Fattening cattle in Lao PDR with cassava pulp

by: **Phanthavong Vongsamphanh and team**
Department of Livestock and Fisheries

Cassava has become a major crop in Lao PDR mainly because of the export of starch that is extracted from the cassava root. There are five cassava starch factories with total planted area of 43,975ha, giving an average yield of fresh roots of 24 tonnes/ha. Annual production is of the order of one million tonnes (Department of Agriculture, crop statistic year book 2012).

The cassava for the starch factory in Nashaw village, Pakngum District in Vientiane Capital is supplied by 235 households in 85 villages with total cassava harvested area of 5,207 ha producing 100.000 tonnes per year of cassava roots. During the 6-7 month harvest season from October to March-April (the dry season in Lao PDR) this amounts to 480 tonnes of roots daily. The byproduct remaining after starch extraction, known as cassava pulp, represents from 10 to 15% of the original weight of fresh roots. Over the past 4 years, very little of the cassava pulp was bought by farmers and almost all of it had been stored in a pit adjacent to the factory, which had not been covered or protected in any way (Photo 1). Samples taken to a depth of 7 m (Photo 2) were found to have a pH of 3.5, indicating that the pulp had ensiled naturally and was perfectly conserved. Analyses conducted in the laboratory of Souphanouvong Universityshowed that the potential feed value of the ensiled pulp was only slightly less than that of the fresh whole cassava root (Phanthavong et al 2014, 2015).

Photo 1. The pit holding an estimated 100,000 tonnes of cassava pulp in the cassava factory in Nashaw village, Pakngum District, Vientiane

Photo 2. Taking samples of the contents of the pit

The cassava pulp is composed almost completelyof carbohydrate and is very low in crude protein (less than 3% in the dry matter) and in minerals. To take advantage of the high carbohydrate content of cassava pulp it needs to be supplemented with:

- Fermentable nitrogen that will produce the ammonia needed to optimize the growth of the microbes in the rumen
- Protein that will by-pass the rumen to complement that produced by the rumen microbes
- A source of fibre that will act as the support structure for the formation of biofilms which is where rumen microbes and their required nutrients come together to optimize the digestive process in the rumen
- Minerals, especially sulphur but also salts of calcium, phosphorus and sodium.

- ✓ The cheapest source of ammonia for rumen microbes is urea, which is produced and used as fertilizer.

- ✓ The best source of bypass protein is brewers' grains, a by-product from the beer factory.

- ✓ An excellent source of fiber is rice straw, most of which is presently burned, adding carbon dioxide to the atmosphere and thus contributing to global warming.

- ✓ Minerals are required only in small quantities (1-2% of the feed), and are available locally or can be imported

With these resources it was hypothesized that cattle could be fattened intensively to produce quality beef for export.

An experiment to test this hypothesis was carried out in the farm of Mr Khalma, situated some 20 km from the cassava factory in Nashaw village, Pakngum District in Vientiane Capital .

Two groups each of four local Yellow male cattle, weighing between 80 and 100 kg, were fed on the proposed diet (Table 1):

Table 1. Composition of the diet fed to the Yellow cattle

Ingredient	**kg/day**
Ensiled cassava pulp	10
Urea	0.070
Fresh brewers' grains	4
Rice straw	1
Minerals	0.06

These quantities were provided on the basis of 100 kg live weight. They were increased proportionately as the animals increased in weight

The urea was dissolved in water and sprayed on the cassava pulp. Brewers' grains and rice straw were offered separately.

The data on growth rate, feed intake and feed conversion over the 4 months of the fattening period (Table 2) confirmed that ensiled cassava pulp could be the basis of a successful diet for the intensive fattening of local cattle. The excellent conformation (Photo 3), after 90 days of fattening on the cassava pulp diet, was confirmed by the high carcass yield of the first animal to be slaughtered which was 49% (carcass yields of local cattle are of the order of 35%).

Table 2. Mean values for the feed intake, growth rate and feed conversion over the 120 days of the fattening period

	Group 1	Group 2
Live weight, kg		
Initial	101	84
After 120 days	185	158
Daily gain	0.70	0.62
Feed intake, kg/day		
Cassava pulp	11.3	9.57
Brewers grains	4.87	4.13
Urea	0.11	0.09
Rice straw	1.23	1.04
Minerals	0.08	0.07
Total DM	4.82	4.10
DM feed conversion	6.43	7.05

On a DM basis, the diet contained: cassava pulp 51%, Brewers grains 23%, *urea 2.2%, Rice straw 22%, minerals 1.4%*

Table 3: Feed cost and margin over feed for local cattle fattened on cassava pulp, urea, brewers' grains and rice straw

	Kipp (per animal)	USD (per animal)
Initial cost (100 kg LW)	2,400,000	300
Value after 120 days	3,840,000	480
Increase in value	1,440,000	180
Cost of feed	290,664	36
Margin over feed cost	1,149,335	144

Photo 1. Progress of the cattle from starting the experiment on 1 March until 1 June 2015

Perspectives for cattle production in Lao PDR

It is estimated that the five cassava starch factories in Lao PDR have a yearly production of 200,000 tonnes of pulp. The four breweries produce between 200 and 300 tonnes of brewers' grains daily (about 150,000 tonnes per year).The availability of rice straw is 3 million tonnes per year. These resources would be sufficient to fatten some 200,000 cattle per year with an added value of USD 36 million.

A similar feeding system could be developed with the 50,000 tonnes of molasses by-product from the four sugar factories, which could be the basis of fattening of a further 150,000 cattle per year.

There are sufficient brewers' grains to supplement both the cassava pulp (100,000 tonnes) and the molasses(50,000 tonnes).

Environmental and social issues

The manure produced from cattle fattened in confinement, after being processed through biodigesters, will yield biogas which burned in an engine would generate enough electricity to supply the energy needs of the farm; the residual liquid effluent from the digesters would replace inorganic fertilizers for growing rice and other crops.

Intensive fattening of cattle in confinement will generate employment on large farms. In small scale family farms, a cattle fattening enterprise will generate additional income as well as the benefits from processing the manure into biogas for cooking and the use of the effluent as fertilizer.

Proposed strategy

Distribution of the cassava pulp

The cassava pulp contains 75% water. It is not recommended to dry the pulp as this would require dehydration using fossil fuel, which is expensive and when burned produces carbon dioxide which contributes to global warming. The transport cost in trucks holding 15 tonnes is of the order of USD 0.20/tonne-km (Kipp1600). Delivering the pulp within a radius of 100 km from the cassava factory would thus impose a maximum cost of US20/tonne. Facilities are needed on the farms to store the pulp so that it can be delivered in bulk, A load of 15 tonnes is sufficient for 10 cattle for 3 months. Silos of 15 m^3 capacity would thus be required on a small farm fattening 10 cattle. For larger farms (100 cattle) a load of 15 tonnes would be enough for 10 days. Provided the pulp is protected from sun and rain it can be stored with no loss of nutritive value as it is safely conserved by the low pH.

A cassava factory processing 100,000 tonnes of roots per year will produce 12,000 tonnes of cassava pulp. This is sufficient to fatten 10,000 cattle over a period of 100 days. Assuming the fattening period is 100 days then three batches of cattle can be fattened per year. Thus a cassava factory, such as the one in Nashaw village, Pakngum District, could supply enough pulp for feedlots with capacity of 3000 heads (this equates to 300 small scale farms each with average capacity for 10 animals; or 200 small farms of 10 head capacity and two large farms each of 500 head capacity).

Design of feedlots and manure management

There is little experience in Lao PDR in the design of facilities for intensive fattening of cattle in confinement. The manure that the cattle produce is generally not taken into account in the design of these facilities, yet it is a potential source of renewable energy and fertilizer when correctly processed in anaerobic biodigesters.

There is an urgent need to construct model feedlots to demonstrate and develop the appropriate way of managing cattle manure and transforming it into biogas and liquid fertilizer.

A model unit will be constructed on the farm of Mr Vanath, to test and demonstrate appropriate designs: eg: shape of the feed troughs, floors with 7% slope leading to central “slatted” sections over deep (1m) drainage channels leading to lagoons covered with HDPE (High density polyethylene) plastic to facilitate anaerobic biodigestion to produce biogas and liquid effluent.

Future research

There appears to be an unlimited market for beef in neighbouring countries, especially Vietnam and China. Quality will be an increasingly important factor in order to secure highest prices for the product, either in carcass form or as live animals. Beef quality is achieved by ensuring fast rates of growth which increases growth of lean tissue and the content of the fat (marbling) in the meat, and ensures tenderness of the meat. Growth rates should be of the order of 600 to 700 g/day for local Yellow cattle, and 800 to 900 g/day for crossbred animals to achieve these standards. This in turn requires a diet of high nutritional value; high digestibility and adequate content of “metabolizable” protein. Grasses in tropical latitudes are much less digestible fiber than those in temperate latitudes; they are also lower in total protein, and the protein is “soluble” and rapidly fermented to ammonia in the rumen. Thus, in order to produce beef of high quality (and high price) it is essential to provide feeds that are: (i) highly digestible and have lowfiber; and (ii) are rich in by-pass protein.

Cassava roots fulfil the requirements as being the main source of digestible energy, either as whole roots or as the by-product (cassava pulp) from starch manufacture
The existing cassava factories cover a restricted area of the country. Future developments for the areas of Laos not served by cassava starch factories could be based on ensiled cassava root as replacement for cassava pulp. Research is in progress to develop such a system.

Brewers' grains are one of the best sources of "by-pass" protein but, as in the case of the cassava pulp, access is restricted to the approximately 100km radius from the breweries.

Cassava foliage (leaves and thin stems) have been successfully used as the only protein supplement in diets for cattle basedon urea-treated rice straw (KeoSath et al 201) or molasses-urea (Ffoulkes et al 1978). Initial attempts to use cassava foliage as the sole protein supplement in cassava pulp-urea diets have not yet been successful. However, 50% replacement of the brewers' grains with fresh cassava foliage appears to be feasible, and 100% replacement can probably be achieved in the future, through ongoing research.

Protein-enrichment of carbohydrate-rich feeds through fermentation with yeasts, and/or fungi, is another promising avenue of research that could be applied in regions where brewers' grains are not available. There is ongoing research in this area in the universities in LuangPrabang and Champasack provinces.

To further justify the emphasis on the cassava crop as the basis for intensive livestock production, itis relevant to emphasize the conclusions of a recent study in Africa which indicated that cassava would be least affected, or even benefitted, by global warming, whereas staple carbohydrate crops such as rice and maize would experience reduced yields (Jarvis et al 2012).

Ffoulkes D and Preston T R 1978 Cassava or sweet potato forage as combined sources of protein and roughage in molasses based diets: effect of supplementation with soybean meal. Tropical Animal Production, Volume 3, Number 3 pp186-192 http://www.utafoundation.org/UTAINFO1/TAP/TAP33/3_3_1.pdf

Jarvis A, Ramirez-Villegas J, Herrera Campo B V and Navarro-Racines C 2012 Is Cassava the Answer to African Climate Change Adaptation? Tropical Plant Biology.5 (1) 9-29.

Phanthavong V, Viengsakoun N, Sangkhom I and Preston T R 2014: Cassava pulp as livestock feed; effects of storage in an open pit. Livestock Research for Rural Development.Volume 26, Article #169.http://www.lrrd.org/lrrd26/9/phan26169.htm

Phanthavong V, Viengsakoun N, Sangkhom I and Preston T R 2015: Effect of biochar and leaves from sweet or bitter cassava on gas and methane production in an in vitro rumen incubation using cassava root pulp as source of energy. Livestock Research for Rural Development.Volume 27, Article #72.http://www.lrrd.org/lrrd27/4/phan27072.html