

# Potential of cassava in integrated farming systems

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## **Abstract**

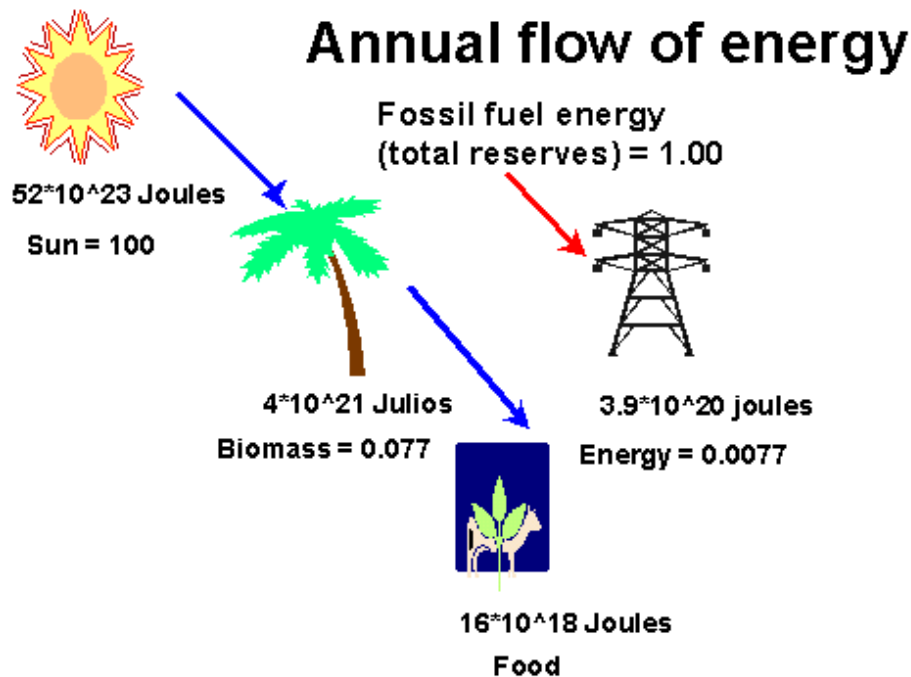
A considerable amount of new research information about the use of cassava as animal feed is becoming available from ongoing research in Vietnam, Thailand and Cambodia. Previously, cassava has been characterized as an “exploitive” crop, destructive of soil fertility. However, when cassava is grown as a component of a farming system, in which live stock and crops are closely integrated, its capacity to “exploit” the nutrients in live stock manure becomes a valuable asset.

Cassava can produce very high yields, especially of protein (up to 4 tonnes/ha/year), which make it an ideal element for taking advantage of live stock wastes. The results are encouraging and lay the basis for future research and development activities that promise to have a major impact in tropical farming systems.

*Key words: Cassava, integrated farming systems, foliage, livestock, recycling*

## **Introduction**

The role of cassava in integrated farming systems is closely linked with two major issues that must be addressed in the course of this century. The first issue is the need to control global warming which, according to one authority (ref.2001), will require halving the present rate of consumption of fossil fuel in order to stabilize atmospheric concentrations of carbon dioxide. This is possible if we have the will to make optimum use of natural resources, the most important of which is solar energy. There is more than enough energy coming from the sun to cover our needs for food and fuel (Figure 1). The second issue is the need to improve the environment and to reduce pollution. The question then is: how can the cultivation and utilization of cassava become a part of the above strategy?



**Figure 1:** Annual flows of energy from the sun and the quantities fixed as biomass and food compared with known fossil fuel reserves and annual energy consumption

### Cassava as a dual purpose crop

Cassava has one important characteristic, namely that it can be managed to maximize production of carbohydrate (in the form of the roots), or protein, by harvesting the leaves. For root production the growth cycle is from 6 to 12 months at the end of which the entire plant is harvested. When maximum protein production is the aim, the foliage is harvested at 2 to 3 month intervals by cutting the stems at 50 to 70 cm above the ground thereby encouraging the plant to re-grow. In this case the roots act as a nutrient reserve to facilitate the re-growth of the aerial part. This process can continue for 2 to 3 years if the nutrients exported in the leaves are recycled as fertilizer. Dual-purpose production systems are also possible whereby one or two harvests of the leaves are taken before the plant is allowed to continue the normal development of the roots.

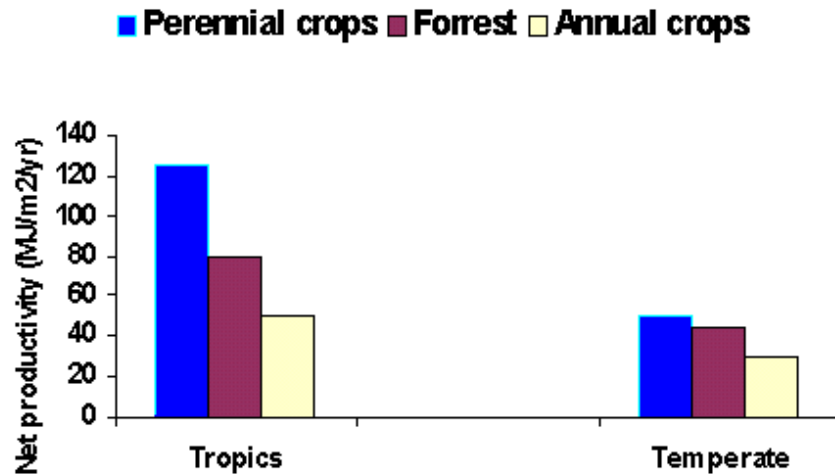
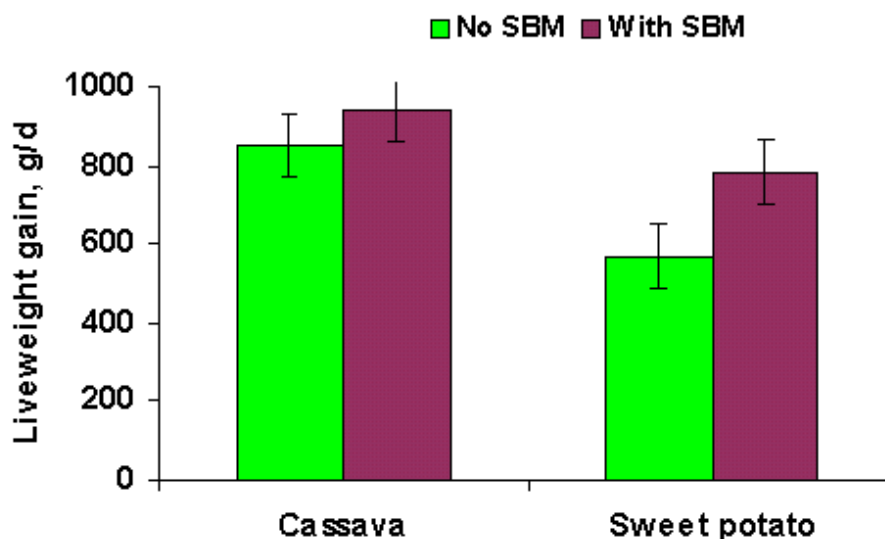


Figure 2: Biomass yield from different ecosystems (Source: Kormondy 1970)

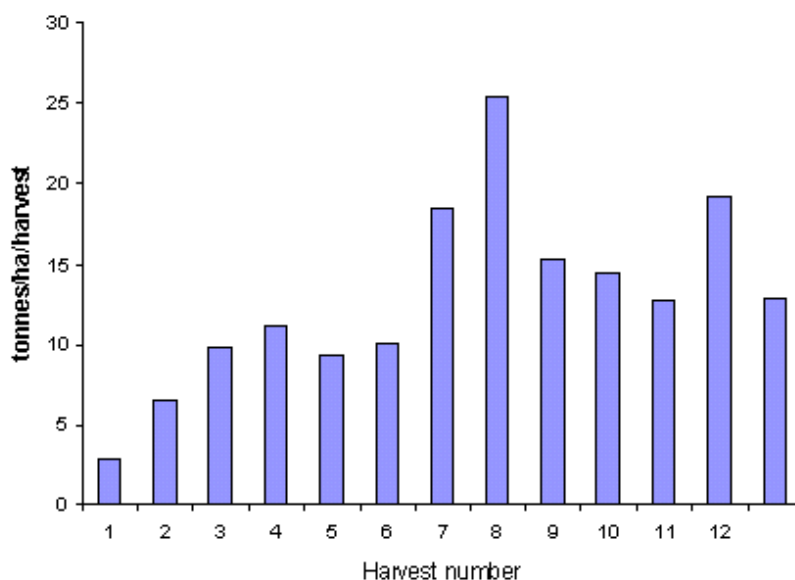
### Cassava as a perennial forage

In tropical ecosystems, the cultivation of perennial crops is the most efficient way to fix solar energy in the form of biomass (Figure 2). Thus the management of cassava as a perennial forage is one way of responding to the need to use solar energy more efficiently. Growing and using cassava as a perennial forage was first proposed by Moore (1976) based on observations at CIAT in Colombia (Moore 1976). High yields of foliage were obtained when cassava was managed as a semi-perennial crop with repeated harvesting of the foliage at 2-3 month intervals. This idea was taken up in the Dominican Republic by Ffoulkes and Preston (1978) who showed that the fresh foliage could be used as the sole source of protein and fibre for supplementing a liquid diet of molasses-urea for fattening cattle. Growth rates were over 800 g/day and were not improved when 400 g/day of additional soya bean meal was given. However, although successful at the level of the animal the system could not be sustained agronomically. Yields of foliage fell rapidly with successive harvests and were negligible by the fourth harvest, due to a lack of appreciation of the need to return to the soil the considerable amounts of nitrogen and other nutrients removed by repeated harvesting (T R Preston, unpublished observations).

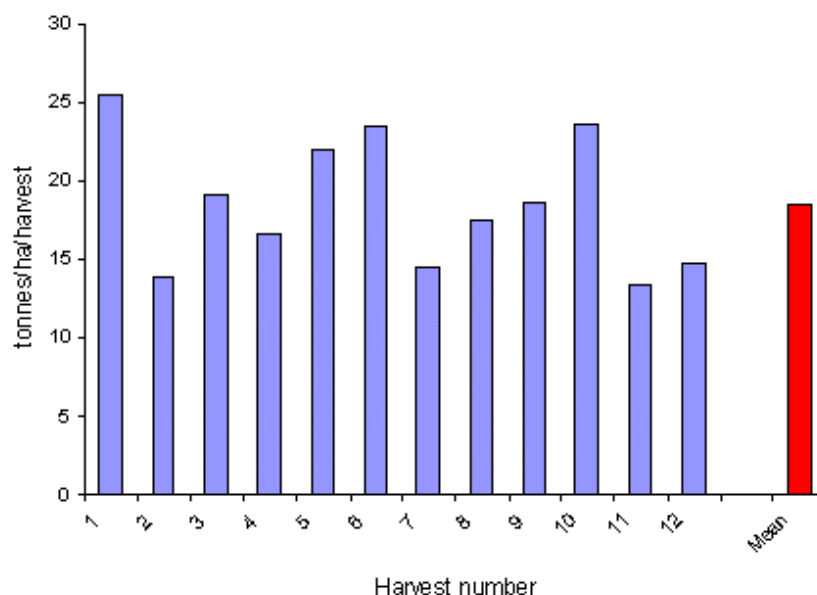


**Figure 3:** Cassava foliage is a better source of bypass protein than sweet potato vines in a cattle fattening diet based on ad libitum molasses-urea (Ffoulkes and Preston 1978)

More recent research, first in Vietnam (Preston et al 2000) then in Cambodia (San Thy and Preston 2001, unpublished data), has demonstrated that the cassava plant can be maintained as a semi-perennial forage crop for at least 2 years provided there is heavy fertilization either with goat manure (Figure 4) or with the effluent from biodigesters charged with pig manure (Figure 5).



**Figure 4:** Fresh foliage yields of cassava managed as a semi-perennial forage crop with repeated harvests at 50 to 70 day intervals and fertilized with fresh goat manure (20 tonnes/ha/harvest) (Source: Preston et al 2000)



**Figure 5:** Fresh foliage yields of cassava managed as a semi-perennial forage crop in Cambodia with repeated harvests at 50 to 70 day intervals and fertilized with biodigester effluent (100 kg N/harvest) (Source: San Thy and Preston 2001, unpublished data)

## Cassava and manure recycling

In countries with industrialized agriculture the disposal of manure from large scale livestock units situated close to urban areas has become a major problem (Narrod 2001). This situation is exacerbated by the restricted growing season in temperate latitudes where industrialized livestock production is concentrated. For example, in Germany the maximum amount of nitrogen that can be applied as manure is only 170 kg N/ha/year. Tropical countries with year-round growth potential do not have this problem. Livestock manure is a major asset and crops such as cassava are capable of taking up as much as 1000 kg N/ha/year in the form of fresh livestock manure or effluent from biodigesters (Preston T R, 2001 unpublished observations).

The processing of livestock manure in biodigesters results in the conversion of much of the organic nitrogen to ammonia (Khieu Borin and Preston T R 2001, unpublished data). This makes the biodigester effluent a potentially better source of plant nutrients than the manure from which it is derived. Data in support of this hypothesis was reported by Le Ha Chau (1998) who showed that the effluent supported higher yields of foliage with a higher protein content than the raw manure (either from cattle or pigs) used to charge the biodigesters.

## Cassava as a source of biomass energy

Irrespective of whether cassava is grown for root or forage production, a considerable part of the biomass is present in the stem. Some stem material is needed as cuttings for re-establishing the crop, however, when it is grown as a perennial forage this requirement is much reduced as the plant will continue to produce from the same root stock for at least 2 to 3 years, provided there is an adequate supply of nutrients.

The cassava stem is a potential source of energy and has been used successfully as a fuel source in a downdraft gasifier (Dinh Van Binh and Preston, unpublished observations). Cassava as source of fuel (the stems) and protein (the leaves) is a logical complement to energy-rich sugar cane in a co-generation system to provide energy and animal feed (Table 1) from high biomass crops.

## Cogeneration: electricity and feed from sugar cane and cassava

	Cane/ha/yr	Cassava/ha/ yr
<b>Biomass, tonnes</b>	<b>190</b>	<b>120</b>
<b>Electricity, kwh</b>	<b>61,920</b>	<b>37,840</b>
<b>High test molasses, tonnes</b>	<b>16</b>	
<b>Leaf meal, tonnes</b>		<b>8</b>
<b>Protein, tonnes</b>		<b>2.24</b>

**Table 1:** Potential for production of electrical energy (by gasification of residual fibre from sugar cane and cassava) and feed energy and protein (high test sugar cane molasses and dehydration cassava leaves) in a co-generation system

### Cassava foliage as animal feed

Recent work in Cambodia has aimed to evaluate cassava as a protein supplement for cattle and goats (the fresh foliage) and pigs (the ensiled leaves). The latter aspect is discussed by Ly and Rodriguez (2001) in a companion paper. In contrast with the cassava research programme in Thailand, which is mainly based on production and utilization of cassava hay for dry season feeding (Wanapat 2001), in Cambodia the emphasis is on use of the fresh foliage on a year-round basis. Results from feeding fresh cassava foliage as a supplement to Brewer's grains for goats are summarized in Figures 6 and 7. There were positive effects of the cassava foliage in reducing nematode worm burdens (Figure 6) and in supporting growth rates (Figure 7). For cattle the emphasis is on the use of the cassava foliage to supplement untreated rice straw as a fattening system for local Yellow cattle. The results are encouraging, especially when the cassava foliage was combined with a single drench of vegetable oil at the beginning of the fattening period (Figure 8).

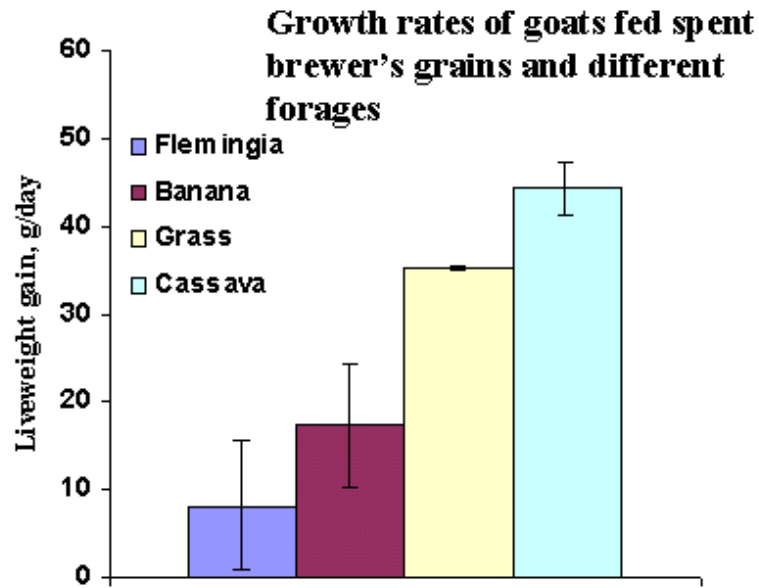


Figure 6: Effect of tree foliages on nematode infestation in goats

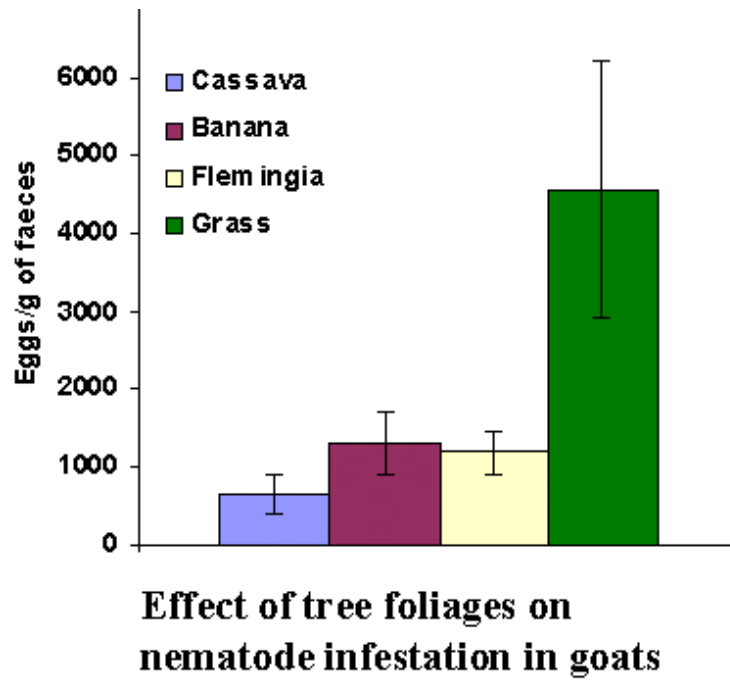
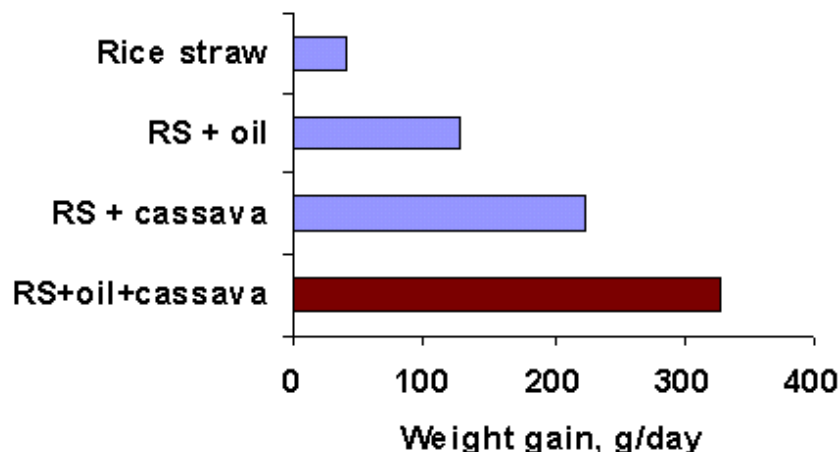


Figure 7. Effect of tree foliages on growth rate of goats

### Supplementing rice straw with cassava foliage and a single oil drench for local cattle in Cambodia (all had urea-minerals)



**Figure 8:** Supplementing rice straw with cassava foliage and a single oil drench for local cattle in Cambodia (all had urea-minerals)

## Conclusions

A considerable amount of new research information about the use of cassava as animal feed is becoming available from ongoing research in Vietnam, Thailand and Cambodia. Previously, cassava has been characterized as an “exploitive” crop, destructive of soil fertility. However, when cassava is grown as a component of a farming system, in which live stock and crops are closely integrated, its capacity to “exploit” the nutrients in live stock manure becomes a valuable asset.

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