ABSTRACT

Food production in the Philippines is primarily derived from the agricultural sector with contributions of 15% from crops; 16% from fishery, 18% from livestock and 15% from the poultry sub-sectors. The total value of agricultural products in 2016 accounts for P456.4 billion. The livestock subsector provides domestic supply of meat and milk with sufficiency levels of 69.9% for carabeef, 76.6% for beef and 1% for milk. Sufficiency levels for these animal derived products are still low but opportunities are inevitable with the support and commitment of the government to provide affordable and sustainable food to all its constituents. Buffalo farming is a promising enterprise and a profitable livelihood to small-scale farmers. This has been demonstrated under the national carabao development program being implemented by the Philippine Carabao Center, an attached agency of the Department of Agriculture.

Farmers raising buffaloes implement mixed feeding and management systems. Traditional feeding practices are subject to seasonal forages and cropping pattern, whereby; insufficient supply of forages is observed during the dry season that affects body condition score of the animals causing slow growth, poor reproduction, long calving interval, low milk production and high mortality rates. Rainy season is a period of feed abundance but experience suggests that available native grasses only support the nutrients requirement for 300 grams ADG for growing buffaloes and 4 l milk/hd/day for lactating buffaloes. Considering the genetic potential for meat of crossbred buffaloes gaining 700 to 1,200g/day and 8-10 l/day for purebred dairy buffaloes, there is really a mismatch in the feeding protocols of the farmers to really enhance animal productivity and farmer’s profitability. An overview of the innovations in the feeding and management of buffaloes through science and technology based farm interventions and the adoption of climate-smart feeding systems is hereby presented and discussed to address the research gaps, policy issues and technology transfer or extension service protocols to enhance the carabeef and milk production not only in the Philippines but to other ASEAN communities.

Keywords: Climate smart, Feeding systems, Buffalo, Carabeef, Milk production
INTRODUCTION

The Philippine is an Agricultural country having an area of 297,170 km$^2$. As of June 2016, the country’s human population is 102.3M with an average annual birth rate of 1.45%, (PSA, 2016). The prevalence of undernourishment is 13.6% which equivalent to an average food deprivation of 93kcal/person/day. The country ranks 74$^{th}$ globally as regards the level of food security index. The food affordability which is defined as the quantity of stuff consumed as a share of household expenditure accounts to 44.2%, while the food availability (sufficiency) and quality or safety had category scores of 53.4 and 54; respectively, (Dupont, 2016 in Food Security Index).

Domestic food production in the Philippines is contributed by the agricultural production that is commonly derived from crops, fishery and livestock. In 2016, the food production from the agricultural sector (specifically for crops and fishery sub-sectors) went down by 1.11% due to the devastating effects of two typhoons “Karen” and “Lawin” that hit the country in October. Meanwhile, the livestock and poultry posted an output increment of 4.5% and 1.39%, respectively during the same year. The total gross value of agricultural production amounted to P456.4 billion with the P268.8 billion contributions from the crops subsector; 125.7 billion from the livestock and poultry sector and 61.8 billion from the fisheries subsector; respectively, (PSA, 2017). The Gross Domestic Product (GDP) is valued at $PPP738.1 billion. Sufficiency of these different food products was recorded at 92.04% for rice; 80.91 for meat (pork, chicken, beef and carabeef); 100% for fishery and only 1.0% for milk.

With the aspirations of the President of the Philippines and the Secretary of the Department of Agriculture to achieve 100% food self-sufficiency, they both committed to make food available and affordable to all Filipinos. In addition, the government’s livelihood program would like to help the farmers and fisher-folks increase their income and improve their family nutrition as well as in increasing the resilience of the people to overcome the risks that will bring about by climate change.

The Carabao Industry Scenario

Carabao Population

As of 2016, the total inventory of carabaos in the country is 2.89 million heads. Majority of these buffaloes are raise for draft and meat and only 17,800 hd are utilized as dairy animals. Ninety nine percent (99%) of the buffaloes are in the hands of the smallhold farmers and the remaining 1% represents the commercial buffalo raisers. Overall, the annual growth rate of the carabao population in the country accounts for 0.47%, Figure 1.
Comparing the carabao population with that of cattle and goat for the last thirty years, (1982 – 2012), Figure 2, there was almost stable biennial population of carabaos even though there was a reported extraction rate of 400hd live animal equivalent of buffaloes slaughtered annually. This indicates a remarkable contribution to carabeef production or meat supply in the country. The trend in the population of cattle is slightly decreasing in numbers from 1980 to 1990 but onwards, there was a light increase in the population towards the year 2012. For goats, there was also an increasing trend in the population with a peak population data in 2010. This was followed by a decreasing trend in the number of population as observed towards the year 2012.

The Carabao as Producer of Meat

The carabaos are domestically raised at the smallhold farming system as contributors of protein rich food such as meat and milk. In 2016, the carabao sub-sector produced 144.680 metric tons of carabeef, with a total value of Php113.270 million (PSA, 2017). This volume and value of meat production represents an annual increase of 1.85% which is about 3% lower than the
production data of cattle with 5.09%. Overall, the annual carabeef production from slaughtered buffaloes supports 78% of the total carabeef requirement of the country. The deficiency of 22% for carabeef supply was met by other alternative sources like pork, chicken meat or fish as there was no reported carabeef importation during the year.

*The Carabao as Producer of Milk*

In 2016, the total inventory of dairy animals reached 44,432 heads. This composed of dairy cattle 24,512 heads, dairy cattle; 17,802 heads dairy buffaloes and 2,118 heads dairy goats, Figure 3. Of this total dairy herd inventory, there were about 12,825 heads on the line which are producing total milk production of 20.39 million liters. Of the total milk produced, 63.42% was contributed by the dairy cattle, 39.43% by dairy buffaloes and 1.65% by dairy goats. The milk per capita consumption of the country is registered at 22l/hd/year.

![Figure 3. Inventory of dairy animals, 2016](image)

Considering the small volume of domestic milk production, the country remains import dependent (99%) on milk and dairy products. Opportunities however; are inevitable with the support and commitment of the government to provide affordable and sustainable food to all its constituents. The equivalent volume of import is 1,793.3 MT valued at US$694.5, annually. Eighty percent of the milk import is in the form of powdered milk with a liquid milk equivalent of 1,932MT, and the main milk exporting countries are the US, NZ, Australia and Holand.

*The Carabao Development Program*

The Carabao Development Program (CDP) is a continuous and organized effort of the Philippine Carabao Center, an attached agency of the Philippine Department of Agriculture aimed to increase the genetic potential of the native carabao for meat, milk and draft that would lead to the development of buffalo-based and related enterprises, aimed at increasing income of the farmers and improvement of the nutritional status of farming communities. The CDP is a socio-economic program that addresses the national concerns on poverty alleviation, nutrition improvement, income equity/distribution and people empowerment, (PCC, 2014).
The CDP has three components namely; 1) the genetic improvement program (GIP) – aims to develop a Philippine Dairy Buffalo breed with high potential for milk production. The GIP is carried-out all over the country through intensified artificial insemination activities and by means of a bull loan program to enhance production of genetically superior dairy and meat animals; 2) carabao-based enterprise development- this promotes the carabao through establishment of dairy federation, dairy cooperatives and dairy farmer’s associations. Qualified members of the aforesaid associations are entrusted with female dairy buffaloes and utilize these animals to build enterprises/income from the sales of live animals, meat, milk and other by-products; 3) research for development- this addresses the problems of the dairy farmers through the development of science-based technologies to sustain forage/feed supply, improve the nutrition, breeding, reproduction, health, dairy operation biosafety and resilience to climate change.

**Requisites to Enhance Carabeef and Milk Production of Carabaos**

*Locally available feed resources*

The Philippines has vast array of natural grasslands and crop plantations, Table 1. There are available 1.5M hectares of natural pasture and with an estimated DM yield and carrying capacity of 0.4 animal unit per ha/year, this can support the requirement of 600,000 hds of buffaloes cattle. Areas devoted for rice and corn account for 3.2M and 2.3M ha annually,. with an estimated yield of 5.48 tons rice straw/2 cropping/year and 18.25 tons forage or fodder/ha/year, and a carrying capacity of 0.6a.u and 2.0a.u/ha/year, these feed resources can support the needed forage for 1.920M hd cattle and 4.6M heads buffaloes, respectively. Sugarcane and coconut plantations also contribute forage supply to livestock. With the existing 0.3M sugarcane land and 3.4M coconut farms, the annual available forages from these two sources can feed 0.132M and 1.36M hd of cattle or bufaloes at a carrying capacity of 0.5 and 0.4a.u, respectively. Overall, these available feed resources in the country can support the annual forage requirement of around 8.612M hd of ruminants.

Table 1. Feed resources for feeding ruminants (buffaloes, cattle and goat)

<table>
<thead>
<tr>
<th>ITEM</th>
<th>Farm land m. ha.</th>
<th>Est. DM yield t/ha/yr</th>
<th>Carrying capacity, a.u./ha/yr</th>
<th>No. of animals supported ‘000</th>
</tr>
</thead>
<tbody>
<tr>
<td>Native pasture</td>
<td>1.5</td>
<td>3.65</td>
<td>0.4</td>
<td>600</td>
</tr>
<tr>
<td>Rice land</td>
<td>3.2</td>
<td>5.48</td>
<td>0.6</td>
<td>1,920</td>
</tr>
<tr>
<td>Corn land</td>
<td>2.3</td>
<td>18.25</td>
<td>2.0</td>
<td>4,600</td>
</tr>
<tr>
<td>Sugar cane land</td>
<td>0.3</td>
<td>4.56</td>
<td>0.5</td>
<td>132</td>
</tr>
<tr>
<td>Coconut land</td>
<td>3.4</td>
<td>3.65</td>
<td>0.4</td>
<td>1,360</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td></td>
<td></td>
<td></td>
<td><strong>8,612</strong></td>
</tr>
</tbody>
</table>
Production of home-grown forages and legumes for feeding carabaos

To come up with standard and complete diet for feeding dairy buffaloes, the production of home-grown forages (grasses and legumes) is currently being promoted in partnership with dairy carabao farmers at the identified impact zone for dairy buffalo production/enterprise. Farmers were trained to produce their own feed resources to sustain the annual fodder requirements of their animals using improved grasses such as Super Napier (Pakchong), Mumbasa, Ruzi and Molato as energy source and improved legumes (Indigofera, Ipil-ipil, Rensoni, Gliricidia, Pigeon pea and Stylo) as protein sources. The farmers were provided guidance and the option to select which of the grasses and legumes will be planted in their farm land base on the soil condition, topography and irrigation requirement of their forage area. Strip planting of the grasses and legumes is followed and the forages that will be harvested will be used in the formulation of the ration of their buffaloes (for growing or lactating). It is expected that through this innovation; the growth rate, reproduction and milk production of the buffaloes will be improved. In addition; the problem associated with liverfluke infestation which is common in the area will be addressed because the farmers will be shifting their feeding management practice from tethering to complete confinement.

Current Feeding Practices for Buffaloes

Majority of the carabao farmers, (62%) practice mixed feeding systems in taking care of their animals. These feeding combinations involve tethering, cut and carry and complete confinement system of management. With more than 20hd animal holdings, the farmers tended to shift their feeding management from tethering to complete confinement system. They believe that having more animals would require wider areas for grazing. Report showed that 44-47% of the smallhold buffalo or cattle raisers maintain forage garden, mostly planted with Napier grass. The forage areas range from 200-1000 m² however, this does not support the annual forage requirement of their animal because proper cultural management practices to increase forage yield are not regularly employed. In addition, the source of irrigation and other logistics support like equipment/tools are limited thus resulting to lower grass yield and utilization.

The availability and supply of quality forages for feeding buffaloes and cattle is climate dependent. Oftentimes, the farmers experience feed scarcity during the dry season (December to May) with observed dropped in body condition score from 3.5 to 2.5 or 2.0. This drop in BCS gave an equivalent decline in body weight of about 90-100 g/animal/day. Consequently, this scenario led to poor reproduction/long calving intervals ranging to 18-20 months and with lower milk production among the lactating cows. High mortality rate during dry season was also observed among grazing animals to as high as 20% not only due to feed shortage but also due to cases of liver fluke infestation causing low profitability of the farmers.

Smart Feeding Practices to Improve Milk Production of Carabaos

The development of smart and science-based feed technologies is a requisite to a successful feedlot or dairy farming operations. Feeding and nutrition is the largest single cost in farm operation representing up to 60% of the total input costs. Getting the right amount of feed, at the right time, is a key to achieve optimum animal performances; good health (body condition score), normal growth, milk production, good reproduction and increase farm profitability.
Enhancing the milk and meat production of carabaos through science and technology-based (S&T) feeding interventions are components of the research for development (R for D) being carried-out under the Carabao Development Program of the Philippine Carabao Center. The existing feed resources, current feeding practices, and the production performance of the carabaos raised by the farmers were assessed. Likewise, the nutritional gaps were identified as the bases in formulating interventions for village–scale production of sustainable grasses and legumes for feeding dairy buffaloes; establishment year-round practical feeding system utilizing home-grown forages to increase meat and milk production of buffaloes to promote developed technologies and encourage more farmers to adopt developed technologies on improving animal performance and profitability of the dairy buffalo farmers. The following S&T-based feed technologies are some of the practical solutions to fill-up the identified gaps at the smallhold carabao farming system.

*a. Preparation and feeding of urea-treated rice straw to dairy carabaos*

The country has 3.2M ha rice land with a potential to produce 5.48M tons of rice straw annually. If this feed material can be used as fodder, this can support the year-round requirement of 1.920M heads of buffaloes/cattle. The utilization of rice straw is limited by its low nutrient contents (4.5%CP) and poor digestibility (47%), however; urea-molasses treatment (spray or ensiled) of rice straw proven improvements in terms of CP content to 7-9%; nutrient digestibility by 55-57%; voluntary organic matter intake by 25%, hemicellulose digestibility by 26% and ruminal VFA production by 24%.

A community Science & Technology-based farm project was piloted to establish coop-led adopters on the preparation and feeding of UTRS. The farmers were trained on the preparation of UTRS and how to use it as fodder for the daily ration of dairy buffaloes. According to the partner farmers, the UTRS is easy to prepare, cheap and readily available source of feed materials for their buffaloes. When fed to dairy buffaloes, the UTRS supported the nutrients requirement for 924 kg milk production/carabao for 210 milking days or an equivalent milk yield of 4.44kg/hd/day compared to 777kg total milk production of buffaloes without UTRS or 3.70kg/hd/day. The benefit derived from UTRS feeding to buffaloes resulted to milk yield difference of 18.9% or an equivalent net profit of Php27, 467 (U$554.9/lactation) or an increase of 33.13% net profit over pure rice straw feeding, Table 2. More farmers are now adopting this technology (fast-food for carabao/cattle) not only every after harvest but during those months or period when forages are scarce, (Aquino et al., 2016).
b. **Flushing with supplementary concentrates to dairy carabaos**

At the village level, low milk production and reproductive abnormalities such as irregular estrus cycle, low conception rate, longer service period (>120-200 days) and long calving intervals, (18-20 months) are some of the commonly observed problems among dairy buffaloes. These conditions are usually associated with poor nutrition which directly affects the body condition score (e.g. BCS <2-3) of the cows. To address the problem, flushing is a management term of providing high quality rations or nutrients to the cow during the last stages of gestation to post-calving period to overcome physiological stress or nutritional imbalances. Flushing of the cow enables to cope up with the nutrients demand for milk production and subsequent reproduction. Reports have shown that flushing postpartum cows with 4-5 kg of concentrate supplement for 90 days increase conception rate from 30 to 45%. The service period from calving to conception was shortened to 40-90 days due to early uterine involution and a reduction in calving interval from 18 to 14 months.

A science and technology based-farm project was carried-out for one lactation period of buffaloes to assess the benefits of flushing on the productivity of buffaloes. Flushing was introduced to pregnant buffaloes owned by the dairy farmers by giving 2-4kg concentrates one month before calving up to two months post-calving on top of the animals’ dairy ration. Flushing improved the total milk production of buffaloes from 1,330 kg to 1,654.6 kg and with a longer lactation period from 260 to 270 days. The cows produced 6.0 kg milk daily which was higher by 1 kg than the milk yield of cows with no flushing (5.0 kg/day). The “flushed” cows exhibited estrus as early as 47 days post-partum and within 127 days service period, 70% of them were confirmed pregnant. The calving interval was reduced from 18.4 months to 14.8 months. With flushing, the farmers gained a net income of P33, 532.35 (US$667.42)/lactation due to enhanced milk production and reproduction of their animals.
Feeding practices to manage the peak milk and lactation persistency

The peak of milk production is an important indicator in formulating appropriate nutrition for the dairy cows. Peak yield is achieved when the lactating cow reaches the highest production level during its entire lactation period. Normally, the cow exhibits milk peak at 45 - 90 days in milk (DIM), followed by the gradual decline in milk production over time until the animal completely dries-off, (Anwar, 2009). The milk yield and the 2 average days to peak-milk are important parameters in assessing the lactation performance of the cows, Habib, (2009). Report showed that for every kilogram increase in peak yield, a total forecast of 200 to 250 kilograms additional milk is expected per lactation period of the cow, (Khols, 2002).

a. Challenge feeding of carabaos

Challenge or augmented feeding is one of the practical interventions to manage the peak milk and the persistency of lactation among carabaos. This can be done by giving additional supplementary concentrates, (2kg/hd/d) one month before calving or giving supplementary concentrates to buffaloes at 0.50kg/hd/day for every kg increase in milk production immediately
after calving up until the peak of lactation is reached. The lactating ration of the carabaos is composed of the corn silage (67.3%), rice straw (9.5%) and dairy concentrate pellets (23.2%). Farm trial suggested that augmented feeding significantly increase the daily and total milk production/cow (12.0 kg/day) compared to carabaos not subjected to challenge feeding, (8 kg/day). The milk peaks of the cows were observed at 72 days post-partum for cows with no challenged feeding compared to 68 days for the Feed intake (14.3 vs. 13.6 kg DM/d) and digestibility (63.66% vs 66.8% protein digestibility) of the diets were also increased by challenge feeding the cows. The benefit derived from this technology was equivalent to P25,881 (US$522.85) vs. P11,223 (US$226.73)/lactation.

Table 5. Influence of challenge feeding of peak milk, daily milk yield and lactation persistency

<table>
<thead>
<tr>
<th>ITEM</th>
<th>Treatment</th>
</tr>
</thead>
<tbody>
<tr>
<td>Peak-milk, kg/d</td>
<td>8.4</td>
</tr>
<tr>
<td>Average peak-day</td>
<td>78</td>
</tr>
<tr>
<td>Adjusted 305d milk yield, kg</td>
<td>1120.9</td>
</tr>
<tr>
<td>% Lactation Persistency</td>
<td>93.6</td>
</tr>
</tbody>
</table>

b. Influence of feed supplements/feed enhancers to carabaos

The newly calved carabaos experience negative energy balance during early period from postpartum. At this stage, nutrients competition or imbalances are observed due to metabolic stress caused by the development of the fetus during pregnancy up until its termination from the womb of the dam and secondly, the physiological stress for preparation of the mammary gland of the cow for lactation. The cow should be given complete nutrients diet to compensate the nutrients losses and to bring back its ideal body condition score (BCS).

There are commercially available feed supplements in the form of rumen undegradable proteins/amino acids and by-passed fat which could increase milk production, milk protein and milk fat of the carabaos milk. Trials had been made involving the carabaos of the dairy farmers and results showed that by-passed protein gave significantly higher milk yield, (10.60% vs. 8.40%); milk fat, (9.72 vs. 7.04%) and protein, (5.00% vs. 4.33%) and total milk solids (19.98 vs. 16.15%).

Rumen protected or by-passed fat is also available in the market. This product was prepared from an oil product which is stable in the form of calcium salts of long chain fatty acids. This is beneficial to dairy carabaos to overcome the problem of negative energy balance during the early stage of lactation. By-passed fat also enhances the peak milk production and persistency of lactation and decreases the metabolic disorders such as ketosis, acidosis and milk fever.

The use of slow-released non-protein nitrogen supplements (NPN) to dairy carabaos was also been tried to assess the milk production performance of carabaos, however; there no significant influence observed on animal milk performance and milk composition.
The supplementary by-passed amino acids in combination with slow-released NPN supplements to carabaos that were subjected to challenge feeding had given promising results. The gathered data were superior in terms of daily dry matter intake, dry matter and protein digestibility of the diet leading to significant increase in milk production, fat and protein contents of the milk. Through this feed technology the dairy carabao farmers are now aware of the importance of improved feeding for their carabaos. Using this technology, high level of production and profitability was recorded even reaching a net income of P33,762.00 (US$ 720/hd) per lactation of the carabaos.

*Preparation and feeding of corn silage*

More than 3,500 dairy buffaloes owned by smallhold farmers experience forage scarcity. This ranges up to 40% of the forage requirement with equivalent volume of 6,300 metric tons annually. This forage scarcity usually coincided with the dry seasons (January to May) in times of rice planting season where grazing carabaos are deprived from grazing areas. With increasing number of animal holding, the dairy farmers are slowly making shift from traditional tethering to cut and carry or complete confinement system of management.

Corn silage is now commercially available for dairy carabaos and cattle feeding. A TechnoMart modality of the Philippine Council for Agriculture, Aquatic and Natural Resources Research and Development (PCAARRD) provided an opportunity to address the problem of forage scarcity. Basically, TechnoMart involves the planning and development of product commercialization, business matching and development of product promotional strategies including provision of information, education, and communication (IEC) materials, and capacity–building activities (PCAARRD, 2010). The project was able to demonstrate the feasibility and profitability of a farmer-led, community-based enterprise producing and marketing corn silage on a commercial scale. These include engagement with a product champion person, capability building of participating farmers, provision of small farm equipment and supplies, product promotion through various IEC materials and participation in trade fairs, and business matching or market linkage.

<table>
<thead>
<tr>
<th>Market</th>
<th>Type of Animals</th>
<th>Approximate number of animals</th>
<th>Total weight of corn silage marketed (kg)</th>
</tr>
</thead>
<tbody>
<tr>
<td>PCC institutional herds in Nueva Ecija and Laguna</td>
<td>Buffaloes</td>
<td>2,600</td>
<td>1,268,668</td>
</tr>
<tr>
<td>Dairy cattle farmers in Nueva Ecija</td>
<td>Buffaloes</td>
<td>35</td>
<td>49,230</td>
</tr>
<tr>
<td>Commercial dairy cattle farms in Quezon, Batangas, Pangasinan, and Nueva Ecija</td>
<td>Cattle</td>
<td>1,600</td>
<td>1,048,943</td>
</tr>
<tr>
<td>Farms in Nueva Ecija and Tarlac</td>
<td>Goat</td>
<td>1,030</td>
<td>34,516</td>
</tr>
<tr>
<td><strong>TOTAL</strong></td>
<td></td>
<td></td>
<td><strong>2,401,377</strong></td>
</tr>
</tbody>
</table>
Feeding practices for meat production

The potential of carabao as meat animal provides opportunities in the local market because it is a very good ingredient for processed meat products such as corned beef, hot dog and sausages. In 2015, the country imported 133.84 thousand metric tons of carabeef valued at US$ 386.06 million. This value of carabeef imports would be lessened if there are efforts in looking at the potential yield and quality of carcass of fattened carabaos. As for now, there is no commercial feedlot operator of buffaloes in the country. Most of the carabaos slaughtered were retired from work and these possess low quality lean meat.

Carabeef coming from young and properly fed carabao according to Lapitan et al.; 2007 is comparable to beef in terms of tenderness or chewiness. It has also been well recognized that the carabeef tends to be popular with beef consumers as a healthy meat in developed countries, because the carabeef generally contains relatively low levels of fat and cholesterol (i.e. a high proportion of lean meat) as compared with normal beef. It is in this respect that the research towards exploring the meat characteristics of carabaos using practical rations to meet specific ADG and fattened weight is being directed.

Dairy farmers do not give much attention if their dams gave birth to a male calf. They think that the calf would compete with the daily sale of milk produce by the dam thus; as early as 3-5 months old, they already sell the male calf at a very low price (US120-150).

Comparing the fattening performance of crossbred Brahman and crossbred carabaos at the same age by Lapitan et al.; 2007 and using the same ration made up of 50% corn silage, 30% brewers’ spent grain and 20% concentrate supplement at 3% of body weight to support 0.75kg ADG was studied. Results seemed to suggest that there are very good attributes of carabeef over the beef in terms of some carcass traits and sensory evaluation.

Feeding of Total Mixed Ration

Good feeding management practices must be followed to achieve maximum performance of the herd. Improved feeding efficiency often occurs with herds using a TMR. According to De Laval, 2010, each mouthful of feed that the cow consumes contains the proper amount of ingredients for a balanced ration, resulting in a more stable and ideal environment for the rumen microbes and providing adequate carbohydrates and nitrogen sources that vary in their ability and rate of rumen breakdown. This in turn can lead to production of higher levels of microbial protein by the rumen microbes throughout the entire 24-hour day. A 4% increase in feed utilization can be expected when using a TMR compared to a conventional ration of forage and grain fed separately, twice daily. In addition, the ability to use feeds with various rates of breakdown is enhanced, often enabling even better nutrient utilization. Farmers can also utilize a greater variety of byproduct feeds with a TMR, thereby allowing for possible ration cost savings. The incidence of digestive and metabolic problems often decreases when a TMR is fed, and milk
production has been shown to be as much as 5% higher with a TMR compared to conventional rations as a result of these benefits. One of the major advantages of blending all the feeds together in a TMR is that it can mask the flavor of less palatable feeds. Feeds such as urea, limestone, fats, and some by-pass protein sources may be less palatable. However, through blending, they can be added to TMR in reasonable amounts with little to no reduction in feed consumption.

CONCLUSION

To enhance carabeef and milk production of carabaos in the country, there has to be a developed standard, practical but science and technology-based feeding innovations which can be adopted both by small and large scale dairy and feedlot operators. The research for development on establishing feeding protocols to meet the nutrient requirements for specific rate of growth, volume of milk production and production efficiency is important and this has to be sustained through year-round supply of quality forages and feed supplements which will make-up the complete nutrient diets for the carabaos. There are advanced feed technologies at hand but the adoption and practical application will depend on the resources and the benefit that the farm operator will derive from.

REFERENCES

Rosalina M. LAPITAN, Arnel N. DEL BARRIO, Osamu KATSUBE, Tomomi BAN-TOKUDA, Edgar A. ORDEN, Alberto Y. ROBLES, Tsutomu FUJIHARA, Libertado C. CRUZ, Hideya HOMMA and Yukio KANAI. 2007. Comparison of carcass and meat characteristics of Brahman grade cattle (Bos indicus) and crossbred water buffalo (Bubalus bubalis). Original copy


KOHLS, D.2002. Feed and Nutrition Consultant Form-A-Feed, Inc. and TechMix, LLC articleinfo@formafeed.com


