A New Future for Cassava in Asia:

Its Use as Food, Feed and Fuel to benefit the Poor

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THE USE OF CASSAVA STARCH FACTORY WASTE (PULP) AS FEED FOR DAIRY CATTLE BY SMALLHOLDER FARMERS IN EAST JAVA, INDONESIA

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ABSTRACT

A field survey on the use of cassava pulp as feed for dairy cattle was conducted in three dairy cattle production centers of East Java. A total of 32 small-scale dairy farmers with not more than 15 heads of cattle, and four large-scale ones with more than 100 heads of cattle were surveyed. The survey aimed to study the importance of cassava pulp as feed for dairy cattle by smallholder farmers.

Out of the total number of dairy farmers surveyed, 28 small-scale dairy farmers and three large-scale dairy farmers always used cassava pulp as additional feed for all stages of dairy cattle, except calves. The other four smallholder farmers surveyed used the pulp only sometimes during the dry season when there was a large supply of the pulp available.

Cassava pulp was periodically supplied to the farmers by cassava starch factories and in smaller quantity by traditional home-scale cassava starch industries. In addition to forages, the pulp was fed to dairy cattle in wet form and mixed with concentrate by smallholder farmers or with concentrate and tofu waste by bigger dairy cattle farmers, either with or without water added.

Most of the farmers experienced that feeding cassava pulp to dairy cattle gave some advantages in improving palatability of concentrate feed, making cattle looked more satisfied than fed concentrate without cassava pulp, and increasing the milk yield, although this feeding method slightly decreased the milk fat content. Those advantages were more important during the dry season when the availability of forages was limited. The farmers used the pulp regardless of either the HCN content or the physical condition of the pulp after having been stored for weeks in their farm, as they had never experienced any negative impact of feeding cassava pulp on cattle, including poisoning due to the HCN content of the pulp.

It was concluded that cassava pulp was potentially important as feedstuff for dairy cattle feeding by farmers. However, lack of its availability in relation to the dairy cattle population had limited the use of the pulp as feed by farmers. Increasing cassava production would be expected to improve the availability and the potential of cassava pulp being used as dairy cattle feed.

Key words: cassava, cattle, feed, pulp, starch factory waste

INTRODUCTION

Forages are naturally the main feed for wild ruminants, from which the animals get nutrients to support their live and production. This also happens in the case of intensively managed ruminant production systems, although in such systems forages are generally supplemented with concentrate feeds to improve the nutrient concentrations in the rations supplied to the animals. However, forages availability has become a major constraint in the ruminant production systems, especially for smallholder farmers due to certain conditions. The contrasting seasonal availability of forages in the wet and dry seasons is one of those conditions. During the wet season, forage is available in excess of the animals' requirements, but these same forages become scarce during the dry season. In addition, average land ownership by farmers in Indonesia, mainly in Java island, which is the most

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densely populated island of Indonesia, is very small, not more than 0.5 ha per farmer. The first priority of use of the land is for crops rather than for forage production. Almost no land is specifically used for growing fodder. Some farmers are even landless. The dairy cattle population in Indonesia is mostly concentrated in hilly upland areas around forests which is primarily for two important reasons, i.e. for utilizing the forest as a forage resource for dairy cattle, and for the lower environmental temperature, which is required for dairy cattle. However, these two reasons do no longer support the system, as the forests have been degraded in the last ten years due to illegal logging and utilization of opened forest land for crop plantations by farmers.

Consequently, the demand for non-conventional feedstuffs for use in animal diets has increased as a result of the increase in livestock production in the last few years and the decrease of the availability of feed/forage resources. Cassava pulp is one of the non-conventional feedstuffs which can be potentially used in the livestock diets. This product is produced after extraction of starch from cassava roots in the starch factories. Cassava roots produce approximately an equal amount of starch and pulp (Grace, 1977). Marjuki reported that when fresh cassava roots were completely sun-dried, they produced a dry weight of 37-45% of the fresh weight (unpublished data). Obalua (2007) also reported that dry pulp constitutes about 20% of the original weight of fresh cassava roots. Cassava pulp still contains quite high levels of starch and fiber (cellulose and hemi-cellulose), but is low in protein. It contains about 56.0% starch, 35.9% crude fiber, 5.3% crude protein (CP), 0.1% fat, and 2.7% ash on a dry matter basis (Grace, 1977). With these nutrient contents, cassava pulp has potential as an energy source feed, especially for ruminant animals. Thus, this research aimed to study the potential use of cassava pulp as feed for dairy cattle by smallholder farmers in East Java province of Indonesia.

MATERIALS AND METHODS

The research was conducted in dairy cattle production centers in Malang, Kediri, and Blitar regencies of East Java province, Indonesia, in June-August 2008. A Rapid Rural Appraisal (RRA), followed by a survey, were conducted. The RRA was aimed to get general information about dairy cattle production in the area of study. During the RRA, interviews and discussions were held with key persons including people from local livestock service offices and representatives of dairy cattle farmers (the head of farmers group). Based on the RRA data, 10 to 11 dairy cattle farmers from two villages in each regency, each rearing 5 to 15 heads of dairy cattle, and having worked for more than five years as dairy cattle farmers, were purposely randomized and sampled as respondents in the survey. The survey included direct observations, interviews and discussions with a total of 32 selected respondents with an emphasis on dairy cattle feeding practices and the use of cassava pulp as feed for dairy cattle.

A semi-structured questionnaire was prepared and used for interviewing the respondents. The main points listed in the questionnaire for the survey were dairy cattle production by farmers and their feeding practices; whether they know or not about cassava pulp as feed for dairy cattle; if they know about it, whether they use it as feed for their dairy cattle or not, and what are their reasons; if they use it, how is the feeding practice of the pulp including frequency, method and amount of feeding. According to the farmers, what is the effect of feeding such pulp on cattle performance; from where and how do they get

the pulp; what is the price; and how is the supply to the farmers? The collected data were analyzed using descriptive statistics.

Attempts were also made to survey feeding practices of dairy cattle in four larger-scale dairy cattle farms, each with more than 100 heads of dairy cattle to compare with those practiced by the smaller-scale dairy cattle farmers, especially on the aspect of the use of cassava pulp as feed for their dairy cattle. In addition, a survey was also conducted among cassava starch factories in East Java.

RESULTS AND DISCUSSION

Dairy Cattle Production and its Importance for Smallholder Farmers

As in other areas or in other tropical developing countries reported by Devendra (1999), smallholder farmers in the area of study in East Java are mostly involved in mixed farming systems with crop production (mainly food and horticulture crops) and livestock production (mainly dairy cattle) as the two major agricultural enterprises. Both these enterprises are operated together and get more or less the same attention by the farmers with respect to the allocation of resources, especially labor and capital, but not in terms of land. The farmers utilize as much as possible their own family labor in the enterprices. Land owned by the farmers is mainly used for growing crops, but not for fodder plants. Food crops, mainly rice, maize and on a minor scale cassava, are grown especially to provide food for their own family consumption, while horticulture crops, including vegetables, potatoes, garlic, and onion are grown mainly for sale to provide cash income.

Dairy cattle production, especially milk, is the most important source of daily income for most farm households in the area of study. Lactating dairy cows are milked twice a day, in the morning and afternoon. Milk is then delivered to the local dairy cooperatives after every milking, through a milk collecting unit in each village. The milk is in turn delivered to milk industries by the cooperatives. The farmers get payment for milk from the cooperative every fifteen days after subtracting several costs such as for their regular saving, payment for concentrate feed, artificial insemination and health services for their cattle, and repayment of their credit in case they have credit from the cooperative. Dairy cattle also have a main function as savings, especially in the form of calves, and as a source of fertilizer in the form of manure. Recently, some farmers in Malang have established biogas plants from cattle manure supported by the local government forestry department. The biogas plants are used to supply gas for daily cooking, and are also intended to reduce the collecting of fire wood from forests by farmers, while the sludge produced by the biogas plants can be used as fertilizer.

In contrast to the small-scale dairy cattle farmers, dairy cattle production for the larger-dairy cattle farmers is the dominant enterprise with respect to resource utilization and source of income. Labor is mostly recruited with monthly payment. Some large dairy cattle farmers also function as nucleus farms who coordinate other small dairy cattle farmers.

Feeding Practices of Dairy Cattle by Smallholder Farmers

Feeds given to dairy cattle by all farmers in the area of study are in the form of concentrate feeds and forages. The concentrate feeds are bought by farmers from the local dairy cooperatives under a credit system. The forages are collected mainly from forest and agricultural fields. Some farmers grow elephant grass and leguminous shrubs/trees on their

own non-arable land, especially on steep land along fences, on field banks or along boundaries. Some farmers have also a chance to rent forest land from local forestry departments for IDR. 150,000 per ha per year (1 USD = IDR. 9,300) for growing food crops and fodder plants, especially elephant grass under forest trees, while the farmers have the responsibility to manage the land and the trees. During the wet season the fodder plants grow well and the forages are available in abundance. During this season, much of the elephant grass is too mature to be cut, and much of it is left in the fields under-utilized; when this feed is given to cattle, most parts, especially the stem parts, are refused by the cows as the stem to leaf ratio is too high. In contrast, the same forages are scarce during the dry season; hence, crop residues, such as rice straw and maize residues are collected from other areas and together with a small amounts of grass are used as feed for dairy cattle. Sometimes during the dry season, farmers also use banana stems as dairy cattle feed. However, the dry season during this year was much less intense than those in previous years, as the rains came earlier in August than in the previous years, when it started to rain in December or January. Thus, the availability of forages this year was much better than in previous years.

Cut-and-carry systems are used by all farmers in this area. Farmers never store or conserve the excess of forages available in the wet season for dry season feeding, nor do they graze their cattle as there is no rangeland available for grazing. These systems require less cash inputs by the farmers, which is suitable for smallholder farmers which generally have limited cash flow. However, the system has some disadvantages, i.e. the farmers must be pushed to collect forages every morning regardless of the weather conditions, and the systems is very sensitive to the fluctuation of feed availability. Farmers must also limit the number of cattle that can be maximally reared during the dry season.

The amount of forages given to lactating dairy cows is in the range of 30 to 40 kg/head/day, mostly in the form of elephant grass, rice straw, maize stover, sugarcane tops, and to a lesser extent, the leaves of legume trees/shrubs, and concentrate at a rate of 5 to 7 kg/head/day. The average milk yield is 8 to 9 liters/head/day.

Feeding Cassava Pulp to Dairy Cattle

In addition to the concentrate and forages, most dairy cattle farmers also used cassava pulp as additional feed for their dairy cattle. Out of the 32 smallholder and four larger dairy cattle farmers surveyed, 28 and three of the respective types of dairy cattle farmers, always used cassava pulp as additional feed all through the year, for all growth stages of dairy cattle except for calves. These farmers received a continuous supply of the pulp from suppliers, or directly from producers, as they bought the pulp under contract systems. The other four smallholder farmers did not use the pulp as feed for their dairy cattle at the time of the survey; these latter farmers used the pulp only sometimes when they received a supply of the pulp from a supplier.

Cassava pulp was periodically supplied to the smallholder farmers mostly by suppliers; however, for larger farmers they had direct access to the cassava starch factories to get cassava pulp. The farmers bought the pulp directly or via suppliers under contract systems. By this buying system, the supplier or the larger farmers got priority from the cassava starch factory to get cassava pulp, especially when cassava pulp production was less. This happened especially during the wet season when there wass less cassava root production.

As reported by many authors (Howeler *et al.*, 2001; IITA, 2005) cassava pulp is also commonly used as feed by farmers in Indonesia, especially for ruminant animals. The pulp is fed to dairy cattle by smallholder farmers in wet form at 9.2 $\pm$ 3.6 kg fresh cassava pulp per head per day. The pulp is fed as a mixture with concentrate and some water, twice a day just before milking. Larger dairy cattle farmers feed the pulp mixed with concentrate and tofu waste, either without or with some water added. Dried cassava pulp powder is also commonly used as a component of concentrate for ruminants up to 5 to 10%.

Most of the farmers experienced that feeding cassava pulp to dairy cattle had some advantages in improving the palatability of concentrate feed, making cattle look more satisfied than when fed concentrate without cassava pulp added, and increasing the milk yield, even though this feeding method slightly decreased the milk fat content. Those advantages were more important during the dry season when the availability of forages was limited; hence, cassava pulp played a role in partially substituting for forages. The farmers used the pulp regardless of either the HCN content or the physical condition of the pulp, as they had never experienced any negative impact of feeding cassava pulp on the cattle's conditions, including poisoning due to the HCN content of the pulp. Except, some dairy cattle farmers in a certain village of Malang regency stated that feeding too much cassava pulp, more than 20 kg wet pulp per head per day, could cause hoof lessions. For this reason, farmers in this area did not feed cassava pulp to their dairy cattle.

Cassava Starch Factories as Producers of Cassava Pulp in East Java

Based on their scale of production, cassava starch factories can be placed into three categories, i.e. industrial (large) scale cassava starch factories, medium-home-scale, and small-home-scale cassava starch factories. In industrial-scale cassava starch factories the processing of the roots into starch is completely mechanized, starting from washing and rasping/grating whole cassava roots, as well as extracting and drying the starch, except for the sorting and cutting the stem part of some roots, which is done by hand. Cassava starch is the main product and pulp is a by-product. Each factory in this category can process 100-500 tonnes of cassava roots per day. In certain periods, July to September or October when cassava production is at its peak, some factories operate 24 hours per day with more or less double the amount of cassava roots being processed. However, during times of lower cassava root production, especially during the rainy season, some factories stop processing. There are at least 11 cassava starch factories of this scale in East Java i.e. in Lumajang (2 factories), Pasuruan (1), Malang (4), Kediri (2), Jombang (1), and Ponorogo (1). Two of the cassava starch factories belong to PT. Sorini Agro Asia Corporindo, Tbk., the regional industry which produces sorbitol using cassava starch as the raw material.

In the home-scale cassava starch factories the processing of cassava roots into starch involves the sorting, peeling, washing and grating of cassava roots, followed by sieving, settling and drying the starch. Medium-home-scale cassava starch factories partly use machinery including for grating of cassava roots and sieving the starch. The other processes, including sorting, peeling, and washing cassava roots are done by hand and the drying of starch is done through sun-drying. Medium-home-scale cassava starch factories process 3-5 tonnes cassava roots per day. Small-home-scale cassava starch factories use mostly manpower in the processing of cassava roots to produce starch and pulp. The only equipment used in this process is a machine for grating the cassava roots. Home-scale cassava starch production is mostly done by families in groups with 5-10 members per

group. Each group is coordinated by a family. Mostly, the members work for the coordinator in processing cassava roots to produce starch. The coordinator provides cassava roots as raw material and a communal machine for grating cassava roots, while the members have the responsibility to process the cassava roots to produce starch, starting from peeling and grating the cassava roots, extracting and drying the starch. The members have to submit dried cassava starch back to the coordinator and they receive as payment 5 kg of dry starch for every 20 kg of dry starch which they have submitted to the coordinator. In addition, the members can also take home the peelings, culled small-size cassava roots, and the pulp, which are all produced from the cassava roots they have processed. The latter products are used to feed their livestock, as almost all the members rear sheep, goats or cattle; if not, they will sell these products to other farmers.

These home-scale cassava starch producers can be found especially in Blitar and Kediri regencies. In Jugo village, Kesamben district, Blitar, these home-scale cassava starch producing units were started in the 1960s. In the 1970-80s almost all families in this village were operating these cassava starch factories, but now only 19 families still remain, including three families as coordinators. Each family processes 200 to 300 kg cassava roots every day, almost throughout the year. Cutting the stem part and the end tip of roots, culling small roots and peeling are done by hand in the evening using a special knife made from a bicycle wheel steel (**Figure 1**) to remove the whole peeling including a small part of the root flesh. Then, early in the morning they start rasping/grating the roots using a communal rasping/grating machine provided by the coordinator; this is followed by sieving of the starch, which is completely done by hand. A part of the rasped root mass is put in batches on a screening cloth fastened on four poles and hung like a bag above the drain leading directly to the sedimentation tanks. Sometimes a bamboo basket is used to support the screening cloth. The rasped roots are then vigorously stirred and pressed using both hands. Some water is periodically added to the rasped roots, and then stirring and pressing are continued. This step is repeated several times and is finished when the water draining from the screening cloth is clear. Once finished, the pulp is collected from the batch and put in another bag. The batch is used again for the same process of another part of the rasped cassava roots. After screening out the starch water from all rasped cassava roots, the starch water is left in the sedimentation tank for a few hours to sediment out the starch. When the starch has sedimented, the supernatant water is carefully removed from the tank and the sedimented wet starch is collected for sun drying. This processes is very similar to that reported by Grace (1977).

The cassava pulp produced by the starch factories is commonly marketed directly to dairy cattle farmers or via distributors, either in the fresh (wet) form with 75-80% moisture content, or as dry pulp with 12-15% moisture content. Fresh cassava pulp costs IDR. 250,000 per tonne, equal to US$ 26.3, while the dry pulp costs IDR. 900,000 per tonne, equal to US$ 94.7. Fresh cassava pulp is only locally marketed due to the problem of high transport cost as this fresh product contains a lot of water. Dry cassava pulp, on the other hand is regionally marketed. Some distributors of cassava pulp put their promotion on the internet.

Figure 1. A special knife made from bicycle wheel steel used for peeling cassava roots in home-scale cassava starch factories

CONCLUSIONS

Cassava pulp is potentially important as a feedstuff for dairy cattle. However, lack of its availability in relation to the dairy cattle population has limited the use of the pulp as feed by farmers. Increasing cassava production would be expected to improve the availability and the potential of cassava pulp being used as dairy cattle feed.

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