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POTENCY, CONSTRAINT AND PROSPECT ON UTILIZING OF CROP-RESIDUES AS ANIMAL FEED

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Abstract

The result of intensifying crops will result in not only more food, but also more crop-residues. Integration between crops and livestock is an alternative to fulfil the demand of feed needs. Supply of the crop-residues not always closely placed with the localized cattle farming area that caused value or the cost of such by-product becomes higher to transport in to another places. Parts of feed value criterion should be used with the basic of crude protein content and dry matter digestibility. Some studies have been done with objections were to find ways to use the crop-residues for feed maximally. The reports on using the crop by-product in Indonesia are described here, as a contribution to solve the problems of lack of roughages that needed for balancing the increasing of ruminant productivity. Using the first category feed such as rice straw, corn stover, sorghum straw and sugarcane tops directly in the ration is possible only if the cattle is given another supplement and the feed is constructed in a decent ration. Increasing of crop-residues potential is needed with attempts that focused on biodegradation. In the rural area, many farmers done the attempts to preserve the crop-residues, commonly it is only limited to drying and stocking as back up feed in the famine season. Preservation, which is an attempt to increase the feed value, has not widely known.

Key words: Crop-residues, Feed, Ruminant

Introduction

The improvement of cattle production needs lots of feed, especially cheap and qualities roughages. Widening the area for planting the feed-plants would be limited, especially in the massive islands and the cattle's would suffer by the lack of roughages especially in the dry season. The result of intensifying crops will cause not only more food, but also crop-residues. Integration between crops and livestock is an alternative to fulfil the development of feed needs.

Measurement of crop-residues in Java and Bali (Anonymous, 1982) estimated production of crop-residues in Java (including Madura) and Bali was 22.9 up to 34.4 million tons every year; 67% of total amount was rice straw. All the by-product produced by farmer was partly used for feeding his own cattle and the other part was

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used by someone else; for paying the wages, sold, etc. But sometimes the waste was burned in the farming-field, spread or buried as fertilizer. Recorded survey of Measurement of Crop-residues in Java and Bali (Anonymous, 1982) shown the percentage of respondent farmer who did not use the waste as cattle feed, it is estimated that about 16 million tons of dry matter crops by-product is neglected every year. This paper is written with objective is to give a description about the situation of stock roughages for ruminant and some alternatives in solving the problem about the lack of roughages.

Problems In Using The Crop-Residues As Animal Feed

Plants are usually harvested in certain times depend on the season. Thus caused abundant residues in certain times at the certain places, while in other time, those kinds of residues cannot be found. Supply of the crop-residues not always closely placed with the localized cattle farming area that caused value or the cost of such by-product becomes higher to transport in to another places.

The value of crop by-product as feed will depend on the type of by-product, plants varieties, soil fertility, fertilization, time and how is the plants harvested. Parts of feed value criterion should be used with the basic of crude protein content and dry matter digestibility, which can be seen in Table 1. Based on the figure in *in vitro* digestibility and proximate analysis, crop-residues can be grouped in four categories as follows;

First category is residues with the low crude protein (<7%) and dry matter digestibility value. Those categories are: rice straw, corn stover below the fruit stem, sorghum hay and sugarcane tops. Using these residues for feed needs protein supplement and attempt to increase the digestibility. Second category is the corn stover above the stem. This residue has about 7% protein content and enough dry matter digestibility value. Third category is the by-product that has about 11% protein content that is enough for animal production and dry matter digestibility value. Including here are soybean hay, peanuts hay and sweet potato leaf. Forth category is by-product that has 20% of crude protein with good dry matter digestibility value. Including in this group is cassava leave that have the highest protein content among another crop by-product. In feed classification, cassava leave is in the class of protein source feed.

With the facts about the feed value from these crop by-products, the first category is the most neglected one and becomes a problem. The availability concentration of crop-residues in a certain place at the certain times especially in the not-massive cattle area caused the waste for feed used not in entirely. This situation needs quick solving with an attempt to reserve and increased the feed value altogether. This attempt especially aims to get the feedstock at the time being.

With the competition of using parts of crop-residues as a raw material for industry caused some types of such these materials becomes expensive. This is a possibility that caused the farmer unwillingly using their waste for feed.

Table 1. The value of crop-residues (% dry matter)

Type of residues	Crude protein	*In vitro* dry matter digestibility
Rice straw	4.16 ± 1.01	39.20 ± 3.62
Corn stover*	7.44 ± 1.47	49.19±6.43
Corn stover**	4.77 ± 1.19	45.29 ± 7.73
Sorghum hay	4.39 ± 1.08	39.97 ± 5.19
Cassava leaf	20.93 ± 2.43	49.13 ± 8.11
Sweet potato leaf	11.30 ± 1.79	59.98 ± 6.36
Peanuts hay	11.08 ± 1.22	52.86 ± 6.32
Soybean hay	10.56 ± 3.05	52.86 ± 5.26
Sugar cane tops	5.63 ± 1.27	42.67 ± 2.23

* part above the stem **part below the stem
Source: Anonymous (1982)

Relation Between The Using of Crop-Residues and Feed Value

Many ways to use crop-residues. As identified in the field, there are used as: (1) fuel, (2) source of mineral and organic substance for soil (fertilizer), (3) bedding for cattle, (4) cattle feed, (5) paper *pulp*, (6) media for growing mushrooms (Musofie, 1984; Utomo, 1999). Many farming experts believe that using crops by-product for feeding the cattle is exhausting the natural source of the soil. Thus, the by-product is better to be burned on the field. On the contrary, burning the residues will eliminate million tons of organic substances, including the nitrogen. So, the best thing to do is using the waste for feeding the cattle, while the faeces of the cattle itself returned to the soil as fertilizer.

Some studies have been done with objections were to find ways to use the crop-residues for feed maximally. Those attempts includes the using of such residues directly in the feed, the exact process to increase the feed value, and preserving the by-product in order to anticipate the fluctuation of feed availability. Though such attempts were in many types and varieties, they still cannot be recommended to the farmers entirely.

Using the By-Product Directly In the Ration

Using the first category feed such as rice straw, corn stover, sorghum straw and sugarcane tops directly in the ration is possible only if the cattle is given another supplement and the feed is constructed in a decent ration. Such protein supplement could be taken from the farming industrial waste, leguminous leaves or urea (Lebdosukoyo, 1982).

Among the other crop-residues, rice straw is the most important substitute for ruminant di*et al*ong the dry season when such feed is lessens especially in the lower area. Based on the harvest width in Yogyakarta Special Region and the production of crop-residues, the production of dry matter was estimated about 765.184 tons, and 478.222 tons or 62.50% from the total amount was rice straw (Utomo, 1999). Though so much rice straw available, 36-62% were returned to the field as compost or burned, 31-39% were used for feeding and the rest or about 7-16% used for industrial needs (Anonymous, 1982).

If rice straw were used as the main feed for cattle, it is hard to fulfil the needs of decent nutrient, though such feed was given *ad libitum*. Ruminant needs feed with minimum digestive value about 50-55% and crude protein content 7%, while digestive value of rice straw is only 35-37% with the crude protein content is 3-4% (Djajanegara *et al.*, 1983). This low digestive value caused by the tissue structure of plants support that had had been processed into advanced lignification, so the ligno-cellulose/ ligno-hemicellulose was formed and made the feed hard to digest. The live of rumen microbe needs the feed contains at least 1.28% of nitrogen or 8% of crude protein (Van Soest, 1994). Besides the needs of such nitrogen, synthesis of microbe protein needs carbon content (C), phosphor (P) and sulphur (S).

The given supplement in form of concentrated feed with 16.15% of protein content to the cows that given basal feed such as rice straw, corn stover or sugar cane tops will increase the weight more satisfying than the ones that had not given such supplement (Musofie *et al.*, 1981).

Besides such concentrated feed, leguminous leaves can also be used for feed supplement for the cattle that given the first category crop-residues. Addition of *Leucaena leucochepala* and *Gliricidia maculata* are recommended. Addition of such leaves to goats is recommended not more than 50% of ration. Distribution of *Gliricida maculata* for 4 kg to beef cattle that only given rice straw as their feed can only fulfilling their living needs, not nutrient needs, while mixing urea with the rice straw that supplemented with *gliricidia* leaves will cause better on dry matter digestibility, crude protein, NDF, ADF and energy than if it is not mixed with urea (Rangkuti and Siregar, 1984).

Using sugar cane tops directly in ruminants ration had been implemented by many farmers in around the sugar factory area in Java. Sugarcane usually 12 month-old or more, so that the tops obtained from such plants had the hard texture with

high crude fibre content. Such texture is not a constraint in using this residue as ruminant feed (Wardhani *et al.*, 1982).

The studies done by Musofie *et al.* (1981) showed that post weaning calves are able to be fed by sugar cane tops as well as elephant grass. Using the sugar cane tops to substitute the elephant grass for lactated dairy cows have been observed by Wardhani *et al.* (1983). The observation resulted that substituting parts or all of the elephant grass with sugar cane tops as feed does not cause the real difference for the amount of feed consumption, milk production, and efficiency of ration using. As long as the observation occurred, cattle were given the concentrated feed with 16% of crude protein content that was given appropriate needs of living and production.

Soybean hay had been used by most of farmers in the soybean production area. It planted mostly in the dry season. Generally, the hay produced from them has relatively low protein digestibility value and rich in fibre, and it is a source of feed with quite low quality. Study by Musofie and Wardhani (1990) showed that giving soybean hay *ad libitum* with 2% of *Gliricidia maculata* measured from the cattle body weight (BW) as supplement should increase the daily body weight gain (BWG) up to 24 grams/head/day. If the ration is added with 1% and 5% of the rice bran measured from the cattle body weight (BW), BWG resulted from such addition would be 292 and 451 grams/head/day. Soybean hay can also be used as protein supplement. As a supplement, soybean hay is able to increase the *in vitro* dry matter and organic matter digestibility and increase the consumption of ration, though it does not make any real differences with the weight of the cattle and ration using efficiency (Tedjowahjono *et al.*, 1984).

Corn stover mostly used as grass substitute by farmers in the dry field, fresh or dry, especially in the dry season. Study by Wardhani and Musofie (1991) shown that fresh corn stover could be used as elephant grass substitution without giving the negative effect for cattle productivity. The treatment in the study was that fresh corn stover or elephant grass given *ad libitum*; with the addition of *Gliricidia maculata* supplement of 2% from cattle's weight. This study was also showing the amount of dry corn stover and elephant grass that had been consume, each were about 2.3% to 3.10% from the cattle's weight. Palatability of dry corn stover apparently was not as good as the one that fresh. And the result of the study by Musofie and Wardhani (1990) declared that the consumption of dry matter of corn stover was only 1.5% from the cattle's weight.

Cassava leave is the largest third after rice straw and corn stover. Its residues are the most important waste in cattle feed supply. As a protein source, cassava leave is the most potential one. From some analysis and idea, it has high crude protein content, about 15.8% to 30% (Sudarjanto *et al.*, 1984; Djajanegara *et al.*, 1983; and Mathius *et al.*, 1984). Cassava leaves has a weakness in using it as cattle feed, for having high cyanide compound.. HCN content in the leave will decrease up to 12.8% if it is dried under the sun for 72 hours. Knowing this fact, it is best to do not to make the leave as a single feed, unless if it is mixed with another feed that rich of

energy (Mathius *et al.*, 1984; Sudarjanto *et al.*, 1984). It is suggested to use cassava leaves that mixed with elephant grass with the ratio of 1:2 (Djajanegara *et al.*, 1983).

Peanuts hay have been commonly used as cattle feed in the rural area and specifically used as supplement feed, fresh or dried. Mathius *et al.* (1983) tried to use peanuts hay that had been dried and saved as elephant grass substitute and given to sheep. Result of such observation shown that the goats was able to consume peanuts hay up to 44% from the consumed of dry matter. And giving the peanuts hay supplement proved to increase the weight up to 35.7 grams/head/day.

Processing To Increase the Value of Crop-Residues

Increasing of crop-residues potential is needed with attempts that focused on biodegradation. Physically treatment aim to decrease the size of particles and swell up the cells. Using this treatment to fibered feed by grinding it until the feed sized 2.5-5 cm has not really affected the digestibility (Utomo, 1999). Milling the feed will reduce the particles size, increase the density, increase the surface width, increase the rate of passage of feed in the rumen, reducing the rumination, increasing the feed consumption, and decrease the digestibility (Van Soest, 1994). Hungate in Utomo (1999) described that the feed digested about 71% in the 24 hour-time and 56.5% in 12 hour-time. As the effect of milled-feed, consumption increased up to 100% and caused the feed digesting increase to 56.2% x 2 = 113%.

Some chemical treatment process could dissolve lignin and in certain condition could dissolve cellulose. Adding the chemical substance with alkali characteristic could weaken lignocellulose bond and decrease the cell wall content, while adding the chemical substance with acid characteristic will hydrolyse cellulose on the cell wall so that the sugar and lignin that have *acid labile* characteristic could be loosen. Oxidative treatment aim to separating lignocellulose bond and oxidation of lignin (Soejono *et al.*, 1988). Pre-treatment with NaOH could increase the digestibility, it is also could be harmed, causing Na+ pollution in the farming fields, not increasing the nutrient value, and not economic.

Advantage in using the rice hull ashes is also been tested to increase the value of rice straw feed. As Betta and Sutardi observed (1982), 25% (w/v) of rice hull ashes could be used as a cheap source of bases if it is added with nitrogen and sulphur and could be used to substitute part of grass in goats feed.

Using urea to increase the crop-residues feed value, especially rice straw, has been popular among farmers. The advantage in using urea for ammoniation has often been reported. With electron microscope, it can be seen that rice straw tissues that had been soaked in 2% of NaOH solution (w/w) plus urease enzyme could easily digested than the one that soaked into water, urea 2% (w/w) or rice hull ashes solution 4% (w/w) (Lebdosukojo and Hartadi, 1982).

Ammoniation to pith of sugarcane baggase with urea could increase the crude protein content and increasing dry matter and organic matter digestibility.

Ammonised pith with urea that had been brood for three weeks could replace half of beef cattle grass feed without showing a significant differences to the cattle's weight and ration using efficiency (Wardhani *et al.*, 1989). Using the 'pith-urea-molasses' (contains of 30% of molasses, 3.5 % of urea, and 66.5% of pith) that had been brood for two weeks as a substitute for rice bran in the concentrate feed of beef cattle has not make any significant differences in cattle production (Wardhani *et al.*, 1985a).

Basically, biological treatment is a limited composting. This treatment is an attempt to preserve and pre-treatment that could increase the quality altogether, and such treatment like composting, ensilage, mushroom-growing or enzyme addition (Soejono *et al.*, 1988). During the composting, decomposition of organic matters occurs through biochemical process that involved microbes. In the initial process of composting, the temperature will increase and microbes will multiply. Later, the degradation will slow down until the balancing point is reached. During the aerobic fermentation, the protein percentage will increase, and most of component's residue that had been digested from the metabolised one will decrease the dry matters digestibility. The lost of organic matters and parts of cells content during the composting process caused the increasing of ash and lignin content (Utomo, 1999).

Application of biological treatment using the mixed chicken's and cow's faeces with the ratio of 80:20 and 60% of water content and brooded for about 14 days could increase the protein content from 3.25% to 5.34%, but it could cause the decreasing of organic matters content (Sumadi, 1986). In recent years there is some biological treatment that had been developed to increase the value of crop-residues which all are oriented to thermophilic microbes that produced lignocellulose that can be helped to digest the cellulose before the feed is given to the cattle. The nature bacterial colony contains of cellulolitic, lignolitic, proteolithic and lipolithic bacteria's, and also the nitrogen fixation of non-symbiotic bacteria's had been packed and marketed as probiotic.

Aerobic fermentation to rice straw using 'starbio' probiotic and urea (6 kg of starbio + 6 kg of urea for 1000 kg of rice straw) with water content about 60% had been done to improve the feed quality and conservation altogether; could increase the theoretical degradation of dry matter from 39.9% to 45.41% and increase the gain weight of beef cattle (Agus *et al.*, 1998).

Preservation of Crop-Residues

Preservation, which is an attempt to increase the feed value, has not widely known by farmers. The study of making silage of crop-residues has limited to the sugar cane tops (Tedjowahjono *et al.*, 1981; Achmanto and Musofie, 1988) and corn stover (Mulyaningsih *et al.*, 1988). Adding the molasses for about 3% of the weight of fresh tips and kept for about six months will results the silage with satisfying quality.

Wardhani *et al.* (1982) compared the addition substance to make silage from sugar cane tops in formed of molasses and molasses + urea; each was 3% and 1% from the fresh matters. After being kept for about six months and observed every month, it was concluded that the given additive substance in form of molasses has produced enough good silage, smell nice and fresh with pH of 4 -4.5, while using molasses + urea additive could increase digestibility of crude fibre and crude protein of the produced silage. During the keeping, the damage value of silage with both types of such additives was about 6.53 - 9.7%. It is suggested that the silage that given to cows is not in form of single feed, because the cattle could only consume such silage about 5.24 - 5.36% of its weight.

Attempt to preserve it in the form of pellet is limited only for sugar cane tops. Using it as feed for beef cattle had been reported by Musofie (1984). Giving the sugar cane tops pellet with the addition of concentrated feed with 16% of crude protein content produced the weight gain for 828 grams/head/day; while giving fresh sugar cane tops with the same additive concentrated feed could only produced daily weight gain for 772 grams/head/day. Wardhani *et al.* (1983) concluded that giving the sugarcanes tops pellet to lactated dairy cows with the addition of soybean hay and concentrated feed did not have negative effect on the quality and the quantity of milk production.

In recent years, there is attempt to preserve the sugar cane tops by changing such feed form into the form of wafer that had been done by some private industrialists in East Java as an export commodity that sent to Japan. From the research, wafer of the sugar cane tops had been given better production effect than the fresh formed did not differentiate the digestibility of nutrient (Musofie and Wardhani, 1985; Wardhani *et al.*, 1985b).

Conclusion

Increasing ruminant productivity needs more feed availability especially cheap roughages. By intensifying of crops, food production is not only increasing, but also will caused more crop-residues as well, so that integration between crop and livestock is an alternative to fulfil the developed needs of feed by using the crop-residues as cattle feed.

Major problems caused by attempt to use crop-residues as cattle feed as many as possible in the ration of the cattle is the low quality of feed value, so the supplement for protein source or pre-treatment is still needed.

Harvest time which usually come altogether at the same time in certain seasons caused abundant of crop-residues in a certain time at the certain places, which will caused more expenses to collected and kept it compared with the feed value itself. Those problems need a technology to improve the quality or feed value of the crop-

residues, while harvest fluctuation needs preserved technology that cheap and easily to do to applied in the rural area.

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