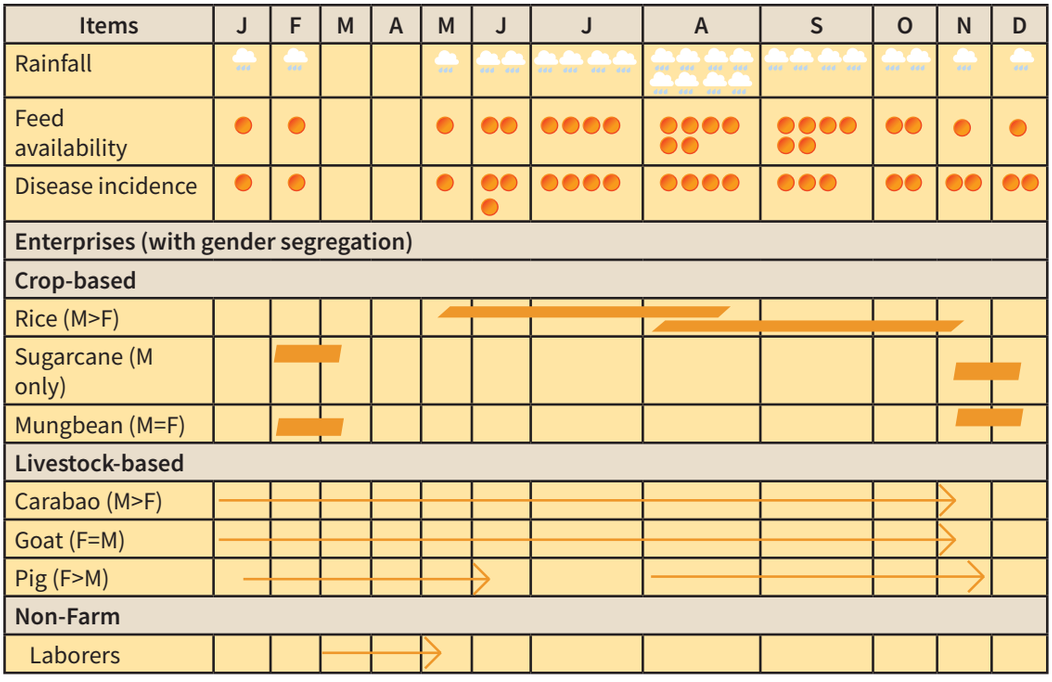
  (2) Feed availability---this shows what feed resources are abundant and when utilized.

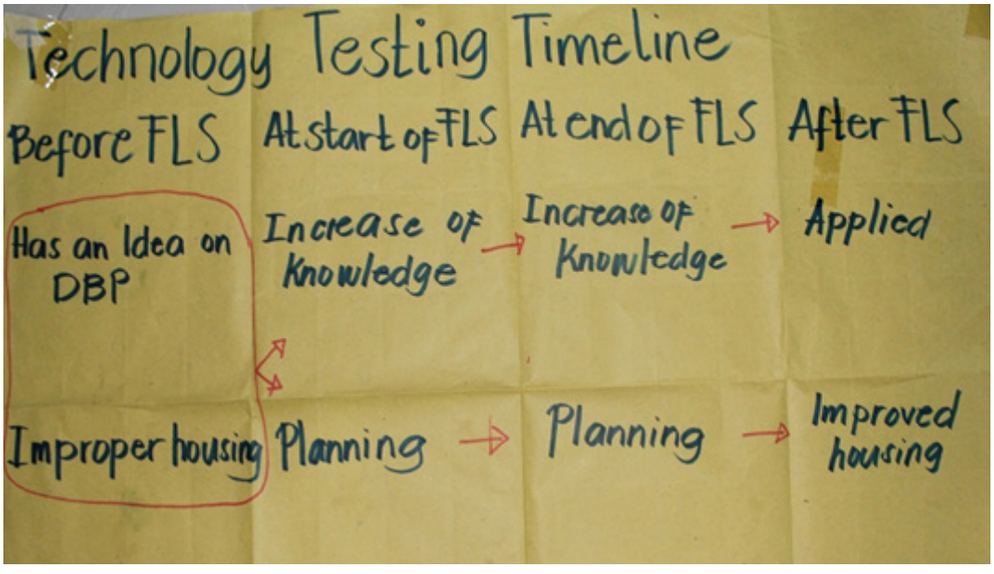
  (3) Disease incidence---shows the prevalence of disease incidence in a year.

  (4) Enterprise calendar---vis-à-vis rainfall calendar, this determines timeliness of activities associated with cultivation of crops and other farm enterprises.

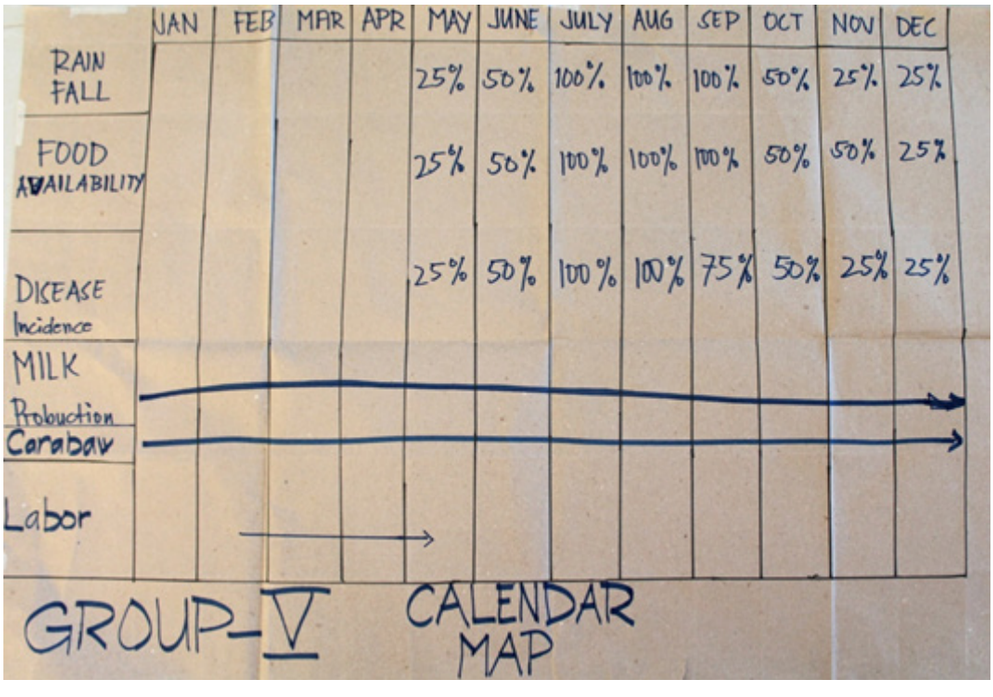
  (5) Time/trend lines---shows farming system changes over time. In the FLS, this is used to show changes in technologies tested over time and reasons for such shifts.

- In making rainfall, feed availability, and disease incidence calendars, the weighting technique may be employed. This is a system, whereby a specific number of counters (e.g., stones, sticks, or seeds) are distributed among the months of the year. The greatest number of counters is placed on the month when rain, feed availability, or diseases are greatest, and the rest of the counters are distributed accordingly to the rest of the year.
- For enterprise calendars, trapezoid marks may be used instead of plain arrows, to signify the range of possible start and end of each activity. For instance, in mungbean production, planting may start from November to middle of December. Hence, your trapezoid would start in the November column and halfway to the December column.
- It is sometimes necessary to add labor distribution among genders, hence, use F and M to symbolize females and males, respectively, and =, > and < to refer to who does more of said activity.
- The above graphical calendars are used in the examples below.





Technology-testing timeline
prepared by the participants during
the conduct of FLS-DBP, May 2017



Rainfall-feeds-disease-milk
calendar prepared by training
participants during the conduct of
FLS-DBP, May 2017.

Sorting Out Farm Problems Using Problem Trees

(Adapted from the Facilitators' Guide to Farmer Livestock School on Goat Enterprise Management Implementation, PCAARRD 2013)

Anna Marie P. Alo
Supervising Science Research Specialist
Livestock Research Division, PCAARRD

- A problem tree in the FLS is visual representation of causes and effects of buffalo-related problems in the communities. With it, you can trace the root cause(s) of a symptom and make an inventory of perceived solutions vis-à-vis the problems experienced.
- It serves as a springboard for introducing possible interventions that address the identified problems.
- Problem assessment tools come in many forms but for the FLS, the Effect-Core Problem-Cause type of tree is suggested. This may be more difficult to do than a normal cause-effect matrix, but it vividly pinpoints areas or aspects that technological interventions can address.
- Another problem assessment tool used in the FLS is the problem-topic matrix, but this is done during curriculum setting, as it is most appropriate when planning capability-building exercises such as training courses.
- General procedure in doing problem trees:

  (1) Give participants cards and pens. Ask them to list down as many problems as they have experienced in raising buffalos. Let them write one problem per card.

  (2) Paste all cards on the board or wall without sorting them.

  (3) Let whoever wrote the problem explain the card. Do this until all cards have been explained. Group cards having the same meaning.

  (4) Let the participants internalize all these problems before asking, which of these problems do you think is the most important of all? There may be two to three responses, but let them discuss among themselves to narrow down the choices. Once there is just one or two, get set on doing the cause-effect analysis.

  (5) Clear the board by putting all cards at the sides. Put the identified major problem at the center and label it CORE PROBLEM.

  (6) Work your way down to the causes, by asking why is this a problem? What caused it? Let the participants get answers from the cards posted at the sides.

  (7) For every "cause" of the main problem, ask again, what caused it? Do this for all the cards that will be identified until you are able to make a causal matrix of the CAUSES of your main problem.

  (8) When all the cards that show "causes" have been consumed, work your way up to the effects of the core problem. This time ask the participants, what was the effect of this problem? Ask this question for all the "effect" cards.

  (9) The point is to arrange all these "problem" cards in such a way that the core problem is at the center, the causes at the bottom, and the effects, at the top. Link them with arrows.

To turn this problem tree into a solution tree, ask the participants to translate the problems (negative statements) into desired improvements (positive statements) and write them in cards as well. Arrange these solution cards like the problem tree. The result is an objective tree, which not only shows how solutions to the problems are also linked to one another, but also vividly points to what participants can aim and plan for.

Analyzing problems on dairy buffalo production using the Problem Tree, participants from PCC, September 2014

Understanding the FLS-DBP

Anna Marie P. Alo
Supervising Science Research Specialist
Livestock Research Division, PCAARRD

1. What is the FLS-DBP?

- FLS-DBP stands for Farmer Livestock School on Dairy Buffalo Production
- It is a 34-week tech-transfer modality that tackles not just the technologies on raising dairy buffaloes but also on building profitable enterprises out of it.
- It was designed for adult learners hence it is highly participatory, holistic, and experiential in approach.
- It takes off from the FLS framework developed by Anna Marie P. Alo of PCAAARRD-DOST for goat enterprise management, which employs conscientization activities, group dynamics, participatory technology development, and participatory evaluation.
- In essence, it works on a capacity-building environment, where farmers' needs and capacities are addressed and where farmers' experiences are weaved into new knowledge to come up with workable production options.

2. What composes the curriculum of FLS-DBP?

- There are two parts to the FLS-DBP. Part 1, which is a prerequisite course for facilitators is titled, Preparing Facilitators for FLS Implementation. It revolves around understanding adults. Lessons under this course dissect the adult audience and lay down guides in facilitating learning processes for them.
- Part 2 is composed of 5 courses. Course 1 is on mobilizing communities for the FLS. Here, participants are made aware of the whats, hows, wheres and whos of the FLS-DBP, and introduces ways of helping farmers understand their realities. It is also in this course where the audience is given a picture of the potentials of dairy buffalo production.
- Course 2, which is on raising healthy and productive buffaloes, is the heart of the FLS-DBP. Here technological options to improve the productivity of buffaloes are discussed. Topics include forage and feed production, feeding, health management, breeding, record keeping, milk production and quality assurance, and meat production from surplus males.
- Course 3 is on building enterprises. It gives meaning and value to improvements in productivity as it discusses the computations of the financial gains from each enterprise.
- Course 4 deals with participatory technology development. Here, the technology options per basket (i.e., breeding, feeding, milking, and enterprise building) are summarized and offered to farmers for testing. This enables them to see which options befit their situations and which options, through their own experimentations, could generate the optimum results.
- Course 5 tackles participatory evaluation. To get a collective assessment of the effects of the processes and technologies on the farming households and their communities, this course will teach participants the use of participatory evaluation tools.

3. How different is this approach from the common training course?

- FLS is an innovative scheme that relies heavily on participatory training methods to convey knowledge to participants, making them confident buffalo experts, self-teaching experimenters, and effective trainers of other farmers after the season-long learning experience.

- Unlike the traditional training course that is usually held in classroom settings, this FLS is field-based. This means that activities are done right in the farmers' own farms and data are gathered and analyzed by using their own animals and situations. It is also season-long, unlike the usual training that only lasts for a few days.
- FLS considers farmers as co-experts, giving the facilitators, the backseat role. After weeks of technical sessions, farmers are then given the chance to choose any or a mix of options to address existing farm problems and given 8 weeks to test these technology mixes in their own farms using their own animals. With this approach, they are able to analyze the differences between their traditional and the new practices, and allowed to redesign the technology to adapt to their situations. After 8 months therefore, they become better at raising buffaloes.
- Evaluation in the FLS is highly participatory. Assessments are done regularly, involving all farmers in the exercise. This enables the exchange of factual, group-validated data without bias.
- Learning materials used in the FLS are farmer-generated. This means that farmers learn from the community maps, problem trees, and timelines that they draw. As these materials are drawn by using their experiences and new learning, these then become conscientization materials or a means to make farmers see their realities.
- FLS also employs co-sharing of resources with the farmers. Specifically, farmers' equity includes time and cash for animal corral construction and purchase of needed biologics, where necessary. Snacks during weekly sessions are also shared by the farmers.

4. How did the FLS start?

- FLS started in 2001 as FLS on Integrated Goat Management (FLS-IGM), a scaling up approach of a project of the Philippine Council for Agriculture, Aquatic and Natural Resources and Development (PCAARRD), known as TAG 443 Development and Testing of an Integrated Approach to the Control of Gastrointestinal Parasites of Goats in South and Southeast Asia. It was the first farmer field school in the Philippines that revolved around integrated livestock management. It was so successful that soon after the Trainers' Training in 2004, many local government units implemented it using their own funds. It was upgraded to FLS on Goat Enterprise Management in 2013.
- Seeing the gains that that FLS-IGM and FLS-GEM have reaped, the Federation of Goat and Sheep Producers and Associations of the Philippines, Inc. (FGASPAPI) embraced it as their National Training Modality in 2014.
- Since the FLS-GEM was seen as a good modality to generate exponential growth in the number of technology adopters in the countryside, it is, thus, being adopted by the Philippine Carabao Center (PCC) as its platform for delivering technological options to dairy buffalo production.

5. What refinements will the FLS-DBP undergo?

- Curriculum development. The technology options on DBP were repackaged into experience-oriented courses from September 2014 to August 2015. Session guides and technical handouts were prepared and team-building games, incorporated. At every step of curriculum development up to piloting and evaluation, PCC was assisted by the FLS developer herself, Ms. Alo.
- Learning Workshop. With the indicative curriculum completed, it was then used to train a test batch of trainers during a 12-day Learning Workshop held on September 14-25, 2015 at the PCC headquarters in Nueva Ecija. This test batch of facilitators was composed of 15 selected LGU partners and progressive farmers from Marcos, Ilocos Norte and Guimba and Talugtug, Nueva Ecija. This Learning Workshop was used not only to equip the pilot set of trainers with the necessary competence in implementing the FLS-DBP with farmers but also to test the functionality of the curriculum. Five months after the 12-day Learning Workshop and prior to the launching of the farm-based FLS, the strategies of delivering each lesson were assessed by the participants themselves, who will eventually be the trainers. Sessions were polished by the module developers and revisions were re-presented to the learners on April 28-29, 2016. After which, participants were made to demonstrate before the developers how they would teach specific lessons.

- First piloting. Armed with the trained facilitators, the FLS-DBP was pilot-tested in three municipalities, namely, Marcos, Ilocos Norte, Guimba, Nueva Ecija and Talugtug, Nueva Ecija in 2016. Each of these sites initially identified 25 participants to be their test audience. Recording was required from the FLS enrollees to monitor the status and effects of the FLS on the farmers and facilitators. Likewise, the project team conducted regular in-course visits to the site and dialogues with the participants and the facilitators to address emerging problems not anticipated during module development.
- Module and curriculum revision. After one cycle, which will run for 34 weeks, the curriculum will be adjusted based on the results of the piloting and a second and third pilot-test will be made before full scale implementation of the FLS is made in all regions.
- Impact assessment. Assessments of impacts of the FLS will be commissioned after three years and revisions to the modality will be incorporated, as needed.

6. How does the curriculum look like?

Table 1. Schedule of activities

WK.	SEASON 1	FLS ACTIVITY (FA)/ FLS LESSON (FL)	TAKE HOME ACTIVITIES	THINGS TO PREPARE
Prelim 1	Start of Summer/ March	Orientation meeting at LGU-Municipal Agriculture Office of the chosen municipality; Discussion about: • Project in the community • Potentials of dairy buffalo production • What FLS is all about • Criteria to be used in choosing participants		Appointment with Municipal Agriculturist
Prelim 2	March	Orientation meeting with Mayor; discussion of: • Potentials of dairy buffalo production • What FLS is all about • Roles of each of the stakeholders • Timetable for the implementation of FLS-DBP		Appointment with mayor Request for presence of MAO and AT before Mayor
Prelim 3	March	Orientation meeting with barangay officials (BO) from participating municipalities Profiling of DB farmers Selection of farmer-participants based on criteria Meeting with selected farmers Soil analysis per municipality		Appointment with BO Request for presence of MAO and AT before BOs Letter to the MAO regarding the profiling Request for meeting with selected farmers
Prelim 4	March	Signing of commitments Discussion of preparations for the launching/ opening of the FLS-DBP		Memorandum of Undertaking or Understanding or Statement of Commitments

WK.	SEASON 1	FLS ACTIVITY (FA)/ FLS LESSON (FL)	TAKE HOME ACTIVITIES	THINGS TO PREPARE
1	Summer/ April	• AM Opening ceremonies • Opening Messages • Getting-to-know-you sessions • Surfacing of expectations • Generation of house rules • Team-building games • Fellowship lunch • PM Helping farmers understand their realities • FA 1: Village characterizations thru storymaps and calendars • FA 2: Sorting out farm problems using problem trees • FA 3: Pretesting		Invitation to local executives and other honorees Fund for opening ceremonies Supplies and materials for all the games and problem diagnosis Preliminary ocular visit to the sites to be included in the transect walk Questionnaires for pretesting
2	April	• FL 1: Understanding FLS-DBP • FL 2: Understanding the potentials of dairy buffalo production • FA: Giving of reminders about next week's field trip; distribution of Learning Journal and discussion of how to use it	None	Game materials: • Paper plates • Pens • Mood setting Text for game, "Winning in the Lotto" • Things-to – remember-in-livestock-raising matrix in brown paper Letter to PCC re: 1st exposure trip Learning Journal (for each pax)
3	April	FA: 1st EXPOSURE TRIP to PCC Gene Pool to observe: • Feeding • Housing • Waste management FA: Reminders to pax to bring plants eaten by carabao next meeting	Planting in individual farms of grass cuttings from PCC trip	
4	April	FL 3: Feed resources for buffaloes FA: Discussion of results of soil analysis FL 4: Establishing improved grass/legumes for buffalo farming	Land preparation for forage area Planting of forages	Specimen of forages, concentrates and crop residues Cartolina/brown papers/ pens, scissors and box Prize for 5

WK.	SEASON 1	FLS ACTIVITY (FA)/ FLS LESSON (FL)	TAKE HOME ACTIVITIES	THINGS TO PREPARE
5	May	FL 5: Forage conservation and enrichment of quality farm by-products	Silage making in individual farms; results for discussion 2 wks after.	Forage specimen Plastic bag Bolo Scissors Packing tape
6	May	FL 6: Feeding the different physiological stages	Identification of nutritional and feeding problems and interventions made in the farms	Pingpong balls 4 Carton boxes Marking pens
7	May	FA: Discussion of previous week's take home assignment FL 7: Health management for various stages of growth	Health activities related to stage of growth of animals in the farm Filling out of Housing Forms for calf and heifer/dry/ grower Writing down of disease signs & predisposing factors observed in individual farms to be discussed during FL 9	Metacards, 7 pcs per color, 5 colors Pens Flaglets (5 colors) Self-retractable measuring tape Bond paper
8	May	FA: Discussion of result of individual silage making FL 8: Proper housing for calves and adults	Design & construction of appropriate pens for evaluation after 1mo.	Sandigan story Newspapers Pen paper
9	June	FA: Discussion of health manifestations & predisposing factors FL 9: Disease prevention and control FA: Discussion with pax field trip next week and reiteration of the use of the Learning Journal		Actual pictures of common diseases Parasite life cycle game boards
10	June	FA: 2nd EXPOSURE TRIP to: 1. PCC Gene Pool to observe: • Breeding • Milking 2. PCC-CLSU (milk quality testing) 3. Milka Krem (milk processing)		

WK.	SEASON 1	FLS ACTIVITY (FA)/ FLS LESSON (FL)	TAKE HOME ACTIVITIES	THINGS TO PREPARE
11	June	FL 10: Assessing the suitability of a cow's body condition and conformation for breeding FA: 3 days before FL 11, synchronize cows	Application of BCS & type trait to score farmer's cows; correlation with breeding and milk production performance	BCS and type trait score sheets Live specimen of cows in various body condition for critiquing by pax Poster A and B Pens & papers
12	June	FA: Discussion of last week's take home assignment FL 11: Heat detection and breeding services	Observation of cows in estrus and calling of VBAIT when estrus is observed Recording of all observations	AI kit Breeding Records Breeding calendar Cows in estrus (synchronized)
13	July	FL 12: Maximizing the use of proper genetics to increase milk production	Recording of cow's milk yield, fat and protein percentages, stage of lactation	36pcs of strings 2ft long Milk analysis report List of questions for End of Lesson Activity
14	July	FA: Group evaluation of pens and forage gardens of participants		Checklist for forage garden evaluation Housing Forms (as many as the pax)
15	July	FL 13: Milking the buffalo cow FA: Discussion of milk recording FA: Reminders to pax to bring milk samples from their cows to class next meeting	Milking individual cows in the farm and recording results Collection of milk to be brought to class next week	Farm where milking will be demonstrated Milk recording forms Manila paper, pen, tape
16	July	FL 14: Milk handling and storage FL 15: Milk quality test		Milk samples from pax and from resource person: good and poor quality Test tubes with cover, 12pcs Plastic cups, 10pcs Tablespoons, 12pcs Candles, 6pcs Pens, papers and tape
17	August	FL 16: Entrepreneurship and Basic financial management	1-week cost and return analysis of farmers' individual enterprises to be reported next meeting	Plastic straws Scissors, cutters Bond paper Cartolina Tapes BBQ sticks Push-pull tape rule Play money Electric fan 2 sets of prizes for 5

WK.	SEASON 1	FLS ACTIVITY (FA)/ FLS LESSON (FL)	TAKE HOME ACTIVITIES	THINGS TO PREPARE
18	August	FA: Discussion of last week's take home assignment FL 17: Forage-based enterprises		Plastic for ice Shredded paper Rubber band Prize for 5
19	August	FL 18: Milk-based enterprises	Preparation of dairy product of choice to be brought to class next week	Pix of milk, salt, vinegar, rennet, sugar, banana leaves, water, stabilizer, chocolate, plastic wrapper, paper wrapper, pineapple Set of evaluation questions (15 questions) 2 sets of prizes for 5
20	August	FA: Critiquing of dairy products prepared as take-home assignment FL 19: Meat-based enterprises		Metacards Pens Tape Set of pictures 2 sets of prizes for 5
21	September	FL 20: Manure-based enterprises	Preparation of compost heap/ vermicompost/ vermibed for 2 months	Modeling clay in diff colors Compost Vermicompost Vermicast Vermitea Dried manure as fuel
22	September	FL 21: Helping farmers to choose technology options to adopt FL 22: Allowing farmers to test option for 8 weeks FL 23: Participatory monitoring and field coaching		5 baskets Metacards Brown paper Pen Field notes
23	September	8-week technology testing		
24	September	8-week technology testing		
25	October	8-week technology testing Monitoring by FLS facilitators		M&E Forms

WK.	SEASON 1	FLS ACTIVITY (FA)/ FLS LESSON (FL)	TAKE HOME ACTIVITIES	THINGS TO PREPARE
26	October	8-week technology testing		
27	October	8-week technology testing		
28	October	8-week technology testing Monitoring by FLS facilitators		M&E Forms
29	November	8-week technology testing		
30	November	8-week technology testing		
31	November	FL 24: Understanding the results of the M&E and the 8-week testing		
32	November	FL 25: Measuring effects and impacts of the FLS • SitApps • Technology testing timelines • Impact-benefit matrix • Spillover mapping • Symbolic expression of the FLS Impact		Manila paper and pens Colored papers Scissors, paste, tape
33	December	FL 26: Evaluating the Conduct of the FLS • Process diagramming • FLS compatibility map • Technology utility map • Ladder of success		Manila paper and pens Colored papers Scissors, paste, tape
34	December	FA: Graduation		

Understanding the Potential of Dairy Buffalo Production

Eric P. Palacpac
Information Officer V
Philippine Carabao Center National Headquarters and Gene Pool

Industry Status

- Smallholders own 99% of 2.88 M carabaos (BAS, 2017)
- Meat production: 144,690 MT in 2016 valued at Php11.327 B (PSA, 2017)
- Milk production: 7.12 M liters in 2016 valued at approximately Php335 M
- Dairy is the 3rd largest agricultural import of the country (after wheat and soybean meal)
- 2.77 M metric tons (LME)

- Up by 54% from 2015 imports
- Valued at US$807.72 M (PHP38 B)
- New Zealand and US

Carabaos for Dairying

- Native carabao

  - "swamp-type" water buffalo
  - source of draft power
  - crossed with "river-type" water buffalo
  - resultant crossbred yields 3X more milk and grows 2X as fast as its native parent

X

Carabaos for Dairying

- Dairy buffalo modules

  - Introduced by PCC to demonstrate immediately the benefits of buffalo dairying
  - Entrustment of purebred dairy buffalos to organized farmer groups
  - Social preparation and technical trainings

- As of CY 2016 (PSA, 2017)

  - 17,802 dairy carabaos in the countr
  - 10,189 of which are female breeders
  - 4,983 of which are in the milking line
  - >1 M liters milk from purebred dairy buffaloes were traded
  - Approximately 5 M liters from crossbred and native carabaos

- Buffaloes are well adapted to tropical agro-climatic conditions
- Subsist well on crop residues
- More resistant to diseases
- Buffalo's milk have more total solids; ideal for dairy processing
- Buffalo's milk are priced higher

Forage and Feed Resources for Dairy Buffaloes

Daniel L. Aquino
Agricultural Center Chief IV
Philippine Carabao Center at Central Luzon State University

Forages are plant materials eaten by the animals directly from the pasture, crop residue or immature cereal crop, also to include plants cut for fodder and carried to the animals, such as hay or silage. These are the major and the cheapest sources of feeds for dairy buffaloes. Under Philippine condition, it constitutes about 70% to 100% of the daily feed intake of the animals. It is either naturally growing or planted species mostly native grasses, some herbaceous plants, shrubs, trees and leguminous or non-leguminous plants. Availability of feed resources, however, is climate dependent, thus, "Never Assume that Forage is Available throughout the Year." Every dry season is accompanied by scarcity and poor quality of forage. On the contrary, rainy season is the time of forage abundance when there is the opportunity to do forage conservation to support the deficiency during the dry season.

Native grasses are usually low yielding and early maturing accompanied by quick loss of quality. Cultivated species usually produce reasonable yields and nutritive value and respond better to improved management. In dairy operation, forage and pasture management shall be done to ensure year-round sustainable supply of cheap and quality feeds.

Available Feed Resources

In the Philippines, there are naturally growing forages and feed resources, of which, our livestock raisers are not aware of. These feed resources (Table 2) are categorized based on specific land use with estimated carrying capacity to support specific number of animal population.

Table 2. Available feed resources

Item	Farm land (ha.)	Estimated DM yield (t/ha/yr)	Carrying capacity (a.u./ha/yr)	No. of animals ('000)
Native pasture	1.5	3.65	0.4	600
Rice land	3.2	5.48	0.6	1,900
Corn land	2.3	18.25	2.0	4,600
Sugarcane land	0.3	4.56	0.5	132
Coconut land	3.4	3.65	0.4	1,360
TOTAL				**8,612**

When properly managed and utilized, the existing natural pastures (1.5 M ha); available rice land (3.2 M ha), corn land (2.3 M ha), coconut plantation (3.4M ha) and sugar cane plantation (0.3M ha) can support about 8.612 million heads of ruminants annually. Most of these feed resources are not utilized for feeding livestock. As such, they mature and dry off, resulting in very poor feeding values.

Classification of feed resources

A. Roughages

1. Grasses are feedstuffs, which provide high level of energy and less than 16% crude protein. These serve as the "rice" for ruminants.

Examples

- For grazing
  a. Native pasture - cogon, Themeda
  b. Improved pasture – Mulato grass, Humidicola, signal grass, para grass, and Kennedy ruzi
- For cut-and-carry - Napier grass, Guinea grass, Mombasa grass, forage corn, and sorghum

2. Legumes are pod-bearing plants with high protein content (18%) compared to grasses. Legumes serve as "viand" for ruminants.

- Shrubs - Rensonii, Flemingia, and Desmanthus
- Vines- Arachis pintoi, Calopogonium, Centrosema, siratro, and stylo
- Fodder trees – Gliricidia (kakawate), ipil-ipil, Sesbania, and Moringa (malunggay)

Locally available feed resources

Grasses (Kanin)

Paragrass
On grazing can support 2-4 hd buffaloes/ha/yr

Guinea grass
On grazing can support 2-4 hd buffaloes/ha/yr

Napier grass
Cut and carry system
Can support 10-15 hd buffaloes/ha

Legumes (ulam)

Ipil ipil
22-24% CP

Kakawate
18-22% CP

Malunggay
22-28% CP

3. By-products

- Farm residues - rice straw, sugar cane tops, corn stover, and sweet potato vines.
- Industrial by-products - rice bran, spent grain, copra meal, and pineapple pulps.

Farm/Industrial by-products

B. Concentrates. These are feeds with higher energy and protein contents than grasses. It comes in mash or pellet form. These are either pure or mixtures of different feed ingredients as follow:

1. Energy source: corn grain, corn grits, sorghum grain, wheat, concentrate mix feeds
2. Protein sources:

- Plant sources – soybean meal, copra meal, rice bran, spent grain
- Animal sources – meat, bone meal, blood meal
- Marine sources - fish meal, shrimp meal
- Non-protein nitrogen source - urea

Feed supplements (concentrates & mineral mix)

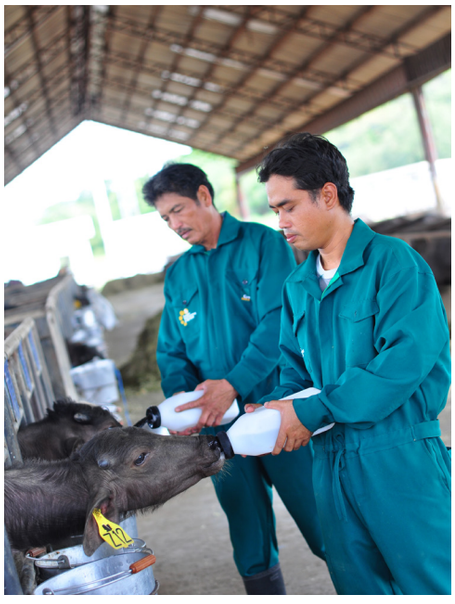
C. Mineral and vitamin supplements. These are feed sources that are added in small amounts in the ration of buffaloes to supply additional nutrients that are deficient in the basal diet.

1. Mineral source: bone meal, oyster shell, dicalcium phosphate, limestone, mono-dicalcium phosphate
2. Mineral lick: UMMB and other commercially available mineral blocks

Mineral block

3. Vitamin supplement are mostly commercially available in injectable forms like Vitamin B-complex for the young and growing buffaloes and vitamin ADEK for all ages of buffaloes.

D. **Milk Replacer** is a commercially available powdered milk formula, which serves as substitute to buffalo's milk in feeding the nursing calf. Use this product from the early growth to the weaning age of the calf.



Advantages of feeding milk replacer to buffalo calves

- Supports the nutrients required for 470 to 500 grams average daily gained (ADG) in weight of buffalo calf.
- Enhances the rebreeding of the dam due to early weaning and reduction of suckling effect.
- Reduces feed cost of maintaining a calf by a daily saving of about Php80.
- No observed health or diarrhea problem

Table 3. Nutrient composition of common grasses and legumes

ITEM	DM %	ME Mcal	TDN %	CP %	CA %	P %
Alabang X (56 days) Dicanthium aristatum	26.7	2.0	49.8	12.3	_	_
Calopo, Calopogonium mucunoides	26.0	2.3	64.0	15.6	1.98	0.2
Centrosema (63 days), Centrosema pubescens	20.2	2.2	61.4	25.7	_	_
Cogon grass, Imperata cylindrica	32.4	1.4	39.2	4.9	0.06	0.06
Corn Silage, Zea mays	30-35	2.4-2.5	65-70	7.5-8.5	0.3	0.3
Corn Stover, Zea mays	89.0	1.7	47.0	3.6	0.62	0.9
Corn Stover Silage, Zea mays	35.0	1.8-2.0	50-56	7-May	0.3	0.3
Cowpea Hay, Vigna sinensis	88.0	2.1	57.0	20.4	1.6	0.69
Guinea grass (42 days old), Panicum maximum	24.0	2.0	54.1	6.1	_	_
Ipil Ipil Leaves, Leucaena leucocephala	27.8	2.6	71.2	21.9	_	_
Napier grass (56 days), Pennisetum purpureum	22.0	2.0	55.0	9.5	0.42	0.39
Para grass, Brachiaria mutica	26.0	2.0	56.0	7.9	0.35	0.33
Peanut Hay, Arachis hypogaea	85.0	2.0	55.0	17.3	0.23	0.15
Pigeon Pea Straw, Cajanus cajan	90.0	2.0	54.0	10.7	1.13	0.36
Rice Straw, Oryza sativa	90.0	1.7	47.0	3.8	0.32	0.1
Star grass, Cynodon plectostachyus	23.0	2.3	63.0	12.4	0.5	0.47
Sugar Cane Tops Saccharum officinarum	31.0	1.9	52.0	6.4	0.2	0.17
Sweet Potato, Ipomoea batatas	14.0	2.5	66.0	11.7	0.13	0.08

Source: IAS-UPLB & DTRI-UPLB, College Laguna

Reference Table 4. Nutrient contents of locally available concentrates (%)

ITEM	DM	TDN	CP	Ca	P
Brewer's spent grain	21	66	23.20	0.33	0.55
Cassava Meal	88	91	3.18	0.34	0.36
Copra meal	88	80	20.45	0.19	0.63
Corn, yellow	87	97	9.77	0.02	0.33
Corn, bran	88	82	10.68	0.05	1.17
Corn gluten feed	88	85	19.32	0.52	0.91
Fish meal, 55%	88	70	63.18	8.54	3.82
Fish meal, 60%	89	70	67.42	4.91	4.43
Ipil-Ipil leaf meal	90	67	24.44	2.20	0.3
Meat and bone meal, 45%	88	-	51.14	12.5	6.59
Molasses, cane	75	72	4.00	1.00	0.11
Rice bran,D1	88	80	15.34	0.07	1.63
Rice bran, D2	88	69	12.50	0.09	1.93
Sorghum	88	85	10.23	0.03	0.32
Soybean meal	88	80	46.86	0.60	0.73
Limestone	98	-	-	38.78	0.00
Oyster shell meal	98	-	-	35.71	0.00
Di-calcium phosphate	98	-	-	22.45	18.37
Tri-calcium phosphate	98	-	-	28.57	13.27

Source: IAS-UPLB & DTRI-UPLB, College Laguna

Forage Production and Establishment

Daniel L. Aquino
Agricultural Center Chief IV
Philippine Carabao Center at Central Luzon State University

Options for forage or pasture establishment

A pasture is a land planted with forage grasses or vegetation cover used for grazing of ruminant livestock. It is the primary source of food for grazing animals like dairy buffalo. Pasture development options will depend on the availability of land, land topography, labor, and financial resources to achieve operational objectives. It can range from simple utilization and management of native pasture to introduction of cultivated pasture species.

A. Native pasture or naturally growing pasture. Native or naturally growing pasture common under plantation crops could be managed as grazing pasture. This can be done by establishing fences and practicing rotational grazing for the continued supply of naturally growing forages while achieving optimum animal productivity.

However, naturally growing forages do not easily respond to area improvement resulting in low carrying capacity.

B. Oversowing legumes in native pastures.
This option is applicable in areas where land cultivation is a problem, i.e., hilly areas. Legume seeds are oversown in native pasture or rootstocks are planted without or with limited cultivation such as furrowing. Legumes have high protein and mineral contents, which can improve the overall quality and productivity of the pasture.
The most commonly used legumes for oversowing are kudzu *(Pueraria phaseoloides)*, Centro (*Centrosema pubescens),* calopo (*Calopogonium mucunoides)*, siratro *(Macroptilium atropurpureum)* and stylo *(Stylosanthes guianensis).*


Native pasture oversown with Centrosema

C. Cultivation of improved forages. It involves complete replacement of naturally growing forages with cultivated forage species to improve productivity in terms of herbage yield and quality, thus, increasing stocking rate. However they require intensive management and inputs than naturally growing forages. Often, the guiding principle is to manage the planted forages as a crop.

D. Management and maintenance of grazing areas

Oversowing legumes in native pasture

A. Preparation

1. Land preparation. Reduce the native vegetation by overgrazing, cutting or burning before seeding.
2. Planting requirement. Seeding rate is approximately 5 kg per hectare.
3. Seed preparation
    a. Scarify seeds before seeding to break dormancy.
    b. Mix seeds with compost or fertile and freely flowing (not sticky) soil to increase volume. Mix 1 kg seeds per bag of compost or vermicast to facilitate sowing and provide ready nutrients to germinating seeds

B. Actual Planting. Broadcast seeds or sow in established furrows at 0.75 m-1 m distance.

C. Reminders and tips in oversowing of legumes

1. Seeding should be done after a rain or when moisture is sufficient for good germination of legume seeds. Initial grazing should be light (refer to section on first grazing) with the end goal of ensuring the sustainability of the component legumes.
2. Reintroduce or replant legumes in the pasture every three years or when need arises.

Establishment of improved or cultivated pasture species

Should management decide to replace naturally growing pasture with cultivated pasture species, the next step is to decide the pasture utilization system and forage species to grow.

A. Selection of forage species for establishment. In deciding which forage species to grow, management should consider the production or feeding system, the adaptability of the species to local climate and soil condition, the availability of planting materials, relative yield, and palatability.

B. Steps in selecting forage species:

Step 1. Selection based on production and feeding system of the farm
Step 2. List down species that has high potential for the specific utilization system
Step 3. Short list selected species based on productivity, quality, and lifespan
Step 4. Short list potential species base on climatic adaptation
Step 5. Short list the potential species based on soil adaptation
Step 6. Select species based on availability of planting materials

Step 1. Selection based on production and feeding system of the farm

Feeding system relative to forage utilization is generally classified as cut-and-carry, grazing, or combination of cut-and-carry and grazing systems. Refer to Chapter 3 on feeds and feeding management.

Cut-and-carry pasture is recommended when:

- Land area is limited
- Labor and capital are available
- High potential for increasing production and market of animal products

Select forage species that:

- are easy to cut and transport
- respond well to fertilization
- produce a lot of regrowth quickly
- are able to sustain high production for a long period of use

Grazed pasture is recommended when:

- land area is adequate to support the number of buffaloes in the farm
- capital for fencing and other facilities are available

Select forage species that can:

- withstand trampling with low grazing heights
- compete with weeds and other non-edible plants
- recover from grazing quickly
- produce adequate amount of reasonable quality feed for a sustained period of time

Step 2. List down species that has high potential for the specific utilization system.

List down all species that are highly adapted ( ) to the utilization system the farm will implement or the specific purpose it will be intended for (refer to Table 5 on Forage species adaptation to production and utilization systems).

- Napier grass, para grass, setaria or gamba grass for cut-and-carry
- B. *humidicola,* signal grass or ruzi grass for grazing system

Table 5. Forage species adaptation to production and utilization systems

	WAYS OF USING AND GROWING FORAGES								
SPECIES	**COMMON NAME**	Cut-and-carry	Grazing	Mixed pasture	Living fences /boundaries	Contour hedgerows	Ley crop	Cover crops	Dry season supplement
Grasses									
Andropogon gayanus	Gamba grass	✓✓	✓	✓✓	✓✓	✓			
Brachiaria decumbens	Signal grass	✓	✓✓	✓✓				✓	
Brachiaria humidicola	Koronivia grass		✓✓					✓✓	
Brachiaria mutica	Para grass	✓✓							
Brachiaria ruziziensis	Ruzi	✓	✓✓	✓✓				✓	
Panicum maximum	Guinea grass	✓✓	✓	✓✓	✓✓	✓			
Paspalum atratum	Atra paspalum	✓✓	✓✓	✓✓	✓✓	✓✓			
Pennisetum purpureum	Napier grass	✓✓		✓	✓✓	✓			
Setaria sphacelata	Setaria	✓✓	✓	✓✓	✓✓	✓✓			
Shrub/herbaceous legumes									
Arachis pintoi	Forage peanut		✓					✓✓	
Centrosema pubescens	Centro	✓					✓✓	✓✓	
Desmanthus virgatus	Desmanthus	✓✓				✓✓			
Desmodium cinerea	Rensonii	✓✓				✓✓			
Pueraria phaseoloides	Kudzu						✓✓	✓✓	
Macroptilium atropurpureum	Siratro						✓✓	✓✓	
Stylosanthes guianensis	Stylo	✓✓	✓			✓	✓✓	✓✓	✓
Tree legumes									
Calliandra calothyrsus	Calliandra	✓✓			✓✓	✓✓			✓✓
Gliricidia sepium	Kakawate	✓✓			✓✓	✓✓			✓
Leucaena leucocephala	Ipil-ipil	✓✓	✓		✓✓	✓✓			✓✓

✓✓ = well adapted ✓ = may be adapted no ticks = not adapted

Napier grass

Setaria splendida

Step 3. Short list selected species based on productivity, quality, and lifespan

If both species are environmentally adapted, the next step is to select based on yield and relative quality. The best example is the popularity of napier grass in cut-and-carry system compared with guinea and para grasses because napier grass has very high yield potential and high relative quality compared to other species.

Step 4. Short list potential species based on climatic adaptation

- Napier grass, para grass, setaria or gamba grass are initially selected for cut-and-carry system.
- Under areas with long dry season, only gamba grass from the initial list has high potential, therefore, it could be the best species to grow under the condition.
- Under water log condition, only para grass has high potential, therefore, para grass can be selected over the other species.

Step 5. Short list the potential species based on soil adaptation

- For grazing system, both Koronivia grass *(B. humidicola)* and signal grass are well adapted under high rainfall condition. Therefore, further short list the species base on soil adaptation.
- Based on the Table on characteristics of common forage species and their adaptation to climate and soils, *B. decumbens* is adapted in moderately fertile soil while *B. humidicola* is adapted under poor or acid soil condition. Based on the soil condition, one species will be selected over the other. This explains the planting of *B. humidicola* at PCC@USF located in Bohol Province and Central Visayas and the planting of *B. decumbens* at PCC@CMU situated in Bukidnon Province, Central Mindanao.

Step 6. Finally, select species based on availability of planting materials

While there are a number of species that could fit in your specific condition, the final decision is on the availability of planting materials. The availability of Napier as planting materials in almost every areas of the country explains its popularity as cut-and-carry pasture.

Para grass

Koronivia grass

Stylo

Centro

Gamba grass

Guinea grass

Table 6. Characteristics of common forage species and their adaptation to climate, soils

SPECIES	COMMON NAME	CHARACTERISTICS/FEATURES					ADAPTATION TO CLIMATE			ADAPTATION TO SOILS			
		Height [a]	Growth Form [b]	Relative Yield [c]	Relative Quality [c]	Life Span (yrs)	Humid with no or short dry season	Long dry season (3-6 mos)	Shade (moderate)	Fertile or neutral to slightly acid)	Moderate fertility or acidity (pH 4.8–5.5)	Low fertility or very acid soil (pH < 4.8)	Water logging
Grasses													
Andropogon gayanus	Gamba grass	T	E	M	L	>3	✓	✓✓	--	✓	✓	✓✓	--
Brachiaria decumbens	Signal grass	M	Tr	H	M	>3	✓✓	✓	✓	✓	✓✓	✓	--
Brachiaria humidicola	Koronivia grass	S	St	M	L	>3	✓✓	✓	✓	✓	✓	✓✓	--
Brachiaria mutica	Para grass	M	E	H	M	>3	✓✓	--	--	✓✓	✓	--	✓
Brachiaria ruziziensis	Ruzi	M	Tr	M	M	>3	✓✓	--	--	✓✓	✓	--	✓✓
Panicum maximum	Guinea grass	M	E	H	H	>3	✓✓	✓	✓	✓✓	✓	--	--
Paspalum atratum	Atra paspalum	M	E	H	M	>3	✓✓	--	✓	✓	✓✓	✓	✓
Pennisetum purpureum	Napier grass	T	E	VH	H	>3	✓✓	--	--	✓✓	✓	--	--
Setaria sphacelata	Setaria	M	E	H	M	>3	✓✓	--	--	✓	✓✓	--	✓
Shrub/herbaceous legumes													
Arachis pintoi	Forage peanut	S	St	L	H	>3	✓✓	✓	✓	✓✓	✓✓	--	✓
Centrosema pubescens	Centro		C	M	H	2-3	✓✓	✓	✓	✓✓	✓	--	--
Desmanthus virgatus	Desmanthus	T	E	M	H	>3	✓✓	✓	--	✓✓	✓	--	--
Desmodium rensonii	Rensonii	T	E	M	H	2-3	✓✓	✓	--	✓✓	✓	--	--
Pueraria phaseoloides	Kudzu		C	M	H	2-3	✓✓	✓	--	✓✓	✓	--	✓
Macroptilium atropurpureum	Siratro		C	L	H	2-3	✓	✓✓	--	✓✓	✓	--	--
Stylosanthes guianensis	Stylo	M	Tr	M	H	2-3	✓✓	✓✓	--		✓✓	✓✓	--
Tree legumes													
Calliandra calothyrsus	Calliandra	T	E	M	H	>10	✓✓	✓✓	--	✓	✓✓	✓	--
Gliricidia sepium	Kakawate	T	E	M	H	>10	✓✓	✓✓	--	✓	✓✓	✓	--
Leucaena leucocephala	Ipil-ipil	T	E	M	H	>10	✓✓	✓✓	--	✓✓	--	--	--

a *T = Tall* *M = Medium* *S = Short*

b *E = Erect* *Tr = trailing (spreads to the sides)* *C = climbing (twining)*

c *H = High* *M = Medium* *L = Low*

✓✓ *= most appropriate* ✓ *= can be grown with some inputs* *-- = can be grown with a lot of inputs*

St = stoloniferous (stems that root on the nodes)

B. Farm planning, layout and fencing

Planning

1. Site selection

   a. Locate the cut-and-carry pasture near the dairy barn to reduce the labor cost of harvesting and feeding the forages. This can also facilitate the utilization of the farm's wastewater to fertilize and irrigate the pasture or forage area.
   b. Locate the grazing pasture near the barn to minimize travel distance.
   c. Ensure the availability of water in each grazed paddocks

2. Determine the size of the cut-and-carry pasture area. It will be dependent on the total herd population, percent forage feeding, and expected forage yield.

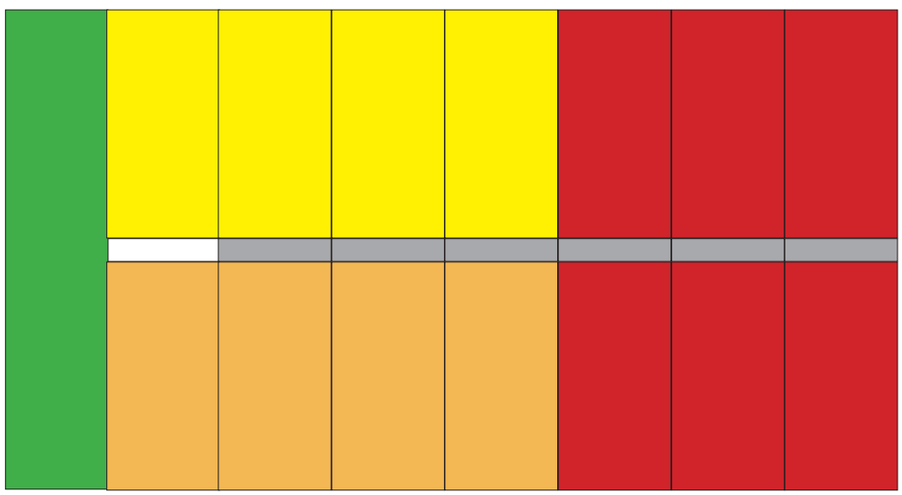
   a. Mature dairy cow weighing 500 kg with feed requirement of 2.5% body weight will consume 12.5 kg DM daily. Assuming 80% feed will be provided by forage, of which, 50% will be taken from cut-and-carry pasture. Hence, the volume requirement from cut-and-carry pasture will be 5 kg DM per day or approximately 25 kg fresh grasses with 20% DM content.
   b. For an average yield of 25 tons dry matter (DM) yield per year at 45 days cutting interval for napier grass, a hectare of napier can support 10 heads at 5 kg DM supplemental feeding per day or five heads at 10 kg DM for full cut-and-carry feeding (see section on stocking rate).

3. Determine the size of the grazing pasture area and the number of paddocks. The number of paddocks or pasture division should correspond to the number of herds and number of rotational paddocks per herd. See sample of farm layout on the next page.

   a. In a minimum of three paddocks rotation per herd, a farm with minimum of two herds shall need to establish six paddocks.
   b. Pasture utilization and efficiency will increase with increasing number of rotation. However, more rotation needs more paddocks, thus, entailing more cost in fence establishment.
   c. Based on a 5 kg DM per day consumption for partial grazing, a hectare of B. decumbens pasture with 17 tons DM production per year can support five animals in a year. However, when animals are fed by full grazing, a hectare of pasture can only support 2 animals.

Recommended Pasture Development and Utilization Lay-out

Color coding refers to the paddocks or divisions in the pasture assigned to the group of animals that utilize it, type of pasture and certain parts of the pasture area.



Legend:

Cut-and-carry pasture
Lactating herd pasture
Calf and yearling herd pasture
Dry and heifers herd
Driving paddock
Barn area

Fencing

- Establish fence line to manage pasture utilization and animal grouping.
- Fencing materials vary from steel pipes, cement post, wooden post or live post, which also vary in cost and durability.
- Carefully plan the layout of the farm to save fencing cost
- Fence the farm before forage establishment to ensure protection from early grazing damage.
- Durable materials require higher cost during establishment, but, they have lower maintenance cost.
- Combination of materials like cement and wooden post reduces the establishment cost, but spread it overtime.
- Steel pipe posts are very expensive and can be stolen easily. Live posts require regular maintenance, especially when it damages the barbed wires during typhoon months.

Table 7. Cost estimates for a kilometer fence using cement post

MATERIAL REQUIREMENTS	NUMBER/VOL	UNIT PRICE (PHP)	TOTAL PRICE (PHP)
iron bar, 10mm	250 pcs	200	50,000
iron bar, 8mm	50 pcs	70	3,500
cement	50 bags	200	10,000
gravel	4 cubic m	700	2,800
sand	8 cubic m	700	5,600
tie wire	4 kg	60	240
Labor for post fabrication	250 pcs	40	10,000
barb wire	40 rolls	1500	60,000
Labor for fence installation	250 pcs	60	15,000
Cost per km (PHP)			157,140

**Distance between posts = 4 meters, Height of post = 6.6 feet*
Number of strands = 4, distance between strands = 1 foot

C. Land preparation

Well prepared area ensures good germination and growth of the forage. It lessens the possible competition of nutrients from weeds, especially during the emergence of the seedlings. After and during germination, good land preparation saves the farm manager from labor cost and possible damage to the seedling due to weeding.

Ideally, good land preparation entails plowing and harrowing twice.

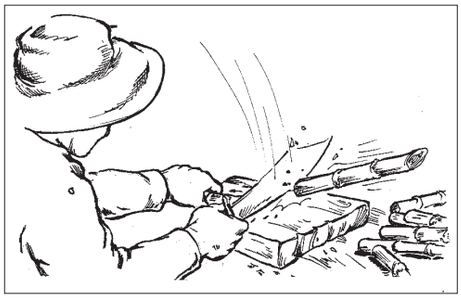
D. Planting

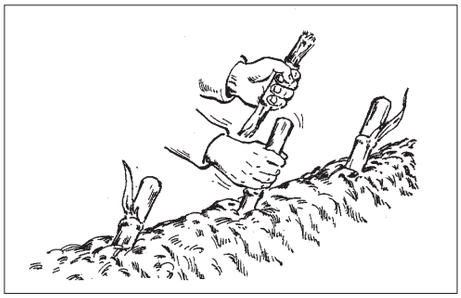
Plant when the soil has sufficient moisture (i.e., during the wet season) to ensure good germination and survival. Planting materials vary from vegetative materials (i.e., stem cutting or rootstocks) or seeds.

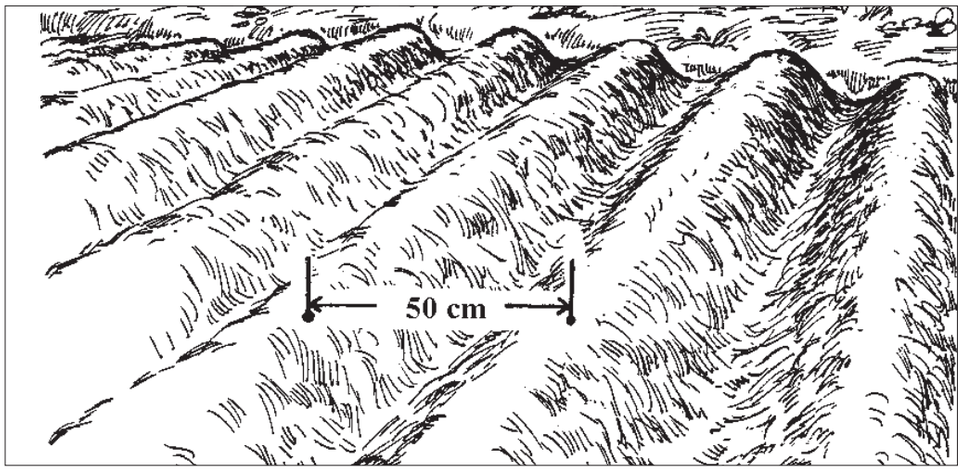
Planting vegetative material

1. Stem cutting. Napier grass is propagated by this method.

a. Select healthy stems that are not too young nor too old, around 2 to 3 months old
b. Cut the cane after every 2 to 3 nodes.
c. Planting may be done by hand or with the use of a hoe or planting stick.
d. Plant the cuttings by sticking the stem in an inclined position, diagonally or vertically, with planting distance of 50 cm between rows or furrows and 50 cm between hills. Make sure the lower nodes are covered by the soil for root formation and the upper node for germination.
e. An alternative method is to lay the stem cuttings in shallow furrows at a suitable depth depending on soil type and moisture conditions and cover with soil by a plow







2. Rootstocks. Most forage grasses, e.g., Guinea grass, Setaria, and signal grass, are propagated from rootstocks or rooted tillers.

a. Select healthy and not too old rootstocks for planting.
b. Dig-out the clumps and separate into tufts of 3 to 5 tillers.
c. Cut excess leaves leaving approximately 6 to 8 inches from the roots.
d. Plant the rootstocks in furrows by hand using a hoe at 25 cm x 25 cm intervals at approximately 7-8 cm deep.
e. An alternative method is to plant the rootstocks in furrows and cover by pushing the soil with the help of the foot.
f. Plant the pieces of rhizomes or stolons by spreading them on loose seedbed and pushing into the soil with foot or by driving a cart or tractor over them.
g. Under wet conditions, scatter mature cuttings on the surface of seed bed and run a disc harrow over them.
h. Under drier conditions or anticipating a rain, scatter mature cuttings on the seedbeds and cover by turning soil with the plow or by pushing soil with the foot.

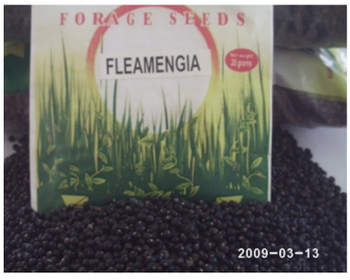
Remember:
Tips in proper planting of vegetative planting materials

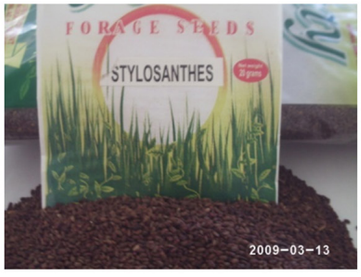
- Use newly prepared planting materials. If this is not possible, keep it moist and store in a cool and shady area.
- Cover with soil and compact area planted to assure soil contact and avoid eroding or washing out of the soil or planting material when heavy rains occur.
- The recommended planting distance is from 50 cm to 75 cm between rows and 50 cm between hills.
- If heavy competition from weeds is expected, adopt a closer planting distance based on the previous recommendation.

Planting from seeds

1. Inspect for spoilage or unwanted materials such as impurities (i.e., weed seeds), dirt and molds upon the arrival of the planting materials.
2. Scarify seeds to break dormancy.

Seed Preparation





How to scarify seed coat:

a. Use sandpaper to scratch off the seed coat.
b. Use hot water to dissolve the wax covering of the seed coat. Water temperature depends on the thickness of seed coat.

i. For thin seed coats (e.g., para grass seeds): Mix 50:50 ratio of boiling and tap water.
ii. For thicker seed coats (e.g., stylo seeds): Prepare a hot water mixture with higher ratio of hot over tap water (e.g., 70:30 hot:tap water ratio). Submerge the seeds in the mixture for about 30 minutes or until the water cools down. The treatment should be supervised by experienced personnel.

3. Inoculate legume seeds using the right Rhizobium strain, a common soil bacterium.

Take note
Rhizobium inoculation

- Legumes is capable of fixing and converting the nitrogen in the air into forms useable to plants through a bacteria in its roots called Rhizobium.
- Different legumes require different strains of Rhizobium to form nodules, ensure growth, and fix nitrogen. Apply only the correct inoculum.
- Rhizobium is commercially available. Purchase and mix with the seed before sowing. Follow the direction as recommended by the manufacturer.
- In case when there is no available inoculum, mix the seed with soil from areas where the forage legume has been growing successfully with many nodules.

Seed volume

1. Check and follow the recommended seeding rates:
   Small seeds: 3-5 kg per hectare
   Bigger seeds: 6-10 kg per hectare
2. Conduct a test on germination rate
3. Adjust the seed volume based on germination rate

   Example: Small seeds: If germination rate is around 80%, adjust the seeding rate by 80%, computed as follows, 3 kg/80% germination = 3.75 kg. This means that in a hectare of forage, you will need 3.75 kg seeds in order to attain the 3 kg recommended seeding rate.

Sowing of seeds

1. Mix seeds with compost or fertile and loose soil (not sticky) to increase volume (bigger volume make equal seed distribution easier). Mix 1 kg of seeds with 1 bag of vermicast to facilitate sowing. Mixing the seeds with organic fertilizer also provides ready nutrients during germination and early growth of the legume forage.
2. Broadcast or sow the seeds in furrows.
3. Space furrows at 75 cm to facilitate weeding, fertilization, and sowing of forage mixtures.
4. Make sure that the seeds are evenly planted in the area. Do this by dividing the planting area into equal parts in the same way you divide the seeds into the same number of parts.
5. Make sure that sowing is not too deep. The ideal depth of planting seed is only 1-2.5 cm below the soil.
6. Compact the soil to prevent runoff or erosion. Do this by pressing the soil cover with your thumb or point finger.

Establishment of mixed pasture

A mixed-pasture establishment refers to the planting of two or more species in the same area.

Example:
Signal and *humidicola* grasses are practical to combine because signal grass grows rapidly after the establishment (2-3 months) while *humidicola* takes longer period (3-4 months). However, the latter is a creeping species and will tend to cover all vacant spaces in the area left by the former, thus, preventing weed growth. Addition of legume in grass pasture such as *Stylosanthes guayanensis* or Arachis pintoi has been recommended in grazing pasture. Addition of twining legume such as centrosema is also recommended in cut-and-carry, grass-legume pastures.

- Combine two or more forage species to maximize pasture productivity and quality.
- Combination must be complementary, i.e., grass and legume. Grasses are high yielding (or produces more DM) while legumes have high nutrient content (protein and minerals).
- Mixed pasture ranges from single grass and mixture of legume species or combination of two more grasses and legume mixture.
- Establish mixed pasture following the above procedures in alternate rows.
- Manage mixed pasture in favor of the legume component.

Management of newly planted forages

Seedlings need adequate light, soil nutrients, and water for growth and development.

1. **Weed control and management.** Weed the pasture area regularly to produce more feed using any of the following methods:

   Inter row cultivation. Cultivate between furrows to remove the weeds. This also loosens the soil, allows aeration to hasten soil microbes, and allows the proliferation of the roots.

   Mowing. Cut the broadleaf weeds to avoid further competition from light and nutrients.

   Uprooting. Uproot the whole plant of noxious weeds that cannot be controlled by cultivation nor mowing once they are established, such as *Chromolaena* and *Lantana.* Uprooting is best done after the rain, when the soil remains soft.

2. **Fertilizer application.** Apply organic or inorganic fertilizer for the forage to grow well and prevent the competition with weeds.

   a. If using organic fertilizer, side dress before planting to ensure the availability of nutrients upon germination. The volume of organic fertilizer depends on soil fertility and availability of materials.

   b. If using inorganic fertilizer:

   - The type and rate of fertilization depends on the existing soil fertility.
   - Side dress only when the plant starts to grow and absorb nutrients. Generally, it is recommended to side dress four (4) bags of complete (14-14-14) fertilizer per hectare.
   - Top dress when the forage had covered the whole soil space. Subsequent fertilization of forage or pastures depends on the requirement of the plants.
   - Know the amount of nutrients that the soil can supply to the plants as well as the nutrient that is depleted annually or every after harvest.
   - A hectare of para grass with a DM yield of 27 tons per hectare per year can withdraw from the soil 344 kg nitrogen, 48 kg phosphorus, 429 kg potassium, 129 kg calcium and 88 kg magnesium per hectare per year (PCARRD, 2001).
   - Napier grass used for cut-and-carry feeding with 18 tons DM yield per hectare per year withdraws 324 kg nitrogen, 22 kg phosphorus and 144 kg potassium. If commercial fertilizer is being used, this requires 704 kg of urea, 245 kg single super-phosphate and 288 kg muriate of potash per hectare annually to be able to restore the depleted nutrients.
   - Reduce the operational cost by reusing animal waste as organic fertilizer. This provides the plants with wider variety of nutrients (i.e., micronutrients) and, at the same time, improves the organic matter and texture of the soil.

3. First grazing or cutting

- First cutting encourages the forage to grow or spread more quickly because it promotes branching and production of new tillers or buds.
- Schedule the first grazing or cutting of established forage. This is important for the long term sustainability of the pasture.
- Do not allow grazing or cutting of new pasture until the grasses and legumes have established strong root system to avoid damage by grazing animals.
- Check when to start grazing or cutting by pulling the plants from the soil. If they are removed easily, then the pasture is still not ready.

a. First grazing

- Use young animals to lessen damage to the pasture. It is preferable to graze many animals for one to two days than let few animals graze over longer period.
- Monitor daily the animal grazing the new pastures. Remove them if possible damage is foreseen.
- Graze mixed pasture very lightly, especially if it contains twining legume or the seed-propagated legumes like centro or siratro. Allow to set the seed during its first year because they are important for the reestablishment of new seedlings, in case of burning or overgrazing.
- Allow first grazing in mixed pasture with twining legumes when the latter start to cling on the component grass to avoid uprooting.

b. First cutting

- Allow first cutting 3 months after planting and every 45 days thereafter.
- In tree legumes, allow first cutting 4-6 months after planting and every 60-90 days thereafter.
- Cutting, however, varies depending on the soil fertility, soil moisture, and forage species.

Pasture rehabilitation

Well managed pasture can last from 10 to 20 years. Major rehabilitation will be costly because it requires the total reestablishment of the pasture. However, for the pasture land to last and prevent major rehabilitation, partial rehab can be undertaken as the need arises. Table 8 presents some recommended maintenance programs for pasture.

Table 8. Types of pasture, duration, and rehabilitation maintenance practices

TYPE OF PASTURE	DURATION	REHABILITATION MAINTENANCE PRACTICES
Native legume pasture	Every 3 years	✓ Rest the grazing area during the flowering months or between September and December, when day length is short ✓ Allow the legumes to flower and seed ✓ Reseed in areas where legume content is very low ✓ Apply 30 kg phosphorus fertilizer per hectare ✓ Allow minimal grazing after 60 days to prevent overgrowth of native grass component
Grazing grass pasture	Every 10 years	✓ Rest the pasture from grazing for 2 months ✓ Disk harrow the pasture during wet season ✓ Apply complete fertilizer to the regrowth at 2 to 4 bags per hectare
Grazing grass legume pasture	When grass component is less than 10%	✓ Rest the pasture area during the flowering months or between September and December, when the day length is short ✓ Allow the legumes to flower and seed ✓ Reseed in areas where legume content is very low ✓ Apply 30 kg phosphorus fertilizer per hectare
Cut-and-carry pasture, e.g. Napier	Every 10 years	✓ Overgrow the pasture for 2 months ✓ Disk harrow the pasture during wet season ✓ Apply complete fertilizer to the regrowth at 2 to 4 bags per hectare

Table 6. Characteristics of common forage species and their adaptation to climate, soils

SPECIES	COMMON NAME	CHARACTERISTICS/FEATURES					ADAPTATION TO CLIMATE			ADAPTATION TO SOILS			
		Height [a]	Growth Form [b]	Relative Yield [c]	Relative Quality [c]	Life Span (yrs)	Humid with no or short dry season	Long dry season (3-6 mos)	Shade (moderate)	Fertile or neutral to slightly acid)	Moderate fertility or acidity (pH 4.8–5.5)	Low fertility or very acid soil (pH < 4.8)	Water logging
Grasses													
Andropogon gayanus	Gamba grass	T	E	M	L	>3	✓	✓✓	--	✓	✓	✓✓	--
Brachiaria decumbens	Signal grass	M	Tr	H	M	>3	✓✓	✓	✓	✓	✓✓	✓	--
Brachiaria humidicola	Koronivia grass	S	St	M	L	>3	✓✓	✓	✓	✓	✓	✓✓	--
Brachiaria mutica	Para grass	M	E	H	M	>3	✓✓	--	--	✓✓	✓	--	✓
Brachiaria ruziziensis	Ruzi	M	Tr	M	M	>3	✓✓	--	--	✓✓	✓	--	✓✓
Panicum maximum	Guinea grass	M	E	H	H	>3	✓✓	✓	✓	✓✓	✓	--	--
Paspalum atratum	Atra paspalum	M	E	H	M	>3	✓✓	--	✓	✓	✓✓	✓	✓
Pennisetum purpureum	Napier grass	T	E	VH	H	>3	✓✓	--	--	✓✓	✓	--	--
Setaria sphacelata	Setaria	M	E	H	M	>3	✓✓	--	--	✓	✓✓	--	✓
Shrub/herbaceous legumes													
Arachis pintoi	Forage peanut	S	St	L	H	>3	✓✓	✓	✓	✓✓	✓✓	--	✓
Centrosema pubescens	Centro		C	M	H	2-3	✓✓	✓	✓	✓✓	✓	--	--
Desmanthus virgatus	Desmanthus	T	E	M	H	>3	✓✓	✓	--	✓✓	✓	--	--
Desmodium rensonii	Rensonii	T	E	M	H	2-3	✓✓	✓	--	✓✓	✓	--	--
Pueraria phaseoloides	Kudzu		C	M	H	2-3	✓✓	✓	--	✓✓	✓	--	✓
Macroptilium atropurpureum	Siratro		C	L	H	2-3	✓	✓✓	--	✓✓	✓	--	--
Stylosanthes guianensis	Stylo	M	Tr	M	H	2-3	✓✓	✓✓	--		✓✓	✓✓	--
Tree legumes													
Calliandra calothyrsus	Calliandra	T	E	M	H	>10	✓✓	✓✓	--	✓	✓✓	✓	--
Gliricidia sepium	Kakawate	T	E	M	H	>10	✓✓	✓✓	--	✓	✓✓	✓	--
Leucaena leucocephala	Ipil-ipil	T	E	M	H	>10	✓✓	✓✓	--	✓✓	--	--	--

[a] *T = Tall* *M = Medium* *S = Short*

[b] *E = Erect* *Tr = trailing (spreads to the sides)* *C = climbing (twining)*

[c] *H = High* *M = Medium* *L = Low*

✓✓ *= most appropriate* ✓ *= can be grown with some inputs* *-- = can be grown with a lot of inputs*

St = stoloniferous (stems that root on the nodes)

Forage/Feed Conservation

Daniel L. Aquino
Agricultural Center Chief IV
Philippine Carabao Center at Central Luzon State University

What is silage?

Silage is a feedstuff produced by fermenting forage with high moisture contents (65-70%).

Ensiling is the name given to the process while the container is called a silo.

KNOW MORE ABOUT SILAGE!!

The feeding of "silage" to animals (buffalo, cattle, goat and sheep) dates back to "biblical times".

"….The beast of burden ate salted, seasoned fodder tossed to them with pitchfork and shovel"

Isaiah 30:24

ADVANTAGES OF ENSILING

- Nutrients are preserved and these are utilized at the desired time
- Less water dependent. Ensiling can be done at any given time whether during dry or wet season
- Silage can be done manually or mechanically
- Best suited for small and large scale production or for commercialization

Forage crops for making silage

Forage crops such as forage corn, sorghum, and napier grass can be used as ensiling materials.

Corn

Sorghum

Napier

Equipment needed

- Forage harvester or chopper
- Tractor hauler or trailer
- Weighing scale
- Silo

Types of containers or silos

a. Small scale production

- Empty drums
- Polyethylene bags or laminated sacks

b. Large scale production

- Bunker silo
- Tower silo
- Trench silo
- Pit silo

Bunker silos

Tower silos

Best silo to be used

Under large scale silage production, the bunker silo is practical because it is easier to load the ensiling materials and unload the silage later.

Pointers in making silage

Feeding silage is important during dry season when the supply of forage is scarce. The quality of silage to be prepared should be based on the number of animals maintained and the number of feeding days (i.e., 6 months dry season).

Assumptions

A dairy cow weighing 500 kg body weight will require forage equivalent to 10% of its body weight on as fed basis. It means that it requires 50 kg forage/silage daily or a total of 9,000 kg for 180 days dry season feeding.

If one hectare of forage corn yields 20 tons fresh forage at 75-80 days maturity, the 9 tons silage requirement of one dairy cow for 180 days feeding can be met only by planting one-half hectare of forage corn.

Assuming that 1m3 silo can yield 200 kg of silage, a 50 m3 silo (Assuming that: 1m height x 10m length x 5m width) should be built to accommodate 10 tons of silage.

Steps:

Making Silage

1. Organize an efficient silage team to finish the ensiling in a short possible time. At least 4-5 people are needed to make 12-15 tons of silage in a day.
2. Prepare all the needed materials and equipment.
3. Harvest the forage crops at the right maturity (75-80 days for forage corn) and moisture content (65%-70%).
4. Chop the forage into 1-2.5 cm in length using a mechanized forage chopper.
5. Fill up the silo continuously and as fast as possible. Use the forage harvester-chopper for unloading of the ensiling materials (forage) into the silo and the tractor for pressing.
6. Pack and compact tightly the forage into the silo to remove oxygen or air spaces.
7. Seal the silo completely with a weighted polyethylene (plastic) sheet. Hold the sheet in place using used tires or sand bags.
8. Harvest the silage and feed to the animal after one month of ensiling.

Remember:

Wilt first forages with high moisture content (75%-80%) like napier and sorghum for 1-3 days to bring down the moisture content to 65%-70% before chopping.

Take note:

If wilting is not possible, the moisture content (MC) of the wet ensiling materials (napier) can be reduced by adding concentrates (rice bran) or dry forage such as rice straw.

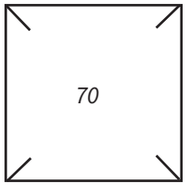
Example: Assuming that the MC of napier is 80% and you want to bring down the MC to 70%, the quantity of rice straw to be used as silage additive, is calculated as follows:

Use Pearson Square to determine the amount of rice straw needed to bring down the MC of Napier to 70%.

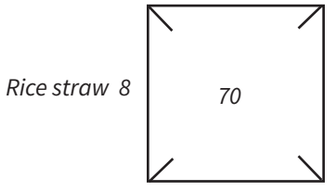
Steps:

Pearson Square Method

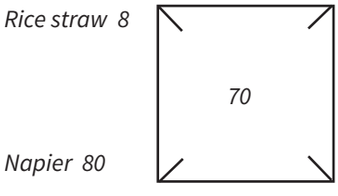
1. Draw a square and put the desired MC of the silage to be made at the middle of the square.



2. Put the name and MC content of the additive (Rice Straw) containing lower MC than the desired moisture of silage on the upper left side of the square.

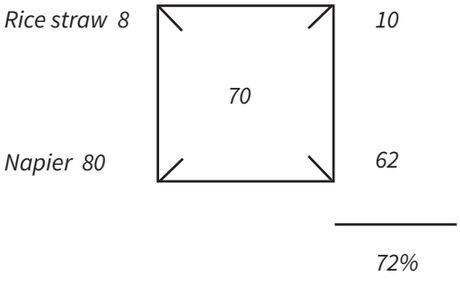


3. Put the name and MC content of the material with higher MC than what is desired



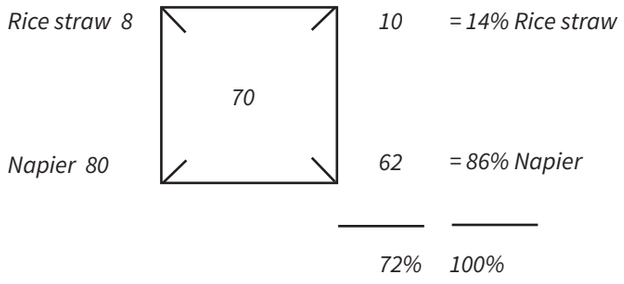
4. Determine the cross-difference by subtracting the desired MC with the MC of the two ensiling materials and get the sum of the two differences.

Example: 1. Desired MC (70) - MC Rice straw (8) = 62
2. Desired MC (70) - MC of Napier (80) = 10



5. Add the difference of the combination and determine the proportion of napier and rice straw to be ensiled to meet the 70% MC of the silage.

Calculation: 1. Quantity of rice straw needed = 10/72 x 100 = 14 %
2. Quantity of napier needed = 62/72 x 100 = 86%



6. Check if the desired MC (70%) is met or not:

14 parts Rice straw	x	MC of Rice straw (0.08)	==	1.12 % MC
86 parts Napier	x	MC of Napier (0.80)	==	68.80 % MC
Total % MC of the mixture			==	70.00 % (exactly met)

Take note:

The above calculation showed that for every stack piled containing 86 parts of Napier in the silo, you have to put a layer of 14 parts rice straw to arrive at 70% recommended MC of silage.

Hay making

Steps:

Napier and para grass are examples of good materials in preparing hay for feeding newly weaned calves.

1. Cut the grass at 25-30 days old.
2. Sun dry for 2-3 days to achieve 13% to 15% moisture content.
3. To facilitate drying, turn the grass upside down once in a while until the desired moisture content is attained.
4. Bale and haul the dried hay into a shaded storage area.

Feeding of Dairy Buffaloes at Different Physiological Stages

Daniel L. Aquino
Agricultural Center Chief IV
Philippine Carabao Center at Central Luzon State University

Rationale

Proper and sound feeding management is the heart of every dairy buffalo farm. Genetically superior dairy animals will not express their optimum potential to produce milk without the right quality and proportion of feeds. Thus, the farm manager should provide the required feeds to attain the target productivity in milk production, reproduction, and growth of the buffaloes.

The main objective of feeding lactating buffaloes is to a provide ration that will meet the nutrients for maintenance, pregnancy, and milk production at a reasonable cost. The critical nutrients are energy, protein, calcium, phosphorus, and vitamin A. Their availability is entirely dependent on the kind and seasonality of the feed resources. Adopting a sound feeding strategy is a must to sustain feed supply and to provide balanced quantities and qualities of nutrients for improved growth, increased milk production, good health, and superior reproductive condition of the buffaloes.

Feeding management

Lactating cows should be given the best feed for optimum milk production. Producing milk is one of the most energy demanding processes. When the energy intake of the lactating cow is less than the energy required for milk production, then, it results in significant weight loss.

A. Practical considerations in feeding lactating cows

At any stage of lactation, the buffalo cow should be given the best feed the farm manager can offer. To do this, the manager should consider important considerations. Follow these steps:

Step 1. Determine the cow's body weight and identify the nutrient requirement of the cow from Table 30. The latter provides the recommended amount of feed intake and the corresponding energy, protein, Calcium (Ca) and Phosphorus (P) requirement at a given animal weight and physiological stage. It also provides the resulting estimated gain in weight.

Remember:

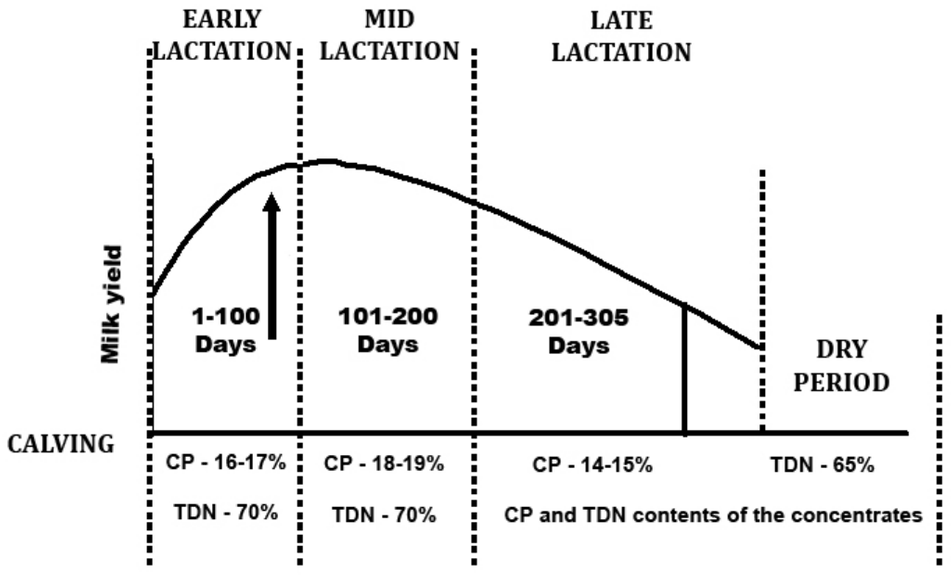
- Giving more energy would increase milk production as a result of the rumen microorganisms to capture more energy and rumen degradable protein and use these nutrients to proliferate in the rumen.
- The more bacteria in the rumen, the more microbial protein is available for digestion in the small intestines and absorbed for milk production.

Step 2. Determine the cow's current stage of milk production and lactation. Lactation has four stages based on duration (in days) of milk production after calving, namely, early lactation, mid-lactation, late lactation, and dry period. Every stage, except for the dry period, has different volume of milk production and requires a specific feeding ration.

Stages of lactation:

- Early lactation - 1 to 100 days (peak milk production) postpartum.
- Mid-lactation - 101 to 200 days (declining milk production) postpartum.
- Late lactation - 201 to 305 days (declining milk production) postpartum.
- Dry period - 60 to 90 days before the next lactation.

The figure below summarizes the nutrient requirements (i.e., energy and protein) of lactating cows at different stages of lactation and volume of milk production. It illustrates the importance of providing the right quality and volume of feed ration to attain optimum production, reproduction, and BCS of the dairy cows.



Step 3. Get the milk yield and its fat content.

a. Identifying the lactation stage facilitates the estimation of volume of milk production. Daily record of milk production, however, is the best reference of milk volume.
b. Laboratory test (i.e., Milkoscan) measures the milk fat content. Conduct milk sampling and analysis every month.

Step 4. Get the nutrient composition of available feed resource for the herd.

a. List down all the available feed resources for the herd.
b. Check and write down the corresponding nutrient composition of available grasses and legumes from Table 2.
c. Check and write down the corresponding nutrient composition of the concentrates from Table 3.

Step 5. Tabulate the information and prepare sample ration.

Sample case

Data

Lactating cow - 550 kg BW
- Milk has 7% butter fat

Below is the summary of data requirement for the formulation of feed ration. Volume of milk production per day and for the whole lactation period and the nutritional requirements based on Table 30.

Table 10. Summary of data requirement for the formulation of feed ration

ITEM	LEVEL OF PRODUCTION, liters				
Daily milk production, kg	4	6	8	10	12
Total milk production, kg	1220	1830	2440	3050	3660
Requirements					
Dry matter (DM), % BW	2.5	2.7	3.0	3-3.5	3.5
TDN, kg	5.9	6.9	8.3	8.8	9.7
Protein, g	1028	1264	1618	1736	1972
Calcium, g	34	41	50	54	60
Phosphorus, g	26	31	39	42	47
Vitamin A, IU	27	27	27	27	27

Daily milk production:
During early lactation - 8 liters
Mid-lactation - 6 liters
Late lactation - 4 liters

The table below enumerates the common and available feed resources for the dairy herd.

Table 11. Common feedstuffs fed to dairy buffaloes

ROUGHAGE SOURCES	ENERGY CONCENTRATES	PROTEIN SOURCES
Legume hay	Corn	Concentrates
Grass	Rice bran	-Soybean
Silages	Wheat pollard	-Copra meal
-corn	Corn bran	-Brewer's spent grain
-sorghum	Molasses	-Urea
-grass		Legumes
Crop residues		- *Desmodium rensonii*
-rice straw		- *Arachis pintoi*
-corn stovers		- *Stylosanthes spp.*

After understanding the requirement of a lactating cow and the nutrient content of available feed resources for the herd, the farm manager should now consider the feed ration according to the stage of lactation, BCS, and mineral requirements.

B. Feeding lactating buffaloes

1. Feeding according to lactation stage

a. Feeding a cow during early-lactation

Feeding of buffaloes during the first 100 days of lactation is crucial because it is the stage when the cow's milk production increases to a peak point. The objective at this stage is to feed sufficient nutrients to attain maximum milk yield. High milk yield during early lactation has a significant influence on milk yield for the entire lactation.

At this stage of lactation, the cow requires more energy or about 25% higher than the maintenance ration to sustain milk production. The cow should be given more feeds to encourage and maximize feed intake. Offered feeds should fit with the level of milk production and the peak DM intake should be 2.7%-3.0% of BW. Since the milk yield increases more rapidly than the DM intake during the early lactation, the high demand for energy pressures the cow to mobilize its body fat to make up for this energy requirement. Thus, if there are available energy-rich feeds offered to the cow, then it will be able to sustain and improve its milk production. On the other hand, deficiency would result in consequent body weight loss.

Take note:

- Challenge the cow by adjusting its feed ration. This is done by giving 500 g concentrates per kg milk production to increase nutrient intake. Add more concentrate until the volume of milk production levels off.
- At this stage, a cow will consume approximately 2.7%-3.0% of the body weight on DM basis.
- Chopping and partial drying of forages increase DM intake.
- Protein is a critical nutrient during early lactation. Meeting or exceeding crude protein requirements during this period helps stimulate feed intake and utilization for milk production.
- The protein content of the concentrate mix should be 19% or more to meet requirements during this period.

For lactating buffalo weighing 550 kg body weight producing 8 kg milk/day with 7.0% milk fat.

Table 12. Sample ration: early lactation

FEED RESOURCES	RATION 1 AMOUNT, kg As fed	RATION 2 AMOUNT, kg As fed
Napier grass	55.0	40.0
Rice straw	-	2.3
Concentrate	3.3	4.4
Mineral lick	Free choice	Free choice
TOTAL	**58.3**	**46.7**

TOTAL 58.3 46.7
Requirements: TDN=7.82 kg, CP=1,500 g, Calcium=47 g, Phosphorus= 36 g

- Good quality forage (e.g., napier cut at 45-52 days regrowth) is recommended; chop and feed 3-4 times a day to maximize intake
- Rice straw can be used in minimum quantity in the ration for lactating cows. However, this is more costly because it implies an increase in concentrate supplements to meet the nutrient requirements for milk production.
- In case napier is not available in the farm, the manager should refer to Table 2 for some grass substitutes.

b. Feeding a cow during mid-lactation

It is the lactation period between 101 to 200 days after calving. At the beginning of this phase, the cow just passed the peak in milk production (8-10 weeks after calving). Feed a ration that will maintain high level of milk production. During mid-lactation, the cows is already bred or in the early stage of pregnancy, hence, it is very important to satisfy the energy requirement during this stage. Protein requirements are less critical than they were during the early lactation stage with the DM requirement decreasing to about 2.5 to 2.7% of the body weight.

For lactating buffaloes (550 kg body weight) producing 6 kg milk/day with 7.0% milk fat.

Table 13. Sample ration: mid lactation

FEED RESOURCES	RATION 1 AMOUNT, kg As fed	RATION 2 AMOUNT, kg As fed
Napier grass	55.0	40.0
Rice straw	-	2.3
Concentrate	3.3	4.4
Mineral lick	Free choice	Free choice
TOTAL	**58.3**	**46.7**

Requirements: TDN=6.68 kg, CP=1,264 g, Calcium=41 g, Phosphorus=31 g

c. Feeding a cow during late-lactation

The late lactation stage covers the 201 days after calving to the end of the lactation (at about 305 days). It is when milk production slowly declines and dries off. During this period, the milk yield and feed intake decline from 6 kg to 4 kg of milk per day and from 3.0% to 2.5% of the BW, respectively. However, the cow will start gaining weight to replenish the adipose tissue lost during the early lactation phase. Towards the end of the lactation period, more of the increase in body weight will be due to the growing fetus. Sources of protein and energy are less important during this late lactation stage compared to the requirements during early and mid-lactation. The BCS of the cow should be at least 3 to prevent abrupt drop in milk production and to persist until 305-day lactation.

Sample ration for buffaloes with 550 kg BW during late lactation and producing 4 kg milk/day with 7.0% milk fat.

Table 14. Sample ration: late lactation

FEED RESOURCES	RATION 1 AMOUNT, kg As fed	RATION 2 AMOUNT, kg As fed
Napier grass	55.0	40.0
Rice straw		2.3
Concentrate	0.6	1.1
Mineral lick	Free choice	Free choice
TOTAL	**55.6**	**43.4**

Requirements: TDN=5.9 kg, CP=1,028 g, Calcium=34 g, Phosphorus=26 g

2. Feeding lactating cows to manage BCS

The BCS is a simple numerical scale that shows the relationship between the body muscle mass or fat cover and the nutritional status of the animals. It illustrates the importance and implication of the health status of the animal on the efficiency of production and reproduction. In dairy operation, BCS is a good measure to improve milk production.

a. Assess the BCS of your cows and feeds if you want to increase the current milk production. Rate them accordingly: BCS=1 is very thin and BCS=5 is very fat. Refer to the detailed body condition scoring in Chapter 8 on record and record keeping.
b. The overall body condition of the herd cows is a reflection of its level of nutrition and health management.
c. Feed cows to attain a BCS of 3.5 and not below 2.5 or above 4.

Scenario no. 1

- If a lactating cow is too thin (<2.5 BCS)

Interpretation

It means that you are not feeding enough energy compared to the energy used for producing milk. Remember that energy consumed above the maintenance is converted into milk or body fat. Take note also that high producing cows (>2,000 liters per lactation) may have poor BCS.

Remedies

- Feed more energy by giving additional concentrate (2-3 kg/day) or other high energy feed ingredients (e.g., corn) until the BCS is back to 2.5.
- Then, challenge her potential to produce even more by feeding increasing levels, 1 kg at a time, of high energy and high protein concentrate until milk production plateaus.
- Feed the cow with ad libitum good quality forage

Scenario no. 2

- If lactating cow is too fat (> 4 BCS)

Interpretation

- The cow may not be receiving enough protein.
- Your cow is consuming excess energy in relation to the energy that is used for milk production.
- The cow does not have the genetic potential to increase milk production or maybe the cow is at the end of lactation.

Remedies

- Increase the protein content of the ration by providing one kg of soybean and see if the cow responds to produce more milk
- Reduce the amount of concentrate feed but increase the proportion of forage in the diet
- Feed the cow with ad libitum good quality forage

Scenario no. 3

- If lactating cow is between 3 and 4 BCS

Analysis/Interpretation/Implication:
- This is the ideal range of BCS in dairy animals.

Remedy

- Challenge the cow by increasing the amount of concentrate mix until the milk production plateaus.
- If there is no response, then the animal's genetic potential is already expressed
- Maintain the level of concentrates in the diet to maintain milk production and the BCS
- Feed the cow with ad libitum forage

3. Mineral supplements for lactating buffaloes

When to supplement minerals

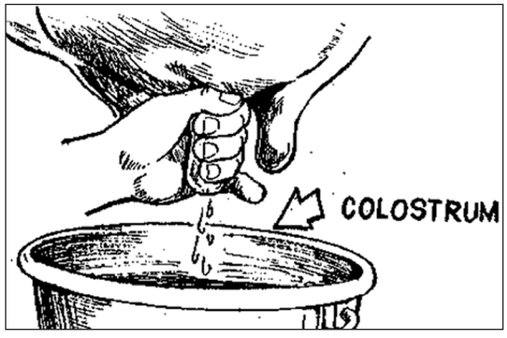
- Supplementation is necessary when the mineral contents of feeds fall short of the animal requirements.
- A good source of mineral mix should have balanced macro and micro minerals to suit the requirements of buffaloes.
- A cow producing more than 4 kg milk daily should be supplemented with additional 3.3 g calcium and 3.6 g phosphorus per kg of milk being produced.
  Among the symptoms of mineral deficiencies include milk fever, anemia, osteomalacia, incidence of prolapse, and grass tetany.

Table 15. Mineral sources and requirement of buffaloes

Type	% Calcium		% Phosphorus	
	Average	Range	Average	Range
Feed source				
Grasses	0.39	0.06-0.74	0.35	0.06-0.90
Legume	1.37	1.10-1.98	0.33	0.15-0.69
Concentrate mix	1.40	1.17-1.90	0.70	0.44-0.87
Requirements:				
Calf, 100 kg	0.50		0.39	
Growing, 200 kg	0.27		0.25	
Heifer, 300 kg	0.21		0.19	
Pregnant, 400 kg	0.29		0.22	
Lactating				
4 liters/day	0.32		0.24	
6 liters/day	0.38		0.31	
8 liters/day	0.44		0.38	

c. Feeding of calf from birth to weaning

- It is the first milk of the mother, which contains the essential nutrients needed in the early growth of the calf.
- It contains high antibodies, which serve as defense against common diseases, providing passive immunity for the calf.
- It has higher protein, carbohydrates, and fat content compared to normal raw milk.
- It has most of the vitamins and minerals as compared to normal cow's milk.
- It triggers the excretion of the mecomium, the calf's first feces. Colostrum has a laxative effect or stimulates defecation in calf to remove the wastes it acquired from the dam during pregnancy.



Remember:

- Feed the calf with the colostrum within the first three hours after calving, either through the pail or bottle or by natural suckling.
- In artificially reared calf, the milk replacer is gradually introduced to the calf at the rate of 50:50 (normal milk: milk replacer) for a week and, thereafter, the calf is fed with 100% milk replacer up to the weaning period of 90 days.

Table 16. Nutrient composition of colostrum and normal buffalo milk

COMPONENT	COLOSTRUM (%)	NORMAL MILK (%)
Total solids	**3I.0**	**8.36**
Solids-not-fat	27.0	I0.I2
Ash	0.9	0.78
Milk fat	4.0	7.27
Lactose	**2.2**	**5.05**
Total protein	23.8	4.49
Casein	7.7	3.20
Albumin	3.6	0.15
Globulin	I2.5	0.42

Take note:

DOs in training a calf on bottle or pail feeding

- Always wash hands thoroughly with soap and water before feeding the calf.
- Clean, disinfect, and dry the pail or feeding bottle and nipples.
- Milk the dam to collect the colostrum. Evaluate its quality by sensory evaluation to test its safety before feeding to the calf.
- Put the desired volume of colostrum or milk replacer into the pail or feeding bottle.
- Measure the milk temperature. The standard temperature is between 38oC and 40oC. If it is lower, warm the milk before feeding to the calf.
- Position the feeding bottle at an eye-level of the calf, then, let it suck the milk.
- In case of pail feeding, the caretaker should dip his/her clean middle finger into the pail containing the milk serving as the nipple to facilitate suckling.
- When the calf starts suckling, slowly and gently move the fingers in and out of the mouth of the calf until it is trained to drink milk from the pail.
- Ensure that the calf sucks or drinks enough colostrum from birth to 5 days of age.
- Provide fresh drinking water to calves at all times.
- Follow the recommended feeding guide for artificially reared calf.

1. Artificial feeding of calf. In a dairy operation, artificial feeding using milk replacer is highly recommended. Although it is laborious, it helps regulate the feed intake of the calf. It is economical because milk replacer is cheaper than the buffalo's milk.

Table 17. Feeding schedule of artificially-reared calf

Age (in days)	MILK		CALF STARTER CONCENTRATES (in grams)		HAY*	FRESH GRASS	Remarks
	AM	PM	AM	PM			
1 - 5	2	2					Colostrum - pail or bottle feeding
6 - 15	2	2	50	50	50 g	90 g	Milk replacer
16 - 25	2.5	2.5	150	150	150 g	680 g	"
26 - 35	2.5	2.5	200	200	250 g	1.1 kg	"
36 - 45	2.5	2.5	250	250	400 g	1.8 kg	"
46 - 55	2.5	2.5	300	300	500 g	2.3 kg	"
56 - 65	2	2	400	400	750 g	3.4 kg	"
66 - 75	2	2	500	500	Ad lib	Ad lib	"
76 - 85	2	2	550	550	Ad lib	Ad lib	"
86 - 90	1	1	600	600	Ad lib	Ad lib	Weaning Age

** Para grass or Guinea grass hay*

Warning: Feeding of cold milk is harmful to calves. When the milk is kept in refrigeration temperature (2-4 0C) overnight, its fat content solidify resulting in indigestion or scouring when fed to calf.

Advantages of artificial feeding

- Regulates milk intake based on the requirement or body weight of the calf
- Eliminates the incidence of scouring due to overfeeding
- The dam can be trained easily for machine milking.
- Excess milk from the dam after feeding the calf can be sold into cash
- Facilitates early rumen development and early weaning of calf
- Absence of suckling effect shortens the occurrence of post-partum estrus of the dam.

Disadvantages of artificial feeding

- Labor-intensive
- Induces milk contamination when hygiene is not strictly observed

Feeding milk replacer

Milk replacer is a substitute to the normal mother's milk in feeding buffalo calf during its early life. It is prepared from powder formulation to nourish the calf.

Preparation of milk replacer

1. Prepare a clean pail.
2. Dissolve 280-320 grams of milk replacer-powder in clean warm water (50oC). Use liter of water for every 140-160 grams of powder. Dilute it with tap water to make 2 liters of milk.
3. Check the milk solution; feed it to the calf if the temperature is around 38-40oC. Refer to the steps on pail or bottle feeding of calves.
4. Repeat steps 1 to 4 in the afternoon.
5. Follow the recommendations from the previous table on feeding schedule of artificially reared calf.

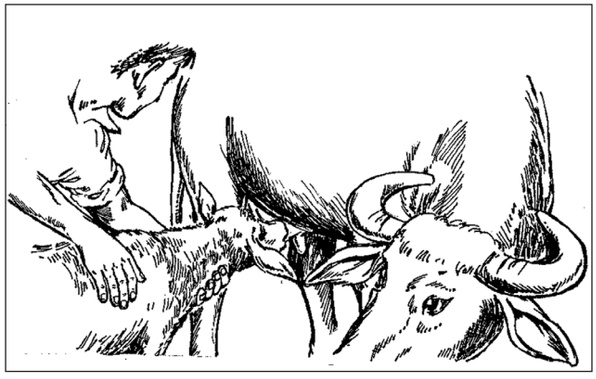
Benefits of feeding milk replacer

- Enhances growth rate of the calves
- Lessens the occurrence of related health problems (i.e., scouring incidence)
- Economical with daily feed cost savings of about PHP42.00 per calf
- Promotes rumen development and early weaning in calves

2. Natural suckling under cow-calf operation

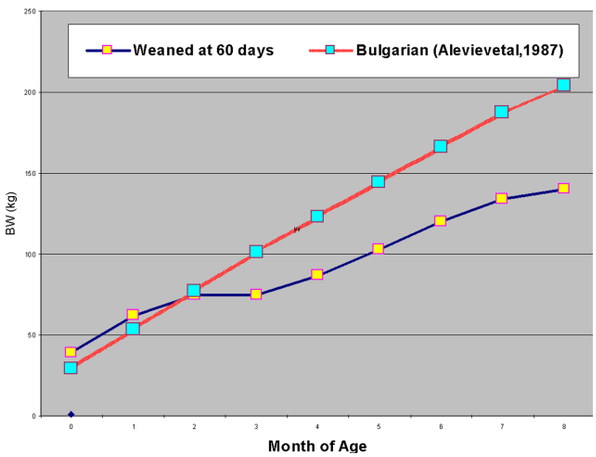
Rearing of calf by natural suckling

- When a newly born calf starts to stand, bring or lead it to the dam to suck the colostrum.
- As in artificial rearing, the suckling of colostrum by the calf is complete after five days from birth.
- The calf sucks milk 4 to 5 times a day, with about 5 to 6 minutes interval or lag time between sucklings.
- A calf sucks an average of 3 to 4 liters of milk a day.
- Monitor the calf during suckling. Excessive or minimal milk intake leads to health problems.



C. Feeding management of weanling buffaloes (3 – 6 months)

At weaning, the calves weigh around 80 to 90 kg. Management of newly weaned calves is important because these animals will serve as replacement bulls or heifers for future breeding and dairy production.



The graph shows that immediately after weaning or two months post-weaning, the ADG of newly weaned calves declines. This is due to the changing pattern of feeding, i.e., from liquid (milk) to solid-based diets. The growth rate, however, slowly increases three months after weaning, when the calves are able to adjust to solid feeds and their rumens become fully developed and functional.

Recommended rations for newly weaned calves

Give the growing calf good quality roughage with supplementary concentrates to ensure normal growth and body conditions. A daily ration composed of fresh napier grass (ad libitum) plus 1.3 kg concentrate (20% CP) mixture is adequate to attain 600-750 grams ADG. Legume fodders such as Ipil-ipil, gliricidia or shrub legumes (i.e., Centrosema, Siratro, or Rensonii), are some of the nutritious and economical feed supplements in place of concentrate feeds.

Table 18. Suggested ration for newly weaned calf, weighing 80 kg, ADG =500g

RATION, AS FED	FEEDING SYSTEM	
	GRASS-BASED	GRASS-LEGUME BASED
Grass (napier, para grass, humidicola)	3-4 kg	3-4 kg
Legume (rensonii, stylo)	None	1.4 kg
Concentrate, starter mix	2.2 kg	1.6 kg
Mineral mix	Free choice	Free choice

Assumptions: Dry matter of grass=25%; legume=35%; concentrate=90%

How to feed hay?

1. Offer the calf with limited quantity of hay starting at 7 days old.
2. Increase the quantity of hay gradually until the calf consumes it ad libitum.
3. Complement hay with starter concentrates to support its desired ADG of 500-600 grams.
4. Chop the grass to about 2-3 cm to have better DM intake of hay. This will enhance the digestion of feed materials.

Remember:

Good quality hay is preferred for calf because it is more nutritious (CP >10%), gives the right DM, and reduces the incidence of scouring in calf. Feed this ad libitum with starter concentrate mix containing at least 22% crude protein and 75% total digestible nutrients.

D. Feeding of heifers

Heifers are the future dairy animals. They require adequate nutrition for normal growth and early achievement of pubertal weights. The heifers may be fed individually or in group with other heifers. To reach pubertal age, they should have an ADG of 500-600 grams. There are three phases of feeding heifers based on their age and BW to meet their nutrient requirements.

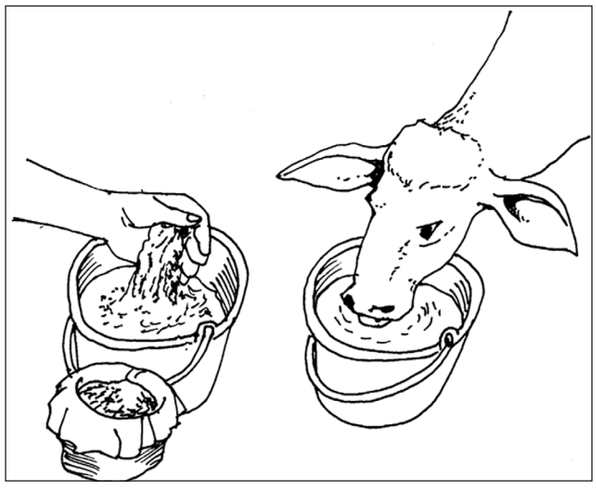
Table 19. Suggested ration for heifers weighing 180 kg, ADG = 500g

RATION, AS FED	FEEDING SYSTEM	
	GRASS-BASED	GRASS-LEGUME BASED
Grass (napier, para grass, humidicola)	14 kg	14 kg
Legume (rensonii, stylo)	None	1.7 kg
Concentrate, starter mix	1.1 kg	0.6 kg
Mineral mix	Free choice	Free choice

Assumptions: Dry matter of grass=25%; legume= 35%; concentrate=90%

Phase 1. Growing heifers (6 - 12 month old)

- At this age, the heifers are already weighing 150-230 kg.
- Give heifers feed ration that is composed of fresh grasses with supplementary concentrates and/or legumes.
- Supplement them with vitamin and minerals during the dry season because their ration is mostly composed of rice straw or hay and other farm by-products.



Phase 2. Heifers at 13 - 18 month old heifers

- At this age, the heifers are already weighing 230-310 kg and nearing its pubertal weight.
- Feed them with rations containing adequate levels of protein, energy, minerals, and vitamins to support an ADG of 500 grams.
- Give supplementary concentrates containing 15%-16% CP and about 65%-70% TDN.
- The ration containing fresh grass (ad libitum), spent grain, and rice straw or combinations of fresh grass and legumes can support the desired ADG.

Table 20. Suggested ration for growing heifer, weighing 270 kg, ADG =500g

RATION, AS FED	FEEDING SYSTEM	
	GRASS-BASED	GRASS-LEGUME BASED
Grass (napier, para grass, humidicola)	20.4 kg	20.4 kg
Legume (rensonii, stylo)	None	2.8 kg
Concentrate, starter mix	2 kg	1 kg
Mineral mix	Free choice	Free choice

Assumptions: Dry matter of grass=25%; legume= 35%; concentrate=90%

Phase 3. Heifers at 19 - 24 month old

- At this age, the heifer is already weighing 310-350 kg.
- Give ration containing more energy balanced with protein to support an average daily gain of 300-400 grams.
- In confinement system, use rations containing rice straw (ad libitum) and supplementary concentrates or spent grain.
- Fresh grass (napier or para grass) can support 300-400 grams ADG of the animals. Whenever available, legumes can serve as a practical supplement to support the daily nutrient requirement of breeding heifers.

Table 21. Suggested Ration for growing heifer, weighing 330 kg, ADG =400g

RATION, AS FED	FEEDING SYSTEM	
	GRASS-BASED	GRASS-LEGUME BASED
Grass (napier, para grass, humidicola)	25 kg	25 kg
Legume (rensonii, stylo)	None	3.7 kg
Concentrate, starter mix	2 kg	1 kg
Mineral mix	Free choice	Free choice

Assumptions: Dry matter of grass=25%; legume= 35%; concentrate=90%

E. Feeding of pregnant buffaloes

- During the early stage of pregnancy, the cow's feed ration is similar with its maintenance requirement.
- During the last trimester, pregnant cows need about 25% to 30% more nutrients than their maintenance requirement to support the fetus development and the regeneration of the mammary tissues.
- Pregnant cows require 50% higher digestible protein (DP) and 25% higher TDN than that of the maintenance requirement.
- Flush the cow by giving additional 1.0 kg to 1.5 kg concentrates. This provides additional nutrients to prepare the pregnant cows prior to parturition, lactation, and subsequent reproduction (re-breeding). Do this 1 to 2 months before the expected calving up to 2 months after parturition.

Remember:

It is important to restore or build-up the body reserves during pregnancy as they directly influence the subsequent milk production.

Table 22. Suggested Ration for pregnant cow, weighing 350 kg, ADG - 450g

RATION, AS FED	FEEDING SYSTEM	
	GRASS-BASED	GRASS-LEGUME BASED
Grass (napier, para grass, humidicola)	26 kg	26 kg
Legume (rensonii, stylo)	None	4.2 kg
Concentrate, starter mix	2.4 kg	1.2 kg
Mineral mix	Free choice	Free choice

Assumptions: Dry matter of grass=25%; legume= 35%; concentrate=90%

F. Feeding of dry cows

- Feed dry cows with high energy and low protein diets to meet their daily nutrient requirements for maintenance.
- Maintenance ration is composed of rice straw with minimal concentrates like rice bran or spent grain.
- Rice straw sprayed with urea-molasses solution can support the maintenance requirement of dry cows. Use 50 urea-molasses solution: 50 straw ratio. Feed it ad libitum.
- If good quality forage is available, giving supplementary concentrate is not necessary.

Table 23. Suggested Ration for dry cow, with 550 kg body weight

RATION, AS FED	FEEDING SYSTEM	
	GRASS-BASED	GRASS-LEGUME BASED
Grass (napier, para grass, humidicola)	55.2 kg	55.2 kg
Legume (rensonii, stylo)	None	4.2 kg
Concentrate, starter mix	1.1 kg	None
Mineral mix	Free choice	Free choice

Assumptions: Dry matter of grass=25%; legume= 35%; concentrate=90%

Feeding of bulls

Use the same feeding management for the young bulls as those for growing heifers to achieve the desired ADG of 500 grams. Give good quality forage and concentrate supplement at this stage of growth.

G. Mature bulls are normally fed based on their maintenance requirement.

- Avoid overfeeding, as this will lead to obesity and may reduce libido or sexual urges, semen volume, and other semen characteristics.
- Preferably, the maintenance ration for breeding bulls should have adequate amount of fresh forage to meet its DM, CP, TDN, and mineral requirements.
- In preparing ration, include macro and micro minerals such as calcium, phosphorus, copper, selenium, and iron.
- In cases when dry forage (i.e., hay or straw) is used, supplement with vitamin ADEK regularly.

Critical nutrients in feeding dairy buffaloes

Nutrients are substances in the buffalo's diet to maintain its productive and reproductive functions. Nutrients are in the form of organic and inorganic nutrients such as water, carbohydrates, fats, proteins, minerals, and vitamins.

A. Water is the cheapest and the most important of all nutrients. Supply of drinking water for buffaloes comes from potable water sources, feeds, and from the animal body as product of nutrients digestion and metabolic reactions.

Functions

- Aids in the digestion of feed and absorption of nutrients
- Transports the absorbed nutrients to the different parts of the body
- Aids in cellular functions
- Regulates body temperature
- Helps in the excretion of wastes such as manure, urine, and gases
- Serves as lubricant of the body

Remember:

1. Water requirements:
   - Calf = 10 to 20 L/day
   - Dry cows/Heifers/Bulls = 60 L/day
   - Lactating/pregnant cows = 90 L/day
2. At birth, the body of the calf contains 75%-80% water.
3. In mature animal, the body consists only of 54% water.
4. A loss of 10% of the body fluid causes dehydration and death.

B. Carbohydrate is composed of simple sugars and polysaccharides including starch, cellulose, hemi-cellulose, and pectins. It makes up about 75% of the plants' dry weight in the form of soluble (starch), rumen degradable (cellulose, hemicellulose), and indigestible (lignin) components.

Functions

- Major source of energy for the growth, reproduction, and milk production of buffaloes
- Degraded in the rumen through microorganisms (i.e., bacteria, protozoa, and fungi) to produce volatile fatty acids (acetic, propionic, and butyric).

C. Fats consist of glycerol and fatty acids and commonly termed as triglycerides. These are concentrated form of energy containing 2.25 times more energy than proteins and carbohydrates.

Functions

- Serve as energy source for the animals
- One of the important components of buffalo's milk
- Involved in the synthesis of steroid hormones for reproduction

Take note:

The level of fat in buffalo rations should be less than 4% because it affects fiber digestion. Likewise, high level of fat hastens feed rancidity.

D. Proteins are composed of amino acids. These are derived by buffaloes from plants, animals, and microorganisms, in the form of microbial protein.

Functions

- Body maintenance and growth of the animal
- Needed in fetal development
- Enhance milk production and milk protein synthesis
- Aid in the repair of injured and worn-out tissues

E. Minerals are inorganic substances found in food and feeds needed by the body in small amounts and are essential to life.

Classifications

- Macro-minerals : Calcium (Ca), Phosphorus (P), Sodium (Na), Sulfur (S), Potassium (K), Chlorine (Cl) and Magnesium (Mg)
- Micro-minerals : Iron (Fe), Copper (Cu), Cobalt (Co), Molybdenum (Mo), Manganese (Mn), Iodine (I), Zinc (Zn), Selenium (Se) and Flourine (F).

Functions

- Major components of the skeletal system; responsible for the development of bones and teeth
- Promote normal body and muscular functions
- Serve as regulators in body metabolism and transport of nutrients
- Component of the enzyme system and are in association with protein (hemoglobin) and vitamins (B12, D, and E)
- Vital components of milk, meat, and even semen

F. Vitamins are nutrients with regulatory functions, which come from either plants or animals.

Classification

- Fat-soluble vitamins - vitamins A, D, E, K
- Water soluble vitamins - B-complex and C vitamins

Fat-soluble vitamins are vitamins that are not soluble in water and cannot be synthesized or processed by ruminants. Thus, regular supplementation is necessary. Examples are Vitamins A, D, E, and K. These are commercially available and mostly in injectable forms.

Water-soluble vitamins are composed of the vitamin B or B-complex and C. Vitamin B-complex is important for the normal growth of calves because at this physiologic stage, their rumens are not yet functional and capable of synthesizing these vitamins.

- Vitamin B is naturally occurring in grains, milk products, fish, coconut meals, and soybeans. Examples: thiamine, riboflavin, pyridoxine, niacin, cyanocobalamin, and folic acid.

- Vitamin C occurs only in few feedstuffs such as potatoes, milk powder, and green plants. The bioavailability of naturally occurring ascorbic acid is adequate. However, its storability in processed feeds is limited.

Take note:
Mature buffaloes can synthesize Vitamins B and C through the action of the rumen microorganisms, thus, supplementation is not necessary.

Feeding systems

A. Grazing system. The buffaloes are allowed to graze in the pasture areas composed of pure grasses (marginal or improved) or combination of grasses and legumes. Refer to Chapter 4 on forage production and pasture management

Examples:

- Native grass pasture – cogon, themeda
- Improved grass pasture – signal grass, humidicola, and gayanus
- Improved grass:legume pastures – any combinations of the following:
    - Signal grass: stylo
    - Humidicola: Arachis pintoi
    - Themeda: stylo

Advantages of grazing

- Economical
- Animals can select freely the succulent and nutritious parts of the forage
- Promotes maximum utilization of available pasture
- Reduces the incidence of mastitis among dairy buffaloes (rotational grazing)

Disadvantages of grazing

- Overgrazing ensues if carrying capacity of the pasture is overloaded
- Causes damage since buffaloes tend to build wallowing area in pasture areas
- Presence of obnoxious plants or weeds that can harm when ingested by the grazing animal
- Buffaloes require large grazing areas
- Low quality and quantity of grasses available during dry season

B. Cut-and-carry system (under complete confinement). In this system, the feeds are harvested and hauled or handfed to the animals in their corral. The performance of the animals depends on the quantity and quality of the feeds and how they are being provided.

All roughage diets: Feeding of buffaloes with pure grasses, legumes, or farm by-products (rice straw, corn stover or sugar cane tops).

Examples:

1. Feeding of napier, para grass, guinea grass and sweet sorghum, and silage corn.
2. Combinations of napier: centrosema or para grass: rensonii
   Recommended grass legume combination is 70:30
3. Grass:legumes: by-products combinations

Remember:

- The recommended grass:legume ratio is 70:30.
- Vitamin and mineral supplements should be added to the daily ration, especially, if the buffaloes are on their peak of growth, last trimester of pregnancy, and during lactation.

C. Roughage and concentrates diets. This system is highly recommended when buffaloes are on their early age or 3-6 month old, peak of growth rate (750 g to 1,000 g ADG), and the last trimester of pregnancy or during lactation. These stages of growth and production of the animals require 15%-25% (energy, protein, mineral, and vitamins) above the maintenance requirement.

Examples:

Use any of the following ratios

- Grass:calf starter (70:30)
- Grass:grower mash (80:20)
- Grass:dairy concentrates (60:40)

Advantages of complete confinement system

- Feed intake and quality of the ration given to the animals can be easily monitored.
- Animals will remain docile compared to those grazing, which may go astray.
- Incidence of disease among animals can be monitored easily.

Disadvantages of complete confinement feeding system

- Labor-intensive
- Expensive because it requires bigger capital and investments for housing and other facilities
- Bulk wastes disposal and management can become a problem
- Spread of diseases is faster because the animals are in close contact with each other

D. Combination of grazing and confinement. This system of feeding is appropriate for farms with grazing areas and night corrals. The buffaloes are allowed to graze freely on the pasture for about 8 hours during the day. At night, they are driven back to the corral and fed with cut roughages.

E. Nutritional deficiencies. Nutrient deficiency is caused by prolonged exposure to subsistence feeding or low plane of nutrition. In this case, the animals are receiving diets whose quantity and quality are way below their maintenance requirements.

Consequently, the animals will have:

- Declining body weights
- Poor growth (grows below its normal ADG)
- Low milk production
- Shorter lactation period
- Poor reproductive efficiencies, such as irregular estrus, low conception rate, long calving interval, and abortions
- Low immunity against infections or diseases

Nutrient requirements, deficiency symptoms, and prevention of mineral deficiency

Table 24. Water requirements, deficiency symptoms, prevention of dehydration

GROWTH STAGE	DAILY REQUIREMENT (L)	DEFICIENCY SYMPTOMS	PREVENTION
Young	10-20	Dehydration	Free choice of water
Adult	60	Dehydration	Free choice of water
Lactation	90	Dehydration	Free choice of water

Table 25. Energy requirements, deficiency symptoms, and prevention

GROWTH STAGE	DAILY REQUIREMENT (L)	DEFICIENCY SYMPTOMS	PREVENTION
Young	1.84 kg TDN	Hypoglycemia Anemia Reduced blood glucose	Provide adequate TDN, energy content of the ration
Adult	3.65 kg TDN	Poor reproductive performance	
Pregnancy	4.2-6.4 kg TDN	Abortion, stillbirth	
Lactation	4.6 – 7.3 kg TDN	Hypoglycemia, Low milk production Short lactation period	

Table 26. Protein requirements, deficiency symptoms, and prevention

GROWTH STAGE	DAILY REQUIREMENT (L)	DEFICIENCY SYMPTOMS	PREVENTION
Young	288 g CP	Stunted growth,	Provide adequate protein in the ration
Adult	566 g CP	reproductive disorder,	
Lactation	282 g DP/kg milk	low milk production	

Table 27. Vitamins requirements, deficiency symptoms, and prevention

NUTRIENT	DAILY REQUIREMENT (L)	DEFICIENCY SYMPTOMS	PREVENTION
Vit A	100-200 iu / kg BW	Growth depression, sterility, increased susceptibility to diseases, stillbirth	Regular supplementation of vitamin A
Vit D	10-50 iu D3 / kg BW	Rickets, osteodystrophy, growth disorder, tooth enamel defects	Regular supplementation of vitamin D
Vit E	2 -4 mg / kg BW	Metabolic dysfunction, dystrophy, myopathy, pale meat, reproductive disorder	Regular supplementation of vitamin E
Vit K	1-5 mg / kg BW	Disorder of blood coagulation, hemorrhagic diathesis, growth disorder	Regular supplementation of vitamin K

Table 28. Macro-mineral requirements, deficiency symptoms, and prevention

NUTRIENT	DAILY REQUIREMENT (L)	DEFICIENCY SYMPTOMS	PREVENTION
Calcium	2.3-5 g	Hypocalcemia, milk fever, post-parturient paresis Osteomalacia, Rickets	Calcium supplementation
Phosphorus	12-17 g	Rickets in young animals, Poor appetite, stiff walk, Stunted growth, emaciation, pica	Phosphorus supplementation
Potassium	0.8 to 1.0% of ration	Reduce daily DMI, muscular weakness, stiffness in the hind legs, pica, anorexia, coma	Mineral balances / supplementation
NaCl (salt)	0.1 to 0.2% of ration	Loss of appetite, muscular weakness, edema	Regular supplementation
Magnesium	0.4-7g	Grass tetany, anorexia, hyperemia, calcification of soft tissues	Regular supplementation
Sulfur	57-79 g	Reduced feed intake, slow growth, decreased milk production	Regular supplementation
Cobalt	0.1 ppm	Loss of appetite, retarded growth, decreased milk production, emaciation, anemia, stumbling gait	Regular supplementation
Copper	10 ppm	Enlarge fetlock, rapid weight loss, hair and pigment loss, bone fragility, reproductive disorder	Regular Supplementation

Table 29. Micro-mineral requirements, deficiency symptoms, and prevention

NUTRIENT	DAILY REQUIREMENT (L)	DEFICIENCY SYMPTOMS	PREVENTION
Iron	50-100 ppm	Anemia	Regular injection of iron supplement
Iodine	0.25-0.50 ppm	Enlarged thyroid gland, low body metabolism	Regular supplementation
Manganese	40 ppm	Impaired growth, skeletal abnormalities, low fertility, frequent abortion	Regular supplementation
Selenium	0.1 ppm	White muscle disease (muscle dystrophy)	Vit E or selenium supplementation
Zinc	40 ppm	Swollen feet, listlessness, scaly skin, alopecia, parakeratotic lesion	Regular supplementation

Table 30. Nutrient requirements of buffaloes

Body Weight (kg)	Gain (or loss) (kg)	Intake		Energy		Protein		Ca (g)	P (g)
		(kg)	% of live wt.	ME Mcal	TDN (kg)	Total (g)	Digestible (g)		
Lactating cows producing 4kg milk containing 7%Fat									
350	0.0	8.4	2.4	16.8	4.6	865	537	27	21
400	0.0	9.0	2.3	18.0	5.0	905	559	30	23
450	0.0	9.6	2.1	19.1	5.3	950	580	31	24
500	0.0	10.1	2.0	20.2	5.6	988	600	33	25
550	0.0	10.7	1.9	21.3	5.9	1,028	620	34	26
600	0.0	11.2	1.9	22.4	6.2	1,064	638	35	27
650	0.0	11.7	1.8	23.4	6.5	1,098	659	36	28
700	0.0	12.2	1.7	24.2	6.7	1,144	678	38	29
750	0.0	12.6	1.7	25.3	7	1,178	696	39	30
800	0.0	13.2	1.6	26.4	7.3	1,214	714	40	31
Heifers (last three months of gestation)									
300	0.5	6.7	2.2	14.1	3.9	538	294	16	14
350	0.5	7.4	2.1	15.1	4.2	592	324	21	16
400	0.5	8.1	2.0	16.2	4.5	647	354	23	18
450	0.5	8.8	2.0	17.2	4.8	726	405	26	20
500	0.5	9.4	1.9	18.2	5.0	779	435	28	22
Growing/Fattening									
100	0.00	2.4	2.4	3.95	1.09	163	80	4	4
	0.25	3	3	6.45	1.78	312	195	9	8
	0.50	2.8	2.8	8.95	2.47	373	254	14	11
	0.75	2.8	2.8	11.45	3.16	439	313	20	14
150	0.00	3.3	2.2	5.36	1.48	223	109	5	5
	0.25	3.9	2.6	7.86	2.17	393	242	10	9
	0.50	4.1	2.7	10.36	2.86	486	319	14	12
	0.75	3.9	2.6	12.86	3.55	548	378	17	15
	1.00	3.9	2.6	15.36	4.24	609	437	21	17

Body Weight (kg)	Gain (or loss) (kg)	Intake		Energy		Protein		Ca (g)	P (g)
		(kg)	% of live wt.	ME Mcal	TDN (kg)	Total (g)	Digestible (g)		
200	**0.00**	**4.1**	**2.0**	**6.65**	**1.84**	**288**	**135**	**6**	**6**
	0.25	4.8	2.4	9.15	2.53	464	281	10	9
	0.50	5.1	2.6	11.65	3.22	543	341	14	13
	0.75	5.1	2.6	14.15	3.91	610	400	19	17
	1.00	4.8	2.4	16.65	4.6	682	471	23	20
250	0.00	4.8	1.9	7.86	2.17	327	160	8	8
	0.25	5.5	2.2	10.36	2.86	525	315	12	9
	0.50	5.9	2.4	12.86	3.55	604	374	15	12
	0.75	6.1	2.4	15.36	4.24	677	433	19	17
	1.00	5.6	2.2	17.86	4.93	732	493	22	19
300	0.00	5.6	1.9	9.01	2.49	377	183	9	9
	0.25	**6.2**	**2.1**	**11.76**	**3.25**	**579**	**343**	**13**	**12**
	0.50	6.8	2.3	14.51	4.01	663	402	17	16
	0.75	7.0	2.3	18.26	5.04	736	461	21	19
	1.00	6.5	2.2	20.01	5.52	790	521	26	23
350	0.00	6.4	1.8	10.11	2.79	426	205	10	10
	0.25	7.1	2.0	13.11	3.62	620	357	13	12
	0.50	7.6	2.2	16.11	4.45	703	416	17	15
	0.75	7.8	2.2	19.11	5.28	776	475	20	18
	1.00	7.2	2.1	22.11	6.11	826	535	23	21
400	0.00	7.0	1.8	11.17	3.09	469	227	11	11
	0.25	7.7	1.9	14.42	3.98	653	369	14	13
	0.50	8.4	2.1	17.67	4.88	740	428	17	16
	0.75	8.7	2.2	20.92	5.78	818	487	20	19
	1.00	8.3	2.1	24.17	6.68	874	547	23	21
450	0.00	7.7	1.7	12.21	3.37	515	248	12	
	0.25	8.6	1.9	15.71	4.34	675	365	14	14
	0.50	9.1	2.0	19.21	5.31	758	424	16	16
	0.75	9.5	2.1	22.71	6.27	936	482	18	18
	1.00	9.2	2.0	26.21	7.24	896	52	20	20
	1.10	8.8	2.0	27.62	7.62	911	566	21	21

Body Weight (kg)	Gain (or loss) (kg)	Intake		Energy		Protein		Ca (g)	P (g)
		(kg)	% of live wt.	ME Mcal	TDN (kg)	Total (g)	Digestible (g)		
Mature Cows (last three months of gestation)									
400	0.4	8.0	2.0	15.2	4.2	15.2	4.2	15.2	4.2
450	0.4	8.6	1.9	16.2	4.5	16.2	4.5	16.2	4.5
500	0.4	9.3	1.9	17.2	4.8	17.2	4.8	17.2	4.8
550	0.4	9.8	1.8	18.2	5	18.2	5	18.2	5
600	0.4	10.4	1.7	19.2	5.3	19.2	5.3	19.2	5.3
650	0.4	11.0	1.7	20.2	5.6	20.2	5.6	20.2	5.6
700	0.4	11.7	1.7	21.2	5.9	21.2	5.9	21.2	5.9
750	0.4	12.2	1.6	22.2	6.1	22.2	6.1	22.2	6.1
800	0.4	12.7	1.6	23.2	6.4	23.2	6.4	23.2	6.4
Adult Non-Producing Buffalo Maintenance									
350	**0.0**	**6.3**	**1.8**	**10.1**	**2.8**	**423**	**205**	**14**	**11**
400	0.0	7.0	1.8	11.2	3.1	469	227	17	13
450	0.0	7.6	1.7	12.2	3.4	512	248	18	14
500	0.0	8.2	1.6	13.2	3.6	553	268	20	15
550	0.0	8.9	1.6	14.2	3.9	597	288	21	16
600	0.0	9.5	1.6	15.2	4.4	633	305	22	17
650	0.0	10.3	1.6	16.1	4.4	683	327	23	18
700	0.0	10.6	1.5	17.0	4.7	714	346	25	19
750	0.0	11.0	1.5	17.9	4.9	752	364	26	20
800	0.0	11.5	1.4	18.8	5.2	788	382	27	21

Derived from: Kearl 1982. Nutrient Requirements of ruminants in developing countries
**Note: The Adult Non-Producing Buffalo is also called dry cow*

Table 31. Nutrient composition of common grasses and legumes

ITEM	DM	ME Mcal	TDN %	CP %	CA %	P %
Alabang X (56 days), *Dicanthium aristatum*	26.7	2.0	49.8	12.3	_	_
Calopo, *Calopogonium mucunoides*	26.0	2.3	64.0	15.6	1.98	0.2
Centrosema (63 days), *Centrosema pubescens*	20.2	2.2	61.4	25.7	_	_
Cogon Grasss, *Imperata cylindrical*	32.4	1.4	39.2	4.9	0.06	0.06
Corn Silage, *Zea mays*	30-35	2.4-2.5	65-70	7.5-8.5	0.3	0.3
Corn Stover, *Zea mays*	89.0	1.7	47.0	3.6	0.62	0.9
Corn Stover Silage, *Zea mays*	35.0	1.8-2.0	50-56	7-May	0.3	0.3
Cowpea Hay, *Vigna sinensis*	88.0	2.1	57.0	20.4	1.6	0.69
Guinea grass (42 days old), *Panicum maximum*	24.0	2.0	54.1	6.1	_	_
Ipil Ipil Leaves, *Leucaena leucocephala*	27.8	2.6	71.2	21.9	_	_
Napier grass (56 days), *Pennisetum purpureum*	22.0	2.0	55.0	9.5	0.42	0.39
Para grass, *Brachiaria mutica*	26.0	2.0	56.0	7.9	0.35	0.33
Peanut Hay, *Arachis hypogaea*	85.0	2.0	55.0	17.3	0.23	0.15
Pigeon Pea Straw, *Cajanus cajan*	90.0	2.0	54.0	10.7	1.13	0.36
Rice Straw, *Oryza sativa*	90.0	1.7	47.0	3.8	0.32	0.1
Star Grass, *Cynodon plectostachyus*	23.0	2.3	63.0	12.4	0.5	0.47
Sugar Cane Tops, *Saccharum officinarum*	31.0	1.9	52.0	6.4	0.2	0.17
Sweet Potato, *Ipomoea batatas*	14.0	2.5	66.0	11.7	0.13	0.08

Source: IAS- UPLB & DTRI-UPLB, College Laguna

Table 32. Nutrient contents of locally available concentrates (in %)

ITEM	DM	TDN	CP	Ca	P
Brewer's spent grain	21	66	23.20	0.33	0.55
Cassava meal	88	91	3.18	0.34	0.36
Copra meal	88	80	20.45	0.19	0.63
Corn, yellow	87	97	9.77	0.02	0.33
Corn, bran	88	82	10.68	0.05	1.17
Corn gluten feed	88	85	19.32	0.52	0.91
Fish meal, 55%	88	70	63.18	8.54	3.82
Fish meal, 60%	89	70	67.42	4.91	4.43
Ipil-Ipil leaf meal	90	67	24.44	2.20	0.3
Meat and bone meal, 45%	88	-	51.14	12.5	6.59
Molasses, cane	75	72	4.00	1.00	0.11
Rice bran,D1	88	80	15.34	0.07	1.63
Rice bran, D2	88	69	12.50	0.09	1.93
Sorghum	88	85	10.23	0.03	0.32
Soybean meal	88	80	46.86	0.60	0.73
Limestone	98	-	-	38.78	0.00
Oyster shell meal	98	-	-	35.71	0.00
Di-calcium phosphate	98	-	-	22.45	18.37
Tri-calcium phosphate	98	-	-	28.57	13.27

Source: IAS- UPLB & DTRI-UPLB, College Laguna

Proper Housing For Calves and Adults

Nancy S. Abes/Cyril P. Baltazar
Project Evaluation Officer III/Farm Superintendent
Philippine Carabao Center National Headquarters and Gene Pool

Meriam M. Cabling
Science Research Specialist I
Philippine Carabao Center at Central Luzon State University

Importance of Housing

Proper housing for buffaloes is essential for good health, comfort, and protection from inclement weather conditions. It ensures better production and more efficient management.

Design Considerations

Factors to be considered while designing a pen: **"SEC-C "**

- Safety of animals and caretakers
- Economy
- Comfort and protection to animals
- Convenience to animals and raisers

Pen location and orientation

- Construct the pen, which is accessible to service roads, water supply, and electric lines.
- The area must have proper drainage.
- Consider also the east-west orientation of structure, which facilitates either the morning or afternoon sunlight towards the pen.

Roof Structure

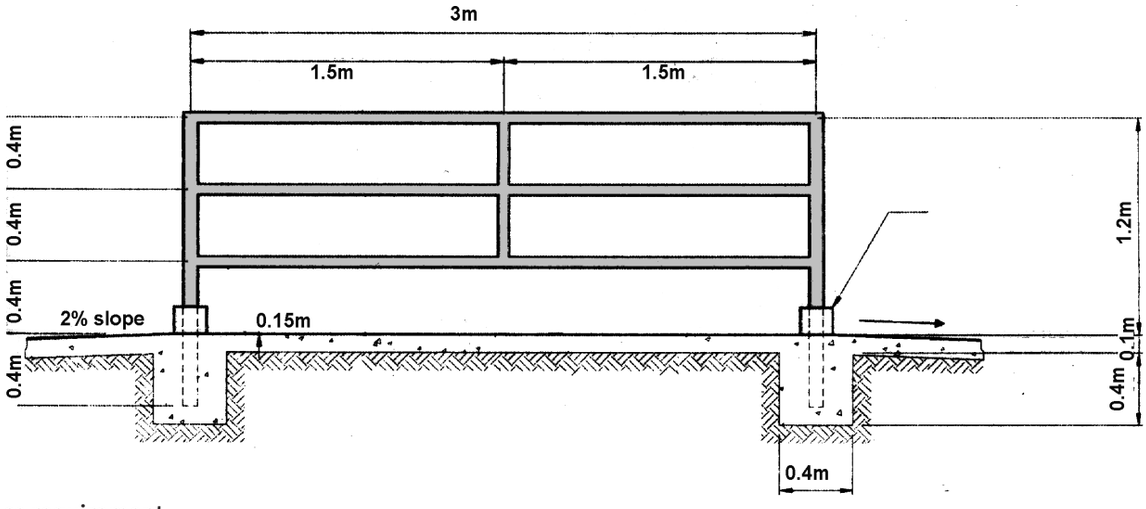
- Roof protects the animals from sun and rain. It also protects the internal pen structures.
- The roof slope should be not less than 25%.
- The roof can be made up of GI sheet, canvas or tent or indigenous materials (cogon or nipa, bamboo, and wood)
- For the roof made of indigenous materials, the minimum roof slope should be 58%.
- The lowest point of the roof should be at least 2.5m high.

Floor Structure

- Flooring must facilitate hygienic feeding and effective removal of both liquid and solid waste products.
- It should be of medium consistency.
- It may cause hoof disorder if too rough and accidental slipping if too smooth.
- The minimum floor thickness is 76 mm with 2%-4% slope towards the drainage.
- In an earth floor, slope should be 4%-7% to facilitate drainage.
- Dry floor controls spread of diseases.

Pen Wall

- Wall is a supporting structure in a pen.
- It should be 1.2m-1.5m high.
- Pen walling and post can be made from bamboo, wood, and GI pipes.
- The GI pipes Schedule 40 used in pen walling and post should have 0.05 m horizontal railings and 0.075 mm vertical post.
- The maximum center to center spacing between posts is 3 m.
- The post should be embedded in a concrete pedestal with minimum depth of 0.4m.
- Each post must have 0.15m concrete protectors.
- The pen wall should be free from any sharp edges or projections to avoid injury to animals.



Space requirement

The pen must have adequate space to accommodate the number and body size of animal. It also helps to lessen the incidence of injury or accident to the animal and caretaker.

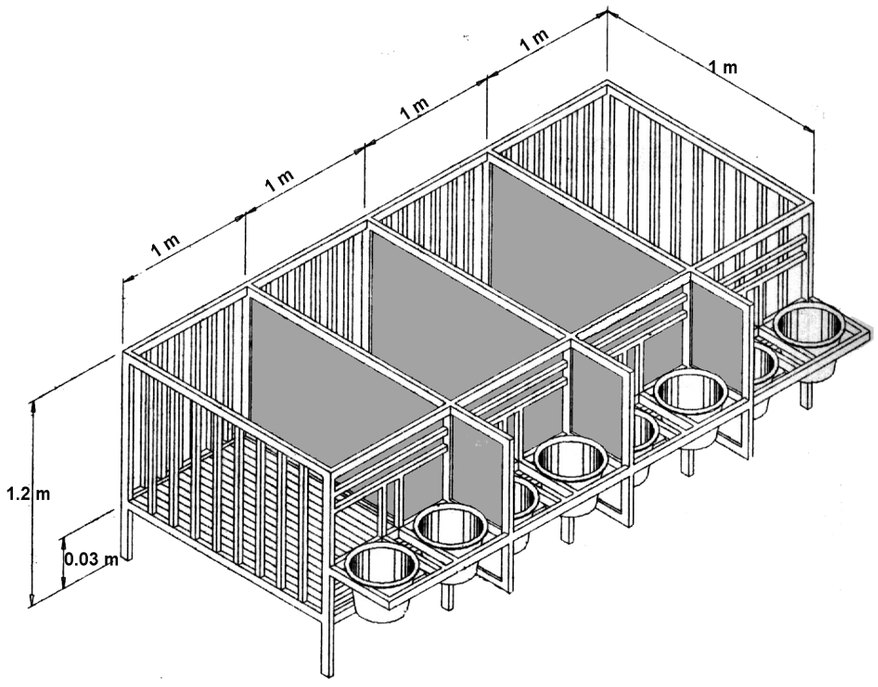
**Group the animal according to size and sex to minimize competition.*

The following table lists the recommended space requirement of animals according to class, age, size and sex.
Minimum floor space requirement for dairy buffaloes

CLASS, AGE, SIZE OF ANIMAL	FLOOR AREA (m2/ animal)
Calves (up to 3 months)	1
Calves (3-6 months)	2
Calves (7 months-one year)	3
Yearlings (1-2 years)	4
Heifers/Steer (2-3 years)	5
Milking and dry cows	6
Cows in maternity stall	10
Mature bulls	8

- Calf pen specifications (from birth to 3 months)

- The minimum space requirement is 1 m2 per animal (1 m width x 1 m length).
- The height of pen should be at least 1.2 meters.
- The elevated pen should have about 0.30 m (30 cm) high from the ground to facilitate cleaning.
- Wood or GI pipes can be used depending on the available materials (concrete or slatted floor)
- The pens should be provided with 2-4 gallon-capacity drinking pail and another pail with 1-2 kg capacity for concentrate feeds.
- For unelevated pen, rice straw or hay, saw dust, rice hull, and wood shavings can be used as bedding to absorb excess moisture from urine and water spillage.



- Growing animals/heifers

  - For growing calves, yearlings, and heifers, the minimum space requirement is 2 to 4 square meters.
  - Allow the growing buffaloes to graze during daytime and confine them at night for practical management.

- Milking, pregnant, dry cows and mature bulls

The minimum space requirement is 6 square meters. Provide feeder and waterer in each pen.

- Calving buffalo

- It requires more floor space, i.e., about 10 square meters for comfort and easy movement.

Housing Fixtures

- Feeders

- Place the feeding trough along the sides of the pen.
- It can be made of bamboo, plastic drum (cut in half), or concrete material.
- The inside surfaces of feeder made of concrete material should be smooth with rounded corners to facilitate cleaning.
- Recommended dimension of feed trough:

  - Calves up to one year: 0.4m depth, 0.45m-0.70m bottom width, and 0.7-0.9m top width
  - Older animals: 0.25m depth, 0.4-0.65m bottom width, and 0.65-0.85m top width.

- Drinking or water trough

- It can be made of concrete or galvanized metal tanks.
- The shape should be cylindrical or trapezoidal.
- Provide with concrete or gravel packed aprons (coating) with a slope of 2%-4% to improve sanitation and keep the water clean.
- It can be elevated by 1 meter to facilitate easy filling and drinking.
- A plastic drum (cut in half) can also be used as a water trough.

Functional requirement and other facilities

- Maternity/calving pen

Provide maternity pen to cows that are two months away from parturition. It should be bedded with straw, rice hull, or any suitable materials for use during calving.

- Feed room

  Provide good storage facilities for all feedstuffs, such as hay, grain, mineral salt, and others. It should always be dry, protected from rodents, and not easily accessible to animals.

- Working corral/working chute

  - It is a concrete yard where weighing, vaccination, deworming, AI, pregnancy diagnosis, and other related activities are conducted.
  - It should have good drainage facilities.
  - One of the important fixtures at the working corral.

    - It is necessary to restrain the animals properly.
    - Recommended size of chute is 2 m long, 1 m wide, and 1.2 m high.
    - It can be made of GI pipes, wood or bamboo with concrete flooring.

- Milking parlor

  - It is one of the essential structures in a dairy farm.
  - It is a separate structure from the carabao pens to minimize the contamination of feeds, feces, urine, and dust.
  - Materials to be used are the same as the chute

- Isolation shed
  - Separate the sick animals from apparently healthy animals to avoid transmission of diseases to healthy stocks.
  - It should be located at the corner of the shed.

Health Management for Various Stages of Growth

Nancy S. Abes/Cyril P. Baltazar
Project Evaluation Officer III/Farm Superintendent
Philippine Carabao Center National Headquarters and Gene Pool

Meriam M. Cabling
Science Research Specialist I
Philippine Carabao Center at Central Luzon State University

Table 33. Health management common to all animals in the herd

ACTIVITIES	Calves (0-3 mos.)	Weanlings (3 mos-1 yr)	Growers (1-3 years)	>3 years (not pregnant)	REMARKS
VACCINATION					
Hemosep	>3 months	6 months	6 months thereafter		Hemosep vaccine
FECALYSIS and DEWORMING	>2 weeks	As needed (treatment depends on the result of fecalysis)			Albendazole, rafoxanide
TB TESTING	Once a year (for animals above 1 year old)				TB antigen
BRUCELLA TESTING	Every two years				Submit serum to a laboratory
MASTITIS TESTING				Case to case basis	Only lactating animals
DELOUSING	As needed				
BLOOD PARASITE MONITORING	Every 3 months/especially the start of rainy season				
VITAMIN SUPPLEMENTATION	Refer to program for each herd class				
TREATMENT	As needed				

Table 34. Herd health program

CLASSIFICATION	ACTIVITIES	FREQUENCY	MEDICATION USED	REMARKS
Calves (birth up to 3-4 months)	Navel cord treatment	After birth	2% Povidone Iodine	
	Weighing	Monthly		Until the animal reaches 300 kg
	Feeding of colostrum	0-5 days old 3-5 days old; follow-up as needed		
	Iron supplementation		Iron injectables	
	Multivitamins/ Vitamins ADE and B supplementation	3-4 months and below	Multivitamin injectables	Case to case basis
	Ear tag application	As soon as possible after birth		
	Provision of water and concentrate feeds	As early as 7 days		
	Dehorning	2 weeks		As needed
	Fecalysis	2-3 weeks old (if found positive, deworm and examine stool after 1 month)	Broad-spectrum dewormer: treatment based on fecalysis result	Treatment based on breaking the life cycle of the parasite
	Vaccination	3 months and above (initial dose) and 6 months thereafter (booster)	Hemosep vaccine	
Weaning up to 1 year	Fecalysis	As needed		Case to case basis
	Deworming	After fecalysis (if positive)	Treatment based on fecalysis result	
	Vitamin ADE supplementation	As the need arises	Vitamin ADE injectables	Especially in dry season
	Vaccination	6 months of age	Hemosep vaccine	
	Water flushing/ douche	After calving	Distilled water	Recommended for animals experiencing difficulty in delivery
Lactating cows(from calving)	Oxytocin administration	Only when needed (especially if there is no milk)	Oxytocin	For milk letdown and expulsion of fetal membranes
	Mastitis testing	Every week	CMT reagent and paddle	
	Mastitis treatment	Strict implementation of predipping and postdipping	Stripping	Intramammary infusion of antibiotics (when needed only)
Pregnant females (including those that are still milking)	Vitamin E & Selenium supplementation	When needed	Vitamin E & Selenium injectables	
	Deworming	2–4 week prior to calving	Albendazole	
Growing males and females (1-3 years old)	Vitamin ADE supplementation	As needed, quarterly	Vitamin ADE	
	Vitamin E & Selenium	As needed	Vitamin E & Selenium injectables	Case to case basis
	Fecalysis	As needed		Case to case basis
	Deworming	After fecalysis (if positive)	Treatment based on fecalysis result	
	Delousing	As needed	Amitraz	

Disease Prevention and Control

Nancy S. Abes/Cyril P. Baltazar
Project Evaluation Officer III/Farm Superintendent
Philippine Carabao Center National Headquarters and Gene Pool

Meriam M. Cabling
Science Research Specialist I
Philippine Carabao Center at Central Luzon State University

All management systems are designed and executed in such a way that livestock remains healthy and attains optimum production. Health is a state of optimum physiological functioning of all the system of the body rather that the state of normal existence without evidence of disease. All body structures should be normal and should function to their optimum capacity in relation to the animals' age, sex, and utility.

A healthy animal should show alertness without nervousness. It should eat, drink and sleep regularly. Posture should be easy and free. Glossy hair coat, movable elastic skin, bright and clear eyes, moist glistening mucous membrane, no abnormal discharge from natural orifices, and consistency in production.

Disease is indicated by such conditions as drop in milk yield, cessation of rumination, rough hair coat, off color and congested conjunctiva, dry and outstretched nostrils, salivation, hard breathing, and off feed. In group dwelling animals, prominent behavioral alteration indicates ill health.

Systemic approach to general examination

Handling of Sick Animals

Systemic approach to examination means diagnosis of animals in terms of body systems, namely: physical body condition, respiratory, digestive, cardiovascular, mammary, and urogenital systems.

Steps

1. Get the disease history (what, where, when, who)
2. Observe for abnormalities in the following:

a. Posture and locomotion, i.e., animal's ability or inability to stand

- Can the animal stand on its own?
- Arched back?
- Lameness?

b. Behavior

- Incoordination?
- Jerky movement?
- Excessive salivation?

c. Physical condition, i.e., swelling on any part of the body, body condition score (BCS), hair and skin condition, color of mucous membranes

- Dehydrated, severely thin or obese/fat
- Dull and rough haircoat
- Infestation with external parasites (e.g., louse)

d. Vital signs: Pulse, temperature, and respiratory rate

- Normal pulse rate: adult: 60-90 beats/min
  calf: 90-110 beats/min
- Normal rectal temperature: adult: 38°C-39.5°C
  calf: 38°C- 40°C
- Respiratory rate: adult: 15-35 breaths/min
  calf: 20-50 breaths/min

How to Assess Vital Signs?

Pulse (rhythmic, periodic thrust felt over an artery in time with the heartbeat)

- Touch artery at the lower edge of the jaw (external maxillary artery).
- Hold it steadily with the fingers and apply gentle pressure.
- Count the pulse for one full minute to determine the rate.

Temperature (degree of heat of a living body)

- Ensure proper restraint of the animal. Measure its body temperature using a clinical thermometer.

When using the thermometer,

- Shake the mercury column into the bulb end.
- Moisten or lubricate the tube.
- Insert the bulb end through the anus into the rectum until its full length and leave for 2 to 3 minutes.

Respiration (act of breathing)

- Observe the chest and abdomen during inspiration and expiration or expulsion of air from the lungs.
- Count the number of inspiration (expansion of chest and thorax) per minute.

e. Respiratory system, e.g., difficulty in breathing

- Nasal discharge (unilateral or bilateral)
- Consistency (watery, cloudy, bloody)
- Thoracic (chest) or abdominal breathing
- Coughing

f. Digestive system

- Appetite

  - Decrease in appetite - be able to differentiate as a sign of possible disease against estrus behavior
  - Loss of appetite is a major indicator of sickness
  - Abnormal appetite, e.g., craving for non-food materials and excessive licking of another animal

- Rumination should be regular and evenly distributed at approximately 360-790 times a day.
- Infrequent, impaired or absence of eructation due to tympany or bloat
- Gas accumulation in milk-fed calves due to fermentation or decomposition of milk in the forestomach.
- Vomiting
- Difficulty in defecation
- Diarrhea/shooting diarrhea or watery feces
- Rumen

  - Normal rumen feels moderately soft

- Colic, if the animal shows any of the following:

  - Restlessness
  - Alternate lifting of the feet
  - Kicking at the belly
  - Frequent lying and standing

- Distention of abdomen

Getting the heartbeat

g. Cardiovascular system (heart and blood vessels)

- Involvement/occurrence of the disease may be primary or secondary.
- Observe for:

  - Blood-tinged discharge in body openings
  - Cold ears or extremities
  - Animal gets tired rapidly during movements
  - General stiffness
  - Abnormal pulse
  - Fever
  - Pale or cyanotic (bluish) mucous membranes

- Circulatory shock: Critical condition: severe dehydration

  - Fall in blood pressure indicated by rapid, weak, and “thready” pulse
  - Pale mucous membranes
  - Cold extremities
  - Shallow and rapid breathing
  - Lying down

h. Mammary system

- Swelling and discoloration of the udder
- Abnormal discharge or secretion
- Blood-tinged milk
- Injuries

i. Urogenital system

- Difficulty/straining in urination
- Blood-tinged or dark-colored urine

Difference between healthy and sick animal

Parameter	Apparently Healthy Animal	Apparently Sick Animal
Appearance/Behavior	Alert, active and aware of its surrounding	Usually separates itself from the herd Excessive licking of other objects other than feed or supplement
Posture	Straight back	Arched back
Movement (gait)	Walks easily and steadily with all of its feet taking its weight	Irregular movement results from pain in the feet or limbs Incoordination and jerky movement
Physical condition	Smooth and shiny coat	Presence of swelling in any part of the body Dull, rough or scaly coat
Eyes	Bright and alert	Presence of abnormal discharge and discoloration of the eyes Sunken eyeballs
Ears	Move in the direction of any sound	Abnormal discharges Cold when felt
Nose and Muzzle	The nose should be clean with no discharge The muzzle should be moist	Abnormal nasal discharge Dry muzzle Excessive salivation Presence of erosion, vesicles, and masses
Breathing	Smooth and regular at rest Movement and hot weather will increase the rate of breathing	Heavy with unusual sound
Manure	Firm	Sour smell Tarry, extra stiff, very soft or watery
Appetite and Rumination	Eats and drinks normally Chewing cud	Decrease in appetite or not eating nor ruminating Not chewing cud
Milk		Sudden drop in milk production Blood in milk; mastitis (inflamed mammary gland)

Being able to differentiate sick from healthy animals is imperative for optimum performance of the herd. This is by way of early detection, treatment, control and prevention of the spread of the disease. Having knowledge on the signs and symptoms of the disease can be of great help to the animal raiser especially in the absence of a veterinarian or animal health technician. Immediate action of the animal raiser is the most crucial part in treatment of emergency cases, e.g., bloat and prolapse.

Preventing the Entry of Diseases in the Farm

Strict Quarantine Measures

1. Quarantine new stocks for at least 30 days. Examine and declare free from any infectious diseases prior to introduction to the rest of the herd.
2. Require regular herd screening or testing for brucellosis, leptospirosis, tuberculosis, trypanosomiasis, blood parasites, and other diseases.
3. Remove test-positive animals.

Farm Gate Disinfection Procedures

1. Observe the use of footbath for personnel and wheel bath for vehicles entering or leaving the farm. Use iodine-based disinfectant, the most potent and widely-used disinfectant in the farm. Other disinfectants, such as quaternary ammonium compounds and phenols may also be used. Clean and change the footbath and wheel bath weekly to maintain their potency.
2. Personnel coming into (i.e., traveling from the outside to) the farm must change clothing and footwear before entry.
3. Limit the entry of visitors and vehicles into the farm.

Preventing the Spread of Diseases

Prevent the transfer of disease from animals to animals, animals to humans, and humans to animals through proper handling and strict compliance to farm protocols. Since zoonotic diseases are transmissible to humans, animal handlers must always practice high level of safety.

1. Always begin herd inspection from the young stocks to mature animals.
2. Always examine healthy animals first before the sick animals.
3. Conduct routine check-up of the herd first before performing necropsy.
4. Self-quarantine the personnel after performing necropsy.
5. Use new needles for every injection especially when treating an animal.
6. Wash, disinfect, and store all equipment in a clean and dry place after every use.
7. Clean and maintain the working area especially after each work session.
8. Observe for any abnormal signs exhibited by the animals and move them to the examination area.
9. Isolate or keep sick animals in a confined area while undergoing treatment.

Regular Disease Monitoring and Surveillance

- Conduct regular testing against brucellosis, tuberculosis, leptospirosis, and parasitic diseases.
- Check for surra or trypanosomiasis especially at the onset of rainy season.
- Conduct a weekly California Mastitis Test (CMT) for all lactating animals.

Safety Measures to Protect Against Highly Transmissible Diseases

- Always wear the prescribed uniform (e.g., rubber boots and working clothes) inside the farm premises.
- Always wear gloves during animal examination and when collecting blood, feces, secretions, and other laboratory samples.
- Always wash hands thoroughly with soap and water before and after handling animals.
- Always use hand antiseptics and disinfectants after treatment of sick animals.

Common dairy buffalo diseases

A. Infectious Diseases

1. Mastitis

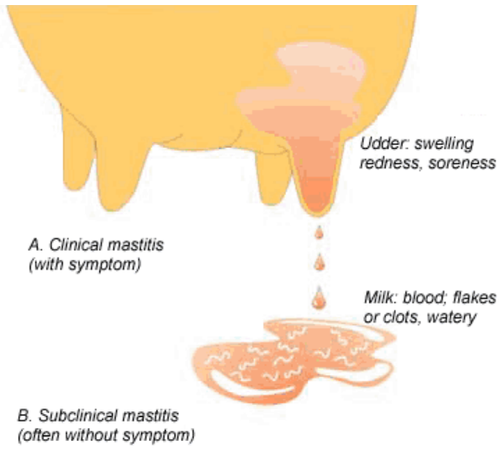
Mastitis is an inflammation of the mammary glands and may be classified as acute or chronic. In many milk-producing countries, mastitis may be the costliest disease of the dairy industry.

Why do cows get mastitis?

In healthy teats, few bacteria enter because:

- the skin protects them against bacteria; and
- the teat opening is tight since a waxy substance seals the opening.

If the teat is unhealthy, has a lesion, or is dirty, bacteria can easily enter and spread to the cow's mammary glands, then, the cow gets mastitis.



Causes

- Injuries to teat and udder
- Damage by defective milking machines
- Poor milking methods
- History of mastitis
- Dietary problems

Remember:

Cows can also get mastitis because other diseases such as metritis, pneumonia, digestive problems or low nutrition, make them weak.

Types, Signs, and Symptoms

1. Subclinical mastitis

- no change observed in the milk or the udder, but the microbial count and somatic cell count are high
- harder to detect than other types of mastitis

2. Clinical mastitis

- typical swelling of the affected udder; the animal feels pain when udder is touched
- milk is altered and blood is sometimes seen, as well as flakes, clots and colorless pus

Types of clinical mastitis

a. Acute mastitis – life-threatening

Signs

- Fever
- Reduced feed intake
- Mammary gland is swollen, hot, and painful
- Reduced milk production

b. Chronic mastitis

Signs

- Udder is slightly swollen and hard
- Appearance of milk is slightly abnormal
- In some cases, mammary glands cannot produce milk. The gland is replaced by hard, nodular connective tissue.
- CMT or laboratory test will confirm diagnosis

Diagnosis

1. Stripping
   - detects clinical mastitis
   - flushes the bacteria out of the teat canal
   - stimulates milk letdown

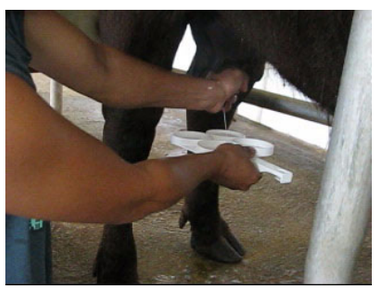
   How?

   a. Strip a few streams of milk on a strip cup.
   b. Observe if there is a presence of milk clumps or blood.
   c. Clean and sanitize the strip cup between each milking.

2. California Mastitis Test (CMT) measures the approximate number of somatic cells present in milk.
3. Bacterial culture of milk is the isolation and identification of microorganisms that cause inflammation of the mammary gland (over 50,000 bacteria/ml can indicate the source of contamination).
4. Somatic cell count, where a high number of somatic cells is associated with a reduction in milk production (over 200,000 cells/ml indicates subclinical mastitis).

How to Perform CMT?

1. Milk a few streams of milk from each teat into different holes of a paddle strip cup.



2. Add approximately 2 ml of the CMT reagent to the foremilk on each hole.

3. Move the paddle gently.

4. Observe for the following results (Refer to CMT Scoring)

CMT Scoring (Radostits et al., 2000; Quinn et al., 2000)

California Mastitis Test Scores	Reaction Observed	Equivalent Milk Somatic Cells/ml
Negative (0)	Homogenous mixture, no thickening	0–200,000
Trace	Slight (faint, cloudlike) thickening that disappears in about 10 seconds	150,000–500,000
1	Distinct slime formation occurs immediately after mixing, but no tendency to form a gel. This slime may dissipate over time	400,000–1,500,000
2	Distinct slime formation occurs immediately after mixing, with a slight gel formation	800,000–5,000,000
3	Distinct slime formation occurs immediately after mixing; distinct gel is formed and the surface of the mixture becomes elevated like a fried egg	>5,000,000

Remember:

- CMT can give a rough indication of somatic cells present and only the laboratory cell counts can give the exact figures.
- The age of the cow, stage of lactation, teat or udder injury, stress or other diseases also affect the somatic cell count.

Treatment

- Stripping of affected teats twice a day until no milk clots are observed or no milk is left at the teat cistern.
- Normal treatment involves the infusion of antibiotic preparation into the teat canal. In acute cases, however, systemic treatment may be necessary.

Remember:

- Antibiotics used for mastitis are prescription drugs and can only be obtained by a licensed veterinarian.
- Clean, dry, and disinfect the teats with alcohol or 10% povidone iodine before infusion.
- When infusing the udder, do not push the cannula of the syringe too far into the teat canal. It may damage the canal and cause further bacterial infection. Partial introduction (3-4 mm) into the teat opening gives much better treatment results.

Control and Prevention

9 Important Points in Preventing Mastitis

1. Maintain clean, dry, and comfortable environment in order to avoid the growth of mastitis-causing pathogens.
2. Prevent the entry of pathogens in the teat canal by teat disinfection pre and post milking.
3. Do not allow the animal to lie down for thirty (30) minutes after milking in order to prevent entry of pathogenic microorganisms.
4. Dry cow antibacterial therapy.
5. Use internal teat sealant.
6. Segregate and milk chronically affected animals last.
7. Use antioxidants in nutrition to reduce prevalence.
8. Monitor regularly the udder health status using somatic cell count and CMT.
9. Maintain the milking equipment properly.

Other Factors that may help in Preventing Mastitis

1. Plan the order of milking.
   a. Milk first the cows without mastitis.
   b. Secondly, milk the cows with suspected mastitis.
   c. Lastly, milk the cows with mastitis.

2. Keep accurate records.
   a. Keep record of mastitis incidents and treatment. This will help in finding problem cows.
   b. Follow the occurrence of mastitis, not only for each cow but also for the herd as a whole.
   c. Keep records on:

   - Identity of infected cows
   - Time of infection
   - Symptoms commonly observed
   - Treatment given

2. Liver Fluke Infection (Fasciolosis)

Liver flukes are flat, leaf-like parasitic worms. The infective stage of the worm is carried by a specific small snail. It is released by the snail and attach itself to the forages growing in watery areas such as rice fields, irrigation, creek, marshland, etc. It is the most common parasitic infection of water buffaloes in the field, characterized by high morbidity and mortality.

Adult flukes are found in the liver and gallbladder.

Causes

- Fasciola gigantica
- Fasciola hepatica (limited cases)

How is infection acquired?

- By allowing the animal to graze on or by hand feeding water-laden forages, which contain infective stage of liver flukes
- When the animal drinks from any bodies of water containing infective stage of liver flukes

Types, Signs, and Symptoms

1. Subacute fasciolosis

   - Severe liver damage upon necropsy
   - Animal dies from severe hemorrhage and anemia.
   - Animals usually survive within 7-10 weeks after acquiring the infection.

2. Chronic fasciolosis

   - Anemia
   - Chronic weight loss
   - Decreased milk production
   - Edema in the jaw
   - Usually, even heavily infected animals display no clinical signs

Diagnosis

- Examination of a fecal sample (fecalysis)
- High power ultrasonography (if available)

Treatment

- Treat the animal with any available flukecide (e.g., alternate treatment with triclabendazole, albendazole, and rafoxanide)
- Remove the animal from the source of infection
- Give liver tonic, vitamin ADE, mineral supplement

Control and Prevention

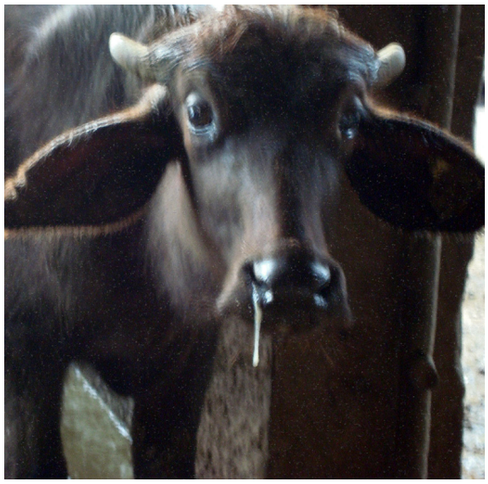
- Regular deworming of animals with any available flukecide; treatment regimen depends on the farm management system:
- Pure confinement – twice a year
- Freely grazing – 3-4 times a year
- Establish or develop a pasture or forage area that is free from snail (intermediate host).
- Practice pure confinement and feed the animal only from the developed forage area.
- If grazing of animal is preferred, then avoid bringing the animal in a waterlogged area.
- Sun-dry for one day the harvested grasses from waterlogged areas before feeding.

3. Hemorrhagic Septicemia

Hemorrhagic septicemia (HS) is an acute, highly fatal bacterial disease characterized mainly by respiratory signs. The disease is most devastating to smallholder farmers where improved husbandry and preventive practices are wanting and free-range management is common. The disease is most prevalent during the rainy season.

Cause

Pasteurella multocida



How is infection acquired?

- Healthy animals harbor P. multocida (around 5% of total microbial population) in the tonsils, which can cause infection after periods of stress such as:

  - high temperature and humidity
  - concurrent infection (blood parasites, etc.)
  - poor nutrition
  - work stress

- Direct contact with infected oral or nasal secretions from either healthy carrier animals or animals with clinical disease
- Ingestion of contaminated feed or water

Signs and Symptoms

- Nasal discharge
- Dyspnea or breathing difficulty
- Fever (40°–41.1°C)
- Excessive salivation
- Enlargement of the neck area
- Loss of appetite
- Abdominal pain and diarrhea (some cases)
- Death can occur within 8-24 hours after the first signs developed.

Diagnosis

- Check for history of outbreaks, vaccination lapses, and environmental conditions contributory to infection.
- Based on clinical signs (e.g., fever and edematous swellings, which indicate typical HS) and characteristic necropsy lesions
- Isolation and characterization of the pathogen using conventional and molecular techniques

Treatment

- Treat immediately using appropriate antibiotics prescribed by a licensed veterinarian. (Note: Administer antibiotics immediately at the onset of HS since it progresses rapidly.)

Control and Prevention

- Regular vaccination (twice a year for endemic areas)
- Avoid stress/overcrowding
- Proper feeding
- Quarantine of infected or suspected herd/animal
- Regular disinfection of the premises

4. Bovine Tuberculosis

Bovine tuberculosis (BTb), is a chronic bacterial disease in ruminants such as water buffalo. It is equivalent to human tuberculosis. This disease from water buffalo can also infect humans.

Cause

Mycobacterium bovis

How is infection acquired?

- An infected animal is the main source of the organism, which is excreted in exhaled air, sputum, feces, milk, urine, and vaginal and uterine discharges.
- It can be transmitted to healthy animals through:

  - Inhalation of contaminated dust particles or droplets
  - Ingestion of infected and unpasteurized milk by calves
  - Direct contact with urine, feces, or vaginal and uterine discharges

Note:

Human can acquire infection through:

- Inhalation of contaminated droplets
- Drinking unpasteurized milk
- Eating uncooked contaminated meat

Warning

BTb can also infect humans, especially those who have direct contact with the animals (e.g., veterinarians, farm workers, farm owner). It is important to wear personal protective equipment (e.g., boots, mask, gloves, eye protector, working clothes) when dealing with suspect/infected animals.

Signs and Symptoms

- In the early stage, there is no clinical sign except for the appearance of general inactivity and discomfort.
- Persistent cough
- Loss of appetite
- Gradual loss of body condition
- Persistent diarrhea
- Hard and painless enlargement of the mammary gland
- Watery milk
- Presence of cheese-like mass in the lungs and lymph nodes upon necropsy

Diagnosis

- Intradermal tuberculin test at the base of the tail
- Comparative Tb testing using purified protein derivatives from M. bovis and M. avium once tested as reactor for intradermal tuberculin test
- Interferon gamma assay
- Necropsy findings of the classic "tuberculous" mass in the lungs and lymph nodes (suggestive of BTb)
- Culture/isolation of the bacteria
- Molecular test (Polymerase Chain Reaction or PCR)

Treatment

- Treatment is not recommended due to the costs involved.
- Immediate culling and slaughter of the animal once confirmed positive

Control and Prevention

- Regular herd intradermal skin testing (once a year, once every two years)
- Quarantine of infected or suspected herd/animal
- Slaughter testing
- Regular milk pasteurization

5. Johne's Disease

It is a chronic, highly transmissible granulomatous enteritis characterized in cattle and water buffalo by persistent diarrhea, progressive weight loss, debilitation, and eventually death. It is a priority disease for international trade.

Cause

Mycobacterium paratuberculosis, also known as Mycobacterium avium subsp. paratuberculosis

How is infection acquired?

- Through herd expansion or replacement purchases (export from countries endemic for this disease)
- *M. paratuberculosis* is excreted in large numbers in the feces of infected animals and in lower numbers in their colostrum and milk.
- Through the fecal-oral route, ingestion of the organism when nursing on contaminated teats, consumption of milk, solid feed, or water contaminated by the organism, or licking and grooming behavior in a contaminated environment

Signs and Symptoms

- Infection is acquired early in life (often soon after birth) but clinical signs rarely develop in less than 2 year-old animal because progression to clinical disease occurs slowly.
- Weight loss and diarrhea occur in the late phases of infection, but infected animals can appear healthy for months or even years.
- Ventral and intermandibular edema may develop due to a protein-losing enteropathy.
- Drop in milk yield
- The disease is progressive and ultimately terminates in emaciation and death.

Diagnosis

- Bacterial culture from fecal sample
- PCR
- ELISA

Treatment

- Not recommended
- Immediate culling and slaughter of the animal once confirmed positive

Control and Prevention

- Introduce replacement stocks that are free from the disease.
- Employ good sanitation and management practices aimed at limiting the exposure of young animals to the organism.
- Routine testing using ELISA

Surra or Trypanosomosis

It is an infection caused by blood and occasional tissue parasite to a variety of animals, which is transmitted by biting flies. The disease has devastating effect on livestock health and leads to incalculable economic losses.

Cause

Trypanosoma evansi

How is infection acquired?

- Transmission via biting flies (horse flies) from one animal to another

Signs and Symptoms

Subacute

- Intermittent (on-and-off) fever
- Dullness and depression
- Circling movement
- Sudden drop in milk production
- Slight enlargement of pre-scapular lymph nodes
- Inflammation of the eyes and white mucoid discharge from eyes
- Anemia, loss of body weight, weakness, emaciation
- Abortion

Peracute

- Nervous signs (convulsions, ataxia, apparent blindness, frenzy, and circling movement) and after which, animal dies

Acute

- The animal looks dull
- Shows staggering gait, staring wide open eyes, circling movement
- Fever
- Death in 6-12 hours

Chronic

- Weakness
- Progressive loss in body condition
- Anemia
- Corneal opacity
- Lowered efficiency/production losses
- Water buffaloes usually manifest chronic and asymptomatic type of infection

Diagnosis

- Check for history of surra
- Presence of biting flies (horse flies), which is detected by setting up Nzi traps
- Presence of clinical signs and symptoms
- Laboratory examination of the blood and body fluids by:
  - Thick blood smear
  - Microhematocrit test (checking the presence of trypanosomes in buffy coat)
  - Mouse inoculation test
  - PCR

Treatment

- Use of curative prescription drugs specifically against *Trypanosoma spp.* (consult a licensed veterinarian on the appropriate drugs to be used).

Control and Prevention

- Control of the causative agent
  - Chemoprophylactic treatment using prescription drugs twice a year (before the onset of rainy season and 6 months thereafter)
- Control of the vector
  - Use of Nzi traps specifically for horse flies
  - Insecticide-impregnated cloth (specific shade of blue cloth is an attractant for horse flies)

Note

- Select trypanocides carefully, keeping in mind the problem of drug resistance development in the area.
- Treat the animals for surra before doing any vaccination program, as immunosuppression caused by trypanosomes can interfere.
- Regular disease surveillance and monitoring in apparently healthy animals

7. Leptospirosis

It is an infectious bacterial disease that has a worldwide distribution. It can also infect human aside from a variety of animals.

Cause

Leptospira spp.

How is infection acquired?

- Direct contact; entry through mucous membranes of the eye, mouth, nose or genital tract

Signs and Symptoms

Acute

- Fever
- Hemolytic anemia
- Blood-tinged urine
- Liver damage (jaundice)
- Meningitis (occasional)
- Blood-tinged milk (small quantity)
- Loss of milk secretion

Chronic

- Premature birth
- Stillbirth
- Weak calves
- Abortion
- Infertility
- More common; can result in important economic losses due to reproductive wastage

Diagnosis

- Bacterial culture/isolation
- Direct visualization of organism by dark-field microscopy
- Microscopic agglutination test (MAT)
- Enzyme-linked immunosorbent assay (ELISA)
- Nested PCR
- Loop-mediated isothermal amplification (LAMP)

Treatment

- Administer appropriate antibiotics prescribed by a licensed veterinarian
- Supportive symptomatic treatment (analgesic, etc.)
- Vaccination in combination with antibiotic treatment to obviate chronic reproductive wastage (given that the Leptospira strains in the vaccine is the same with infecting strains present in the area)

Control and Prevention

- Vaccinate
- Disinfect farm premises regularly
- Segregate infected animal(s) from the herd
- Restrict entry of other animals (e.g., dogs, cats, rats, mouse) in the farm

Warning

Leptospirosis can also infect humans, especially those who have direct contact with the animals (i.e., veterinarians, farm workers, farm owner). Wear personal protective equipment (boots, mask, gloves, eye protector, working clothes) in dealing with suspect/infected animals.

8. Brucellosis

It is a highly transmissible infectious disease in livestock, which represent an enormous economic impact particularly in developing countries due to reproductive problems, reduced milk production, and restrictions on animal movements and trade.

Cause

Brucella abortus

How is infection acquired?

- Infected water buffalo expels the bacterium during abortion, and this may serve as a source of infection for herdmates, through direct contact or indirectly (through contaminated wallowing area)
- Coitus or sexual intercourse

Signs and Symptoms

- Abortion, predominantly in the last trimester of gestation
- Premature births followed by retention of placenta and metritis
- Non-viable calves
- Infertility
- Reduction of milk production
- Lameness (in dairy cow)
- Epididymitis and orchitis (in bulls)

Diagnosis

Direct Methods

- Bacterial culture/ isolation
- PCR

Indirect Methods

- Rose Bengal Plate Test (RBPT)
- ELISA
- Milk ring test
- Complement fixation test

Treatment

- Not recommended
- Immediate culling and slaughter of the animal once confirmed positive

Control and Prevention

- Regular serologic tests and slaughter/eradication of positive animals
- Vaccination of all susceptible host in high prevalence countries or regions
- Regular disinfection of farm premises
- Segregation of suspect or infected animal/s from the herd

Warning

Brucellosis can also infect humans, especially those who have direct contact with the animals (veterinarians, farm workers, farm owner). It is important to wear personal protective equipment (boots, mask, gloves, eye protector, working clothes) in dealing with suspect/infected animals.

B. Non-Infectious Diseases

1. Bloat

It is an overdistention of the ruminoreticulum with the gases of fermentation, either in the form of a persistent foam mixed with the ruminal contents or in the form of free gas separated from the ingesta.

Types

1. Primary or frothy bloat
2. Secondary or free-gas bloat

Causes

Primary or frothy bloat

- Feeding large amount of fresh grass with high (>80%) moisture content
- Feeding more than the recommended amount of fresh leguminous plants (>30% of the diet)
- Sudden change in the diet

Secondary or free gas bloat

- Esophageal obstruction due to a foreign body (e.g., rope, etc.)
- Stenosis or pressure from enlargement outside the esophagus
- Ruminal atony that occurs in anaphylaxis and in grain overload

Signs and Symptoms

- Distension of the upper left side of the abdomen (paralumbar fossa or hunger hallow)
- Loss of appetite
- Inability to move
- Lying on its right side
- Difficulty in breathing

Diagnosis

- Checking the abnormal distention on the left hunger hallow from the back of the animal
- Observation of the mentioned clinical signs
- The causes of secondary bloat must be ascertained by clinical examination to determine the cause of the failure of eructation.
- If only one animal is affected in the herd, then the bloat is probably gaseous but if several animals are affected to varying degrees and they are at the pasture, then the diagnosis will certainly be frothy bloat.

Note

Progression of bloat is rapid, thus, give immediate intervention to the animal.

Treatment

For free-gas bloat,

- Disinfect the skin where the hunger hollow is located.
- Puncture the skin and rumen using a clean trocar and cannula.
- Identify the cause of bloat.

Note

- Make an incision to the skin if inserting the trocar and cannula is difficult.
- If there is no trocar and cannula, then metal tubes (such as antenna or metal trunk of umbrella) can be used as alternatives. Clean and disinfect prior to its application.

For frothy bloat,

- Administer or force feed mineral oil.

Note

- Use cooking oil as an alternative.
- If force feeding of oil is difficult, then insert the trocar and cannula and pour the oil directly into the rumen.

Control and Prevention

- Change the diet gradually.
- Minimize feeding high amounts of fresh legumes.
- Avoid overfeeding with concentrates.

2. Hardware Disease or "Wired Cow"

It is one of the common causes of death among water buffaloes, wherein pieces of metal or sharp objects are ingested, resulting in perforation of the reticulum and other adjacent organs such as liver, lungs, and heart.

Cause

- Swallowed metallic object like nails, wire, screw, distorted ring, welding rod, and bolt

Signs and Symptoms

- Drooling of saliva with the mouth open
- Sharp fall in milk production
- Decreased fecal output or scanty feces
- Usually shallow and rapid respiration
- Unable to stand (downer)
- While standing, the animal exhibits arched back (posture), reluctance to move, and uneasy gait.
- Body temperature is normal at the early stage

Diagnosis

- When pressure is applied just behind the front legs, a percussion or painful groaning noise is heard or felt.
- Appropriate ultrasound machine (if available)
- Electronic metal detectors (if available)

Treatment

- Perform surgical rumenotomy (rumen surgery) in the early course of the disease

Control and Prevention

- Cut or grind off exposed wire and remove them from the feeding area.
- Remove any wire, nails or other metal scraps from areas to which cattle have access.
- Include powerful magnets in feed mixers.

3. Foreign Body Syndrome

Cause

- Ingestion of non-food materials such as rope, plastics, and clothes that are mixed in their food

Signs and Symptoms

- Decreased fecal output or scanty feces
- Loss of appetite
- Vomiting (abnormal rumination)
- Intermittent production of stomach gases
- Loss in body condition

Diagnosis

- Appropriate ultrasound machine (if available)
- Clinical signs

Treatment

- Perform surgical rumenotomy (rumen surgery) in the early course of the disease.

Control and Prevention

- Practice complete confinement.
- Regularly remove any non-food materials that may be mixed in the food of the animals.
- Maintain the cleanliness in the farm.

4. Degnala Disease

It is a disease of water buffalo characterized by lameness, edema of the extremities, gangrenous ulceration or necrosis of mouth, ears, hooves and tail (sloughing of epidermis), general wasting, recumbency, and eventual death. The condition is usually without fever and limits the movements of the affected animals due to painful condition of the legs. It affects the milk yield of dairy animals leading to significant loss of milk yield. The disease is strongly associated with the feeding of rice straw containing multiple dark specks (i.e., fungal growth).

Causes

- Mycotoxin produced by different species of fungi namely *Fusarium spp., Aspergillus spp., Penicillium spp.,* etc. that grow in paddy/rice straws.
- Rural farmers usually practice improper storage of rice straw (as feedstock for water buffaloes), which likely spoils with fungal contamination.
- May be due to excess ingestion of toxic amount of selenium (Se) in rice straw grown on selenium-rich soil.

Signs and Symptoms

- Drying and necrosis of tail and ear tip
- Swelling of legs
- Drying, necrosis, and gangrenous lesion on foot
- Loss in body weight due to lack of appetite
- Reduction in milk production by 70%-80%

Diagnosis

- Check for history of feeding moldy rice straw
- Fungal culture (using samples from skin scraping and rice straw)
- Hematology examination

Treatment

- Stop feeding fungi-contaminated rice straw to the animal.
- Administer pentasulfate mixture for 10 days; 60 ml on first day, then 30 ml for next 9 days.
- Spray antibiotic and fly repellant to skin lesions.
- Supplement with vitamins and minerals.
- Give antibiotics for secondary bacterial infection (consult a licensed veterinarian for the appropriate prescription drugs).
- Provide selenium antagonists such as arsenic and sulfur.

Control and Prevention

- Avoid feeding of fungus-contaminated rice straw
- Appropriate drying and storage of rice straw
- Train or familiarize farm technicians and farmers about the disease

5. Dehydration/Water Deprivation

Cause

- Lack or inadequate source of drinking water

Signs and Symptoms

- Sunken eyes
- Dry mouth and nose
- Weight loss
- Fast or very slow pulse
- Cold ears and/or cold legs
- Dry, scant, and difficult-to-expel feces

Diagnosis

- Clinical signs
- Check for the history of management on the animal

Treatment

- Rehydrate by oral, intravenous, or subcutaneous administration of electrolytes.
- Consult a licensed veterinarian.

Control and Prevention

- Ensure available and sufficient supply of drinking water.

C. Postpartum Disorders/Diseases

1. Retained placenta

The placenta is normally expelled within 2-4 hours after calving. It is considered retained if it is not expelled by the animal 12 hours post-calving.

Causes

- Lack of uterine contractions due to:
  - Uterine inertia (primary or secondary)
  - Low level of calcium (likely to occur following an abortion and in cases of dystocia or difficulty in giving birth)
  - Hormonal deficiency particularly in estrogen
  - Improper balance of progesterone and estrogen

- Severe deficiency in selenium and Vitamins ADE
- Inflammation of placenta due to bacterial, viral, and fungal diseases
- Miscellaneous causes: short dry period, transport stress, changes in the locality in advanced pregnancy, high milk production, parasitic infestations, underfeeding, and other causes of debility

Signs and Symptoms

- Loss of appetite
- Decrease in milk production
- High rise in body temperature
- Severe straining
- Placenta hanging from the vulva
- Foul smelling discharge from the vulva
- Extreme retention of placenta leading to pyometra and septic metritis (may lead to toxemia)

Diagnosis

- Presence of degenerating, discolored, ultimately fetid membranes seen hanging from the vulva >24 hours after giving birth
- Foul-smelling discharge (when the retained membranes remain within the uterus and not readily apparent)
- Observance of other abovementioned signs and symptoms

Note

- Uncomplicated retention of fetal membranes is generally not directly harmful to the cow. However, cows with retained fetal membranes are at increased risk of developing metritis, ketosis, mastitis, and even abortion in a subsequent pregnancy.
- Cows that once had retained fetal membranes are at increased risk of recurrence at a subsequent parturition.

Treatment

- Inject oxytocin (only in cases where some part of fetal membrane is hanging from the vulva).
- Manipulate manually (if the placenta is hanging).
- Consult a licensed veterinarian.

Control and Prevention

- Feed with balanced ration (especially in the last 2 months of pregnancy) with adequate amounts of calcium and phosphorus.
- Supplement with Vitamin E and selenium (consult a licensed veterinarian).
- Supplement with Vitamin A.
- Supplement with calcium prior to expected date of calving.
- Provide adequate fiber in feeds.

2. Uterine/Vaginal Prolapse

It is the complete/incomplete eversion of the uterus, which usually occurs after abortion and calving.

Causes (Predisposing factors)

- obesity with concurrent hypocalcemia (low calcium level)
- birthing difficulty

Signs and Symptoms

- Everted vagina or uterus
- Severe straining

Diagnosis

- Confirmed by speculum or manual pelvic examination
- Presence of everted uterus seen hanging from the vulva of the animal

Treatment

- While waiting for veterinary assistance, isolate the cow immediately and clean the exposed part carefully with clean water.
- Use ice or sugar to reduce the swelling, cover the prolapse with wet towels, and support the prolapse above the vaginal level to avoid congestion.
- Facilitate replacement of the exposed part via epidural anesthesia while the cow is still standing and the hind legs are placed in a higher position compared to the front legs.
- Administer calcium borogluconate intravenously and broad-spectrum antibiotics.
- Apply Buhner sutures in the vulva to prevent the recurrence of prolapse.
- For mild cases, apply a rope that is tied around the pelvic area, then passing at the base of the tail and vulva, and finally locked in between the hind legs (known as “T-back”).

Note

Treatment of uterine/vaginal prolapse requires immediate attention to avoid extensive trauma to the uterus, which might result in further hemorrhage.

Control and Prevention

- Supplement with adequate amounts of calcium and phosphorus.
- Feed with fresh grasses (especially in the last 2 months of pregnancy).
- Avoid obese condition of the pregnant animal especially in the last trimester of pregnancy.

3. Birthing Difficulty (Dystocia)

It is a delayed or difficult calving, sometimes requiring significant human assistance. It has a considerable impact on production and future reproduction of dairy and beef cows.

Causes

Fetal

- Oversized fetus
- Disposition

  - Malposition (dorsal, ventral and lateral) of the calf in the birth canal
  - Abnormal posture of the legs (knee, hock and fetlock flexion, lateral deviation of the head and neck, posterior position of the calf)
  - Malpresentation or breech position
- Mummified fetus
- Twin calves

Photo by Dr. A. Salazar of PCC at CLSU

Maternal

- Anatomical (narrow birth canal)
- Constriction/obstruction of pelvic canal
- Pelvic injuries
- Vaginal prolapse

Signs and Symptoms

- Suspect dystocia if the delivery of the calf takes more than 2 hours, or if the cow stops straining.

Note

There are three stages of labor in normal calving:

1. Cervix dilation: lasts from 1 hour to 24 hours.
2. Calf birth: begins when the cow starts contracting; delivery should be completed within 2 hours after.
3. Placenta delivery: first 8 hours post calving.

Diagnosis

- Clinical signs
- Examination of vagina, cervix, water sac, calf position, and calf size

Treatment

- Call a veterinarian for an immediate assistance to correct the cause of the dystocia.

Control and Prevention

- Encourage farmers to leave the animal undisturbed for four hours after the appearance of a mucus string or allanto-chorion at the vulva. However, investigate any frequent bouts of powerful abdominal contractions occurring more frequently than every five minutes or so.

D. Mineral Deficiencies

1. Hypomagnesemia

It is a decrease in plasma magnesium (Mg) concentration.

Causes

- Reduction in food intake during inclement weather, transport, or when cows graze short-grass dominant pastures containing <0.2% Mg on a dry-matter basis
- Low herbage availability

Signs and symptoms:

- Suddenly throw their heads up, bellow, gallop in a blind frenzy, fall, and exhibit severe paddling convulsions
- Convulsive episodes may repeat at short intervals, and death usually occurs within a few hours
- In less severe cases, the cow is obviously ill at ease, walks stiffly, hypersensitive to touch and sound, urinates frequently, and may progress to the acute convulsive stage after a period of as long as 2–3 days

Diagnosis

- Usually confirmed by response to treatment followed by confirmation of hypomagnesemia in samples taken before treatment

Treatment

- Animals showing clinical signs require treatment immediately with combined solutions of Ca and Mg, preferably given slowly intravenously while monitoring the heart.

Control and prevention:

- Mg must be given daily to animals at risk because the body has no readily available stores

2. Hypocalcemia

Milk fever, post-parturient hypocalcemia, or parturient paresis is a disease, primarily in dairy cattle and water buffalo, characterized by reduced blood Ca levels. It occurs following birth of calf, at the onset of lactation, when demand for Ca for colostrum production exceeds the body's ability to mobilize it.

Cause

- Inadequate Ca in the body needed during giving birth and lactation

Signs and Symptoms

- Occurs within 72 hours after giving birth

Three Stages of Hypocalcemia

Stage 1

- Ambulatory but shows signs of hypersensitivity and excitability
- Mildly ataxic, has fine tremors over the flanks and triceps, and displays ear twitching and head bobbing
- Restless, shuffling its rear feet and bellowing

Stage 2

- Unable to stand but can maintain sternal recumbency
- Obtunded, anorectic, and has a dry muzzle, subnormal body temperature, and cold extremities

- Auscultation reveals tachycardia and decreased intensity of heart sounds.
- Peripheral pulses are weak.
- Smooth muscle paralysis leads to GI stasis, which can manifest as bloat, failure to defecate, and loss of anal sphincter tone.
- An inability to urinate may manifest as a distended bladder on rectal examination.
- Cows often tuck their heads into their flanks, or if the head is extended, an S-shaped curve to the neck may be noted.

Stage 3

- Cows lose consciousness progressively to the point of coma
- Unable to maintain sternal recumbency, has a complete muscle flaccidity, unresponsive to stimuli, and can suffer severe bloat
- As cardiac output worsens, heart rate can approach 120 bpm, and peripheral pulses may be undetectable. If untreated, then cows in stage 3 may survive only for a few hours.

Note

Hypocalcemia can contribute to dystocia, uterine prolapse, retained fetal membranes, metritis, abomasal displacement, and mastitis.

Diagnosis

Clinical signs
Dry chemistry test

Treatment

Restore normal serum Ca levels as soon as possible to avoid muscle and nerve damage and recumbency. Recommended treatment is IV injection of a Ca gluconate salt, although SC and IP routes are also used. A general rule for dosing is 1 g calcium/45 kg (100 lb) body weight.

Warning

Calcium is cardiotoxic. Therefore, administer Ca-containing solutions slowly (10–20 min) while performing cardiac auscultation. If severe dysrhythmias or bradycardia develops, then stop administration until the heart rhythm has returned to normal. Endotoxic animals are especially prone to dysrhythmias caused by intravenous Ca therapy.

Control and Prevention

Calcium supplementation months prior to expected date of calving

3. Downer Cow syndrome

If treatment of the underlying cause of recumbency is not successful and the animals are unable to rise for >24 hour after initial recumbency, they may develop a secondary recumbency from pressure damage to muscles and nerves, often termed “downer cow syndrome”.

An alert downer cow does not show signs of systemic illness or depression, is able to eat and drink, and remains in sternal recumbency for no apparent reason. A non-alert downer cow appears systemically sick and depressed downer cow syndrome also describes the pathology of pressure-induced muscle and nerve injuries after prolonged recumbency.

Cause

- Numerous metabolic, traumatic, infectious, degenerative, and toxic disorders.
- The most important pathophysiologic event that develops during prolonged recumbency is a pressure-induced ischemic necrosis of the thigh muscles that frequently affects both hind legs.

Signs and symptoms

- Unable to stand (recumbent)
- Weak
- Pressure may develop due to prolong recumbency

Treatment

- Downer cows are often hypocalcemic. If an apparently hypocalcemic cow does not respond to calcium therapy, potassium, phosphorus, and magnesium should be given as additional treatments pending results of laboratory tests.
- Monitoring blood mineral status is an important part of a downer cow management.
- In most cases, recovery depends on the quality of recumbency management and nursing care

Management of Downer Cow

- •Lateral recumbency must be corrected immediately to avoid regurgitation and inspiration of stomach contents.
- The animal should be rolled into sternal recumbency. However, if this posture is to be maintained, the limb on which the animal has been lying should be drawn from under the body. In other words, if the animal was presented in lateral recumbency on its left side, it should be rolled into sternal recumbency on its right side.
- Support (e.g., straw bale) placed under the shoulder may be required for some animals to maintain sternal recumbency.
- On every day of the recumbency, an attempt should be made to bring the cow to its feet. Several simple but effective techniques can be tried. In one method, the clinician stands with feet pressed under the cow at a point below the scapulohumeral joint. A sharp blow is delivered by driving the knees into the muscle mass below and caudal to the scapula.
- If the animal struggles to rise, an assistant should grasp the root of the tail with both hands and lift it. Recumbent cows must be provided with clean water at all times. A shallow rubber feed bowl prevents spillage. If the cow does not drink, she must be given fluid therapy either by drench or parenterally.
- Cow sling can be used from time-to-time to help the animal in standing and promote good blood circulation and proper posture.
- Every effort must be made to roll the cow from one side onto the other at least three times a day, with more frequent movement being desired.
- The downer cows most difficult to treat are those that do not try to eat. A cow that salivates on its feed will not eat it later. Rather than being offered large amounts of feed, the cow should be tempted with sweet hay.

E. Calf Diseases

Calf Scour or Diarrhea

Calf scour or diarrhea refers to an alteration in the normal pattern of defecation that results in the frequent passage of unformed stools. Calf scour is not a single disease. It is a clinical sign associated with several diseases characterized by diarrhea. Diarrhea prevents the absorption of fluids from the intestines of calves. This condition is life-threatening because scouring calf loses fluids and rapidly dehydrates, considering that a calf is approximately 70% water at birth. Calf scour causes more financial losses to cow-calf producers than any other health problems in their herds.

Causes

Non-infectious (predisposing or contributing factors)

- Inadequate nutrition of pregnant dam (poor quality of colostrum)
- Inappropriate environment for the newborn calf (poor hygiene and sanitation)
- Insufficient attention to the newborn calf
- Sudden change in feeding regimen can cause scouring and commonly affects suckling and newly weaned calves

Infectious

- Bacteria (Escherichia coli, Salmonella spp., Clostridium spp., and other bacteria)
- Virus (Rotavirus, Coronavirus, BVD virus, IBR virus)
- Fungi (yeasts and molds)
- Parasites (Ascaris spp., coccidia)

Signs and Symptoms

- Projectile, watery stool (may be brown, grey, green or yellow in color, with occasional blood and mucus)
- Anemia
- Weakness
- Fever
- Thin
- Sunken-eyed appearance, as a result of dehydration

Diagnosis

- Provide clinical (e.g., age, vaccination record, and clinical signs) and farm history to clinicians for determining the cause of diarrhea.
- Determine exact cause through bacteriology and tool examination.

Treatment

- Rehydrate by oral, intravenous, or subcutaneous administration of electrolytes.
- Thermal support (Provide beddings and appropriate shelter against wind, rain, sun, etc.)
- Consult a licensed veterinarian.

Preventive Measures

- Ensure that all newborn calves receive colostrum.
- Regular deworming of animals using an appropriate dewormer
- Segregate calves by age to prevent passage of infectious agents from apparently healthy older calves to newborns.
- Keep and maintain the calf stall clean and dry.
- Practice proper biosecurity measures.

Assessing the suitability of a cow's body condition and conformation for breeding

Ester B. Flores
Supervising Science Research Specialist
Philippine Carabao Center National Headquarters and Gene Pool

I. Characteristics of a desirable dairy cow

A. Fertility and reproduction

- Produces a live calf each breeding year
- Has feminine appearance
- Lean and trim in brisket, over its shoulders and flanks
- Long hips to pin bone
- High and wide pin bones

B. Feet and legs

- No lameness and swollen joints
- Hooves are well shaped and even
- Strong legs and feet

C. Mammary system

- Strong mammary system
- Evenly attached udder with close front teat placement and strong suspensory ligament
- Evenly shaped udders with moderate sized teats that are not too big nor too small
- Good udder depth and wide rear udder width

D. Body shape, size and capacity

- Cow is large enough with deep, wide chest and with an adequate body capacity
- Cows with very good body depth and capacity are always high producing cows.

Assessing body condition and conformation can be done in a systematic manner. Scoring systems for body condition and conformation are independent of each other but can be done together.

II. Body Condition Scoring (BCS) in Dairy Buffaloes

A. What is BCS System?

1. It is a system for evaluating nutritional status of dairy buffaloes.
2. An aim of BCS is to keep the animal healthy.
3. Dairy animals are scored from 1 to 5.

B. Features

1. BCS can be changed through feeding management.
2. It is not related with age.
3. It is an objective and standardized means to check the degree of accumulation and mobilization of body nutritional reserves, mostly body fat.
4. This is done by observing and palpating certain body parts.
5. BCS is usually done once a month
6. Very useful technology for veterinarians, extension workers, and farmers.

C. Implications

1. BCS of an animal is closely related to reproductive performance and milk production performance.

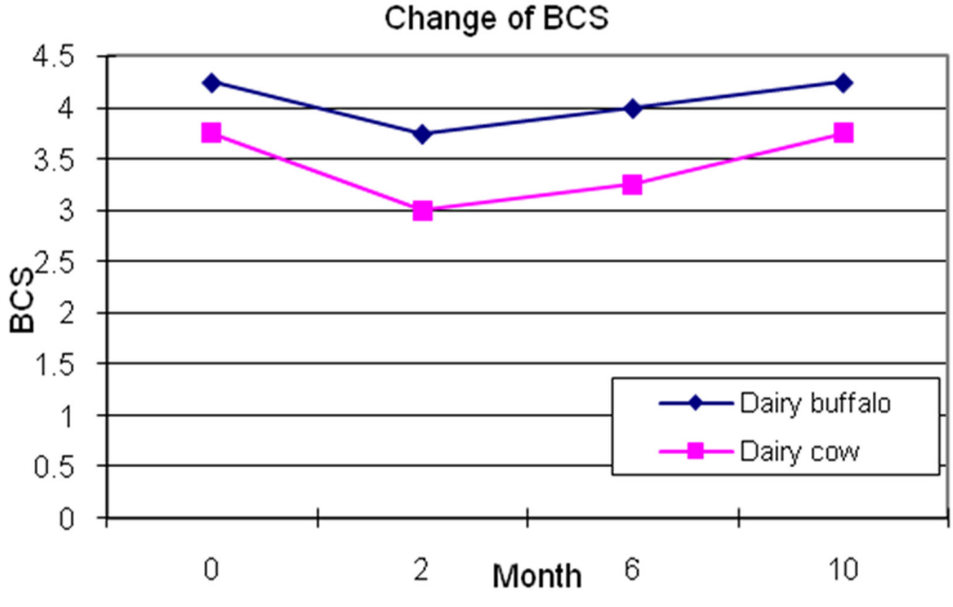
   • Too thin
   - Poor milk production
   - Retained placenta
   - Anestrus or unclear signs of estrus
   - Poor reproductive performance

   • Too fat
   - Dystocia or difficult parturition
   - Low milk production
   - Reproductive difficulties

2. BCS should not be more than 4.75 before calving.
3. BCS should not be less than 2.75 before breeding or at any given time in the lactation period.
4. BCS should not decrease more than 1 point after delivery. If this happens, this means the cow is not getting enough energy for maintenance and milk production.

D. Ideal body condition score for dairy buffalo cows

1. At calving : 4–4.5
2. 1-2 months after calving : 3–3.5
3. Dry period : 3.5–4

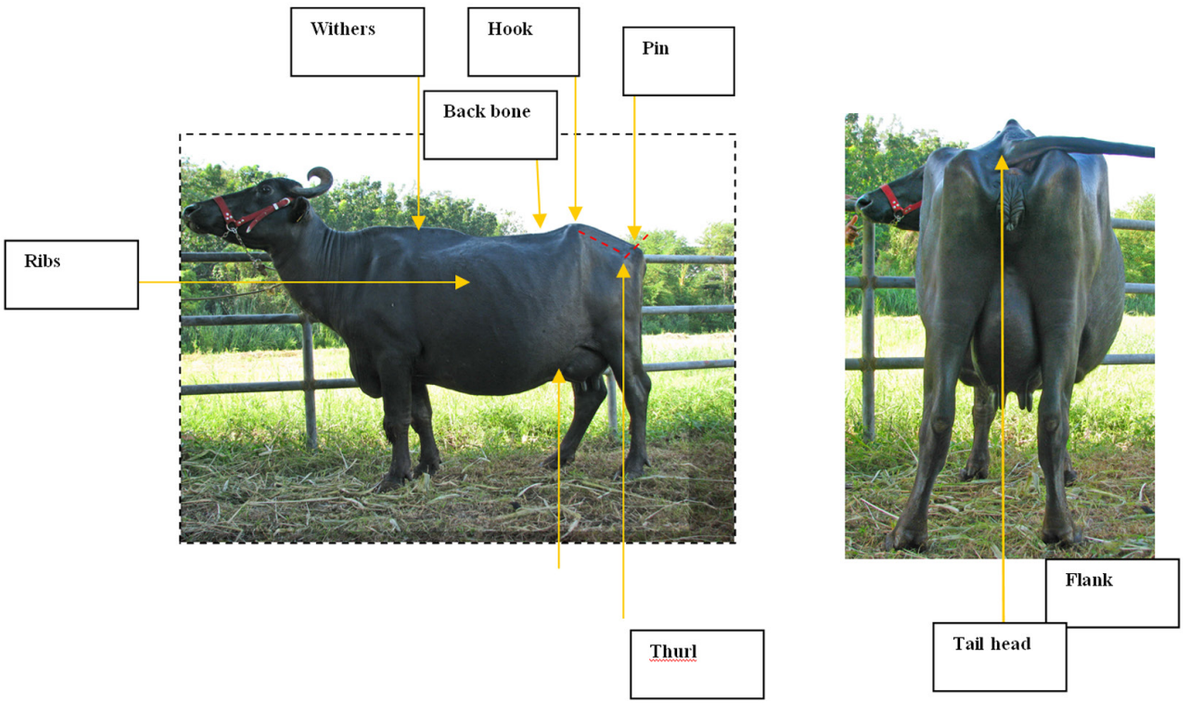


How to do body condition scoring

Begin by a review of the general names for the various body locations that will be referred to in the systematic approach to body condition scoring.

Keep in mind that this system of scoring is designed to be done from behind the animal. Also you may have to discard your old system of BCS, as the scores will probably be different.

Anatomical points for observation and palpation in Body Condition Scoring System



Step 1. First, view the pelvic area from the side. Check line from hooks to thurl to pin.
- Make a decision about the line over the thurl, this is the cut point between 3.0 or less and 3.25 or greater scores.
- If line forms a V, then the score is 3.0 or less.
- If the line forms a flattened U, then the score is 3.25 or greater.

Step 2. Palpate the pin bones and hip (hook) bones.
- Are the borders sharp or rounded?

Step 3. Observe the part on either side of the tail head and rectum.
- Is there a cavity or is the area filled?

Step 4. Observe the back bones
- Are they clear or not?

Step 5. Palpate the ends of the spine
- Are they sharp and covered only by skin, or rounded and covered by fat under the skin?

Step 6. Observe and palpate the ribs
- Are they individually visible or covered by muscle and fat?

Step 7. Integrate and interpret observations. Interpretation is as follows:

1. BCS 1 –Very thin

a. Backbone and ribs are very clear
b. Pin bone are angular
c. Part on either side of tail head and rectum has marked cavity
d. Rump is indented
e. No fat layer under the skin

2. BCS 2 - Thin

a. Backbone and ribs are still clear.
b. Pin bone are still angular.
c. Part on either side of tail head and rectum still has a cavity.
d. Rump is a little indented.
e. A thin fat layer under the skin

3. BCS 3 – Average

a. Ribs and backbone are a little clear.
b. Pin bone and hip bone are a little rounded.
c. Part on either side of tail head and rectum is a little filled.
d. Rump seems flat.
e. A medium fat layer under the skin

4. BCS 4 – Fat

a. Ribs and backbone are not visible.
b. Pin bone and hip bone are rounded.
c. Part on either side of tail head and rectum is filled.
d. Rump seems flat.
e. A thick fat layer under the skin

5. BCS 5 – Very fat, Obese

a. Ribs and backbone are not visible.
b. Pin bone and hip bone are not visible.
c. Part on either side of tail head and rectum is well filled.
d. Rump is very bulging.
e. A very thick fat layer under the skin

Step 8. Assign scores based on observation. Do this in a gradual manner.

a. Start with classification of exterior. Start if animal is 3.0 (average) score. If not, determine if animal is below or more than 3.0.
b. Use the various anatomical points' observation for a more detailed scoring, as shown below in assigning score

First Step		Second Step	Third Step
Score	Exterior	Score	Score
1	very thin	1	1.25
		1.5	1.75
2	thin	2	2.25
		2.5	2.75
3	average	3	3.25
		3.5	3.75
4	fat	4	4.25
		4.5	4.75
5	very fat	5	

III. What is Linear Type Trait Evaluation

Aside from taking milk production record and body measurements, linear type trait scoring is also being done. This is the best measure of evaluating body conformation to determine how close a cow is to an ideal dairy cow. This is taken only once in a cow, i.e., during the first three months after first calving, which is done to standardize measurement.

a. It is the basis of all modern type classification systems and serves as the foundation of all systems of describing the dairy cow.
b. It is based on the measurements of individual type traits instead of opinions in evaluating body conformation.
c. It describes the degree of trait and not the desirability of the animal.
d. We can adapt the same for dairy buffaloes.

As a management tool, this can be applied in:

- Breeding program
- Tracking of herd improvement
- Herd mate comparison

Advantage of linear scoring

- Traits are scored individually
- Scores cover a biological range
- Variation within traits is identifiable
- Degree rather than desirability is recorded

Scoring system for standard trait

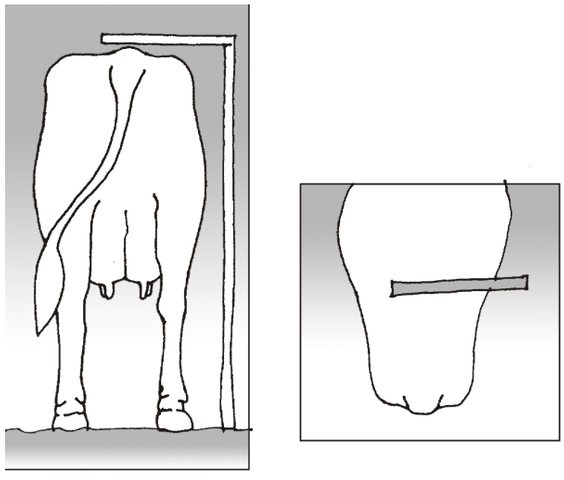
- Each trait is scored between 1 and 5 points.
- Scoring is based on the standard traits of a 3-year old buffalo.
- Do not make adjustments for stage lactation or nutrition in any trait. Rear udder width is the only exception to this rule.

Linear type trait evaluation

1. Stature

- Reference scale: 117 cm - 140 cm
- Measured from top of the spine in between hips to the ground.

1	Short	(117 cm)
3	Intermediate	(130 cm)
5	Tall	(135 cm)

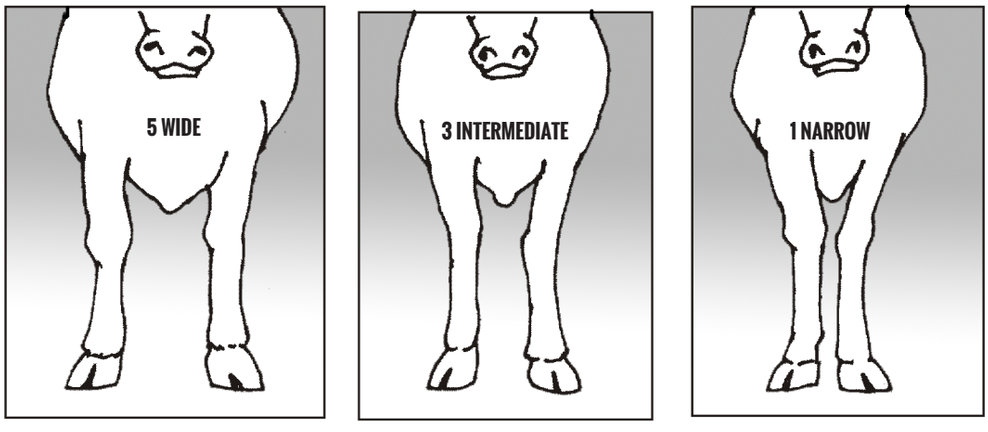


2. Chest Width

Measured from the inside surface between the top of the front legs.

- Reference scale: 10 cm - 29 cm; 2 cm per point

1	Narrow
3	Intermediate
5	Wide

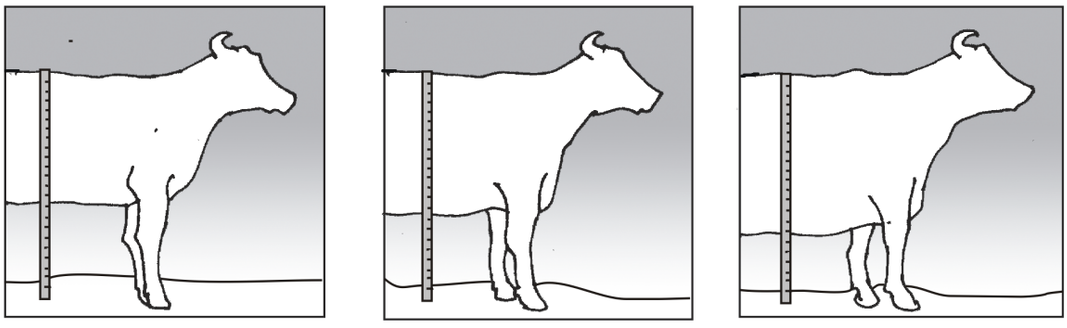


3. Body depth

- Distance between the top of the spine and bottom of barrel at last rib–the deepest point. Independent of stature.

  Reference scale: optical in relation to the balance of the animal

  1 – 2 Shallow 3 Intermediate 4 – 5 Deep

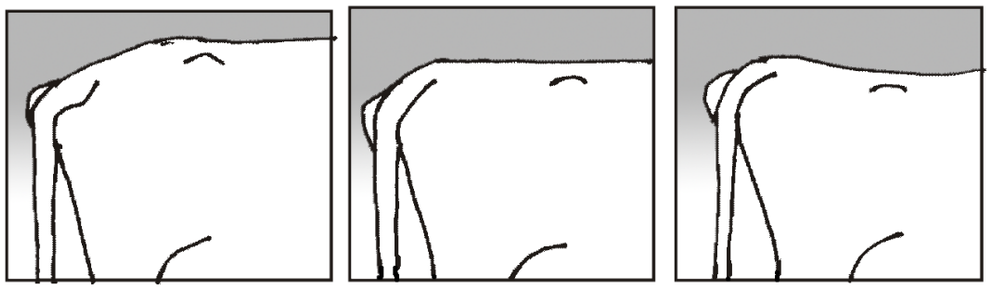


SHALLOW 1 | INTERMEDIATE 3 | DEEP 5

4. Rump angle

- Measured as the angle of the rump structure from hooks (hips) to pins.

1	High Pins	(+ 4 cm)
2	Intermediate	(+ 2 cm)
3	Level	(0 cm)
4	Intermediate	(- 4 cm)
5	Extreme slope	(- 10 cm)



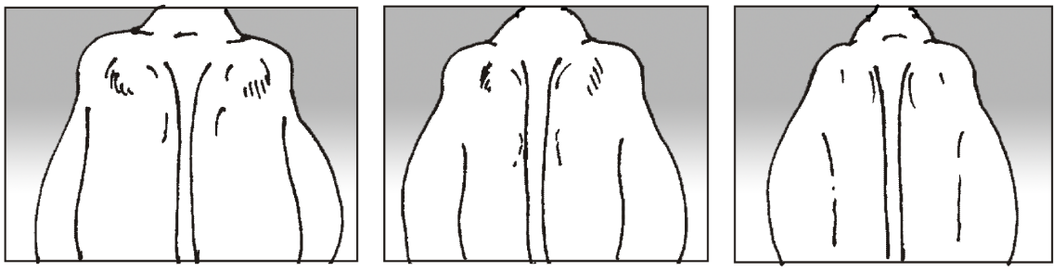
EXTREME 5 | INTERMEDIATE 3 | HIGH 1

5. Rump (Pin) width

- The distance between the most posterior point of pin bones.

  Reference scale: 10 cm-26 cm: 2 cm per point

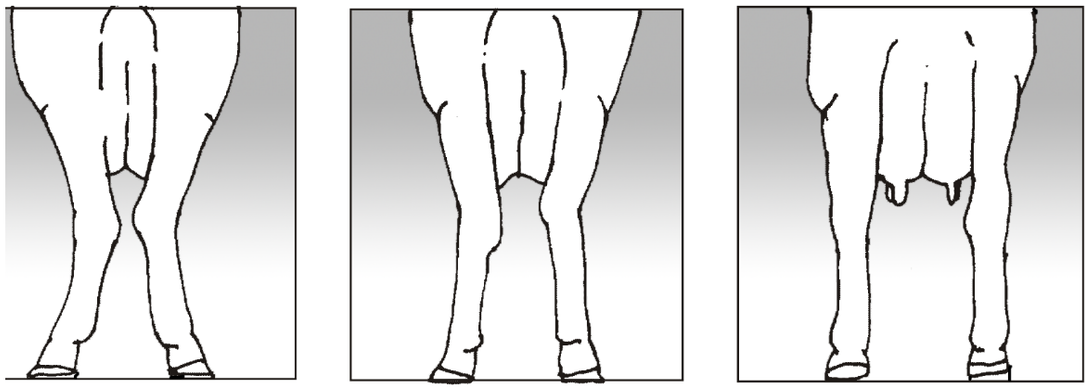
  4 – 5 Wide 3 Intermediate 1 – 2 Narrow



WIDE 5 | INTERMEDIATE 3 | NARROW 1

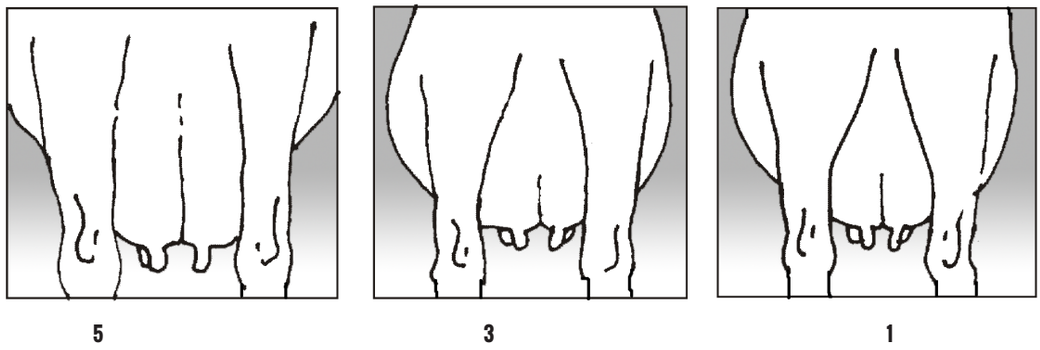
6. Rear legs, rear view

- Direction of feet when viewed from the rear.
  - 1 Extreme toe-out
  - 3 Intermediate: slight toe-out
  - 5 Parallel feet



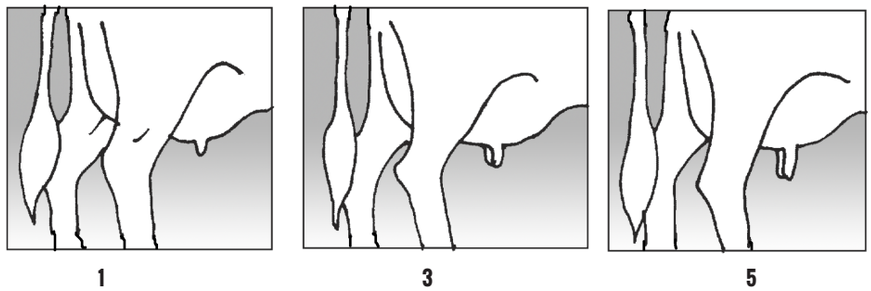
7. Rear udder width (optional traits)

- This is measurement of the width of the rear udder at the point where the lateral ligaments of the udder attach to the body.
- Adjust all cows for rear udder width to reflect their width at milking time (10 to 12 hours of milk).



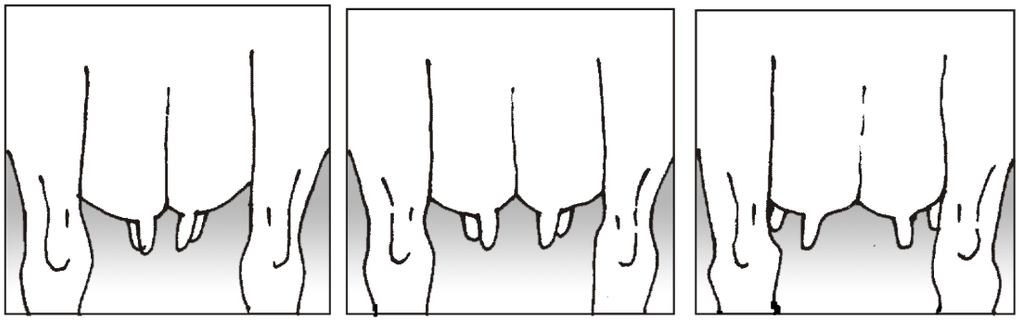
8. Teat length

- Length of the front teat:
  - 1 – 2 Short
  - 3 Intermediate
  - 4 – 5 Long
  - Reference scale: 1 cm - 9 cm; 1 cm per point



9. Front teat placement

- **The position of the front teat from center of quarter**
  - 1 – 2 Outside of quarter
  - 3 Middle of quarter
  - 4 – 5 Inside of quarter

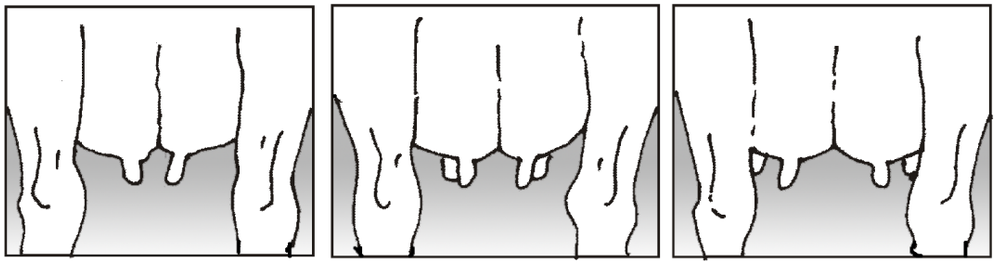


5 3 1

10. Rear teat placement

- The position of the rear teat from center of quarter.
  - 1 - 2 Outside
  - 3 Mid-point
  - 4 – 5 Inside of quarter

To obtain population distribution, it is recommended that 3 represents mid-point of the quarter.



5 3 1

Pointers in selecting replacement heifers for breeding

- **Prefer heifers that are:**

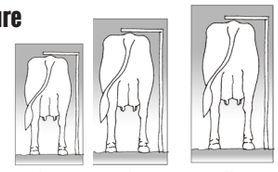
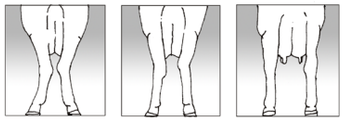
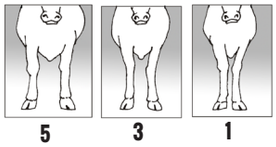
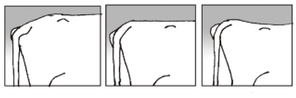
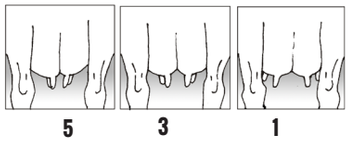
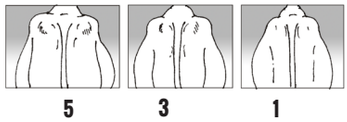
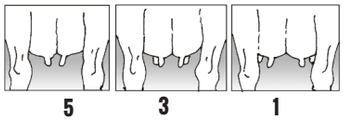
  - with known pedigree; at the very least, choose from cows with high milk production.
  - Preferably sired by bull out of AI
  - Choose heifers that are average or above average in weight for its age.

- **Prefer heifers that are of good conformation**

  - Should have no physical defects
  - Score conformation using the type trait score sheet

Animal ID Number:

LINEARIZED DESCRIPTIVE TRAITS
SCORE SHEET

Form	Score	Legs and Feet	Score
Stature  1 3 5		Rear Legs Rear View  1 3 5	
	Score	Udder	Score
Chest Width  5 3 1		Rear Udder Width  5 3 1	
	Score		Score
Body Depth  1 3 5		Teat Length  1 3 5	
	Score		Score
Rump Angle  5 3 1		Front Teat Placement  5 3 1	
	Score		Score
Pin Width  5 3 1		Rear Teat Position  5 3 1	
Topline			Score
 1  3  5			
Body Condition Score			Score
 1  2  3  4  5			

Heat detection, breeding services, recording and record keeping

Ester B. Flores/Peregrino G. Duran
Supervising Science Research Specialist/Scientist I
Philippine Carabao Center National Headquarters and Gene Pool

Grace R. Recta
Agricultural Center Chief IV
Philippine Carabao Center at Mariano Marcos State University

What is the purpose of breeding dairy buffaloes and how can you do it?

- Select animals that are happy and perform well under tropical conditions.

  - Must have good milk production
  - Must have ideal body conformation and mammary system that support high milk production
  - Produce live calf every breeding season
  - Good resistance to diseases and internal parasites

- Recognize signs of heat and breed at the right time.

What is reproduction?

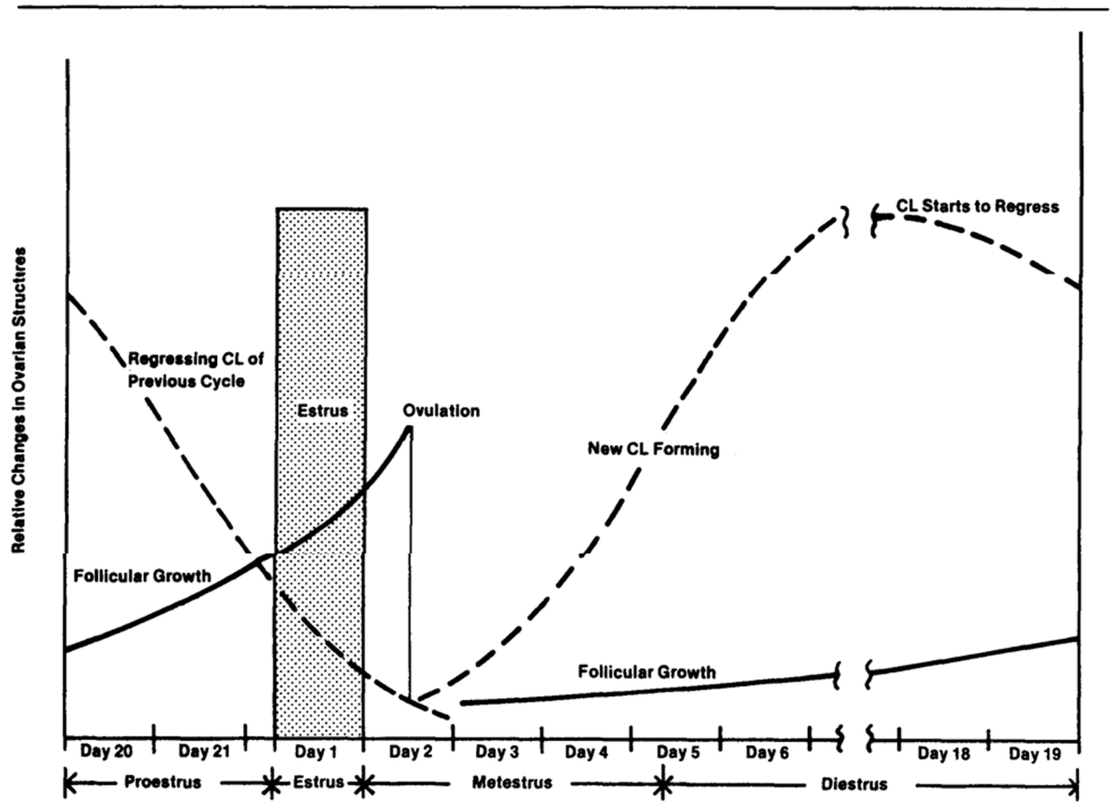
Reproduction is a process in all organisms by which offspring are produced. By reproducing, an organism ensures that when it dies, there is another individual of its kind to take its place. In this manner, a species of organism guarantees its survival. However, in the case of domestic of farmed animals, reproduction is largely controlled by the farm manager and technicians. Recent development in reproductive biotechnology has made possible the breeding of females even without the presence of a bull in the farm.

Artificial insemination (AI) has become a major tool in reproduction in order that the desired genetics carried by a superior male is passed on to as many offspring as possible. An understanding of the basic reproductive cycle of the female buffaloes to achieve proper time for AI is inherent to the success of any breeding program. Table 35 presents the basic reproductive parameters for riverine buffaloes.

Reproductive Parameter	Buffalo Cow	Remarks
Age of puberty, months	16 - 22	
Estrous cycle, days	21 (18 – 24)	Duration of estrus varies with breed and the environmental conditions
Duration of estrus (heat), hours	24 (12 – 72)	Hot temperatures tend to reduce the length of estrus periods for individual cows and increase the difficulty in detecting estrus.
Ovulation, hours from end of estrus	15 (10 – 17)	Actual ovulation time may vary due to breed, season, and environmental conditions
Age at 1st calving, months	3.5 (2.5-3.5)	
Gestation period, days	312 (295 – 320)	
Service period or days open	165 (79-244)	
Calving interval, months	11.5 -19	

When is the proper time to breed females?

Given that estrus, the time in the estrous cycle wherein a female is receptive to the male and can be bred, is just a few hours in duration in buffaloes, it is important that signs of estrus are recognized by the AI technician or farm owner in order to apply the proper timing for insemination. The figure below illustrates the normal estrous cycle of buffaloes and the period wherein the female can be inseminated.



The periods of the estrous cycle and the accompanying changes in the follicle and corpus luteum.

The average duration of estrous cycle is 21 days (18 – 24). In each cycle, there are four continuous distinct phases: Proestrus, Estrus, Metestrus, and Diestrus. It is only when the female is in estrus or "in heat" that it has a chance of getting pregnant. However, this is also the shortest period, lasting only an average of 18 hours. It is important that the female be bred at this small window of opportunity. Intact bull is most efficient in detecting females in heat. Artificial insemination (AI) technicians can also observe signs when a female buffalo is in estrus.

Observation of heat is absolutely necessary

Failure to detect estrus or inability to recognize the signs of estrus is the most serious and widespread problem that affects breeding efficiency in heifers and cows. Recognizing signs of estrus is key to successful use of AI. The occurrence of heat has a pattern such that the best time to observe signs is during the night until the early morning.

Table 36. Distribution of heat occurrence in a 24-hour period.

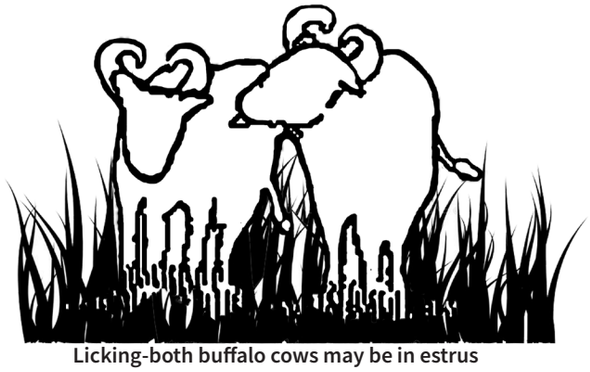
Time	Cows showing heat signs
6 a.m.-noon	22%
Noon-6 p.m.	10%
6 p.m.-midnight	25%
Midnight-6 a.m.	43%

Jeffrey Keown & Paul Kononoff.
http://www.ianrpubs.unl.edu/pages/publicationD.jsp?publicationId=717

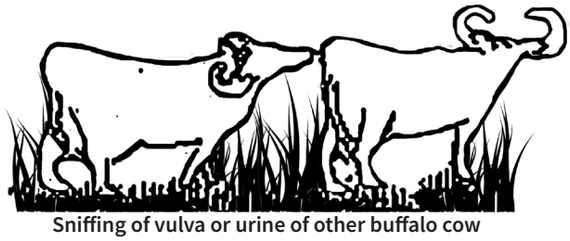
A farm manager should recognize signs of estrus and must understand not only the behavioral and physical signs of estrus, but also the factors influencing detection of estrus. The onset of behavioral estrous activity is usually gradual and occurs over several hours. Thus, the intensity of estrus and the typical pattern of behavior in a given female will vary from the beginning to the end of estrus. Signs can be classified into changes related to behavior and the vulva.

Early signs of estrus

- Increased nervousness and/or restlessness
- Twitches and elevates its tail
- May repeatedly attempt to mount other animals in the herd but will not stand to be mounted herself (see figure below).
- Nudging, licking, and sniffing of the genital area of other cows.
- May bawl or bellow frequently before actual standing estrus.
- The lips of the vulva become swollen, pink, and glistening.



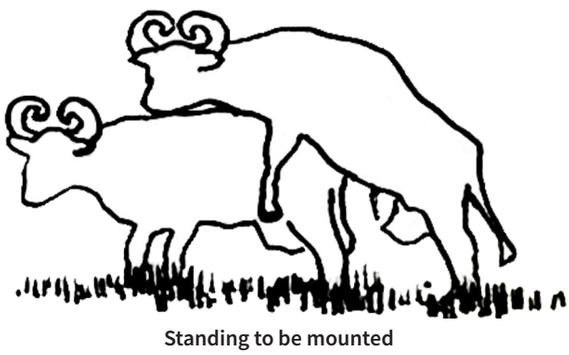
Licking-both buffalo cows may be in estrus



Sniffing of vulva or urine of other buffalo cow

Signs during standing "heat" or standing estrus

- A female stands to be mounted by another animal in the herd.
  - A female is considered in standing "heat" if it does not avoid being mounted initially even if she begins to walk away due to weight of mounting female afterwards.
  - A female is considered in standing estrus if it does not avoid the mount and does not turn and butt or attack the mounting animal.
- There is a thin, clear, watery mucus discharge from the vulva resembling the white of an egg.
  - Sometimes, only upon palpation of the reproductive tract will the mucus discharge flow from the vulva. This clear discharge should not be confused with a white or pus-like discharge, which may be an indication of vaginal or uterine infections.
- Reduction in feed intake and milk production.



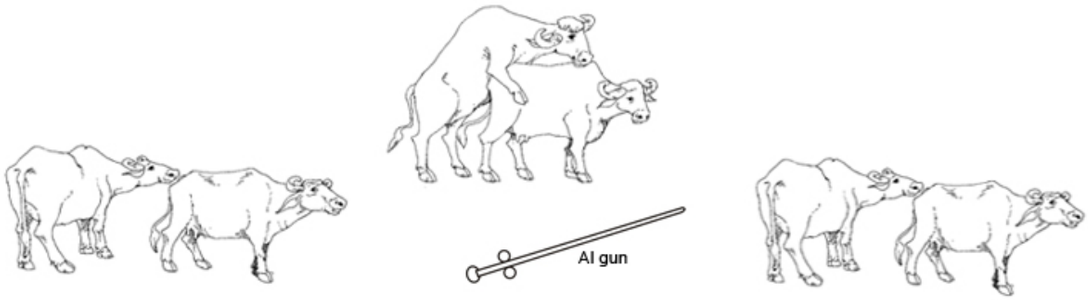
Standing to be mounted

Clear mucus often seen at estrus

Blood mucus see after estrus

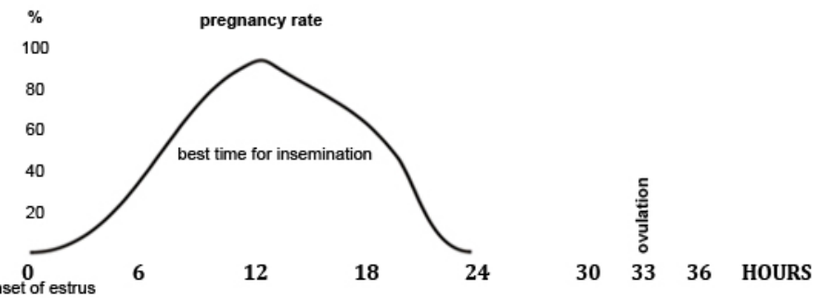
Late signs of estrus

- Females no longer stand to be ridden, but may mount another female in standing estrus.
- Hair on the tailhead is rough or rubbed off due to mounting. Mud or manure on the hips or rear flanks is also a sign that mounting may have occurred.



FOLLICULAR DEVELOPMENTAND OVULATION

PREGNANCY RATE VS. INSEMINATION IN RELATION TO ONSET OF ESTRUS



PROESTRUS

Early signs of estrus

- Increased nervousness and/or restlessness.
- Twitches and elevates its tail.
- Repeated attempt to mount other animals but will not stand to be mounted herself
- Nudging, licking and sniffing of the genital area of other cows
- Bawls or bellows frequently before actual standing estrus
- Lips of vulva become swollen, pink and glistening

ESTRUS

Standing "heat" or standing estrus

- Stands to be mounted by another animal
  - allows being mounted even if she begins to walk away due to the weight of mounting female
  - allows mounting and does not turn and butt or attack the mounting animal
- Presence of thin, clear, watery mucus discharge from the vulva like the egg white
  - Sometimes mucus discharge flows from the vulva only upon rectal palpation
  - Clear discharge should not be mistaken with the white or pus-like discharge, which may indicate vaginal or uterine infections
- Reduced feed intake.
- Drop in milk production

METESTRUS

Late signs of estrus

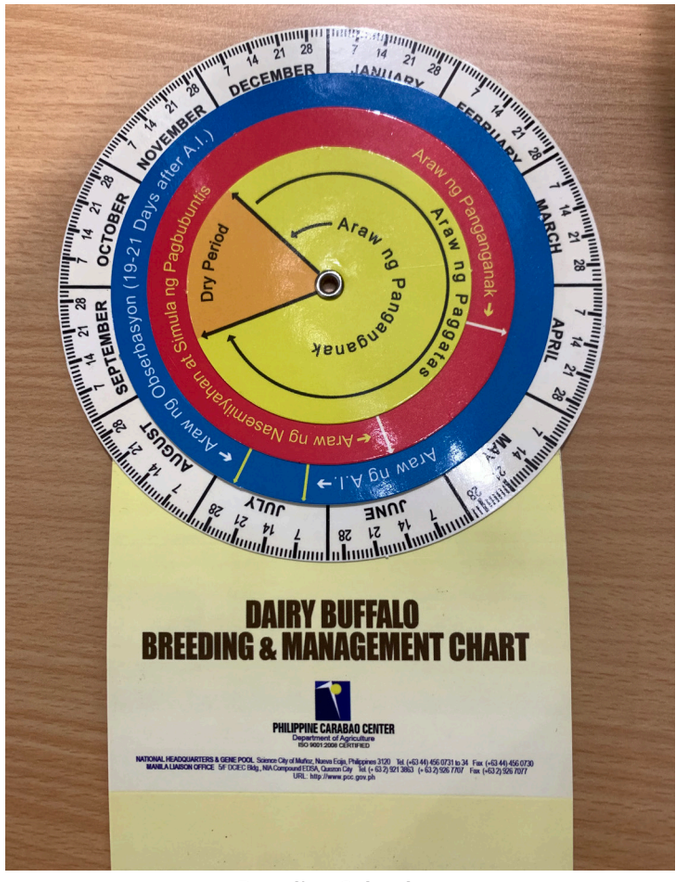
- Avoid being mounted but may mount another female in standing estrus.
- Hair on the tailhead is rough or rubbed off due to mounting.
- Mud or manure on the hips or rear flanks may be a sign that mounting had occurred.

Remember

- Anticipate heat with the use of records/breeding calendar.
- Short cycles are “abnormal”. Cows exhibiting this pattern may have reproductive problem such as “cystic follicle”.
- Cycle lengths of approximately 30-35 days may also be “false heats” that occur after a breeding or reflect early death of the embryo.
- Cycle length may be slightly shorter in heifers than mature cows.
- Silent estrus occurs when ovarian changes are normal including ovulation, but standing estrus fails to occur. This should not be confused with unobserved estrus due to estrus detection failure.
- Majority of estruses occur between 6 p.m. and 6 a.m. Estrus detection is best done early in the morning before or after the morning milking.
- There are areas in the pen or pasture called “hot spots” where mounting activity is more concentrated. These are flat surfaces with good footing or shady areas. Focus estrus observation on these spots.

Pointers in Estrus Detection

- There is no substitute for good observation of a dairy herd. Pick animals in estrus by their behavior and signs.
- Use estrus detection aids such as heat mount pads, chin ball marker, or use of vasectomized bulls if available.
- Use a breeding calendar or prepare a list of cows that are expected to come into heat every week so that effort on estrus detection is focused on these cows.



Breeding Calendar

Determining correct timing for AI

Establishing the stage of estrus (early estrus, standing estrus, late estrus) in a cow upon observation is vital to determining the correct time to inseminate. The best time to inseminate a buffalo in estrus is:

- Towards the end of estrus (4-6 hours prior to end of estrus), the latter 2/3 of standing estrus (around 8-14 hours after the onset of estrus), or may be within a few hours after estrus (about 6 hours after estrus or 7-18 hours before ovulation).
- Insemination too early or too late in estrus may result in reduced conception rate because the cervix at this time is already closed. Insertion of the AI gun will be difficult.
- Estrus detection should be done twice a day, one early in the morning and another one in the afternoon. Follow the "AM-PM" rule.

As a rule of thumb, an animal observed to come in estrus in the morning should be inseminated in the afternoon (between 12 noon and 3 p.m.) and those observed to come in estrus in the evening should be inseminated in the morning (6 to 8 am) of the following day.

When to breed cows and heifers

The following are the standard operating procedures of breeding in estrus heifers and cows though AI.

Heifers

Heifers must be reared properly to be able to reach puberty and be bred as early as possible. Onset of puberty is largely influenced by weight rather than age. With proper feeding and management, heifers may reach puberty as early as 16 (range of 16–22) months in riverine type buffaloes.

1. Start breeding when heifers weigh at least 300 kg for riverine buffaloes.
2. Body condition score (BCS) should be at least 3.0.
3. Allow 1-2 cycles to pass before breeding heifer for the first time to establish regular estrous cycle.
4. Check reproductive system (ovary, cervix, uterus). Ask your AI technician to do this.

a. Ovary should be bigger than a corn kernel (approximately at least 1.5 cm in diameter) and has a dominant follicle.
b. Cervix should be at least 2 cm in diameter.

5. Inseminate (AI) up to a maximum of five times, (assuming estrous cycle is well established). If the heifer is not yet pregnant, then expose it to a clean-up bull for natural mating.

Cows

Cows should be bred as soon as possible after calving to minimize too long days-dry and long calving interval. The following guideline is to be followed in the PCC institutional herds as standard procedures for cows after calving.

1. Have your AI technician do this:
    (a) Flushing the reproductive tract using 4% Betadine Solution (Povidone-Iodine) of cows with retained fetal membrane (placenta) or other reproductive problem or disorder. This is done immediately after calving.
2. Estrus observation commencing 15 days postpartum.
3. Do AI service for cows in estrus if:
    (a) Mucus discharge is clear and has no foul odor and there are no other discernible reproductive problems
    (b) The BCS is at least 3.0.
4. Follow the "AM-PM" rule, that is, AI when the animal is in estrus and do follow up AI if the animal still shows signs of estrus after 12 hours. Repeat AI every 12 hours until estrus signs have disappeared.
5. The acceptable breeding services should be 3 breeding services within the 90 day post calving period. Cow could be served by a bull by natural service after this period. However, allow one cycle or 21 days to pass from last AI date before introducing the cow to the bull for mating.

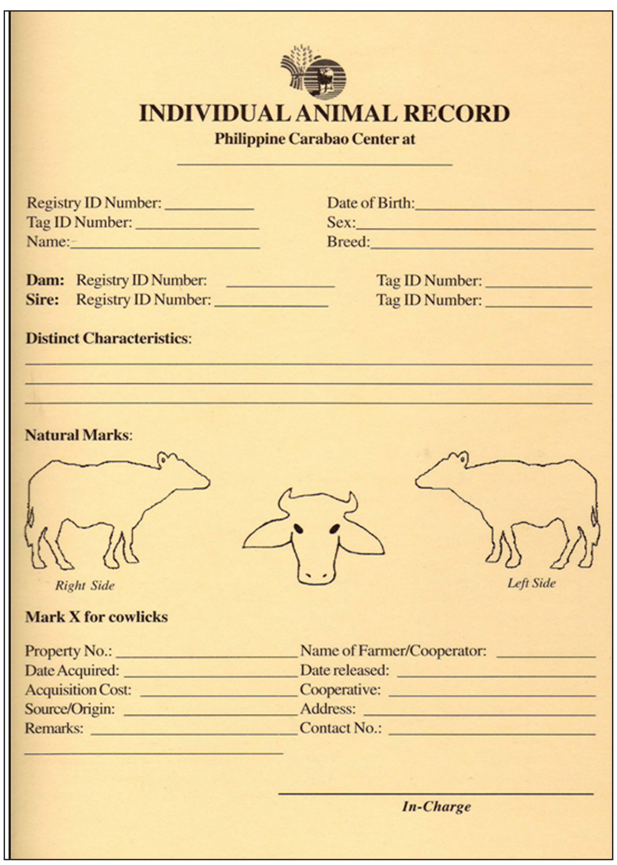
Breeding of Problem High Milk Producing Cows

Problem cow is a cow not showing estrus beyond 90 days, and a BCS of less than 3.0. These are very often high yielding cows. The challenge for the farm manager is how to get them pregnant within acceptable period.

1. Follow the same procedures outlined above.
2. Exert effort to inseminate before 45 days after calving. Estrus in high yielding cows is often not detected once the cow has reached maximum milk production between 45 days and 90 days after calving.
3. Make sure that the BCS of high yielding cows is at least 2.75 at peak production
4. Intervention should be done if cow is not cycling beyond 45 days after calving.
   (a) Palpate reproductive tract – check if cow is cycling and the uterus has involuted already. Flush the uterus if uterus has not involuted yet. Ask your AI technician to do this.
   (b) Feed additional concentrate and grass to improve BCS, if needed.

Remember

- Have the AI technician record all breeding services and reproductive check done on a cow or heifer in the individual animal record.
- Always ask for a copy of the AI service receipt from the AI technician.
- Do not forget to record the date of natural service and the ID number of the bull that provided natural service to the cow if she did not get pregnant out of AI service. Write these in the individual animal record.



INDIVIDUAL ANIMAL RECORD
Philippine Carabao Center at
____

Registry ID Number: __________ Date of Birth: __________
Tag ID Number: __________ Sex: __________
Name: __________ Breed: __________

Dam: Registry ID Number: __________ Tag ID Number: __________
Sire: Registry ID Number: __________ Tag ID Number: __________

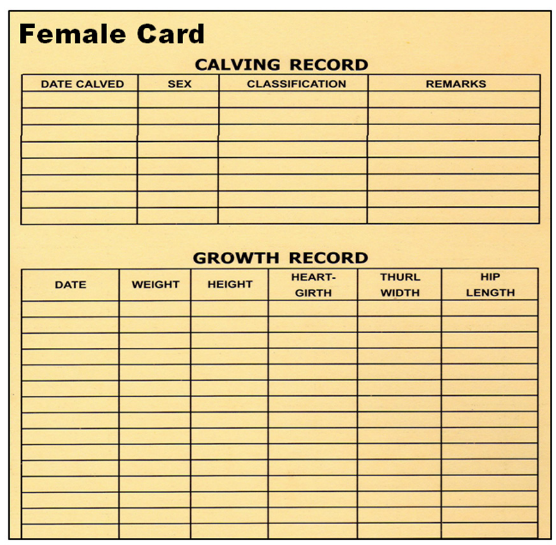
Distinct Characteristics:

Natural Marks:

Mark X for cowlicks

Property No.: __________ Name of Farmer/Cooperator: __________
Date Acquired: __________ Date released: __________
Acquisition Cost: __________ Cooperative: __________
Source/Origin: __________ Address: __________
Remarks: __________ Contact No.: __________

____
In-Charge



Female Card

CALVING RECORD

DATE CALVED	SEX	CLASSIFICATION	REMARKS

GROWTH RECORD

DATE	WEIGHT	HEIGHT	HEART-GIRTH	THURL WIDTH	HIP LENGTH

Records and Record Keeping

Animal Identification and ID System

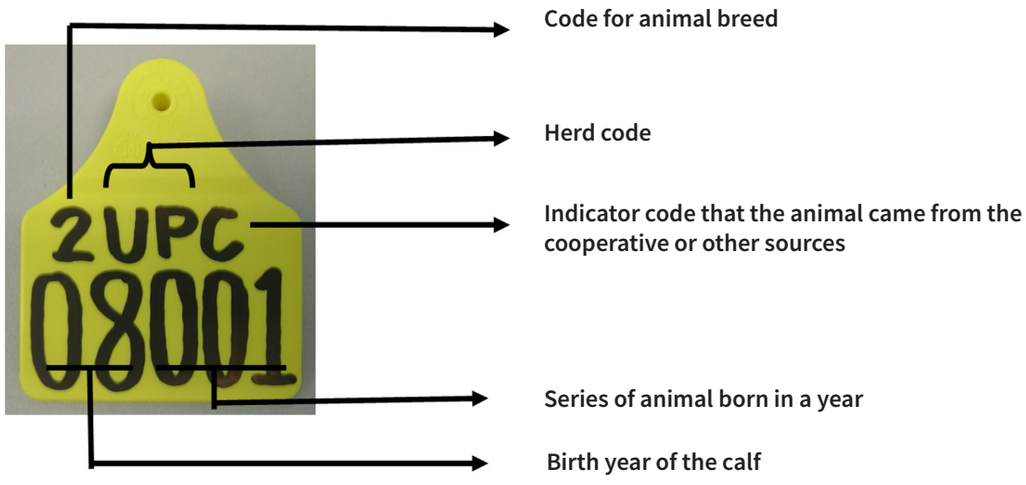
Animals of the Philippine Carabao Center (PCC) are identified by plastic ear tag and earnotch. The PCC is using its own animal identification system for all its participating herds. Assigning unique identification to individual animals is essential in animal recording systems. Having an organized animal recording system provides for accurate, complete and cost-effective information for evaluating herd performance and making management decisions, breeding management, disease surveillance/monitoring, research, and other purposes.

Purpose of Animal Identification in PCC

- Unified identification of buffaloes in participating herds
- Tracing back of pedigree or in case of disease outbreak
- Identification of buffaloes for easy management and record keeping

Assignment of Identification (ID) Number

Registry ID Number – this is the official ID number assigned to each buffalo immediately after birth. Each animal is identified in official documents using this ID system. This is a unique ID number written on plastic ear tags applied to both side of the ears. Both ears are tagged as back up in case one tag falls off. Example ID number below is given for the first riverine buffalo born in 2008 from a PCC at UPLB-supported dairy cooperative.



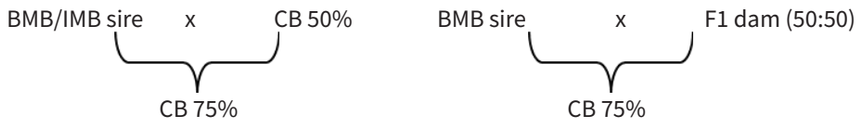
Breed code – the first character in the ID number system indicates the breed of the buffalo

1 Philippine Carabao (PC) or Native Swamp Buffalo
2 Bulgarian Murrah (BMB), Brazilian Murrah (BrMB), Italian Mediterranean (ItMB) or Philippine Dairy (PDB) buffaloes that are offspring of original BMB stocks and/or other riverine breeds.
3 Indian Murrah (IMB) buffaloes that are offspring of Indian Murrah origin.
4 American Murrah (AMB) that are offspring of buffaloes imported from U.S.
5 Crossbred (CB) buffaloes that are offspring of a cross (F1) between native swamp and any riverine breed of buffaloes. This could also be an inter se cross of two F1 parents (50:50) or any other cross of undetermined riverine blood.

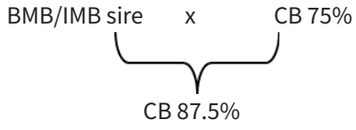
PC x BMB/IMB → F1 (CB 50%)

F1 sire (50:50) x F1 dam (50:50) → F2 (CB 50%)

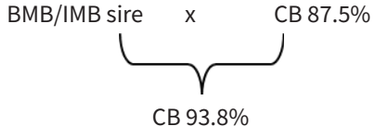
6 Backcrossed buffalo of known/recorded 75% riverine blood or offspring of any crossbred of undetermined riverine blood backcrossed or mated to purebred riverine bull.



7 Backcrossed buffalo of known/recorded 87.5% riverine blood



8 Backcross buffalo of known/recorded 93.8% riverine blood or higher



9 Others

Herd Code: the second and third character in the ID number system indicates from which PCC institutional herd the animal was born. However, if the animal was born outside of PCC institutional herd such as PCC-supported cooperatives, villages or private farms, a fourth character, i.e., the letter "C" is added

PCC at CSU	–	CS	PCC at VSU	- VS	PCC at USM	-	US
PCC at MMSU	-	MM	PCC at USF	- US	PCC at MSU	-	MS
PCC at DMMMSU-		DM	PCC at LCSF	- LC	PCC at CMU	-	CM
PCC at UPLB	-	UP	PCC at WVSU	- WV	PCC at MLPC	-	ML
PCC at CLSU	-	CL	GENE POOL	- GP	NATIONAL IMPACT ZONE	-	NIZ

For PCC-supported cooperatives and other farmers' association, use the same system but add a letter "C" after the herd code, e.g., 2UPC08001. *The number series for coop's ID system is different from the institutional herd and should not be merged.*

Year Code: The fourth and fifth characters in the ID system represent the year the animal was born or if the animal was acquired outside and the acquired animal does not have ID number, an ID number is assigned immediately. However, if the acquired animal does not have date of birth, the year it was acquired by PCC will be used in the fourth and fifth character of the ID number system. If the animal came with its own unique ID system, this should be retained.

Examples of year of birth and corresponding year code

1991	-91	1996	-96	2001	-01	2006	-06
1992	-92	1997	-97	2002	-02	2007	-07
1993	-93	1998	-98	2003	-03	2008	-08
1994	-94	1999	-99	2004	-04	2009	-09
1995	-95	2000	-00	2005	-05	2010	-10

Number series: the last three characters stand for the birth order of the animal in the herd for the current year. Each center should only have one number series for the institutional herd regardless of the breed born for each year. The number series goes back to 001 at the beginning of the following year. Example: three calves born from PCC at UPLB

Calf 1 – F1 crossbred born December 28, 2008	5UP08011
Calf 2 – BMB offspring born December 30, 2008	2UP08012
Calf 3 – BMB offspring born January 1, 2009	2UP09001

Another number series is maintained by each regional center for dairy cooperatives and recorded crossbred populations in its area of responsibility regardless of the breed, cooperative or farmer's association the calf was born at. The number series goes back to 001 at the beginning of the following year. Example: three calves born in various cooperative

Calf 1 – 75% backcross from Gen. Trias co-op born December 28, 2008	- 6UPC08040
Calf 2 – BMB offspring from Pagsanta co-op born December 29, 2008	- 2UPC08041
Calf 3 – F1 (CB 50%) from Pagsanta co-op born January 1, 2009	- 5UPC09001

Records for Keeping

What a desirable record should be:

- Simple
- Complete
- Accurate
- Up-to-date
- Understandable
- Requires minimum time to keep

Requirements for Successful Record Keeping

- Establish a place in an office where permanent record of the animals could be kept safely and orderly, to facilitate recording of data in a day-to-day activity.
- Set up a chart or bulletin board in a place where everyone can summarize the overall situation in the herd. This also serves as reference point for an activity to be done to the herd immediately, daily or monthly basis.
- Keep the individual record cards with the information such as individual number, history of reproduction, health status, and pedigree record intact.
- Record keepers should carry pocket/field notebook/form/log book at all times. Record all herd information collected in the field, and then transfer the information to permanent records and in electronic file or database as soon as possible.

Maximizing the proper use of genetics to increase milk production

Ester B. Flores/Peregrino G. Duran
Supervising Science Research Specialist/Scientist I
Philippine Carabao Center National Headquarters and Gene Pool

The milk production potential of a buffalo cow or any given cow is determined primarily by its genetic make-up. However, the environment and feeding management largely dictates whether that full genetic potential would be expressed or not. Hence, use of proper genetics and right feed is vital to maximizing milk production. Keep in mind to use the right kind of genetics or breed for dairying, record milk production performance, and implement culling or selection in cows and breeder bulls.

Select the right type of buffalo for dairyings

Select the right breed of buffalo for dairying. The riverine type buffaloes have been selected and known to provide milk with high volume and quality (high milk fat and protein percentages) relative to the swamp buffalo.

Acquire breeder animals from stocks with good milk production performance and breeding efficiency. Purebred riverine buffalo stocks are of the dairy breeds such as the Murrah, Bulgarian Murrah, and Italian Mediterranean.

The use of crossbred buffaloes through continuous backcrossing of the swamp type to the riverine buffalo breed to produce the Philippine Dairy Buffaloes is also a good alternative to acquire stocks (Fig. 2).

Take note that it is not advisable to use the crossbred males (50:50) for breeding. Always use the purebred riverine bulls for breeding to increase the riverine blood in your stocks. As the percentage of riverine blood increases, milk production potential comes close to the purebred riverine buffalo cows.

Use the best genetics available

Within the purebred buffalo population, there are differences in genetic potential. To improve the genetic potential of your stock, use breeding bulls that come from cows with milk production records to achieve genetic improvement in the offspring. However, assessing the genetic potential of available breeding bulls might be difficult in the absence of estimated breeding value (EBV), which is a measure of the genetic merit of an individual and can be used for comparing animals. The use of AI is one way to ensure that the bull is of high genetic merit as only top ranked bulls are selected for use in the AI program. Other distinct advantages to the use of AI in breeding are as follow:

- It allows creation of new sire lines. As new sires are added to the list of available bulls for AI every year, there is a wider choice of sires to choose from that is not on the same lineage as your current stock. The village-based AI technician can provide such a list.
- It improves or corrects some faults of a cow line. AI bulls are selected to have good conformation. And while there is no “perfect” bull, each bull will have strong points that can be used to correct or improve the fault of individual cows.
- Less concerns with health issues. AI bulls need to pass rigorous health tests to ensure that they are not able to pass diseases to cows during breeding.
- No need to manage or maintain a bull. The AI technician can provide the breeding service to cows in estrus.
- Programmed breeding can be done by inducing the cows to come into estrus through the use of hormones. Thus, individual cows or group of cows can be planned to calve to coincide when demand for milk is highest. Programmed breeding is a good way to distribute calving throughout the year. Only trained AI technicians are allowed by PCC to conduct fixed time AI (FTAI) or AI following estrus synchronization (ES-AI).

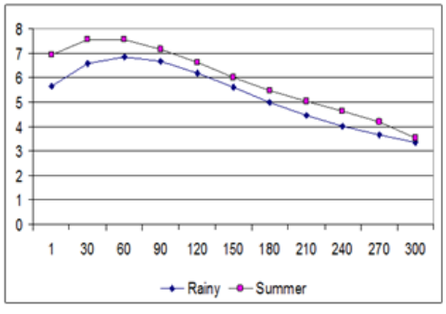
The second best option in getting the best genetics is to avail the services of a bull loaned from PCC for natural service. This ensures that pedigree details can be made available to the farmer, thus, inbreeding can be avoided. Furthermore, bulls loaned from PCC come from dams with good milk production performance. There are two bull loan schemes being implemented by PCC. Avail of bulls under bull loan scheme 1 assigned to cooperatives or crossbred buffalo modules.

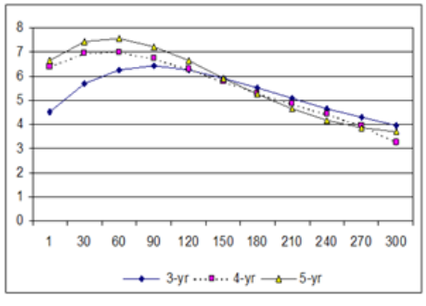
Record milk production performance of individual cows

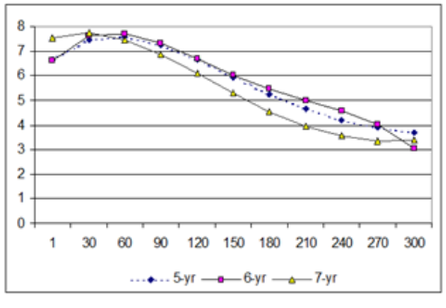
Genetic improvement is faster if the best available bull genetics is mated to the best cow. In order to do this, milk yield of individual cows should be recorded and compared to determine the best performing cows. Milk yield can be recorded daily on a form provided by the PCC, which in turn can be submitted monthly.

INDIVIDUAL MILK PRODUCTION RECORD					
Taon: 20___					
Name of Farmer-Recipient:_____					
Name of Cooperative:_____					
Date of Calving: _____					
Animal Number: _____					
Month	Daily Milk Yield		Volume sold (Liter)	Selling price (Liter)	INCOME
	a.m.	p.m.			
1					
2					
3					
4					
5					
6					
7					
8					
9					
10					
11					
12					

Another option is to set aside a copy of the daily record and sum up the daily yields from the beginning to the end of lactation. The sum will be the total production for that particular lactation. Individual cows can be compared on this basis but in reality, comparison is not that straightforward. Cows calving for the first time normally have lower milk production compared to cows in their 2nd , 3rd or 4th calving (Fig. 2). However, this does not mean that the cow calving for the first time is genetically inferior than older cows. The difference in production level may just be due to age. The level of production also changes as lactation progresses. Milk yield increases from the start of lactation and peaks at about 75-100 days after calving for first time cows and 45-90 days for multiple calving cows.







Age/Season of calving	Mean (kg)
3 yr	5.4
4 yr	5.5
5 yr	5.7
6 yr	5.75
7 y4	5.2
Rainy season	5.2
Summer season	5.8

Average lactation curve of buffalo cows calving at different ages and seasons

Another option is determining milk production performance of individual cows is for the dairy cooperative or association to enrol in the PCC milk test day recording. Milk production of individual cows is weighed and a sample is taken for milk quality analysis. This is done every month by PCC extension officers. The result of analysis as well as interpretation of result is discussed with the co-operative the following month.

The average milk yield, fat % and protein % on the same stage of lactation as the cow sampled is given in the result of analysis beside the actual measurement of the milk from the sampled cow. Thus, there is an average record from which to compare the cow sampled as a gauge of how good the cow is relative to the population average.

Department of Agriculture
PHILIPPINE CARABAO CENTER
National Headquarters and Gene Pool
Science City of Muñoz, Nueva Ecija

Pagsusuri sa Kalidad ng Gatas

Pangalan ng miyembro: Caisip, Arnold
Kooperatibang kinabibilangan: MINABUYOK

Numero ng kalabaw: 2NIZ08197
Araw ng kapanganakan: 11/13/2015
Haba ng araw ng paggagatas: 83

Resulta

Kategorya	Resulta ng Analisa sa Laboratoryo	Pamantayan
% Fat	5.77	6.6
% Protein	4.47	4.0
% Lactose	3.14	3 to 4
Somatic Cell Counts	70,000	1,000 to 200,000
Timbang ng gatas (Kg)	4.10	5.58
Kabuuang dami ng gatas (Kg)		

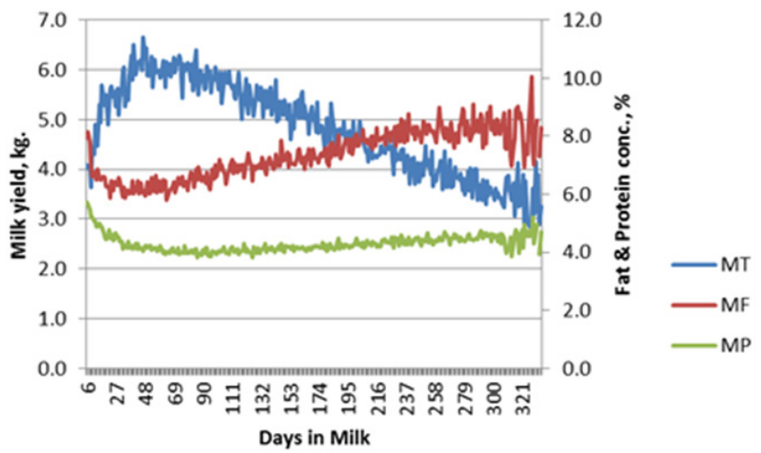
Maaring sanhi ng di magandang kalidad ng gatas

Rekomendasyon

Analyzed by:
PAULENE S. PINEDA
Laboratory Analyst

Extensionists:
LESTER VERONA
GILLANNE GANTIOQUE
KRISTINE JOY PRADES
CHARITO GUTIERREZ

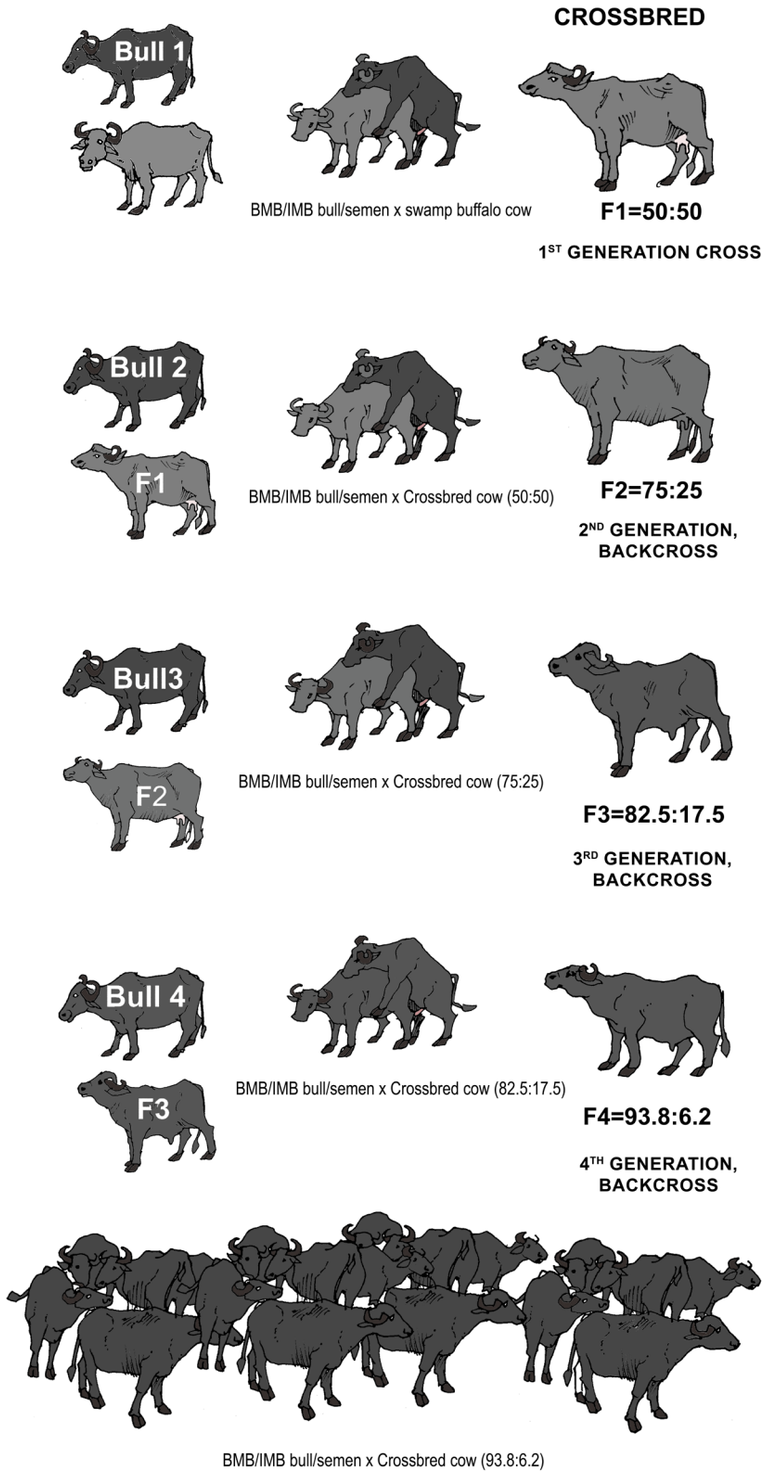
Aside from milk yield, other parameters are also reported such as fat %, protein %, lactose, freezing point, and somatic cell count. Fat % and protein % are inversely correlated with milk yield, thus, at peak milk production, the said parameters are also at their lowest. Fat % and protein % in the milk are normally affected by the amount and quality of forage or grasses given to a cow. The cow needs to have its DM intake requirement met to have high fat % and protein %. This requirement cannot be replaced by concentrate. High somatic cell count, i.e., >200,000 cells/ml, is a reflection of not so good udder health and indicates high probability of subclinical mastitis. These results will be discussed by the PCC extension staff.



Average daily milk yield, fat % and protein % of dairy buffaloes

Practice culling & selection

Once individual cow milk performance is known, replacement heifers can be selected or shortlisted from the best cows in the groups. The next step is to look at conformation. Using the score sheet for BCS and linear type traits, shortlisted heifers are evaluated based on conformation. Heifers shortlisted based on their mother's performance together with good conformation and absence of abnormalities are the bases for selecting good heifers. On the other hand, old cows that already have low production due to age should be culled.



POPULATION OF PHILIPPINE DAIRY BUFFALOES

Backcrossing scheme to produce the Philippine Dairy Buffaloes in the villages

Milking the Buffalo Cow

Peregrino G. Duran
Scientist I
Philippine Carabao Center National Headquarters and Gene Pool

Introduction

Buffalo's milk is a healthy food, which provides important nutrients needed by the body. It is also a product of high value. It is less in cholesterol content but high in phosphorous and total saturated fatty acids. It is much richer than cow's milk in terms of nutrients. It has higher fat (7%-8%), protein (4.5%-5%), and total solids content (see Table below).

One advantage of buffalo's milk is its good processing quality. The high contents of fats, proteins, and total solids give it a rich flavor and added value. It has higher resistance against oxidation, which is ideal in preparing tradi¬tional sweets. Aside from pasteurized and flavored milk, it is the best milk in the preparation of mozzarella, soft cheese, pastillas de leche, and other high value products.

With the increasing consumption and utilization of milk and milk products in both the local and export market, the potential contribution of dairy farming to improve the economic and social conditions of rural farming communities is very important. As the role of buffalo shifted from a mere source of draft to being a profitable source of good quality milk, the challenge lies to all dairy farmers and dairy farm managers to optimize production through sound management practices.

Milking is a critical and laborious process, which involves hormonal reflex and is performed within 5-8 minutes. With the advent of modern technology, it is now possible to extract large volume of milk from the udder with relative ease and quickness through milking machines.

Hand milking of cows was a traditional method of milking used by most of the buffalo farmers who are milking less than five animals until such time when milking machines became common. Milking machines allowed for herd sizes to increase with their ability to milk more cows in a short period of time.

The cows are brought into a holding yard before entering the milking parlor. Cows often have their preferred timing in the queue for milking and there will be cows that choose to go first and those that want to go last. Some farmers choose to feed concentrate to the cows while milking.

There are many different designs of milking parlors, e.g., rotary parlors for larger herds of over 100, herringbone and parallel parlors for large and smaller herds, and single stalls for very small herds.

Substance	Buffalo	Cow
Protein (gm)	4.30	3.20
Fat (gm)	6.50	4.10
Carbohydrates (gm)	5.00	4.40
Energy (kcal)	117	67
Calcium (mg)	210	120
Phosphorous (mg)	130	90
Iron (mg)	0.20	0.20
Thiamine (mg)	0.04	0.05
Riboflavin (mg)	0.10	0.19
Vitamin C (mg)	1.00	2.00
Vitamin B12 (mg)	0.14	0.14

Principles of removing milk[4]

1. Natural Technique (calf suckling) – Here, the calf draws the milk from the dam's udder by pressing the teat with its tongue and palate on the other side. The calf's tongue encircles the teat creating a vacuum in the mouth. A calf's suckling is the best method of extracting the milk with the least damage to the delicate tissue of the mammary gland.

2. Manual Technique (hand milking) – This is the most common practice of harvesting milk from the cow. The order of milking of various teats differ.
    a. Teats crosswise left four and right hind or right four and left hind.
    b. Fore quarters teat together
    c. Hind quarters teat together
    d. Milk first teats that appear more distended. The milk should only be squeezed and not drawn.

Strip Cup

It is a device with four circular plates intended for collecting milk from each quarter of a cow's udder. A few strips of milk are drawn in the respective circles to allow assessment of the physiological status of the udder. If there is any change in the milk's color, consistency, and appearance, then the milk from such quarter should be drawn last to prevent spreading the disease from one quarter to the other.

Methods of manual milking[1]

a. Fisting or Full Hand Milking – Hold the whole teat first with the thumb and the index finger encircling the base of the teat. Close the base of the teat by the ring formed by the finger, so that the milk that is trapped in the teat canal cannot slip back into the gland cistern. Simultaneously, squeeze the teat between the hollow of the palm and with the middle, ring, and index fingers. Repeat the process in succession. Avoid knuckling, i.e., bending the thumb against the teat canal and dragging the milk out, as this would injure the teat.

b. Stripping – Practice this method towards the end of milking in order to draw the milk completely. Perform stripping in quick succession to prevent delay in the milk let down process. The last drawn milk (stripped milk) is rich in fat.

Do not mix the first few strips of milk from each quarter with the rest of the milk as the former contains highest number of bacteria.

3. Mechanical Technique (machine milking) – Here, the milking pressure on the teat ranges from 350 mm to 400mm Hg. In buffalos, 400 mm of Hg of pressure is applied. Such pressure facilitates milk expulsion from the teat canal.

Modern milking machines are capable of milking cows quickly and efficiently, without injuring the udder, if they are properly installed, maintained in excellent operating conditions, and used properly. The milking machine performs two basic functions.

a. It opens the streak canal through the use of a partial vacuum, allowing the milk to flow out of the teat cistern through a line to a receiving container.
b. It massages the teat, which prevents congestion of blood and lymph in the teat.

Advantages:
1. Extracts milk easier
2. Does not require any skill
3. Keeping quality of milk is high
4. Prevents spreading of possible disease from a milker
5. Less time consumed, as more animals can be milked simultaneously

Disadvantages:
1. High cost
2. Requires electricity

4 Adapted from http://eagri.org/eagri50/LPM201/lec10.pdf

Frequency of milking

Milk the cow regularly, i.e., early in the morning and late in the after¬noon. Follow the set time of milking religiously. The ideal interval between milking is 12 hours. For example, if the set time for morning milking is 4:00 am and the after¬noon schedule is 4pm, this should be followed religiously thereafter.

Tips in milking:

Get the cows in the proper mood for milking

- Keep the parlor quiet and free from disturbance
- Avoid very loud voice
- Do not allow visitors inside the parlor during milking
- If possible, play soft music to relax the cow
- Cows are habit forming, thus, they tend to stick to routines
    - Same milking stall
    - Feeding of concentrates
    - Milking order of the cows

Practice method of milking consistently throughout the lactation period of each cow. For example, if cow number 1 started its lactation using milking machine, it should finish its lactation using the same. **Do not switch to hand milking** at any time during the period of lactation.

Milk the cow at least once a day. Most people prefer to do once-a-day milking instead of the usual twice-a-day, since it gives them more time during the day to do other things. Either way, have a stanchion and/or stall where the cow can be restrained during milking.

Once-A-Day Milking

Milking a cow once a day still is a common practice when maximum milk production is not always the goal. It is also common where a dairy cow calves seasonally to coincide with feed availability. For example, the cows are grazed with the calves for approximately half the day, and then the calves are separated from the cows while the latter are being milked by hand, then allowing the calves to join the cows after. The effect of the calves' frequent nursing during the day may stimulate milk production.

Twice-A-Day Milking

This is the most common milking routine wherein cows are milked at usually twelve-hour intervals. Milking on a 10-14 hour interval is also a common practice.

Important Factors to Consider in Milking

1. Avoid excitement of the animal during and prior to milking. If the animal is excited, then there is a release of adrenaline and it will cause vasoconstriction, which prevents milk let down.
2. Prepare and collect all the milking equipment prior to milking.
3. Milking operation should be continuous.
4. Follow exact time of milking.
5. Prepare the cow for milking.
6. Complete the milking within 5-8 minutes.
7. Use both hands for milking.
8. Use correct method and type of milking.
9. Do not milk weaned animals with the calves nearby.
10. Provide concentrate feed mixture at the time of milking.
11. Remove the first few strips of milk as they contain possible abnormalities
12. Group the animals 2 hours prior to milking.
13. More than one milker should milk a cow during the lactation so that any change in the milker will not cause any problem in milking especially in the letting down process of lactating animals.

How to Milk a Cow?

Proper milking includes disinfecting the cows' teats before and after milking to prevent introduction of bacteria into the milk supply. Dairy cows typically are milked twice a day to empty her milk supply.

Snap a lead rope onto your cow's halter and lead her to a quiet and clean area. Tie her to a stable object such as a fence or gate on a short tie so her nose is close to the area she is tied. Tying a cow short keeps her from being able to move around much while you milk her.

Observe your cow's udders and teats for any red and swollen areas that are hot to the touch because of fever. These are signs of mastitis that cause an infection in cows, which need a veterinarian's treatment.

Wrap your thumb and forefinger around the base of one teat and slightly squeeze to capture milk in the teat. Release the pressure of your thumb and forefinger, wrap your hand around the entire teat, and squeeze gently to release the milk into a bowl. Repeat this procedure two to three times on each teat to strip out the milk while observing it in a bowel. If you see milk that is thick, discolored or contains blood, do not milk your cow, as these are signs of mastitis.

Pour pre-milking disinfectant into an applicator bottle. Screw on the lid and place the top over one teat of your cow. Squeeze the bottom of the bottle to apply the disinfectant to the teat. Repeat cleaning the remaining three teats. Allow the disinfectant to sit on the teats for about 30 seconds and wipe each teat with a shop towel.

Tip

Pre- and post-milking disinfectants may be a dip, a foaming dip, or in a spray form. Follow the instructions on your particular product for best results.

Place a milking stool next to your cow near the teats. Place a bucket underneath the teats. Milk one teat at a time as you did to strip the teats. Direct the milk into the bucket. If your cow is not nursing, empty all the milk from each teat to prevent mastitis.

If your cow is nursing a baby, stop milking when you get small amounts from each teat and release the cow. The nursing young will clean and disinfect the teats in the pasture or barn when it feeds.

If your cow is not feeding a calf, apply a post-milking disinfectant in the same manner as the pre-milking disinfectant and leave it on the teats until it is dry. Do not wipe post-milking disinfectant of the teats before you release your cow.

Preparations for milking

Preparation of milker

The milker's health and cleanliness or tidiness are important considerations in ensuring safety, sanitation, and quality in milk collection, handling, and pro¬cessing.

Qualities of a good milker

- Clean
- Friendly to animals
- Good milking techniques
- Good application of milking procedures
- Must be healthy

Attire and preparation of the milker

- Wear clean and proper attire for milking.
- Wash hands with soap and clean water. Ensure to rinse them thoroughly.
- Dry hands with clean towel before holding the cow's teats.

Preparation before milking

- Bathe the cows properly and transfer them in a separate pen to dry off.
- Prepare all materials and utensils such as individual clean cloth, strainer, paddle, and disinfectant.
- Wash the milk buckets and milk cans thoroughly with soap and disinfect them with sodium hypochlorite. Place it upside down using a simple stand to dry it off.
- Be sure to disinfect all materials properly.
- For machine milking, rinse the milking machine pipeline system with tap water, followed by hot water.
- Squeeze the first few drops of milk from each teat into a mastitis paddle or through the black silk-stocking fabric.

Warning:

- The teat is mastitic if the milk is watery and has lumps. This must not be used for processing.
- Feeding of concentrates is a practice; offer it first to the feed bunk before leading the cows to the milking parlor.

Milking procedure

Hand milking

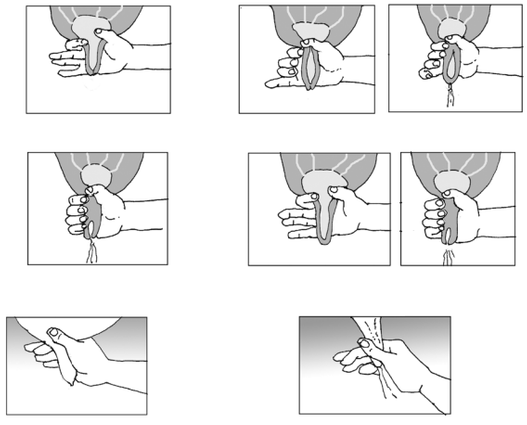
1. Sit on a small chair and position at the side of the rear part of the cow to reach the udder.
2. Wipe the udder with clean disinfected cloth and start stimulating the cow by gently massaging the teats.
3. Place the milk pail with strainer just below the udder.
4. Squeeze each teat 3 to 4 times. Observe the milk. If normal, continue milking. In cases of clotted and blood-tinged milk, consult a veterinarian. Refer to **Organoleptic test in evaluating the quality of milk.**
5. Continue milking until the last drop of milk.
6. Record the weight or volume of the milk collected.
7. After milking, disinfect the teats by dipping or spraying using 10% tincture of iodine.
8. Drive the cow back to the corral.
9. Milk another animal by following steps 1 to 6 until all lactating cows are milked.
10. Clean, wash, and disinfect all used utensils after milking. Dry them in a clean and well-ventilated area.

Steps:

Proper technique in hand milking:

1. Grasp the teat with the thumb and first finger.
2. Close the second and the third finger, then the milk will squirt out.
3. Close the little finger and squeeze the teat with the whole hand.
4. Release the teat so that it will be filled with milk again. Feel the teat to see if all the milk has come out.
5. Again, grasp the teat with your thumb and first finger.
6. Run your fingers down to the tip of the teat to force some milk in it to come out.

Adopted from Good Milking Technique. A practical manual for small scale dairy farmers in Vietnam. Dairy Vietnam 2008.



How to Milk a Cow by Milking Machine?

Machine milking is gradually being adopted by dairy farmers because it reduces labor and performs a better quality milking job than hand milking. However, most dairy farms have small herd sizes and cheap labor is available, thus, farmers do not see the need to install milking machines. This is also because milking machines require power and are more expensive to install compared to the few equipment needed for hand milking.

But milking machines have many advantages over hand milking. For high yielding dairy cows, it is normally difficult to ensure all milk is removed from the udder within the required time. A cow should be milked within 5-8 minutes. Milking beyond this time is not productive because the hormone oxytocin that stimulates milk production will have long ceased to be effective. Machine milking on the other hand is very fast such that all the milk will have been removed by the end of this time.

Effective milking has a direct bearing on the long-term milk yield of the cow. Cows that are not completely milked gradually reduce milk production whereas those that are completely milked increase milk yield. The importance of complete milking, therefore, cannot be over-emphasized. Also note that cows cannot endure delays in scheduled milking without serious reductions in milk yield.

Although the cost of installing milking machines is high, investing in a good milking machine is a good decision if conditions allow. Many types and sizes of milking machines suitable for different categories of farmers are available in the market. Small scale farmers with small herds of between 5 to 10 cows can invest on simple milking machines to replace the inefficient and labor intensive method of manual milking.

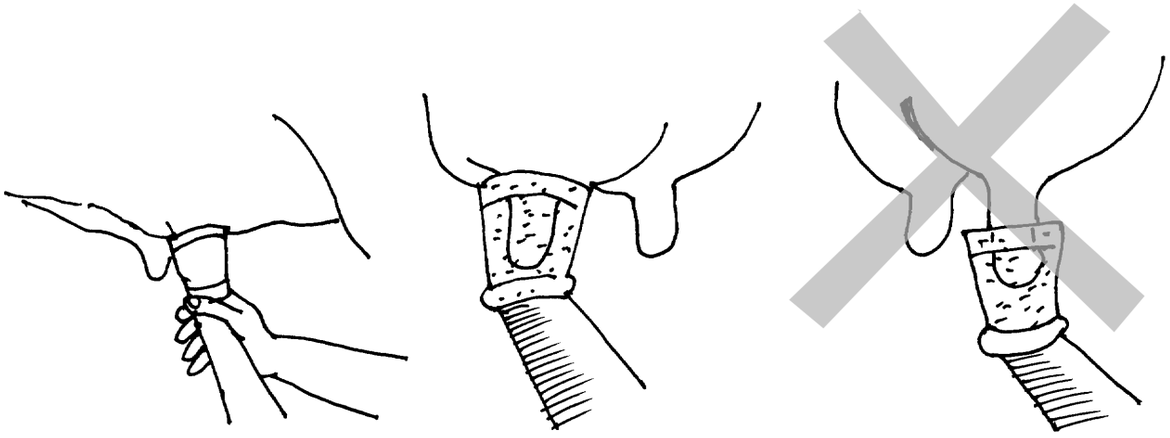
Machine milking

1. Lead the milking cows into the bathing area and wash them properly, especially their udders.

2. Transfer the cows to the drying area for about 15-20 minutes, then, allow them to dry.

3. Prepare the milking machine, individual towels for cows, disinfectant or iodine and the cooling tank for milk storage.
4. Follow the proper attire and other preparations for milking. Lead the cows to the milking parlor. Ensure that the feed bunks are loaded with concentrates.
5. Wipe and massage the udder and teat with a clean towel.
6. With the use of a paddle, squeeze each teat 3-4 times and observe for clotted or blood-tinged milk. If these are observed, **consult a veterinarian. Refer to Organoleptic Test in Evaluating the Quality of Milk.**
7. If the milk is normal, attach the milk clusters to each teat and start milking. Refer to **Organoleptic Test in Evaluating the Quality of Milk.**
8. Gently remove the clusters after milking. It is commonly completed in 7 to 12 minutes

9. Record the weight or volume of the milk collected.
10. After milking, disinfect the teats by dipping or spraying using 10% tincture of iodine.
11. Lead the cow back to the corral.
12. Drain the milk into the cooling tank.
13. Follow steps 1 to 12 until all cows are milked.
14. Clean all the used milking facilities and utensils with caustic soda for base-sensitive dirt and phosphoric acid for acid-sensitive dirt.
15. Disinfect the (milking machine) system and utensils with sodium hypochlorite.



Cleaning and disinfection

- Rinse the milk bucket and milk can with cold water first, followed by boiling water with sodium hypochlorite as disinfectant.
- After thoroughly cleaned, place it upside-down to drip dry.
- Wash the milk, wash, and drying cloths with detergent soap after each milking; rinse thoroughly and dry.
- Clean the refrigerated milk tanks manually using cold or warm detergent or disinfectant solutions; drain to dry and store.
- In cleaning milking machines, follow manufacturer's instruction manual.

Take note:
Daily routines for cleaning and disinfecting of dairy utensils and equipment include the methods of removing dirt and milk residues followed by disinfection.

Maintenance of a milking machine

In a regular milking operation, maintenance of the milking machine is a must. Faulty milking machines can result in poor milk let down, slow milking, milk of high bacterial count, and mastitis.

- Follow the correct maintenance routine.
- Check the mechanical parts of the machine regularly.
- Check the performance of the pulsators and vacuum pumps and make sure that they are operating correctly.
- Correct any faults found, otherwise, regular checking becomes useless.

Frequency of maintenance[4]

- Conduct simple checking immediately before each milking.
- Perform checking on a weekly or monthly interval.
- Ensure to conduct an annual check-up of the complete plant by trained technicians.

Bucket milking machines

Bucket type or portable milking machine is applicable for small and medium scale dairy buffalo production. The machine can have one to four buckets, which are enough to milk 40 dairy cows for about 2-3 hours operation.

Cows are milked on a level floor of a stable or milking shed. The milking machine is mounted on a trolley with one or two buckets at the base. About 8-10 cows per hour are milked with one bucket type and 16-20 cows per hour with 2 buckets.

Simple hand-driven, mobile, low-cost milking machines powered by combustion engine are available in the market.

Pipeline milking plant

This set up has continuous pipeline through which milk is transported direct from the cow's udder to a common milk reservoir. It is suitable for large dairy farms where the work load is usually heavy.

Parlor milking systems

Parlor milking systems are usually installed in milking parlors such as tandem and herringbone. All the equipment is centralized and the cows come to the parlor for milking.

Each milking machine type has a pump to remove air from the vacuum pipeline, a vacuum regulator, and a container to collect the milk that comes into the teat cup assembly during milking.

4 Adapted from Rangoma, M. Machine milking and milking machines. https://www.livestockkenya.com/index.php/blog/cattle/120-machine-milking-and-milking-machines

Factors to consider when installing milking machine[2]

Number of cows

Although you can install a milking machine for just one cow, it is not an economical undertaking. If the size of the herd ranges from 6 to 10 milking cows, then the single cow milking machine is suitable. A herd size above 10 animals will require bigger sized machines.

Table 38. Suggested milking machine based on the cows online

Number of cows	Type of milking machine	Number of milking chutes	Milking time, hours
1-5	Hand milking	1	1-2
6-10	Portable, one bucket	2	2-3
11-20	Portable, two bucket	4	2-3
21-40	Portable, four bucket	8	2-3
Above 40	Tandem type	12	2-3

The level of milk production

Although milking machines can be used to stimulate higher milk yields, it is not justifiable to install them for a low yielding herd. Manual milking for cows that produce more than 10 liters per session is often ineffective and milking machines should be considered.

Infrastructure

Most milking machines are powered by electricity so a source of power is important. But where there is no power, other alternatives are available in which simple combustion engines or solar energy are used to drive the vacuum and milk pumps.

Machine milking routine practices

Machine milking is a highly skilled operation that requires continued use to be perfected. Cows develop habits. If you establish and maintain a persistent milking routine, cows will feel comfortable and respond positively with a steady production. An important part of the procedure is the control and prevention of mastitis.

- Gently and calmly restrain the milking cows in the milking parlor.
- Ensure that all equipment and tools are clean and in proper working condition.
- Wash your hands thoroughly using clean water and soap before starting to milk.
- Clean and massage the cow's udder and make sure the teat is dry after cleaning.
- Use individual cloths for each cow or thoroughly wash the cloth before using it to clean the next cow.
- Take a few squirts from each teat and test for mastitis.
- Use a pre dip to disinfect the outside of the teat.
- Put on the milking unit within one minute after preparation.
- Monitor the milking and adjust the unit if it starts squeaking or if the cow appears uncomfortable.
- Take the unit off when the milk flow has ceased or is very low.
- Dip the teats of the cows within one minute after take-off to disinfect and protect the teat canal.
- Record your observations on the individual cows during milking
- Milk treated and sick cows separately after all the healthy cows have been milked.

[2] Adapted from Rangoma, M. Machine milking and milking machines. https://www.livestockkenya.com/index.php/blog/cattle/120-machine-milking-and-milking-machines

Milk Handling Procedures

Equipment/containers/utensils

All multi-use containers and equipment, milking systems, and other equipment in the handling, storage, bottling, or capping of raw milk or raw milk products shall be made of smooth, non-absorbent, non-corrodible and non-toxic material and can be easily cleaned and kept in good repair. Store utensils and associated equipment in a sanitary manner.

Clean all milk product contact surfaces of multi-use containers, equipment, and utensils used in the milking, handling, and storing of milk and milk products immediately after use with approved cleaners followed by an acid rinse and are sanitized immediately before use.

Clean sanitized, smooth copper-free, and dry containers may be used for handling, processing and transporting milk. Stainless or aluminum milk cans and food-grade plastic containers are good examples.

How to train a pregnant heifer for milking?

1. Teach the pregnant heifers to line up with the milking cows in entering the milking stall 5-7 days before calving. For this purpose, they are led by 2-3 experienced buffaloes.
2. In the milking stall, assign a definite place for each heifer where she will be brought every day.
3. The milker should spend a few minutes with each pregnant heifer, silently approaching while gently patting it on the back.
4. The milker should gently rub the udders and holds and squeezes every teat gently.
5. Repeat steps 1-4 until the pregnant heifer gets used to the milker, the milking process, and its environment.

MIlk Handling and Storage

Renelyn M. Labindao
Science Research Specialist II
Philippine Carabao Center at Central Luzon State University

Introduction

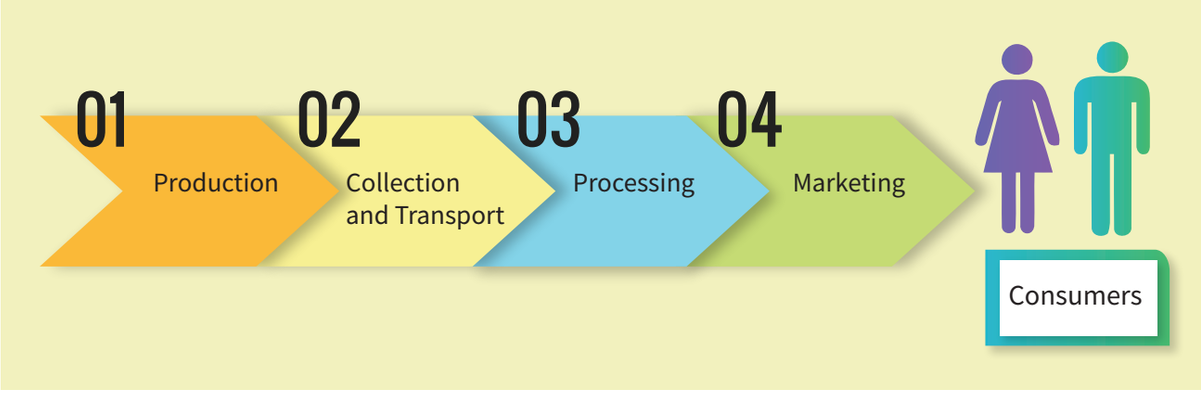
Maintaining a high standard of hygiene is one of the most important milk production objectives. The hygiene level directly influences the production's economical result and dairies are enforcing this by steadily raising quality requirements for raw milk. More importantly though, consumers are concerned about the safety of dairy products and the conditions under which these are produced. It is therefore critically important to ensure high quality raw milk produced from healthy animals under good hygienic conditions and that control measures are applied to protect human health.

Legal requirements for safety, quality, and production conditions are currently enforced in many countries. Raw milk must come from healthy animals and should not endanger human health. Furthermore, the equipment, tools, and conditions under which milk is produced must fulfill certain minimum requirements. Milk's content must also meet specified hygienic standards in terms of bacterial and somatic cell counts.

Good quality milk is essential for production of good quality dairy products, free from pathogens and long keeping quality.

In order for milk to reach the processor and ultimately the consumer in good condition, a number of things must be observed right from the farm level to the processing factory, and thereafter to the retailers and consumer.

The final quality of dairy products offered to the consumer, is determined by characteristics of the whole process - from the animal's feed production to the consumer's table.



Good quality dairy products cannot and can never be made from poor quality raw milk

Buffalo's Milk

Buffalo's milk contains higher total solids than cow's milk, which makes it thicker. It has 100% more fat content than cow's milk, which makes it creamier and thicker. Due to high peroxidase activity, buffalo's milk can be preserved naturally for a longer period. It contains more calcium, better calcium to phosphorous ratio and less sodium and potassium, which make it a better nutritional supplement for infants.

- A very nutritious food
- A good medium for the growth of bacteria

Characteristics of good quality raw milk:

a. Safe for human consumption
   - Free from disease-producing microorganism
   - No antibiotic or any chemical residue

b. Has high keeping quality (cold storage)
   - Has low microbial count/somatic cell count

c. Has high commercial value
d. Can be transported over long distances
e. High quality base product for processing
f. No adulteration

What causes milk spoilage?

A. Bacteria in Milk

The major group of bacteria in milk is the group of lactic acid bacteria. These are able to use the lactose in the milk and to convert it into lactic acid. The most important family in this group is the Streptococcus lactis. These multiply and grow very fast when the milk is kept at ambient temperatures after milking. The produced lactic acid causes the natural souring of milk. The primary source of these bacteria is the environment: air, dust, dirty equipment and operators, etc. How soon the milk turns sour depends on the degree of contamination and on the temperature of the milk. Therefore, proper cleaning and sanitizing procedures are essential to control the quality of milk.

Cooling to a temperature of 4^{0}C makes the bacteria inactive and prevents them from growing and producing lactic acid. The milk should be produced as clean as possible in the first place, but after that it should be cooled soonest.

There are also types of microorganisms, which make use of other milk components, like the proteins and the milk fat. All this microbial activity deteriorates the milk quality. Therefore, only fresh milk of tested quality should be used as raw material to enable processing into high quality milk products. For this reason, the dairy industry strictly controls the quality of the incoming milk from the dairy farmers. If the milk quality does not fulfill the set minimum quality standards, it is rejected. This means an economical loss to the farmer. Most countries have implemented special laws and regulations concerning the composition and hygienic quality of milk and milk products to protect both the consumers and the public health.

B. Somatic Cell in Milk

Somatic cell counts represent another important milk quality parameter. The word somatic means body and thus a somatic cell is a body cell. Most important in milk are the leukocytes (white blood cells). Milk originating from an infected udder contains a high concentration of leukocytes. Consequently, somatic cell counts are an important indicator of udder health, particularly for mastitis.

Fresh milk from healthy cows has a somatic cell count of less than 200,000 cells per ml of milk. Cell counts from herd bulk milk, which are consistently in excess of 500,000 per ml are an indication of a high prevalence of mastitis in the herd. At the farm, the cows can be checked easily for mastitis by the California Mastitis Test (CMT).

The Milk Chain

The efficient production of milk under good hygienic conditions is the key to successful dairying. The principal constraint in particularly smallholder systems is a high level of bacterial contamination in the milk. This might lead to its spoilage before it reaches the market. The first step for a farmer is to produce good quality milk from healthy (non-mastitis) cows. Provide farmers with advice and assistance on how to produce clean milk. This is the basis, which enables successful collection and marketing of the milk. First, pay attention to the equipment used. This has to be suitable for effective cleaning and sanitization. Second, give emphasis to good hygienic practices during milking. Finally, pay attention to the transport and collection of the surplus milk to the point of sale or processing. Collection and transport of the milk should not take very long to minimize post-harvest spoilage.

- **Milk Collection:**

  Most of the milk is produced by smallholder farmers with less than 5 animals. Their production units are widely dispersed in rural areas with poor infrastructure, while most of the markets are in urban areas. The logistical challenge of linking these producers with the market is compounded by the highly perishable nature of milk. The need for good hygienic practices and a streamlined collection and transport system is crucial. An important step in this respect is the establishment of a simple collection point near to a group of milk producers.

The most crucial aspects to maintain high quality fresh milk are:

- Hygienic milking and milk handling on farms
- Good health status of the animals
- Cooling of milk as soon as possible after milking
- Transport of milk to the collection center and/or processing plant within 2-3 hours after milking
- Good quality and well cleaned milk equipment

Maintaining a good quality of milk is benefiting farmers, milk processing plants, and consumers. It will result in the milk producers receiving the full value for their produce, in minimal losses during processing at the milk plant, and in a reliable quality of the milk products for the consumer.

3 Things to Remember in Keeping the Quality of Milk

1. Cleanliness or hygiene
2. Disinfection
3. Cooling

A. Cleanliness

The concept of clean milk production

Microorganisms are found everywhere: on animals and people, in the air, the soil, in water, and in milk. Good sanitary practices throughout the entire milk chain, from milking through processing to packaging, result in safe milk of a good quality.

The main sources of contamination by microorganisms in raw milk are the surfaces, which they contact. These include the udder, the hands of the milker, and the utensils. This means that it is very important to clean hands and surfaces carefully with clean water. Improving sanitary practices during traditional milk handling and processing may meet resistance from farmers. Therefore training of a practical nature is needed.

Once microorganisms have found their way into milk, they develop easily and multiply rapidly. Microorganisms grow best at room temperature, so keeping milk cool will slow down their growth. Heating the milk, like pasteurization, destroys a large number of microorganisms. Increasing the acidity of the milk by fermentation suppresses the growth of harmful organisms as well.

The term "clean milk" means raw milk from healthy animals that has been produced and handled under hygienic conditions. It is free from extraneous matters like dust, dirt, flies, manure, etc. Clean milk has a normal composition, possesses a natural milk flavor, contains only a small number of harmless bacteria, is free from hazardous chemical residues, and safe for human consumption. The status of raw milk is determined by its bacterial quality and the somatic cell count. With simple and low-cost husbandry practices, it is possible to produce milk with a count of less than 50,000 bacteria per ml.

The unhygienic and undesirable practices that decrease the quality of raw milk can be classified into three categories:

1. Practices related to the animal:
   - Animals are not healthy or suffer from mastitis
   - Animals are dirty, in particular the udder, the teats, the hind quarter and the tail.
2. Practices related to the milker:
   - Hands and clothes of the milker are not clean and he or she practices unhygienic personal habits.
3. Practices related to the milking process:
   - Wrong milking procedures are used; the utensils and the milk can are not cleaned properly.

Contamination and control measures at farm level

On the farm, contamination of milk can occur at the following places and procedures:

- Animal shed and environment
- The animal
- Milker and milking routine
- Milking equipment
- Storage and transport

DIFFERENT SOURCES OF BACTERIAL CONTAMINATION IN RAW MILK

HUMAN
- Coliforms
- Salmonella
- Enterococcus
- Staphylococcus

AIR
- Streptococci
- Micrococci
- Coryneforms
- Bacillus
- Yeasts and Molds

INSIDE UDDER
- Streptococcus
- Micrococcus
- Corynebaterium

OUTSIDE UDDER AND TEATS
- Micrococcus
- Staphylococcus
- Enterococcus
- Bacillus

MILKING MACHINE
- Streptococcus
- Micrococcus
- Bacillus
- Coliforms

SOIL
- Clostridium
- Pseudomonas
- Mycobacterium
- Bacillus
- Yeasts and Molds

FEED
- Clostridium
- Listeria
- Bacillus
- Lactic Acid bacteria

FECES
- Escherichia coli
- Staphylococcus
- Listeria
- Mycobacterium
- Salmonella

Animal shed and environment:

The environment in and around the milking premises determine to a great extent the level of contamination of the milk. If milking is done inside a shed, as is usually the case with smallholder farmers, there is a high risk of contamination through the air and by insects, in particular flies. The shed should provide protection against wind, rain, and excessive heat, but at the same time have sufficient light and ventilation. The milking area of the shed needs special hygienic attention. The floor of the milking place should be made of concrete so that mud, urine, feces, and feed residues can be removed. It should be swept with clean water before and after each milking.

For that reason, locate the shed on a higher place to facilitate proper drainage. Establish facilities for adequate and sufficient supply of safe and potable water. In case all these conditions cannot be met, milking in the pasture or a clean open field is preferable to milking in a dirty and/or muddy stable.

The animal:

The animal itself is an important source of contamination. Care and management of the animal and its health is therefore the starting point for clean milk production. The skin of the animal provides a large surface for possible contamination. Dung, urine, uterine discharge, dirt, dust and hairs can pass millions of bacteria, when it drops from the skin and udder into the milk. Clip long hairs on the flanks, hind legs, tail, and udder at frequent intervals. Grooming the animals regularly can help to keep hair and dust away from milk. When cows are kept indoors or graze in heavily stocked paddocks, the udder will be grossly contaminated with bacteria, even when it appears visibly clean. If the animal is suffering from infections such as mastitis, the milk will contain harmful pathogenic microorganisms. Separate the milk from diseased animals and dispose safely. Routine control on mastitis can reduce the proportion of infected cows. Test the foremilk at each milking with a strip cup.

Milker and milking routine:

In case of hand milking, the danger of contamination coming from the milker is higher as compared to machine milking. As the milker moves from one animal to the next, he/she can transfer pathogenic microorganisms to all the animals in the herd. In this way, the milk can become contaminated as well, making it unsafe for human consumption. Therefore, the milker should be free from contagious diseases. The milker should wear clean clothes and have trimmed and clean nails. He/she should wash hands with soap and water before milking and dry them with a clean towel. The milker should always cough or sneeze away from the milking pail.

A good milking routine prevents contamination of the milk. Consistent milking at regular intervals using a fast but gentle technique, which empties the udder completely, are important aspects.

Avoid feeding roughage at the time of milking, as dust and/or smell easily contaminates the milk. If calves are suckling, the calf should be allowed to suckle at the beginning of the milking.

Wash the udder and teats and massage for at least 30 seconds using clean water and a cloth or individual paper towels. Add a dash (about 15 ml) of disinfectant to a bucket of water. If udder cloths are used, rinse them regularly in between milking different cows. After each milking, wash and disinfect the cloth and hang it to dry. Disposable paper towels are preferable and more effective for drying the udder after washing.

Examine foremilk and discard abnormal milk. Do not allow the foremilk to run on the floor as

this increases the danger of contamination. During milking, all milk should be drawn directly into the pail as fast as possible. The milker should not wipe his/her hands on the body of the animals or on his/her own body. After milking, the teats can be dipped or sprayed with a gentle antiseptic solution.

Filtering or straining the milk removes visible dirt but not the bacteria from the milk. Bacteria will pass through the filter. Cloth filters must be properly washed and dried in the sun after each use.

Milking equipment

Clean all dairy utensils such as buckets, milking cans, and filters thoroughly and immediately after use. Any milk residues on the equipment will allow microorganisms to grow rapidly. Also, clean and disinfect ancillary equipment, including foremilk cups, and udder cloths.

Water supply

A clean water supply is essential to minimize contamination. Unless an approved piped supply is available, it must be assumed that water is contaminated. Some water-borne bacteria are dangerous and can easily enter the milk. Examples are the coliforms, which cause stomach disorders and cholera and may even lead to death. Therefore, boil the cleaning water or add hypochlorite at about 15 ml per 10 liter water. Alternatively, the quality can be improved by adding one drop household bleach to one liter of water. Hard water (i.e., high levels of dissolved calcium and other salts) will cause surface deposits on the equipment and reduce cleaning effectiveness. In such cases, use de-scaling solutions periodically.

B. Disinfection

First, wash the utensils with hot water and a detergent. Use a clean brush with good bristles, which is only designated for cleaning the milk equipment.

Rinse with clean water. After which, disinfect the equipment with either hot water or with a disinfectant. Do not dry the utensils with a piece of cloth, but drain them immediately after washing. Bacteria will not multiply in dry conditions but water lodged in milking equipment will, in the prevailing temperatures, provide conditions for massive bacterial growth. To facilitate drainage of wash water, put the utensils in an inverted position on a drying rack.

- **Equipment**

  The utensils and equipment used during milking should be made of non-absorbent, corrosion-resistant material. The surface should be smooth, have minimal joints or open seams, and should be free from dents. Although expensive, by far the best option is stainless steel. Plastic is not advisable as after some time the surface will contain scratches, which can hardly be seen but are nearly impossible to clean. For the same reason, in case of machine milking, renew the rubber components at regular intervals.

- **Detergents and disinfectants**

  Detergents are necessary to clean milking equipment effectively before disinfection. The effectiveness is increased when warm water is used. This helps to displace milk deposits and to remove dirt, dissolve milk protein, and emulsify the fat. Make sure that the correct concentration is used. Many detergents are available in the market, but if not, an inexpensive mixture can be made by using a solution of soda or even washing powder. About 1 teaspoon per liter water gives the correct concentration.

  Disinfectants are required to destroy the bacteria remaining after washing and to prevent these subsequently from multiplying on the cleaned surfaces. Also, their effectiveness is increased with temperature. Allow sufficient contact time

with the surfaces to be cleaned and disinfected. When hot water is used, it is best to begin the routine with water at not less than 85oC. Many chemicals are suitable as a disinfectant. Some of them are combined with detergents (i.e., detergent-sterilizers). Disinfect with 200 ppm chlorine solution (40ml Zonrox/10 L water). One teaspoon is equivalent to 5 ml.

10 L water	40 ml Zonrox	8 teaspoon Zonrox

C. Cooling

Milk preserving quality:

If the milk is cooled to 4oC within a period of 2–3 hours after milking, it maintains nearly its original quality and remains good for processing and consumption. However, in rural areas, it is hardly possible to achieve this. Other options have to be considered to lower the temperature and to retard the growth of spoilage organisms. Simple alternatives are putting the container with milk in water or placing a moist cloth around the metallic milk containers. Other possibilities are solar-powered coolers or a charcoal box, which is moistened to reduce the milk temperature.

Types of Milk Containers

Container size and type are important. For small quantities of milk, the ideal milk transportation equipment would be metal milk containers made from stainless steel or aluminum. Such containers are made from approved food-grade material and are also durable, easy to clean, and to sanitize. The milk container should have a lockable lid to prevent spillage. These are also easy to clean and disinfect. Plastic is very difficult to properly clean, and it tends to hold onto off-smells and tastes. Stainless steel buckets can be a little expensive, but they are worth the investment.

Aluminum milk cans

Stainless steel milk cans

Plastic milk cans

Store the milk in clean containers with a lid and keep in a cool and shady place where the danger of contamination is minimal. Transport should take place in clean containers as well. Keep the transport time to a minimum and avoid violent movement of the milk. Heat, light, and violent movement can all cause breakdown of certain components in the milk and affect its taste. Milk must reach the milk collection center quickly, ideally within 2-3 hours after milking. Preferably, cool the milk to 4oC and keep it at that temperature until it is processed.

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MIlk Quality Test

Renelyn M. Labindao
Science Research Specialist II
Philippine Carabao Center at Central Luzon State University

Milk testing and quality control are essential components of any milk processing industry whether small, medium, or large scale. Milk quality control is the use of approved tests to ensure the application of approved practices, standards, and regulations concerning the milk and milk products. The tests are designed to ensure that milk products meet accepted standards for chemical composition and purity as well as levels of different microorganisms.

Reasons why we have to have a quality control system for the dairy:

- The Milk Producer
  - The milk producer expects a fair price in accordance with the quality of milk he/she produces.
- The Milk Processor
  - The milk processor who pays the producer must assure himself/herself that the milk received for processing is of normal composition and is suitable for processing into various dairy products.
- The Consumer
  - The consumer expects to pay a fair price for milk and milk products of acceptable to excellent quality.
- The Public and Government Agencies
  - These have to ensure that the health and nutritional status of the people is protected from consumption of contaminated and substandard foodstuffs and that prices paid are fair to the milk producers, the milk processor, and the final consumer.

Milk is tested to determine its quality and composition. Composition refers to the elements that make the milk nutritious, such as fat. A good quality milk:

- Contains enough fat
- Should not be mastitic
- Should not be sour
- Should not be mixed with water
- Is clean and hygienic

Methods of testing

1. Sensory or Organoleptic Test

The organoleptic test permits rapid segregation of poor quality milk at the milk receiving platform. No equipment is required, but the milk grader must have good sense of sight, smell, and taste. The result of the test is obtained instantly, and the cost of the test is low.

Milk characteristics and procedures:

Odor

Smell the milk just above the milk surface immediately after removal of the cover. Smell of urine and feeds are common problems.

Color, appearance and consistency

Normal:

- Perfect white: good normal buffalo's milk
- Yellowish creamy color: colostrum

Abnormal:

- Pink color: stained with blood
- Blue-tinged color: adulterated with water
- Large clots of flakes: sour milk or mastitic milk
- Small white clots or grains: mastitic milk
- Visible dirt and impurities: collected under unhygienic conditions

Taste

Normal:

- Pleasant taste attributed to the balance between the milk sugar's sweet taste and the ash's salty taste, and that of fat and protein.

Abnormal:

- Off-flavor taste absorbed from odors from garlic, onion, bad silage, certain plants, and pastures.
- Souring due to fermentation caused by acid-producing bacteria, improper handling, and storage.
- Absorption of off-flavors from air and milk containers. Fats in milk and the ability to absorb smelling compounds from air, especially milking when it is still warm

2. Laboratory Test

A. Clot-on-Boiling Test (COB)

This test is quick and simple. It is one of the old tests for too acid milk (pH<5.8) or abnormal milk (e.g., colostral or mastitic milk). If a milk sample fails the test, it must contain many acids or rennet-producing microorganisms or the milk has an abnormally high percentage of proteins like in colostral milk. Such milk cannot stand the heat treatment in milk processing and must therefore be rejected.

Apparatus:

- Burner or boiling water bath
- Test tube
- Pipette 2-5 ml

Procedure:

1. Transfer 5 ml of milk into the test tube.
2. Place the test tube in a water bath at a boiling temperature for 5 to 6 minutes.
3. Remove the tube from the bath and rotate them in an almost horizontal position.
4. Examine the film of milk on the sides of the test tube for any precipitated particles.

Interpretation:

- No coagulation (COB -) = milk is fit for pasteurization
- With coagulation, thickening, lumping, flaking or precipitate (COB+) = reject the milk, as it is not fit for processing.

B. Alcohol Precipitation Test (APT)

The test is quick and simple. It is based on instability of the proteins when the levels of acid are increased and acted upon by the alcohol. Also, increased levels of albumen (colostrum milk) and salt concentrates (mastitis) results in a positive test. Alcohol test is used for rapid detection of high acidity in milk. Proteins in milk become sour due to bacterial fermentation. Alcohol will precipitate milk proteins if they are sour.

Apparatus:

- Test tube and pipette

Reagent:

- 60% ethyl alcohol (prepared by mixing 60 ml absolute ethyl alcohol and 40 ml of distilled water)

Procedure:

1. Pour about 2 ml of milk in a test tube.
2. Add equal amount of 60% alcohol.
3. Agitate the contents by gentle movement.
4. Observe for any coagulation.

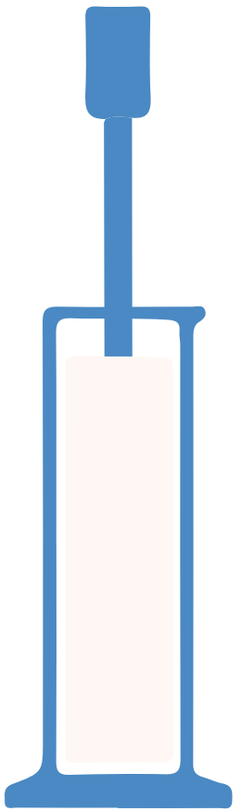
Interpretation:

- Without coagulation/No reaction by alcohol (APT -) = acidity of milk is normal
- With coagulation (APT+) = may be due to increased acidity, increased salt content, or mineral imbalance (in the case of colostrums or mastitis) or hormonal imbalance
- If milk is APT+ but COB -, it is recommended to correlate with other tests such as acidity test.
- If the acidity is within the normal level (0.13-0.16%), the milk can withstand heating, thus it is fit for processing.

C. Lactometer Test (Specific Gravity)

This test is used to determine if the milk is adulterated or when:

- It contains added water resulting in low total solids contents
- Fat has been removed from raw milk
- It contains added skim milk or skim milk powder dissolved in water



Procedure:

1. Temper the milk to about 60°F.
2. Mix well the sample by carefully pouring it several times from one container to another.
3. Pour the sample into the cylinder avoiding air bubbles.
4. Hold the clean lactometer at the top of the stem and gently lower it to the milk and release it to approximately the equilibrium position.
5. Read the result at eye level at the point on the scale that touches the upper edge of the meniscus.
6. The temperature of the milk is observed at the time the lactometer is read. For every degree above 60oF, a correction factor of 0.1 is added to the lactometer reading. The same correction factor is subtracted when the lactometer reading is read at a temperature less than 60oF.

Example:

- If the lactometer reading is 33 at 65°F, then the corrected reading is 33.5.
- If the reading is 33 at 54°F, then the corrected reading is 32.4.

Application:

The Quevenne lactometer reading is converted to specific gravity by merely dividing the reading by 1000 and adding 1. For example, the lactometer reading of 33 corresponds to a specific gravity of 1.033 while the reading 34.2 corresponds to specific gravity of 1.0324.

D. Acidity Test

The titratable acidity test quantifies the acidity in milk.

Apparatus:

- Burette reading to 0.1 ml
- Erlenmeyer flask, 125ml (or white plastic cup)
- Pipettes, 8.8 ml or 9 ml, 1 ml

Reagents:

- 1% phenolphthalein indicator
- 0.1N NaOH (standardized)

Procedure:

1. Measure 8.8 ml (9 g) well mixed milk sample into an Erlenmeyer flask (or white plastic cup)
2. Add 0.5 ml phenolphthalein indicator.
3. Titrate with 0.1 N NaOH and divide this by 10 to obtain percent acidity.

Example:

If you used 1.4 ml of 0.1 N NaOH, divide this by 10 and you get 0.14% lactic acid,
or 1.4ml of 0.1N NaOH = 0.14% lactic acid

$$\frac{\text{_____}}{10}$$

Interpretation:

- Fresh, normal milk has an acidity of 0.13%-0.16%. If the acidity is within the normal level, the milk is fit for pasteurization (liquid milk products).
- Above 0.16%, milk acidity has increased due to bacterial action. If the acidity is above normal level, the milk is used for other milk products (pastillas and kesong puti).

Reference:

PCC Dairy Production Buffalo Handbook

Entrepreneurship and Basic Financial Management

Erwin M. Valiente
Science Research Specialist I
Philippine Carabao Center National Headquarters and Gene Pool

Dairy farming as a business is a relatively new concept for smallholder farmers who have traditionally farmed to provide only their daily basic needs. In maximizing the benefits of this activity, smallholder farmers are required to change the way how they do farming for them to achieve the success in dairying. This is because farming is a profitable venture, which provides employment and a source of livelihood to many people particularly the farmers.

According to Kahan (2012), smallholder farmers usually have the ladder of intensions and reasons for farming: (1) farming exclusively for home consumption, (2) farming primarily for home consumption but with the intension of selling surplus in the market, (3) farming primarily for the market with some home consumption, and (4) farming exclusively for the market.

Importance of the Business

1. Creation of employment
2. Income generation
3. Meeting the needs of the community through provision of goods and services
4. Economic development and promoting the welfare of the community

Entrepreneurship is a key factor for the survival of a small-scale farming. An entrepreneur ("carapreneur") should always look for opportunities to improve and expand his/her chosen business. Aside from being passionate and innovators, carapreneurs will become more innovative and competitive in the market if they have the assistance from the government agencies, extension workers, and private institutions. Extension support after the training is very important to established and expand their farm business by facilitating linkages and develop network and partnership with other players in the dairy buffalo value chain.

Dairy Farming as a Business Enterprise

The best way to start a business is to pick a venture that you have an experience, know personally, and do some research for more information, which is very essential in the business you are thinking. It is difficult to attain success if it does not interest you, but for higher chances of success, consult an expert, and perform financial projection. Forecasting how much the revenue over specified time, cost, and profit are very important in the business so that we have time to adjust the operation if our target is not attained.

If you have already an experience in dairying, you can use this as an advantage. Use your knowledge, training, skills, and network that can help you find financing and customer when you are starting a business like this.

For a smallholder farmer to become a carapreneur, he/she must look for better ways to organize his/her farms. Adoption of new technology fitted in the farm can improve productivity, expand production, reduce risk, and increase profit. Carapreneurs have the qualities of being innovative and forward-looking. They need to manage their farm as a long-term venture to make them sustainable and become more market-oriented or create new markets for their products.

Risk of Starting a New Business

When starting a new business, an entrepreneur faces many challenges that may affect the success of his/her business operation. Identifying those risks early on and determining how to approach them increases the chance for success. According to Ravi (2014), the most common risks in starting a business include:

(1) Product risk. It should be clear on the part of the entrepreneur what product to sell or what business to invest on and why it is worth investing.

(2) Market risk. Know your customer and why, how, and where they buy related products. Research thoroughly and identify these routes to market, and whether you can build them effectively in a timely fashion and within your budget. Controlling this kind of risk depends on devising marketing plan that is strategically sound and financially feasible.

Remember that the competitors are in the market at the same time and place as your business. If you plan ahead of time, have more skills, know the market better and work harder, then you make a better product with less cost and get more customers.

(3) Financial risk. The financial standing of a business can often make or break a company's ability to succeed. Determine if a product or service is strong enough to support the financial obligations of the business.

A lack of startup funds poses a considerable threat to new business. Entrepreneurs who are unable to secure financing often dip into personal savings or overextend credit cards to fund their new business venture. Personal financial success is often tied to the success of a new business. If the business does not succeed, a new business owner could possibly face financial ruin.

(4) Personal risk. Business success can come at a high personal cost. Getting your business up and running may consume most of your time and energy, including your precious evenings and weekends. You may not have much time for family or friends. Before you quit your job, decide whether you (and your family) are ready to make some of the personal sacrifices necessary for you to create a successful business.

Characteristics of Successful Entrepreneur

Entrepreneurship is not for everyone. If you have the desire, you need to evaluate yourself if you have qualities of being an entrepreneur. According to McClelland and McBer (1985) as cited by Peter in 2013, successful entrepreneur possesses competencies in order to perform his or her functions effectively. No matter what the size of the industry is, it requires a set of skills and attributes that not all workers possess.

Although levels of education and experience may vary, successful entrepreneurs often share the same set of characteristics as follows:

(1) Opportunity seeker. An entrepreneur is able to take action on how to seek information to help achieve business objectives or clarify business problems and always looks for and takes action on opportunities.

(2) Persistent. An entrepreneur is able to make repeated efforts or to take different actions to overcome an obstacle that get in the way of reaching goals.

(3) Risk taker. The entrepreneur understands that risk-taking means trying something new, and possibly better, in the sense of stretching beyond what has been done in the past. Constant challenge is to learn how to assess choices responsibly, weighing the possible outcomes against his/her values and responsibilities.

(4) Initiative. The entrepreneur should be able to take actions that go beyond his job requirements and to act faster. He is always ahead of others and able to become a leader in the field of business.

(5) Systematic planning and monitoring. An entrepreneur develops and uses logical, step-by-step plans to reach goals.

(6) Self-Confident. A successful entrepreneur has a strong belief in self and own abilities.

Reasons for Failing a Business

Countless new businesses start up every year and only half of them make it through their first year of operation. According to Small Business Administration, only one-third of these are able to survive for 10 years. There are many reasons why businesses are failing, though Kamo (undated) specified six main reasons as follow:

(1) Leadership Failure. The business will not succeed if the leader exhibits poor management skills, incompetence, and lack of knowledge. When the leader is inexperienced or the management is made up of novices, then your business is as good as dead. They must understand that their role being a leader is to serve others and not vice versa. Always remember that the leader must take the lead to achieve the goals and objectives of the organization.

When starting a new business, it is advisable to get the service and opinion of other people full of experience or have an idea in the same field. They can be your partners, mentors or hire them as your employee.

(2) Lacking Uniqueness and Value. Your business will not succeed even though you have a great product or service to offer when the approach is mediocre or lacks the strong value of negotiating. What worked for A may not work for B.

After proper consultation from the expert, it is better to develop a customized approach and add your own ideas that will distinguish you from the others and that will attract attention and interest of the customers.

(3) Not in Touch with Customer Needs. Your business will fail if you neglect to stay in touch with your customers and understand what they need and the feedback they offer. Your customers may like your product or service just because you changed the feature or procedure on how it was done. Customers' suggestion or advice will be more helpful to improve your business strategy.

A successful business keeps its eye on the trending values and interest of its existing customers.

(4) Rapid Growth and Over-expansion. The desire to be the first in the market with a new product prompts entrepreneur to expand business. While growth is desirable, overexpansion is a serious mistake. Set realistic goals and expand the business if it is needed. Conduct thorough research to ensure the time is right and the funding is available for expansion. Make sure that the initial business is stable before expanding to an additional location.

(5) Poor Financial Management. You must know down to the last cent where the money in your business is coming from and where it is going in order for your business to succeed. Most of the times, many entrepreneurs could not account for their daily sales. Once there is a sale, they spend the money on personal needs believing that they will make another sale. If you must succeed in business, you must be accountable for every cent that you make. Make sure you plan out your spending, for a business you plan to grow.

Financial Management

Many bright ideas and enthusiast farmers become successful in dairy farming. This is because they are easily able to adopt new techniques in dairying and they gladly accepted farming as their business. As part of this, farmers practice good financial management, which involves thorough bookkeeping and proper planning. As a carapreneur, you need to manage your cash flow so that you can generate profit and pay expenses in the farm such as rent, utilities, debt, etc. To do this, you need to spread your expenditure over the year and give your customers strict payment terms.

Financial Analysis

In dairy farm business performance, the cash and the profit are the key measures of business efficiency. Therefore, financial analysis is a very important tool in the process of evaluating the dairy farm business to determine the suitability for investment. It is used to analyze whether it is stable or profitable enough to be invested on. In dairy farming, the farmers will often focus on the income statement, balance sheet, and cash flow statement.

The financial analysis is important in dairy farming enterprise to determine if it needs to:

- Continue or discontinue its operations;
- Acquire or rent certain machineries and equipment in the production;
- Issue stocks or negotiate for a bank loan to increase its working capital; and
- Make decisions regarding investing or lending capital

The income statement presents the financial performance of a farm business for a specific period of time. The statement quantifies the amount of revenues generated and expenses incurred over time, as well as any resulting net profit or loss.

Classification of income

- Gross farm income – output produced, which are sold, consumed and used in the farm. It is the total cash and non-cash income earned by the dairy farm business.
- Farm cash income – total cash income received by the dairy farm business in the form of cash, e.g., milk sales, animal sales, manure sales, sale of by-products.
- Non-cash income – the change in value of livestock over the years and income received in the form of goods and services, e.g., consumed, given away as gift, increase in inventory. A decrease in the value of livestock is recorded as a negative and an increase as a positive.
- Net farm income – the total income less total cost

Classification of expenses

Farm cash cost – where actual payments or paid for in cash are involved, e.g., biologics, feeds, AI service, hired labor, electricity, dairy supply, etc.

- Non-cash cost (imputed cost) – an estimation in the absence of a real cash cost or no obvious payment or does not involve an actual cash transaction, e.g., family labor, own machineries, grasses, and other farm by products as feeds, depreciation, etc.

Pedro's Dairy Farm
Income Statement
For the year ending December 31, 2018

REVENUE	Amount
Cash income	
Milk	xxxx
Animal	xxxx
Total	xxxx
Non-cash income	
Milk consumed	xxxx
Increase in inventory	xxxx
Total	xxxx
Total Income	xxxx
EXPENSES	
Cash expenses	
Biologics	xxxx
Feeds	xxxx
AI service	xxxx
Hired labor	xxxx
Total cash expenses	xxxx
Non-cash expenses	
Family labor xxxx	
Depreciation xxxx	
Total non-cash expenses	xxxx
Total Expenses	xxxx
NET INCOME	xxxxxx

The balance sheet (statement of net worth or statement of financial position) is one of the three fundamental financial statements and displays the company's total assets, and how these assets are financed, through either debt or equity. It presents the business financial position at the end of a specified date.

The balance sheet is based on the fundamental equation: Assets = Liabilities + Equity.

Assets. These are the things that farmers own. They are the resources in dairy farm enterprise that have been acquired through a transaction and have future economic value that can be measured and expressed in pesos, e.g., building and facilities, milking machine, equipment, land, animals, cash, etc.

Liabilities. The amount owed or financial obligation of the farmer to the creditor that arises during the course of the business transaction, e.g., feeds, supplies, veterinary bills, etc. that are not yet paid.

Net worth. Also called owner's equity, it is equal to the amount of assets minus the amount of liabilities.

The cash flow statement is the cash generated and used during a given period of time. For example, the fiscal year ended December 31, 2017. Basically, it involves the flow of cash in and out in a farm business. The operating, investing, and financing activities are the main types of cash flow statement.

Operating activities include the net income or loss over a period of time plus the depreciation (building, milking machine, milking parlor) and amortization (copyrights, royalty) less working capital (difference between current assets and current liabilities). Investing activities are the purchase or sales of assets like land, building, equipment, milking machine, etc. The financing activities include the inflow of cash from investors, banks, and shareholders and outflow of cash to shareholders as dividends.

Cost and return analysis

This involves summarizing the income earned and expenses incurred directly from the enterprise within a given period, for example in one production cycle, and calculating the difference of income above the expenses. The difference between the value of sales and the total variable costs is the total net income of the enterprise. In dairy enterprise, it is better to reflect common practices and level of production in the area so that each farmer can reflect the performance of their farms if they earned profits or incurred loss.

According to Mbatia L. (2010), in order attain success in dairy enterprise, the following are to be considered:

A. To increase profit

(1) Increase revenue without raising costs at the same magnitude.
(2) Maintain the same level of revenue while reducing the costs.
(3) Increase revenue and reduce cost at the same time.

B. To increase revenue

(1) Increasing the volume of milk sold. Increasing milk production, reducing milk losses
(2) Selling where higher prices are obtained. The farmers can identify alternative markets that can pay higher prices without them incurring transport costs that are equal or in excess of additional income to be earned at the alternative market
(3) Preparing and selling high value products, e.g., yoghurt, pastillas, white cheese, flavored milk, etc.
(4) Selling farm-by-products, e.g., manure, vermicompost, feeds like silage, urea treated rice straw, etc.

C. To reduce cost (Identify the respective costs and what can be done to reduce them without reducing the level of milk production)
(1) Timely heat detection to reduce the number of repeat in AI service.
(2) Improved husbandry practices to reduce the incidence of diseases, thus, reduce the cost of veterinary services.
(3) Transport costs could be reduced by bulking the milk from various farms.

Marketing

Farming as a business involves production with the market in mind. It is driven by what is being demanded by consumers. The farmer should, therefore, identify his/her market so that he/she knows what to produce, when to produce, and how much of it. Marketing is important to farming as a business because it involves the processes that move products from the farm to the consumer and translates it into income (Mbatia, 2010).

Four key components of marketing should be considered when making decisions. These are product, price, place, and promotion.

Product. The product to be sold will be determined by the customers' needs, tastes and preferences. The dairy farmer has the option of selling fresh milk or milk products if there is a market for them and they can be produced and sold at a profit. The products should be well packaged and labeled for them to be attractive to customers.

Price. The price of the product will be influenced by production costs, the price being offered by the buyers, the level of supply and demand, the price of similar products or substitutes, desired profit margin and the bargaining power of the farmer, among other factors.

Place. This involves decisions on how the product will reach the consumer. There are different ways of reaching consumers depending on the people involved in the marketing chain. The farmer may take milk to a collection center or engage a transporter to carry the milk

for him, sell it direct to consumers or sell through middlemen. The decision of how the product will reach the consumer will depend on the distance, costs involved, presence of middlemen, transporters, processors and collection centers among other considerations.

Promotion. This involves creating awareness about a product, for example, through advertising and making samples available for tasting. It is essential to the success of the business because customers must become aware of the products so that they can buy. This is particularly important for new products and new brands, which are being introduced in the market.

Access to Credit Facilities

Credit is one of the sources of money for the business. It is money given by one party to another for a time with the understanding that the party, which has received it will pay it back at a later date according to the terms agreed on (Mbatia, 2010).

Why do people take loans?

- Investment, e.g., in business, plots of land, livestock, etc.
- Consumption purposes, e.g., to buy food or household items, pay school fees, etc.
- Attending to emergencies, e.g., illness

When taking a loan:

(1) Make sure that you have a tangible collateral to back up ability to pay back the loan. The amount of collateral will be a factor to be considered by the lender.
(2) If the purpose is to build a business, make sure that you have develop a solid business plan to be successful in business.
(3) Make sure that you borrow an amount that you are able to repay.
(4) Consider the cost of the loan. The investment being funded by borrowed funds should yield a higher return than the amount you pay for borrowing in the form of interest, application fees, processing fees, and other costs associated with using borrowed funds.
(5) Know the terms and conditions of the loan.

Sources of financial assistance (Identify service providers in your area to give relevant examples)

- Banks	- Micro Finance Institutions	- Agricultural Finance Corporation
	- Family and relatives	- Loan (SSS, GSIS, Pag-ibig)

Always remember that money is not the only capital you need. Your business skill, capacity for marketing, people and social skills, technical expertise, and connections can be used as capital for the business.

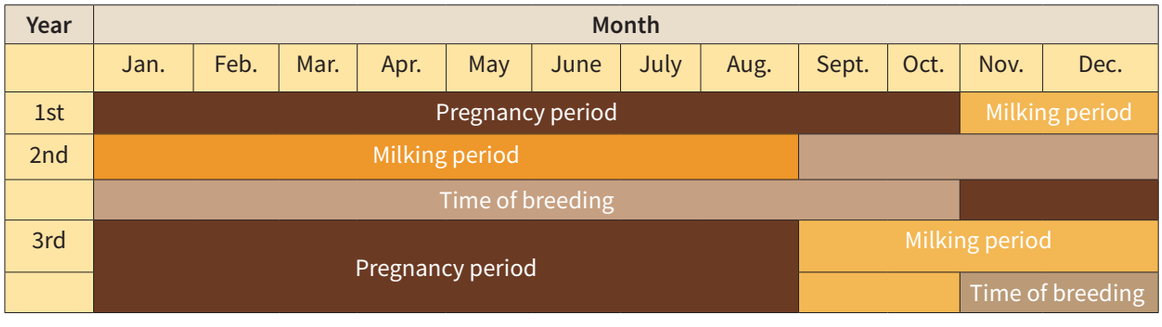
Technical support. (Participate in trainings and seminars, and access technical assistance depending on the needs of the business). The following institutions provide such support:

- PCC	- LGU	- TESDA
- SCUs	- Private sector	- Other government agencies
- CDA	- DTI	

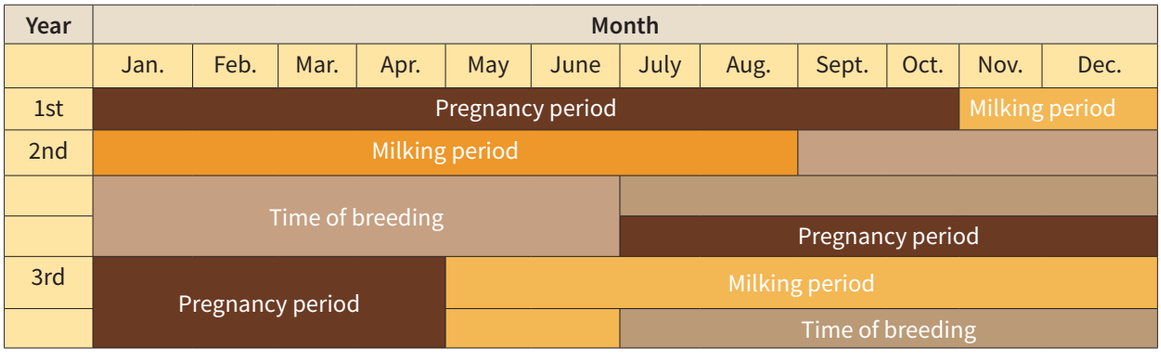
Table 39. The following are some assumptions in dairy buffalo production

Assumptions	Conventional	With Intervention
Number of breedable animals	7 head	7 head
Calving interval	22 months	18 months
% of female calf born	45%	45%
% of male calf born	55%	55%
Price of male animal @ 2 years old	15,000	20,000
Price of milk	PHP50 per liter	PHP50 per liter
Mortality rate	20%	5%
Average milk produced per day (300 days of lactation in liters)	2 li.	4 li.
Breeding cost (AI or bull)	700	700
Cost of housing with 10 years life span	PHP50,000	PHP50,000
Depreciation cost of housing, using straight line method	PHP5,000	PHP5,000
Feeding with concentrates	-	2 kg per day
Price of feeds	-	PHP20/kg
Biologics (twice a year)		
Dam	-	PHP250/appl'n.
Calf	-	PHP150/appl'n.
Cost of milking machine with 10 years life span	-	PHP105,000
Labor cost per month	PHP3,000	PHP3,000
Additional labor for gathering of forage, 3 times a week	PHP450/week	-
Transportation	PHP600/mo.	PHP600/mo.
Electricity	-	PHP150/mo.
Other cost	PHP10,000/year	PHP10,000/year

Conventional



With intervention



First year of operation:

Conventional	With intervention
Number of calves produced • 7 breedable animals produced 7 calf less mortality rate 20% = 6 • Female calf: 6 x 45% = 3 • Male calf: 6 x 55% = 3	Number of calves produced • 7 breedable animals produced 7 calf less mortality rate 5% = 7 • Female calf = 7 x 45% = 3 • Male calf = 7 x 55% = 4
Milk produced • 60 days x 2 li. = 120 li./cow • 240 li. x 7 cows = 840 li. • 840 li. x PHP50 = PHP42,000	Milk produced • 60 days x 4 li. = 240 li./cow • 240 li. x 7 cows = 1,680 li. • 1,680 li. x PHP50 = PHP84,000
Breeding • 7 breedable animals x PHP700 = P4,900	Breeding • 7 breedable animals x PHP700 = P4,900
Housing • PHP50,000/10 years = PHP5,000/year	Housing • PHP50,000/10 years = PHP5,000/year
Feeds • none	Feeds • 2 kg x PHP20 = PHP40/day • PHP40 x 60 days = PHP2,400 • PHP2,400 x 7 cows = PHP16,800
Biologics • None	Biologics • 7 cow x 250 x 2 = PHP3,500
Milking machine • None	Milking machine • PHP105,000/10 yrs. = PHP10,500/yr. • PHP10,500 / 12 mos. = PHP875 • PHP875 x 2 mos. = PHP1,750
Labor • PHP3,000/mo x 12 = PHP36,000 • PHP450/week x 4 x 12 = PHP21,600 • Total labor cost = PHP57,600	Labor • PHP3,000/mo x 12 = PHP36,000
Transportation • PHP600/mo. X 2 = PHP1,200	Transportation • PHP600/mo. X 2 = PHP1,200
Electricity • None	Electricity • PHP150/mo. x 2 = PHP300
Other cost • P10,000	Other cost • P10,000

Second year of operation:

Conventional	With intervention
Number of calves produced • none	Number of calves produced • none
Milk produced • 240 days x 2 li. =480 li./cow • 480 li. x 7 cows = 3,360 li. • 3,360 li. x PHP50 = PHP168,000	Milk produced • 240 days x 4 li. = 960 li./cow • 960 li. x 7 cows = 6,720 li. • 6,720 li. x PHP50 = PHP336,000
Breeding • 7 breedable animals x PHP700 = P4,900	Breeding • 7 breedable animals x PHP700 = P4,900
Housing • PHP50,000/10 years = PHP5,000/year	Housing • PHP50,000/10 years = PHP5,000/year
Feeds • none	Feeds • 2 kg x PHP20 = PHP40/day • PHP40 x 240 days = PHP9,600 • PHP9,600 x 7 cows = PHP67,200
Biologics • None	Biologics • 7 cows x 250 x 2 = PHP3,500 • 7 calves x 150 x 2 = PHP2,100 • Total cost = PHP5,600
Milking machine • None	Milking machine • PHP105,000/10 yrs. = PHP10,500/yr.
Labor • PHP3,000/mo x 12 = PHP36,000 • PHP450/week x 4 x 12 = PHP21,600 • Total labor cost = PHP57,600	Labor • PHP3,000/mo x 12 = PHP36,000
Transportation • PHP600/mo. X 8 = PHP4,800	Transportation • PHP600/mo. X 8 = PHP4,800
Electricity • None	Electricity • PHP150/mo. x 8 = PHP1,200
Other cost • P10,000	Other cost • P10,000

Third year of operation:

Conventional	With intervention
Number of calves produced • 7 breedable animals produced 7 calves less mortality rate 20% = 6 • Female calf: 6 x 45% = 3 • Male calf: 6 x 55% = 3	Number of calves produced • 7 breedable animals produced 7 calves less mortality rate 5% = 7 • Female calf = 7 x 45% = 3 • Male calf = 7 x 55% = 4
Milk produced • 120 days x 2 li. =240 li./cow • 240 li. x 7 cows = 1,680 li. • 1,680 li. x PHP50 = PHP84,000	Milk produced • 240 days x 4 li. = 960 li./cow • 960 li. x 7 cows = 6,720 li. • 6,720 li. x PHP50 = PHP336,000
Breeding • 7 breedable animals x PHP700 = P4,900	Breeding • 7 breedable animals x PHP700 = P4,900
Sale of animal • 3 male animals x PHP15,000 = PHP45,000	Sale of animal • 4 male animals x PHP20,000 = PHP80,000
Housing • PHP50,000/10 years = PHP5,000/year	Housing • PHP50,000/10 years = PHP5,000/year
Feeds • none	Feeds • 2 kg x PHP20 = PHP40/day • PHP40 x 240 days = PHP9,600 • PHP9,600 x 7 cows = PHP67,200
Biologics • None	Biologics • 7 cows x 250 x 2 = PHP3,500 • 7 growing x 250 x 2 = PHP3,500 • 7 calves x 150 x 2 = PHP2,100 • Total cost = PHP9,100
Milking machine • None	Milking machine • PHP105,000/10 yrs. = PHP10,500/yr.
Labor • PHP3,000/mo x 12 = PHP36,000 • PHP450/week x 4 x 12 = PHP21,600 • Total labor cost = PHP57,600	Labor • PHP3,000/mo x 12 = PHP36,000
Transportation • PHP600/mo. X 4 = PHP2,400	Transportation • PHP600/mo. X 8 = PHP4,800
Electricity • None	Electricity • PHP150/mo. x 8 = PHP1,200
Other cost • P10,000	Other cost • P10,000

Summary: Simple Cost and Return Analysis (figures in Philippine pesos)

	Year 1		Year 2		Year 3		3 Years of Operation	
Particular	**Conventional**	**With Intervention**	**Conventional**	**With Intervention**	**Conventional**	**With Intervention**	**Conventional**	**With Intervention**
REVENUE								
Sales of milk	42,000	84,000	168,000	336,000	84,000	336,000	294,000	756,000
Sales of animal	0	0	0	0	45,000	80,000	45,000	80,000
Total	42,000	84,000	168,000	336,000	129,000	416,000	339,000	836,000
EXPENSES								
Breeding	4,900	4,900	4,900	4,900	4,900	4,900	14,700	14,700
Housing	5,000	5,000	5,000	5,000	5,000	5,000	15,000	15,000
Feeds	0	16,500	0	67,200	0	67,200	0	150,900
Biologics	0	3,500	0	5,600	0	9,100	0	18,200
Milking	0	1,750	0	10,500	0	10,500	0	22,750
machine	57,600	36,000	57,600	36,000	57,600	36,000	172,800	108,000
Labor	1,200	1,200	4,800	4,800	2,400	4,800	8,400	10,800
Transportation	0	300	0	1,200	0	1,200	0	2,700
Electricity	10,000	10,000	10,000	10,000	10,000	10,000	30,000	30,000
Other cost	78,700	79,150	82,300	145,200	79,900	148,700	240,900	373,050
Total								
NET INCOME	**(36,700)**	**4,850**	**85,700**	**190,800**	**49,100**	**267,300**	**98,100**	**462,950**

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Forage-Based Enterprises

Daniel L. Aquino
Agricultural Center Chief IV
Philippine Carabao Center at Central Luzon State University

Silage Making

Silage making is a profitable business when fresh forage are scares especially during dry season. It is also a nutritious feed for carabaos and other ruminants as it is a good source of energy and protein. All kinds of grasses and left-over field crops can be processed as silage. The market for silage, especially corn silage, is huge. According to Philippine Statistics Authority, in 2019 there are 2.86 million heads. In 24 hours, a carabao weighing 400-500 kg needs about 25-30 kg of feed.

But not all dairy farmers have access to open pasture. When there is scarcity of green forages, feed requirements may not be satisfied compromising the health of the animals. Making silage, like corn, napier, sorghum and other grasses and food crops will help in ensuring adequate feed resource will be available regardless of season. Silage production may not only satisfy feed requirements but also as a profitable business for dairy farmers.

The table below show the sample computation on the cost of producing a kilo of silage

Price per Kilo of Corn Silage (Based on 2019 price)

Expenses	Needed Items		Price Php
	Quantity	Unit	
A. Expenses in corn planting			
1. Corn Seed	2	sack/bag	1,100
2. Land Preparation	1 time	machine/ person-days	3,000
3. Corn Planting (Contract per hectare)	15	person-days	4,500
4. Fertilizer Wages for laborer Triple 14 (14-14-14) Urea 0-0-60	2 times 12 5 2 2	 person-days sack/bag sack/bag sack/bag	 1,800 6,000 2,000 2,700
5. Irrigation Wages for laborer Oil	6 times 12 100	 person-days liter	 1,800 4,240
6. Off-barring	1	machine person-days	1,500
7. Weed control Wages for laborer Herbicides	 2 2	 person-days liter	 1,200 735
B. Expenses in silage making			
8. Gas for chopper	20	liter	700
9. Harvesting	10	person-days or one machine	1,500
10. Plastic cover	10	kilo	900

Expenses	Needed Items		Price Php
	Quantity	Unit	
B. Expenses in silage making			
11. Silo (plastic)	40	Piece	15,000
12. Wages for laborer	6	Person-days	4,500
Other expenses			1,000
Total Expenses			58,565
C. Corn yield per hectare	30	Tons	
D. Price per kilo of silage			4.00

Important Reminder

Once a plastic bag silo is opened, make sure that silage is fed continuously to the animals until it is consumed. In a pit or bunker silo, always put back its cover each time silage is removed from it to prevent spoilage.

Urea Molasses Treated Rice Straw

Rice straw is an abundant crop residue which can be an improved feed for carabaos and other ruminants. Urea Molasses Treated Rice Straw (UMTRS) is a solution of 4% urea dissolve in water and molasses. This increase the crude protein (CP) content of rice straw from 3.5% to 8%. This technology not only improves digestibility of dry matter from 40% to 50% but also one way of ensuring sustainability of feed resources for buffaloes. The materials for UMTRS is cheap and locally available so it a more economical way of improving the feeding value of rice straw making it a great opportunity for business venture.

Materials Needed

Materials	Quantity (kg)	Recommended Level (kg)
Urea	2-4	4.40
Molasses	5	4
Water	91-93	91.60
Rice Straw	50-100	50-100

Costing

Item	QTY	Unit	Unit Price	Total Price
Urea	4.00	Kg	20.00	80.00
Molasses	5.00	Kg	17.00	85.00
Rice Straw	50	Kg	0.71	35.42
Silage bag	1.00	Pc	75.00	75.00
Packaging tape	50.00	Pc	1.00	50.00
Total				325.42
Total UMTRS produced (kg)				150
Cost of producing a kilo of UMTRS (Php)				2.17

Milk-Based Enterprises

Mina P. Abella
Supervising Science Research Specialist
Philippine Carabao Center National Headquarters and Gene Pool

Introduction

Buffalo's milk is a valuable, nutritious food, having high content of fats, protein, and total solids. It is rich in composition that makes it a very good raw material for processing. Milk, however, is highly perishable. As a low-acid food, microorganisms are able to grow and contaminate any products, which are made from it. If milk is not properly handled or processed or if there is post contamination (i.e., after processing), microorganisms can change the flavor, texture or color of dairy products, making them unacceptable to consumers. Other dangerous microorganisms can grow in milk and cause food poisoning.

Processing of milk, therefore, requires careful control over the processing conditions and good hygiene precautions in order to ensure that dairy products are of good quality, safe to eat, and have the required shelf life. It is, therefore, very crucial that hygiene and sanitation be well implemented at the dairy processing plant from the time the milk is received, processed into various milk products, up until the milk products are consumed or sold.

The following are the basic hygienic practices at the dairy plant:

a. Use only good quality milk for processing. High quality dairy products can only be made from good quality milk. Test milk to determine suitability for processing (Refer to Lesson 4.2)
b. Handle milk and other processing ingredients hygienically to prevent contamination and spoilage.
    i. Cool milk immediately to <10^{o}C upon receiving at the dairy plant. Cool milk in an iced water (preferred) or freezer storage. Do not fill milk cans to the rim to ensure faster cooling of milk.
    ii. Use only clean and disinfected milk containers (milk cans or milk pails).
    iii. Processing ingredients must be stored in clean, dry, and well-labeled containers with cover.
c. Clean and disinfect all processing equipment and utensils before and after use.
    i. Clean processing equipment and utensils with liquid detergent and rinse well with clean potable water.
    ii. Disinfect either with boiling water or with chlorine solution. Prepare 100 ppm chlorine solution as follows: Measure 20 mL Zonrox and add to 10 liters of water. Mix well.
    iii. Drain to remove residual water or chlorine solution.
d. The flow of processing operations should be properly arranged to prevent any contact between raw milk and finished products to avoid cross contamination.
e. Observe high level of cleanliness and sanitation in the milk processing area.
f. Personnel Hygiene (for dairy processors)
i. Be in good health condition. Have yourself examined by medical doctors at least once a year. Keep records of medical examination for reference.
    - Any processor suffering from cuts or wounds, vomiting, diarrhea, or respiratory diseases such as cough and colds should seek medical treatment first before he/she be allowed to handle or process milk.

    ii. Wear clean protective clothing such as apron, hair net or hair cap, face mask, and separate footwear for use only in the processing area
    - Remove protective clothing when leaving the processing area and when entering the comfort room.

    iii. Do not wear jewelries (ring, earring, necklace, watch) while processing, as they might contaminate the milk and dairy products.
    iv. Do not eat inside the processing area.
    v. Keep fingernails short and clean (no nail polish).
    vi. Wash hands with soap and water, followed by disinfection with 50-100ppm chlorine solution (1-2mL Zonrox in 1 Liter water) or 70% rubbing alcohol
    - Before starting to work
    - Every time hands are contaminated
    - After using comfort room
    - After eating

Processing of Milk Products

There are many products, which can be manufactured from buffalo's milk. The following are some of the buffalo's milk products, which can be easily processed on a village-level set up, do not need sophisticated processing equipment, and with market potential, e.g., flavored milk (choco milk), pastillas de leche, and kesong puti.

The quality and shelf life of milk products depend on the quality of raw milk, consistency in the product formulation, and process protocols, how hygienic the products are manufactured, and proper storage of the finished products.

Choco Milk

Choco milk is a ready-to-drink milk, which is the most popular milk choice for children. It is produced from buffalo's milk, skimmed milk powder, cocoa powder, sugar, stabilizer (carrageenan), and water. The mixture is pasteurized to a temperature of 75-80ºC/2-5min to destroy microorganisms and prolong its shelf life. Choco milk will last for 7-10 days at refrigerated temperature.

Materials Needed:

Gas stove, double burner
Weighing scale, 2 kg x 10 g capacity
Double boiler (a stainless casserole placed on top of another casserole/pan with simmering or boiling water)
Thermometer, dial type, 8" stainless needle
Wire whisk or ladle, stainless
Strainer, stainless
Graduated pitcher, 200 mL and 1000 mL capacity
Measuring cup/spoon
Milk bottles, 200 mL capacity
Iced water (in a basin, pour 2 L water and add enough ice to maintain temperature of iced water to 5-10ºC)

Ingredients: (for 5 L choco milk)

1.5 liters buffalo's milk
375 grams (2 cups) refined sugar
250 grams skimmed milk powder
50 grams (3/4 cup) cocoa powder
1.25 grams (1/2 tsp) carrageenan (a stabilizer to prevent sedimentation of cocoa particles on storage)
3 liters water

Steps:

1. Weigh and mix all dry ingredients (sugar, carrageenan, skimmed milk powder, cocoa powder)
2. Add water and dissolve dry ingredients.
3. Add buffalo's milk and mix well.
4. Heat choco milk mixture (double boiler set up) to a temperature of 75-80ºC and maintain for 2-5 minutes.
5. Cool choco milk (in an iced water) with constant stirring to a temperature of <20ºC.
6. Pour 200 mL choco milk into sanitized bottles and cover tightly (Figure 3).
   - Sanitize bottles and caps with chlorine solution. Drain residual chlorine solution for 15-20 minutes before packing.
7. Store in the refrigerator or chiller until consumed or sold.

Adding and mixing of buffalo's milk

Heating choco milk mixture (double boiler set up)

Pouring choco milk in sanitized bottles

Pastillas de Leche

Pastillas de leche is a favorite sweet delicacy among Filipinos and is traditionally made from buffalo's milk and sugar. It is soft, with smooth texture and creamy rich taste. Natural flavors such as pandan, lemongrass, dayap, jackfruit, carrots, and squash may be added. It is made by cooking the mixture of milk and sugar, with continuous stirring, until it is thickened. The mass of pastillas are then cooled and formed into bite-sized pieces before they are individually packed in paper and cellophane sheets. Pastillas de leche has a shelf life of 5-7 days at ambient temperature. It will last longer if kept at refrigerated temperature.

Materials Needed:

Gas stove, double burner
Weighing scale, 2 kg x 10 g capacity
Plastic bag sealer
Frying pan (kawali)
Graduated pitcher, 1000 mL capacity
Measuring cup/spoon
Wooden ladle
Plastic tray, rectangular, approx. 8" x 12"
Plastic bag (as mould) 6" x 8" , cut one end corner

Wrappers - plastic sheet, 6x10 (fold and cut 4x4); bond paper, long (fold and cut 5x4)
Japanese paper (fold and cut 8x5)
Pair of scissors
Plastic bag (for wrapped pastillas), 6" x 4-1/2"

Ingredients:

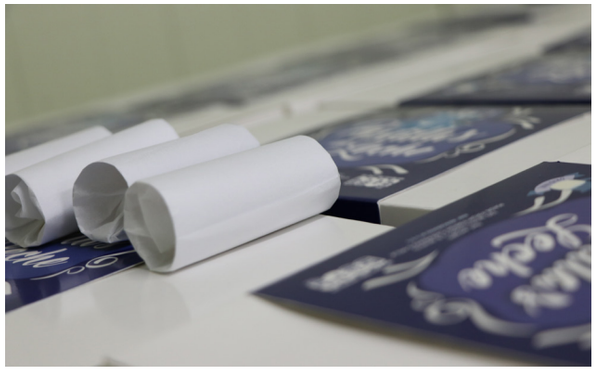
1 liter buffalo's milk
80 grams (1/4 cup) refined sugar
1 tbsp. cassava starch (optional)

Steps:

1. In a pan, pour buffalo's milk, then add mixture of sugar and cassava starch. Mix well to dissolve dry ingredients.
2. Cook the mixture, over medium heat, with continuous stirring, until the whole mass of pastillas can be lifted by the ladle.
3. Transfer pastillas mass into a tray lined with clean dry plastic sheet. Let it cool.
4. Prepare moulding plastic bag, by cutting one end corner of the bag.
5. Mould pastillas into mini logs, by squeezing out pastillas mass into a plastic sheet. Repeat until all pastillas mass is moulded.
6. Wrap each pastillas with Japanese paper lined with bond paper.
7. Pack at 20 pieces per bag and seal.

Cooking mixture, over medium heat, with continuous stirring, until mass of pastillas can be lifted by the ladle

Moulding of pastillas into mini logs



Packaging of pastillas

Kesong Puti

Kesong puti is a soft type of cheese made from pure buffalo's milk. It is best eaten with pan de sal and can also be used for vegetable salads. The milk is coagulated using an enzyme (rennet), thereafter, whey is drained. The drained curds (cheese) are then sliced and packed into plastic sachets or banana leaves. Kesong puti has a shelf life of 7-10 days at refrigerated temperature. Do not store in freezer, as it will affect the texture of kesong puti and may no longer be acceptable to consumers.

Materials Needed:

Gas stove, double boiler
Weighing scale, 2 kg x10 g capacity
Double boiler (a stainless casserole placed on top of another casserole/pan with simmering or boiling water)
Thermometer, dial type, 8" stainless needle
Wire whisk or ladle, stainless
Graduated pitcher, 1000 mL capacity
Measuring cup/spoon
Plastic sachets (cheese wrapper), 5-1/2" x 3-1/4"
Tray, perforated
Cheesecloth
Knife, stainless

Ingredients:

1 liter buffalo's milk
0.01 gram (a pinch) rennet powder (dissolved in ¼ cup water just before adding to milk)
1-2 tbsp. refined salt dissolved in 1 cup water. Boil and cool to lukewarm temperature (40-45^{o}C)

Steps:

1. Pasteurize milk by heating milk (in a double boiler) to a temperature of 72^{o}C for 15 seconds. Do not overheat milk. Overheating causes longer time for milk coagulation and results in soft coagulum.
2. Cool milk to 40-45^{o}C. Stir milk to facilitate cooling.
3. Stir in rennet into the milk and mix well. Cover with sanitized cloth and wait for 30-60 minutes for complete coagulation.
4. Gently cut coagulum into cubes (1-2 in2). Let stand for 5-10 minutes.
5. Cut further into smaller cubes (0.5 in2). Let stand 5-10 minutes.
6. Meantime, dissolve salt in water and cook to boiling temperature, then cool to lukewarm temperature.
7. Scoop out whey (yellow liquid, which separates from curds) until at the level of cheese curds. Whey can be used for other products such as ricotta cheese.
8. Replace whey with lukewarm salt solution and let stand for 15-20 minutes.
9. Pour whey-curds mixture into perforated tray lines with sanitized cheesecloth. Fold cheesecloth to cover curds. Drain for 1-1.5 h.
10. Slice cheese into blocks, approximately 200 g per block.
11. Pack cheese into plastic sachet.

Adding rennet into the milk

Cover with sanitized cloth and wait for 30-60 minutes for complete coagulation.

Cutting coagulum

Slice cheese into blocks, approximately 200 g per block and pack cheese into plastic sachet.

INCOME-EXPENSE ANALYSIS		
CHOCO MILK (for 80 L Choco Milk per day)		
Items	Amount, PHP	Amount, PHP
A. Gross Income: Sales, 400 bottles Choco milk, 200mL @PHP32		12,800.00
B. Expenses:		
1. Ingredients:		2,649.00
Buffalo's Milk, 24L @PHP55	1,320.00	
Refined Sugar, 6k @PHP47.5	285.00	
Skimmed Milk Powder, 4k @PHP190	760.00	
Cocoa powder, 0.8k @PHHP340	272.00	
Carrageenan, 20g @PHP0.60	12.00	
2. Packaging Materials		2,742.40
HDPE bottles, 200mL, 400pcs @ PHP6.104	2,441.60	
Labels, 400pcs @PHP0.70	280.00	
Sando bag, medium, 40pcs @PHP0.52	20.80	
3. Labor, 1 man-day @PHP450		450.00
Total Direct Cost		**1,497.85**
4. Operating Costs (50% of Direct Costs)		2,920.70
Utilities (electricity, water, LPG)		
Cleaning materials/Disinfectants		
Ice		
Transport costs		
Marketing Costs		
Depreciation		
Repairs & Maintenance		
Fuel & Oil		
Total Manufacturing Cost		8,762.10
C. Net Income		4,037.90
		(46.08%)

INCOME-EXPENSE ANALYSIS		
PASTILLAS DE LECHE (for 16L Milk per day)		
Items	Amount, PHP	Amount, PHP
A. Gross Income: Sales, 64 packs, 20pcs/pk @PHP60		3,840.00
B. Expenses:		
1. Ingredients:		923.93
Buffalo's Milk, 16L @PHP55	880.00	
Refined Sugar, 0.75k @PHP53.24	39.93	
Cassava Starch, 0.1k @PHP40	4.00	
2. Packaging Materials		187.14
PE bag, 6x6, 64pcs @PHP1.03		
Cellophane 11 pcs @PHP6		
Bond paper, 64pcs @PHP0.5		
PP plastics, 6x10x03, 45pcs @PHP0.46		
Sando bag, medium, 3 pcs @PHP0.52		
HD plastic 16x24 @PHP0.48		
3. Labor, 1 man-day @PHP450		450.00
Total Direct Cost		**1,561.07**
4. Operating Costs (50% of Direct Costs)		780.54
Utilities (electricity, water, LPG)		
Cleaning materials/Disinfectants		
Ice		
Transport costs		
Marketing Costs		
Depreciation		
Repairs & Maintenance		
Fuel & Oil		
Total Manufacturing Cost		2,341.60
C. Net Income		1,498.40
		(64%)

INCOME-EXPENSE ANALYSIS		
KESONG PUTI (Batch: 4 x17 L milk per day)		
Items	Amount, PHP	Amount, PHP
A. Gross Income: Sales, 120packs Kesong Puti, 200g @ PHP75		9,000.00
B. Expenses:		
1. Ingredients:		3,791.60
Buffalo's Milk, 16L @PHP55	3,740.00	
Refined Sugar, 0.75k @PHP53.24	21.60	
Cassava Starch, 0.1k @PHP40	30.00	
2. Packaging Materials		144.00
HDPE plastic, 5x5, 120pcs @PHP1.2	144.00	
3. Labor, 1 man-day @PHP450		450.00
Total Direct Cost		**4,385.60**
4. Operating Costs (50% of Direct Costs)		1,754.24
Utilities (electricity, water, LPG)		
Cleaning materials/Disinfectants		
Ice		
Transport costs		
Marketing Costs		
Depreciation		
Repairs & Maintenance		
Fuel & Oil		
Total Manufacturing Cost		6,139.84
C. Net Income		2,860.16
		(46.58%)

Meat-Based Enterprises

Rosalina S. Lapitan
Scientist I
Philippine Carabao Center at University of the Philippines Los Baños

Technologies for small-scale meat processing

Introduction

Purebred and crossbred male animals not fit for breeding may be raised for feedlot fattening through intensive feeding either with high energy or high fiber diet. System of feeding affects carcass quality. Animals fed high-energy diet produces carcass with more back fat and interstitial fat than those fed with high fiber diet.

Choice cuts from carabeef are usually excluded from further processing and marketed as fresh meat. The most common fresh meat cuts are tenderloin, sirloin, topside, silverside, rump and parts of the neck and shoulder (Fig. 1). The rest of the carcass meat as well as trimmings derived during the preparation of the above mentioned choice cuts are used as meat for all types of processed products.

Carabeef/Beef has functional properties influenced by the age of the animal. Meat from younger animals has a much higher water binding capacity than meat derived from the carcass of an older animal. Thus, meat from younger animals should be used for products requiring high binding and water holding capacity and meat from older animals is more suited for products undergoing a drying and fermentation process.

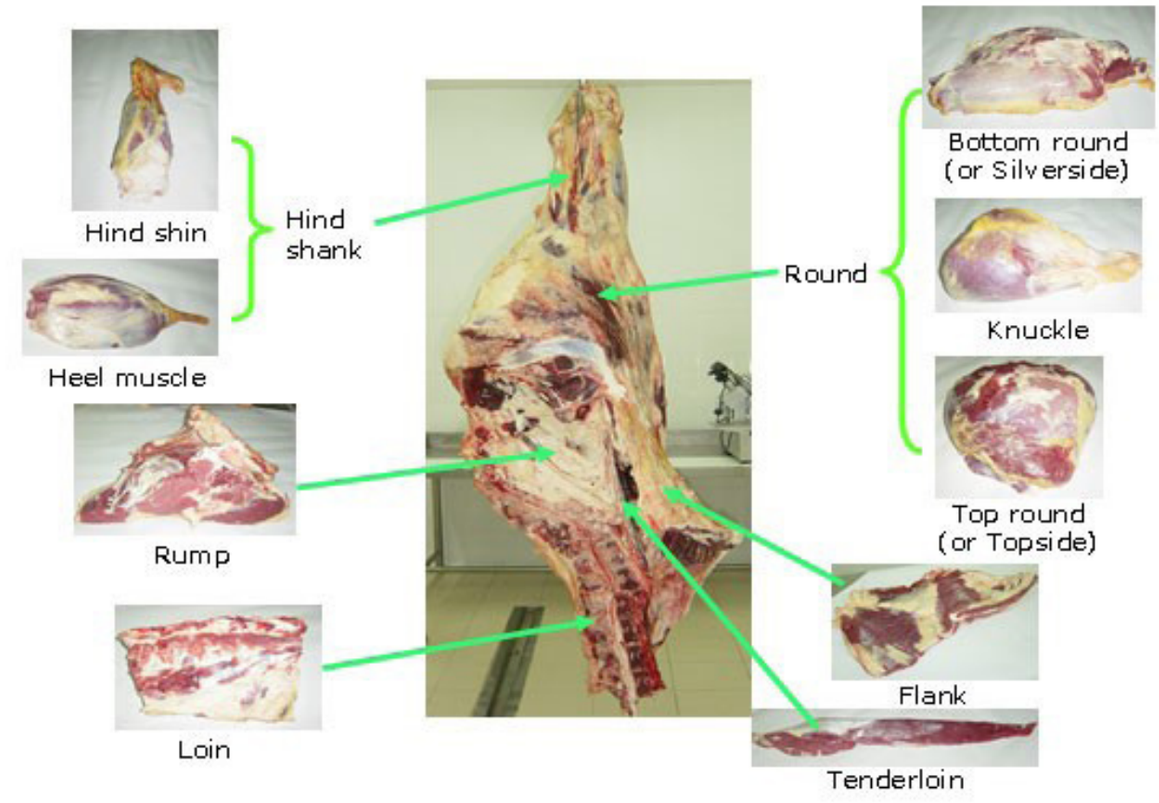
Meat processing technologies include both purely technical and chemical or biochemical processes:

These technical processes are:

- Cutting, chopping, comminuting
- Mixing, tumbling
- Stuffing/filling of semi-fabricated meat mixes into casings, synthetic films, cans, etc.
- Heat treatment

Chemical or biochemical processes, which often go together with the technical processes are:

- Salting and curing
- Utilization of spices and additives
- Smoking
- Fermentation and drying



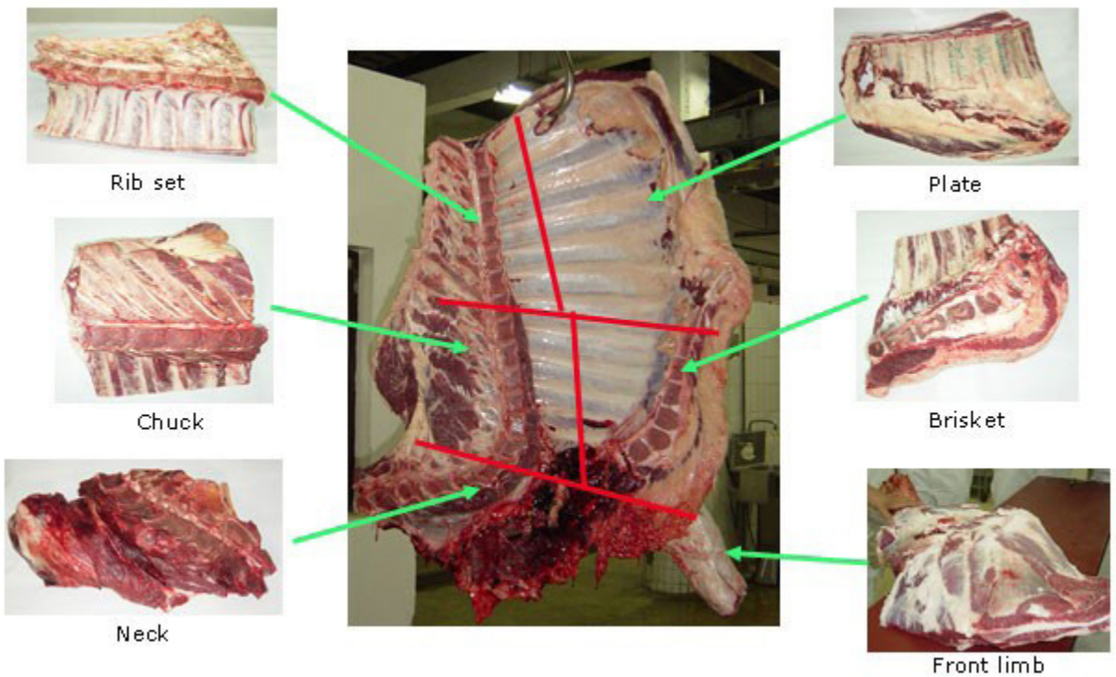


Fig.1. Retail cuts of carabeef/beef

There are three grades of manufacturing meat for beef (Fig. 2), which are sufficient to cater for the needs of small to medium-size manufacturing. Beef fat and skin are usually not used as raw material for meat processing.

Grade Beef 1 (B1)
Lean beef without visible fat and connective tissue

Grade Buffalo 1
Lean buffalo meat without visible fat and connective tissue

Grade Beef 2 (B2)
Beef with less than 10% (visible) connective tissue and less than 10% fat

Grade Beef 3 (B3)
Beef trimmings with up to 20% (visible) connective tissue and 20% fat

Fig. 2. Grading scheme for manufacturing-meat from cattle/buffaloes

The following are the grading scheme for beef:

GRADE Beef 1 (B1) **Lean muscle meat with all visible fat and connective tissue removed**

The meat from the major muscles of the fore and hindquarter with the exception of shanks and belly muscles.

GRADE Beef 2 (B2) **Muscle meat trimmings with small quantities of connective tissue (<10%) and body fats (<10%)**

Meat parts are mainly obtained as muscle trimmings from the manufacture of primal meat cuts and from smaller lean muscles, which are not sold as special cuts.

GRADE Beef 3 (B3) **Muscle meat trimmings with connective tissue (<20%) and body fats (<20%)**

Small meat trimmings removed from bones during deboning, flanks, and shanks. Meat is relatively high in connective tissue and fat and is only used for the manufacture of finely chopped meat mixes. It is not suitable for use as coarse parts in meat mixes due to its tough texture.

In the above illustrations, only grade 1 buffalo meat is shown. Grades 2 and 3 for buffalo is similar as indicated for Beef 2 and 3. Buffalo meat has excellent properties for further processing, in particular a pronounced red color, good water binding capacity, and typical flavor. Buffalo meat differs slightly from beef in terms of:

Color: Buffalo meat has slightly darker red color than beef, also processed meat products containing buffalo meat have a darker and more intensive red curing color.

Taste: Buffalo meat has a more pronounced meat flavor and taste.

Texture: Buffalo meat cuts, upon ripening and aging, can be made sufficiently tender but remain with slightly stronger texture as compared to similar beef cuts.

Fat content: Buffalo meat is usually leaner than beef and the color of buffalo fat is white as compared to the yellowish fat color in beef.

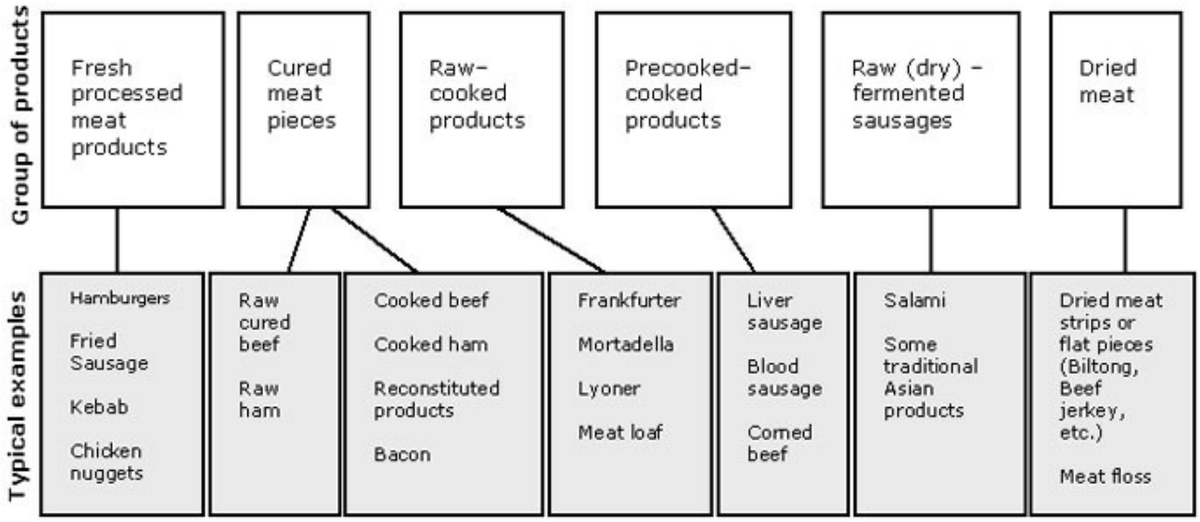


Fig. 3. Fresh Processed Meat Products

Preparation of meat for drying

In order to accelerate the drying process in particular from the inner layers of the meat, it is therefore, a common practice to cut the meat in narrow strips or in flat pieces (Fig. 4 a,b,c).
Recommended shapes for meat pieces to be dried are:

- strips with a rectangular cross-section of 1 x 1 cm
- flat- or leaf-shaped pieces with cross-sections of 0.5 cm x 3-5cm.

Fig. 4a. Cutting of meat in lengthy strips (approx. 1-2 cm width)

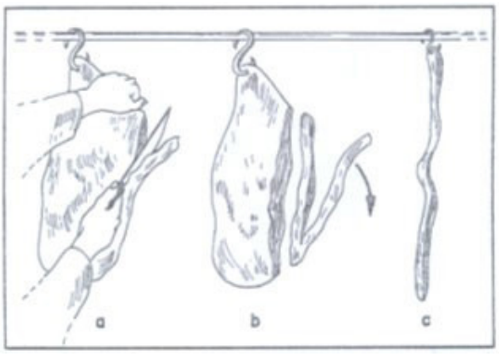


Fig. 4b. Special cutting technique to obtain long meat strips for suspension

Fig. 4c. Cutting of meat in flat pieces in preparation for drying

Flat meat pieces should always be used for successful drying. Spoilage through chemical reactions can occur when fat turns rancid. Adhering visible fatty tissues need to be carefully trimmed off from the lean meat in order not to limit the shelf life of dried meat.

Equipment and tools

Fig. 5. Manual equipment set with basic tools

Without electrical power, the meat processor is limited to manually operated equipment (Fig. 5). A meat grinder is needed to cut meat and non-meat ingredients to the desired size. A manual sausage stuffer allows for easy filling of sausage mixes into the casings. Other tools like knives, hand bone saw, sharpening steel, buckets, one big and several small containers (plastic) and meat hooks are also needed. For grating of peeled roots, stainless steel grating plates are very helpful tools, as they are unbreakable.

Meat Processing Hygiene

Cleaning and hygiene

- Cleanliness of facilities, installations, and personnel is an essential pre-condition in all food processing.
- Sufficient amount of potable water, boiling facilities (charcoal cookers, gas stoves), and detergents and disinfectants must be available.
- Raw materials brought to the processing area must be fresh, clean, and disease-free. It is essential that the facilities, machinery, and tools are properly cleaned before and immediately after processing.
- High level of personal hygiene is required and, therefore, it is essential that staff involved in processing must be in good health and undergoes regular medical checkups. Staff members should never enter the food processing area in street clothes and shoes, instead, wear clean protective clothing, and also carefully attend to personal hygiene.

Principles of meat processing hygiene and regulatory practices

Three principles of meat hygiene crucial for meat processing operations.

- Prevent microbial contamination of raw materials, intermediate (semi-manufactured) goods and final products during meat product manufacture through absolute cleanliness of tools, working tables, machines as well as hands and outfits of personnel.
- Minimize microbial growth in raw materials, semi-manufactured goods and final products by storing them at a low temperature.
- Reduce or eliminate microbial contamination by applying heat treatment at the final processing stage for extension of shelf life of products (except dried and fermented final products, which are shelf-stable through low aw and pH)

Failures in slaughter hygiene, meat cutting, and meat handling/transportation and in the hygiene of by-products and additives will all contribute to quality losses and deterioration of the final processed meat products.

Highly contaminated raw meat is unsuitable for further processing. Final products made from hygienically deficient raw meat materials are unattractive in color, tasteless or untypical in taste with reduced shelf life due to heavy microbial loads. Moreover, there is also the risk of presence of food poisoning microorganisms, which can pose a considerable public health hazard.

For the sanitary quality and safety related to meat processing, two useful schemes can be applied known as:

- Good Hygienic Practices (GHP) and
- Hazard Analysis and Critical Control Point (HACCP) Scheme.

Good Hygienic Practices (GHP)

GHP for meat processing plants refers principally to:

- Appropriate functional plant layout and sanitary design of equipment
- Raw materials that meet hygiene quality standards
- Processing methods that allow safe handling of food
- Appropriate waste and pest control measures
- Appropriate sanitation procedures (cleaning and disinfection)
- Compliance with potable water criteria
- Functional cold chain
- Regular examination of health and personal hygiene of staff
- Regular training of staff on hygiene requirements

Hazard Analysis and Critical Control Point Scheme (HACCP)

HACCP are factory and product specific strictly sanitary control schemes that shall prevent, detect, control and/or reduce to save levels accidentally occurring hazards to consumers' health. Specifically, for meat processing plants, such hazards may be provoked by failures such as:

- Batches of incoming raw meat materials with abnormal tissues or heavy contamination
- Breakdowns in refrigeration
- Failure in cooking/sterilization operations
- Abnormal pH or aw in raw or finished products
- Errors in levels of application of curing salts and other additives
- Technical problems in sealing of vacuum packages or cans with the risk of recontamination.

HACCP schemes serve as additional alarm systems in the interest of consumer protection to prevent such problems from occurring.

To distinguish HACCP from GHP:

GHP describes process requirements and practices including personal hygiene of staff to ensure safety of food. The individual product is not specifically targeted.

HACCP always focuses on the individual product. As technologies vary from product to product, it is obvious that separate HACCP approaches are required for each category of products.

Good Hygienic Practices in meat processing

Microbial meat spoilage or food poisoning through meat can be prevented through strict meat hygiene including an uninterrupted cold chain throughout the entire meat production and handling chain.

Hygienic requirements involves:

a. Personal hygiene
b. Slaughter and meat processing hygiene
c. Hygiene of slaughter and meat processing premises
d. Hygiene of slaughter and meat processing equipment

Principles of personal hygiene

- Wear clean protective clothes
- Wash hands before starting work
- Repeatedly wash hands during work
- No finger rings, watches, bracelets
- Access to production areas with working clothes only
- Clean or disinfect hands/tools/clothes if there was contact with highly contaminated subjects or abnormal animal parts likely to contain pathogens.
- Cover fresh wounds (due to knife cuts, etc.) by a water-tight bandage. Do not allow workers with purulent wounds to work with meat.
- Observe strict toilet hygiene (removal of apron, hand washing, and hand disinfection). Toilets must be kept clean and must not have direct access to production areas.
- Periodic medical examination of staff

Basic hygiene of meat processing

- Ideally, carry out meat cutting/deboning in climatized rooms (approx. + 10°C) with low air humidity. Bring in meat progressively and do not allow it to accumulate on work tables.
- Do not hose down floor and wall areas or equipment next to meat processing operations or final products with a power hose. (Risk of contamination by aerosol/droplets).
- Never take meat pieces, which accidentally had contact with the floor or other contaminated surfaces, back onto working tables or into meat processing machines.
- Do not place containers for meat, fat, or semi–or fully processed meat products directly on the floor but on hygienic stands, pallets, etc.

Hygiene of meat processing premises

Meat processing facilities must meet the following basic hygienic standards in order to ensure and maintain clean and hygienic working conditions:

- Adequate rooms for personnel must be available including sections for changing clothes and for personal hygiene.
- Wall windows must be positioned at a sufficient height from the floors in order to allow profound washing and disinfection of floors and walls
- Walls in all rooms, where meat and by-products are handled, must have smooth and easily washable surfaces up to a minimum height of 2 m in processing plants.
- In order to facilitate proper cleaning, the junction between floor and walls must be coved, i.e., rounded (not rectangular), which can be achieved by extending the floor concrete up to a height of 10-50 cm alongside the walls. Coves at wall floor junctions can also be achieved by using special curved wall tiles. •
- All wet rooms must have floor drains, which should be covered by non-corrosive metal plates or grills. The covers should be easily removable for proper cleaning of the drains. Drain sinks must be of the siphon type (anti-smell).
- Provisions must be made to channel waste water from hand-wash facilities, cool room evaporators, tool sterilizers, etc. by means of water pipes directly into effluent drains without contaminating the floor.
- Rooms for meat processing should have sufficient ventilation. Air conditioning is only required in meat cutting/deboning rooms (10-12°C).
- Supply systems for electrical wiring and pipes for hot and cold water as well as for compressed air should not hamper cleaning operations and be out of reach of possible dirt contamination. Insulations for hot water pipes must have smooth surfaces and be washable.
- Openings for ventilation must be bird- and insect-proof.

Hygiene of meat processing equipment

As a principle in modern meat industries it is commonly accepted that tools and surfaces in contact with meat should be made of food grade stainless steel or synthetic materials.

Stainless steel must be used for working tables, meat hooks (at least their parts contact in meat), blades of knives, saws, cleavers, and axes. All parts of machinery in contact with meat, fat, sausage mixes, and meat ingredients must be of stainless steel such as frozen meat cutter, grinder, meat mixer and tumbler, meat emulsifier, sausage stuffer, brine injector, etc. The bowls of bowl cutters are nowadays also mostly made of stainless steel. All the stainless steel parts must be smooth, easily accessible for cleaning, and without hidden spaces, where particles of meat materials may accumulate.

Packaging of fresh and processed meat

Purpose of packaging

Packaging protects meat and meat products from undesirable impacts on quality including microbiological and physio-chemical alterations. Packaging protects foodstuffs during processing, storage, and distribution from:

- contamination by dirt (by contact with surfaces and hands)
- contamination by micro-organisms (bacteria, molds, yeasts)
- contamination by parasites (mainly insects)
- contamination by toxic substances (chemicals)
- influences affecting color, smell and taste (off-odor, light, oxygen)
- loss or uptake of moisture (evaporation or water absorption)

To stop or reduce microbial growth, combine packaging with other treatments, such as refrigeration, which will slow down or stop the further growth of microorganisms, or with heating/sterilization, which will reduce or completely eliminate contaminating microorganisms

Requirements for packaging materials

A range of synthetic materials suitable for meat packaging are available mainly in the form of plastic films or foils.

Packaging films must be/have:

- flexible, mechanical strength
- light weight, odorless
- hygienic (clean and toxicologically harmless)
- easy recycling
- resistance to hot and cold temperatures and to oil and fats
- good barrier properties against gases
- sealing capability, low-cost

MEAT RECIPES FOR FLS-DBP			
Batutay (Gulmayo, 1999)			
Ingredients	**Batch size**		
Raw Materials	1 kg	5 kg	10 kg
Lean meat, ground	0.75 kg	3.5 kg	7.5 kg
Pork back fat, sliced into small cubes	0.25kg	1.5 kg	2.5 kg
Additives/Curing mix			
Salt, coarse	12 g	60 g	120 g
Curing salt	2 g	10 g	20 g
Phosphate	2 g	10 g	20 g
Water	62.5g	312 g	625 g
Seasonings			
Sugar, refined	24 g	120 g	240 g
Black pepper, ground	5 g	25 g	50 g
Garlic, chopped	15 g	75 g	150 g
Celery powder	1 g	5 g	10 g
Sodium erythorbate	0.3 g	1.5 g	3.0 g
Monosodium glutamate (MSG)	2 g	10 g	20 g

Procedure

1. Select good quality raw meat
2. Grind meat
3. Mix the first three ingredients (salt, curing salt, phosphate, dissolved in water) with the meat until blended
4. Add the rest of the ingredients
5. Mix well until blended
6. Cure at room temperature for 8-10 hours or refrigerated temperature for 1-2 days
7. Stuff in casings. Link into desired length.
8. Pack in styrofoam tray. Store in freezer.
9. Shelf life: 2-3 months in freezer or 1 week in refrigerator.

Costing

Batutay Batch Weight - 10 kilograms	
Selling price - (PHP400 per kilo)	**PHP4,000**
Less: Cost of ingredients	**1,798.97**
Cost of Packaging	225
Procurement Cost (10%)	202.397
Processing Cost (5%)	101.1985
Other Operating Expenses (5%)	101.1985
Marketing Cost (10%)	202.397
Contingencies (5%)	101.1985
Total Expenses	PHP2,732.36
Net Income	PHP1,267.64
Profit Margin = Net Income / Sales	*31.7%*

MEAT RECIPES FOR FLS-DBP			
Buffalo tapa (APMP-APDC-BAI			
Ingredients	**Batch size**		
Raw Materials	**1 kg**	**5 kg**	**10 kg**
Lean meat, round or rump	1 kg	5 kg	10 kg
Pork back fat, sliced into small cubes	0.25 kg	1.5 kg	2.5 kg
Additives/Curing mix			
Salt, refined	12 g	60 g	120 g
Curing salt	2 g	10 g	20 g
Phosphate	3 g	15 g	30 g
Water	62.5g	312.5 g	625 g
Seasonings			
Sugar, refined	90 g	450 g	900 g
Soy sauce	100 g	500 g	1 kg
Vinegar	55 g	275 g	550 g
Garlic, chopped	1 g	5 g	10 g
Black pepper, ground	0.3 g	1.5 g	3.0 g
Anisado wine	2 g	10 g	20 g
Monosodium glutamate (MSG)			

Procedure

1. Cut meat into ¼ inch thick slices
2. Mix the meat with curing mix. Add seasonings.
3. Cure either at room temperature (25-30 oC) for 8-10 hours or refrigerator temperature (4-10 °C) for 1-2 days.
4. Pack in polyethylene (PE) bag or vacuum pack.
5. Store in freezer.

Costing

Buffalo Tapa Batch Weight - 10 kilograms	
Selling price - (PHP380 per kilo)	**PHP5,130**
Less: Cost of ingredients	**2,212.48**
Cost of Packaging	113.00
Procurement Cost (10%)	232.55
Processing Cost (5%)	116.27
Other Operating Expenses (5%)	116.27
Marketing Cost (10%)	232.55
Contingencies (5%)	116.27
Total Expenses	PHP3,139.39
Net Income	PHP1,990.61
Profit Margin = Net Income / Sales	*39 %*

MEAT RECIPES FOR FLS-DBP			
Tapa (APDC-BAI Training Manual for Luntian Multi-Purpose Cooperative)			
Ingredients	**Batch size**		
Raw Materials	**1 kg**	**5 kg**	**10 kg**
Carabeef, fresh (70/30)	1 kg	5 kg	10 kg
Additives/Curing mix			
Salt, refined	6 g	30 g	60 g
Phosphate	5 g	25 g	50 g
Water, chilled	60 g	300 g	600 g
Seasonings			
Sugar, refined	75 g	375 g	750 g
Soy sauce	75 g	375 g	750 g
Vinegar	60 g	300 g	600 g
Garlic, powder	3 g	15 g	30 g
Black pepper, ground	5.0 g	25 g	50 g
Anisado wine	7 g	35 g	70 g
Monosodium glutamate (MSG)	2 g	10 g	20 g

Procedure

1. Slice meat, ¼ inch thick.
2. Mix additives, then add seasonings.
3. Cure at 4-10 °C (refrigerator temperature) for 1 day.
4. Drain for 20 minutes.
5. Dry at 55-60 °C for 5 hours then increase drying at 70 °C for a total of another 23 hours.
6. Pack in vacuum bags according to desired weight.
7. Store at room temperature.

Costing

Tapa Luntian Batch Weight - 10 kilograms	
Selling price - (PHP250 per kilo)	**PHP3,125**
Less: Cost of ingredients	**1910.90**
Cost of Packaging	105.00
Procurement Cost (10%)	201.59
Processing Cost (5%)	100.79
Other Operating Expenses (5%)	100.79
Marketing Cost (10%)	201.59
Contingencies (5%)	100.79
Total Expenses	PHP2,721.46
Net Income	PHP653.54
Profit Margin = Net Income / Sales	*19 %*

Manure-Based Enterprises

Annabelle S. Sarabia
R&D Division Chief
Philippine Carabao Center National Headquarters and Gene Pool

Introduction

Animal wastes are considered as one of the strongest pollutants in the environment. It contaminates bodies of water, soil, and air producing foul smell. If accumulated, they may attract microorganisms that are harmful to human.

These wastes can generally be classified into solid (manure) and liquid (urine) forms. For our purpose, we will focus on the manure, i.e., the solid-phase form. The amount of manure that the water buffalo (carabao) excretes daily ranged from 19 kg to 27 kg (BW=400±50 kg; approximately 5-6% of BW) with 21% total solids (Karttek et al., 2014), depending on the bodyweight of the animal. It is estimated that annually, a carabao can produce a total of 6.9-9.9 tons of fresh and 1.4-2.1 tons dried manure. Taking the nutrient content of buffalo manure to be 0.7% N, 0.5% P and 0.5% K (Chauhan and Singh, 2012), a ton of manure may contain 7, 5 and 5 kg N, P and K, respectively. Hence, if a farmer uses 3 tons of compost in a hectare, the amount of soil nutrient available would be 21, 15 and 15 kg N, P and K, respectively.

Carabao manure if manage properly will be beneficial to farmers as well as to the environment. It is a value-added marketable organic residual. According to Ecochem Innovative Solutions (2015), the potential markets for high quality, composted manure products include horticulture (i.e., gardening, landscaping, nurseries, topsoil production), silviculture (i.e., Christmas trees, ornamentals), reclamation (i.e., landfill covers, mine reclamation) and other environmental uses (i.e., biofilters, erosion control and wetlands restoration).

Manure-based Enterprise Options

There are arrays of options to choose from as to what type of manure management be adopted in order to utilize them for a more profitable activity. This waste material can be composted, vermicomposted, dried, and fermented to be transformed into fertilizer, fuel, and energy sources.

Composting

Definition and Principles. Composting is considered as a viable and environmentally sound method of waste management that hastens the decomposition of the organic waste conditions, thereby reducing its volume. It is a controlled aerobic biological decomposition of organic matter into a stable, humus-like product called compost (Graves, et al., 2000). It is essentially the same process as natural decomposition except that it is enhanced and accelerated by mixing organic waste with other ingredients to optimize microbial growth. During this microbial driven process, microorganisms utilize the decomposable organic waste both as a source of food and energy. Moreover, ccomposting reduces the production of odors and destroys pathogens, weed seeds, and fly larvae. Composted materials have gained wide acceptance as organic amendments for sustainable agriculture, as they have been shown to increase soil organic matter levels, improve soil's physical properties, and modify soil's microbial communities, thereby enhancing microbial biomass, activity, and diversity. Furthermore, compost is a stable, phytotoxicity-free enriching-humus material characterized by a high content of available-plant nutrients such as nitrogen, phosphorus, potassium, calcium, and magnesium.

Requirements for Composting:

1. Microorganisms (bacteria, fungi, actinomycetes, higher organisms such as protozoa, rotifers, and nematodes) whose presence and development respond to different levels of temperature, moisture, oxygen and pH;
2. Carbon to nitrogen (C:N) ratio, with an initial of 20:1 to 40:1 (Graves, et.al., 2000) for materials needed in efficient microbial decomposition;
3. Moisture content of at least 40% (40% to 65%), oxygen level of at least 5%, and a pH of 6.5 to 8 to maintain aerobic condition;
4. Physical characteristics of the compost mix ingredients include porosity, texture, and structure;
5. Composting rate of 1 to 6 months (4 to 24 weeks) depending on conditions; and
6. The quality of compost depends on the compost mix ingredients used and the organisms involved.

Microorganisms involved. Layering is a very important step in composting. It can be done by alternately layering high carbon and nitrogen materials at 30:1 ratio by volume. Bacteria are responsible for the initial decomposition process. They are fast decomposers and stabilize most readily available nutrients, such as simple sugars, as well as digest the products of fungal decomposition. Some bacteria can degrade cellulose. This is followed by fungi, which are larger organisms than bacteria. They form networks of individual cells in strands called filaments. Fungi tend to be present in the later stages of composting because of the nature of the material they decompose. Most fungi decay woody substances and other decay-resistant material, such as waxes, proteins, hemicelluloses, lignin, and pectin. The actinomycetes are the third major class of microorganisms that inhabit a compost pile. They are technically bacteria because of their structure and size, but are similar to fungi in that they form filaments and are able to use a variety of substrates. Actinomycetes can degrade organic acids, sugars, starches, hemicelluloses, celluloses, proteins, polypeptides, amino acids, and even lignins. They also produce extracellular proteases and can lyse (disintegrate or dissolve) other bacteria. Actinomycetes are more prevalent in the later stages of composting when most of the easily degradable compounds have been degraded. The last to invade the compost pile are higher organisms once the pile temperatures cool to suitable levels. These organisms include protozoa, rotifers, and nematodes. They consume the bacterial and fungal biomass and aid in the degradation of lignins and pectins. These higher organisms contribute to the disease-suppressive qualities of the compost.

Procedure. Composting process is divided into two main stages: (1) active composting and (2) curing. Active composting is characterized by vigorous microbial activity, in which readily degradable material is decomposed together with some of the more decay-resistant material, such as cellulose. The next stage, curing, has lower level of microbial activity and the continuation of the decomposition of the products of the active composting stage. If the final stage of curing has reached, the compost is said to be stabilized.

The following are the simple steps in composting at the farm level (Barcelo, 2014):

1. Select the site, design, and materials to use.
2. Prepare compost heap measuring 1 x 4 x 1 m (WxLxH) bamboo fence.
3. Gather rice straw or corn stover, grasses or leaves and carabao dung/manure.
4. Chop rice straw or corn stover, at least 5-8 cm long, to allow enough surface area for microbial activity.
5. Pile first the carbohydrate sources (rice straw, corn stover, grasses), then next are the nitrogeneous materials (leguminous leaves, carabao dung/manure) at a ratio of 20:1 by volume.
6. Water the pile to provide moisture and at the same time turn the mixture at least once a week to provide aeration.
7. Harvest the compost after 4 to 8 weeks, depending on the condition of the compost.

Vermicomposting

Definition and Principles. Vermi is a Latin word for worm. Hence, vermicomposting is a process of composting using worms (earthworms). In a review on vermicomposting published by Manyuchi and Phiri (2013), it was stated that one of the widely used solid waste management methods, vermicomposting is a bio-conversion process, wherein earthworms feed on the organic waste to produce more earthworms, vermicompost, and vermiwash as products. The production of earthworms in vermicomposting is called vermiculture. The product vermicompost also termed as vermicast is odorless, finely divided peat-like, dark brown casts expelled from the earthworm gut, which is rich in nitrogen (N), phosphorous (P), and potassium (K) and a range of trace elements, thus, utilized as bio-fertilizer. Also, it has low C:N ratio, excellent structure, porosity, aeration, drainage and moisture-building capacity, and supplies a suitable mineral balance, improve plant nutrient availability, and acts as a complete-nutrient-source granule (Dominguez and Edwards, 2011). The other product, vermiwash, is a leachate, color dark brown produced during the process of vermicomposting, utilized as foliar spray and acts as pesticide.

Types of Earthworms Used. The commonly used earthworms to perform the process include Megascolex mauritii, Eisenia fetida, Eudrilus eugeniae, Perionnyx excavatus, Lampito mauritii, Eisenia andrei, Lampito rubellus and Drawida willis. Based on the review of Manyuchi and Phiri (2013), Eisenia fetida has been considered as the earthworm of choice since it is adaptable to changing conditions and has the lower chance of compromising the vermicompost process. Accordingly, the following responses of earthworms measure the progress of vermicomposting: (1) weight, (2) length, (3) reproduction rate and (4) population density. Earthworms reduce moisture content, pH, and electrical conductivity compared to composting (Garg et. al., 2006).

Conditions/Requirements. Vermicomposting has been done for various wastes including animal, plant, pharmaceutical, food waste, and sewage waste in periods ranging from 28-120 days using the abovementioned earthworms. Similar to composting, there are two stages in the vermicomposting process (Nasiru, et. al., 2013), namely, (1) active stage is when earthworms process the biomass, modifying the physical and microbial composition of the manure mixture. The earthworm's effect on decomposition of the organic matter during the process is due to gut associated processes (GAPs), which include the modification that organic waste and microorganisms undergo during the passage through the gut of the earthworm; and (2) maturation-like stage, also the cast-associated processes (CAPs). This stage is characterized by the displacement of the earthworm towards fresher layers of undigested waste, where the microorganisms take over in the decomposition of waste and the effects of earthworm are mainly indirect and derived from the GAPs (Lazcano et al., 2008).

The process conditions during vermicomposting ranged from 18-67°C for temperature, pH 5.9-8.3 and moisture content 10.6-80%. Vermicompost yields range from 30% to 50% have been achieved for various organic wastes and composting periods. The vermicompost obtained had NPK compositions ranging from 0.3-4.19%, 0.2-1.6% and 0.2-6.18%, respectively. The vermiwash obtained had NPK composition ranging from 0.14-1.58%, 0.05-7.53%, and 0.47-1.26%, respectively (Manyuchi and Phiri, 2013).

Procedure. The succeeding steps are the processes in the production of vermicompost at the farm level (Sarabia et al., 2009):

1. Selection of suitable area. The area should be shaded, flood-free, accessible to water supply and sources of materials.
2. Gather and prepare materials. Buffalo dung and/or other animal manure and feed refusals may be collected and used for vermicomposting.

3. Preparation of beds

   a. Prepare outdoor beds measuring 1 m x 2 m or larger.
   b. Pulverize dried carabao manure and shred freshly cut grasses at 1-2.5 cm. Follow a C:N ratio of 25-35:1. For example, 75% shredded fresh grass + 25% fresh kakawate is an appropriate ratio for the growth and development of earthworms, which may result in a good quality vermicompost.
   c. Sprinkle/add water to the dry materials to attain 60% moisture content.
   d. Cover the mixture with plastic sheets to start the anaerobic process or partial fermentation within 1-2 weeks. Temperature of the substrate can rise above 60°C

4. Stock or seed the earthworms

   a. When the temperature of the mixture/substrate drops to 37°C or no longer emitting heat, remove the plastic cover to get the bed ready for stocking or seeding or introducing of the earthworms/ vermi. At this stage, the mixture/substrate is pickled with sweet smell.
   b. Use 1 kg of earthworm or about 1,000 pieces of worms for every square meter of vermibed of 100-200 kg carabao manure mixture.
   c. Feed the earthworms by scattering any organic matter (fresh or dried) on top of the vermibed. These worms can consume organic materials equivalent to their body size.

5. Maintain the beds at least 60% moisture level. Water the beds every 2-3 days. Mulch the bed with rice straw, corn stover or banana leaves to maintain moisture and minimize light and evaporation. Cover the vermibed with nylon net or sacks sewn together. This is to protect the earthworms from its natural enemies such as beetle larva, centipedes, ants and rats.
6. Harvest and process the vermicompost. Harvest the casts/castings 30-45 days after the earthworm seeding or introduction. Separate the earthworms from the vermicompost or vermicast. Air dry for 3-5 days.
7. Properly pack the vermicompost. Properly sieve, pack and seal the vermicast in bags or sacks. Store in a cool dry place.

Compost Tea/Vermitea

Definition and Principle. Compost tea/vermitea is a highly concentrated microbial solution produced by extracting beneficial microorganisms from compost and/or vermicompost. Starting with a high quality, microbial rich compost or vermicompost/vermicast is the key in making quality compost tea or vermitea. There are four essentials in creating the best possible growing situation for the microorganisms, namely, water, air, food, and comfort.

Conditions/Requirements. Compost tea/vermitea is a liquid version of compost/vermicompost. Take the solid compost/vermicast, soak it in water and let the mixture sit around for a few hours or a few days. Then separate the liquid from the solid material by sieving (use of screen or through cheesecloth or something similar to strain) into a container/pail/drum. Use clean, de-chlorinated, and potable water. In fact, experienced gardeners recommend rain water as the best source of water. This is to ensure that existing beneficial organisms in the compost/vermicast survive. The compost tea/vermitea is a mild organic liquid fertilizer beneficial to plants and soil. It does not burn plants unlike commercial fertilizers.

Procedure. The following steps are recommended in the preparation of compost tea/vermitea (www.wikihow.com/Make-a-Compost-Tea):

1. Use mature compost/vermicast.

2. Place the compost/vermicast in a container or a drum, filling one-half to two-thirds full, then top up with water. Leave it to soak for 8 hours if you are agitating it regularly, or for 24 hours if leaving it and only agitating a few times.

Another option would be to place the compost/vermicast into a sack. Suspend this sack over a drum of water. Agitate the liquid two to three times on day one then every day or two for a week. It is ready for use after a week of soaking in this manner, or you can hasten the process by stirring it more frequently. Consider more frequent stirring prior to use. Some gardeners believe that this provides more suspension of the nutrients.

In either case, never leave the compost tea brewing for longer than a month.

3. The tea preparation is ready to use.
To use the compost tea/vermitea, decant it into a watering can or a spray bottle/unit. The color of the compost should be light amber; if it is darker than that, dilute it with water.

It can be used safely on all of the gardens and is especially useful for plants that have been newly planted or transplanted, sick plants that need a tonic, potted plants during their growth season, lawns, and the vegetable patch.

Don't use compost tea/vermitea in very cold or hot weather conditions. In summer, apply the compost tea/vermitea in the early morning or afternoon. This is because the plant's stomata are open at these times. It should only be used during the growing season for the plants in question. Plants such as broadleaf and tree crops have stomata on the underside of their leaves, so you need to ensure the entire leaves are covered.

4. Re-soak.
Re-soak the compost/vermicast to create more compost tea/vermitea. Add a little more new, matured compost/vermicast for every re-soaking.

When no longer in use, the compost/vermicast that has been soaked, can serve as mulch or as a soil additive.

Reminders in the Usage of the Compost tea/Vermitea Preparation. The following are some warnings in the usage of the tea preparation:

1. Never store compost tea/vermitea in a sealed container; well-brewed compost tea/vermitea can explode through the container. It is best to use it up once made rather than store it.
2. There will be no human pathogens in the compost tea/vermitea if there were none in the compost/vermitea. Hence, use mature and safe compost/vermicast.
3. In all cases suggested above, do not drink, aspirate (breathe), or do anything daft with the compost tea/vermitea. It is not toxic unless you abuse it. Wear gloves when handling it and if you have respiratory issues or are worried about potential pathogens. Also, wear a mask.
4. Do not use chlorinated water. It will kill the beneficial organisms in the compost/vermicast. Use rainwater if possible, or distilled water, or fresh water from a clean source. Or, you can run tap water (mains water) over the air stones for one hour or more to drive off the chlorine.

Potential Benefits of Compost Tea/Vermitea.

Direct nutritional benefits:

- source of foliar and soil organic nutrients
- chelated micronutrients for easy plant absorption
- nutrients in a biologically available form for both plant and microbial uptake

Microbial benefits:

- compete with disease-causing microorganisms
- degrade toxic pesticides and other chemicals
- produce plant growth hormones
- mineralize plant's available nutrients
- fix nitrogen
- plant surfaces are occupied by beneficial microorganisms leaving no room for pathogens to infect the plant

Dried Manure as Fuel

Definition and Principle. Dung or manure refers to the undigested fecal matter that has passed through an animal's gut (digestive system), usually of the bovine animal species (cattle/cows, yak, water buffalo, bison). It can be used as a fertilizer and fuel for cooking and as a biogas (rich in methane) to produce electricity and heat.

Requirements/Conditions. Traditionally, in countries like India, Pakistan, Bangladesh, Nepal, and other parts of Asia, cow dung is used as a fuel in making food in a domestic hearth called a chulha (in India). Buffalo dung are made into cakes or briquettes with curvatures in order that they could be stuck to the walls and allowed to dry. These are usually molded by bare hands of village women. Once dried, they are put in a pile and covered with thatch called bitauda (in India). One dung cake of an average Punjabi size gives 2100 kJ worth of energy (Wikipedia, 2015).

This bio-fuel has been used for a long time primarily due to (1) easy disposal of the dung/manure; and (2) readily available and source of cheap fuel. After burning, the residue ash is used to wash hands since it becomes germ-free as by-product of burning and sprinkled on crops to get rid of certain pests.

However, there is a health hazard consequence in the use of these conventional fuels. Studies have shown that though dung-briquettes are cheap fuel, it has significant negative effects on human health, like asthma and eye diseases.

Procedure. The following are the steps in preparing dung/manure fuel:

1. Collect fresh carabao/buffalo dung and pile.
2. Take ¼ to ½ kg of fresh dung/manure and form/mold them into a cake or briquette.
3. Ensure that in the molding of cake or briquette, there is a curvature if the molded cake or briquette will be stuck on the wall for drying.
4. Dried dung cake/briquette will automatically fall from the wall.
5. Gather the dry dung cakes/briquettes and file them in a shaded and protected place or cover it with thatch ready for use or trade.

Benefits. The following are the benefits gained from the bio-fuel (dried manure) (Wikipedia, 2015; Vasa, 2015):

- Cheaper than most modern fuels
- Efficient
- Alleviates local pressure on wood resources
- Readily available - short walking time required to collect fuel
- No cash outlays necessary for purchase (can be exchanged for other products)
- Less environmental pollution
- Safer disposal of animal dung
- Sustainable and renewable energy source

Market Potentials of Manure Products

As presented in the previous topic, manure can be transformed from an environmental pollutant/ hazard into an economic enterprise, which a farmer can gain additional income from. Primarily, the conversion of carabao manure/dung into compost, vermicompost, vermicast, compost/vermi tea and fuel have various beneficial uses with economic values, namely, organic fertilizer, soil conditioner, foliar spray, and other environmental uses.

Cost and Return in Vermicomposting

ITEMS	UNIT	QUANTITY	PRICE/UNIT (PHP)	TOTAL COST (PHP)
Housing	lot	1	5,000	5,000
Labor	man-day	7	200	1,400
Hollow blocks	piece	175	8	1,400
Cement	sack	3	250	750
Sand	lot	1	800	800
Vermi/Earthworm	kg	50	400	20,000
Molasses	kg	4	15	60
Effective microorganism	liter	1.5	500	750
Packaging material (sack with plastic)	sack	36	20	720
Weighing scale	piece	1	3,000	3,000
Other materials (harvester, spade, sieve)	lot	1	1,000	1,000
TOTAL				**35,080**

Additional Assumptions:

- The substrate (e.g., carabao dung/manure mixed) is at least two weeks stock prior to use
- The compost bed is at least 8 m x 1 m (L x W) dimension
- Construct at least two compost beds (if the production and harvest of the vermicast is continuous)
- If harvest is every two months, then the following processes are involved:
  - First layer: In a 500 kg substrate, introduce 50 kg worms stock for 10 days (start adding substrate on the 9th day)
  - Second to 6th layer: Add 500 kg substrate on top every 10 days within the two-month period (50 days) following the scheme of starting the feeding period for the worms on the 9th day
  - Seventh layer: Put a screen/net on top and add 250 kg substrate for 5 days
  - It is expected that the worms will be migrating on the top layer, thus, transfer the substrate with the worms above the net to the next vermicompost bed.
  - To ensure that almost all of the worms will migrate to the top layer, add another 250 kg substrate for the next 5 days and transfer this top layer to the bed where the earlier worms have been transferred.
- Allow the vermicompost bed to dry for 3 to 5 days and then, harvest the vermicast.
- The 60% of the recovery rate of substrate will be vermicast.
- There is at least 25% increase in the population (number) of the worms every two months harvest.

Matrix 1: Cost and returns in an annual operation (6 harvest periods, i.e., 1 cycle = 2 months) of vermicomposting with one vermicompost bed.

ITEMS	CYCLE OF OPERATION IN A YEAR COST PER CYCLE (PHP)						TOTAL AMOUNT (PHP)
	1st	2nd	3rd	4th	5th	6th	
Housing	5,000	0	0	0	0	0	5,000
Vermicompost bed, 1 unit, 8mx1m (LxW)	2,950	0	0	0	0	0	2,950
Labor	1,400	1,400	1,400	1,400	1,400	1,400	8,400
Earthworm, 50 kg	20,000	0	0	0	0	0	20,000
Molasses, 4 kg	60	60	60	60	60	60	360
Effective microorganism, 1.5 li	750	750	750	750	750	750	4,500
Packaging, 36 sacks	720	720	720	720	720	720	4,320
Weighing scale	3,000	0	0	0	0	0	3,000
Animal manure, 3,000 kg	0	0	0	0	0	0	0
Other materials	1,000	0	0	0	0	0	1,000
Total cost	34,880	2,930	2,930	2,930	2,930	2,930	49,530
Harvest							
36 cavans @50 kg cavan, costs PHP250/cavan	9,000	9,000	9,000	9,000	9,000	9,000	54,000
Net Income	-25,880	6,070	6,070	6,070	6,070	6,070	4,470

Matrix 2: Cost and returns in an annual operation (6 harvest periods, i.e., 1 cycle = 2 months) of vermicomposting with two vermicompost beds

ITEMS	CYCLE OF OPERATION IN A YEAR COST PER CYCLE (PHP)						TOTAL AMOUNT (PHP)
	1st	2nd	3rd	4th	5th	6th	
Housing	5,000	0	0	0	0	0	5,000
Vermicompost bed, 2 unit, 8mx1m (LxW)	5,900	0	0	0	0	0	5,900
Labor	2,800	2,800	2,800	2,800	2,800	2,800	19,200
Vermiworm, 100 kg	40,000	0	0	0	0	0	40,000
Molasses, 8 kg	120	120	120	120	120	120	720
Effective microorganism, 3 li	1,500	1,500	1,500	1,500	1,500	1,500	9000
Packaging, 72 sacks	1,440	1,440	1,440	1,440	1,440	1,440	8,640
Weighing scale	3,000	0	0	0	0	0	3,000
Animal manure, 6,000 kg	0	0	0	0	0	0	0
Other materials	1,000	0	0	0	0	0	1,000
Total cost	60,760	5,860	5,860	5,860	5,860	5,860	90,060
Harvest							
72 cavans @50 kg/cavan, costs	9,000	9,000	9,000	9,000	9,000	9,000	54,000
PHP250/cavan	18,000	18,000	18,000	18,000	18,000	18,000	108,000
Net Income	-42,760	12,140	12,140	12,140	12,140	12,140	17,940

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Mobile No.: (+63) 916.101.1561 |(+63) 917.552.0259
Email: pccpiat07@yahoo.com

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Email: pccdmmmsu95@yahoo.com

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Science City of Muñoz, Nueva Ecija
Telephone No.: (+63) (044) 456.5238 to 39
Mobile No.: (+63) 917.867.5763
Email: pccclsu@gmail.com

DA-PCC at University of the Philippines at Los Baños
Los Baños, Laguna
Telephone No.: (+63) (049) 536.2729 | Mobile No.:(+63) 908.811.2841
Email: pccuplb@gmail.com

DA-PCC at Visayas State University
Baybay City, Leyte
Telephone No.: (+63) (053) 563.7649 | Mobile No.:(+63) 939.917.0673
Email: pccvsu@gmail.com

DA-PCC at West Visayas State University
Calinog, Iloilo
Telephone No.: (+63) (033) 323.4781
Mobile No.: (+63) 999.991.6115 | (+63) 928.945.7760
Email: pccwvsu@yahoo.com

DA-PCC at La Carlota Stock Farm | La Granja, La Carlota City,
Negros Occidental
Mobile No.: (+63) 947.893.4794 | (+63) 908.813.9048
Email: pcclcsf@yahoo.com

DA-PCC at Ubay Stock Farm
Ubay, Bohol
Mobile No.: (+63) 997.111.7680 | (+63) 945.119.3998
Email: pccusf.ubay@yahoo.com

DA-PCC at Mindanao Livestock Production Complex
Kalawit, Zamboanga del Norte
Mobile No.: (+63) 910.179.5905 | (+63) 906.726.0979
Email: pcc_mlpc09@yahoo.com

DA-PCC at Central Mindanao University
Maramag, Bukidnon
Mobile No.: (+63) 939.916.9719 | (+63) 995.097.3892
Email: pccmusuan@yahoo.com

DA-PCC at University of Southern Mindanao
Kabacan, North Cotabato
Telefax No.: (+63) (064) 572.2250
Mobile No.: (+63) 919.397.0872 | (+63) 920.621.9722
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