Integrating *Clitoria ternatea* and corn in dry land farming for seed production and high quality forage for livestock in West Timor East Nusa Tenggara: Oebelo Village farmer’s experience

D K Hau, P Matitaputty and Y Achadri  
East Nusa Tenggara Assessment Institute for Agriculture Technology.  
JL. Timor Raya Km. 35, Naibonat, Timor, Indonesia.

E-mail: debora_nulik@yahoo.com

**Abstract.** The existing farming in Oebelo Village was a mixed farming. Farmers grow corn once a year in the rainy season, with beans, cassava, onion and pumpkin. Livestock keeping varied between farmers, including cattle, goat, pig, and local chicken. The introduction of *Clitoria ternatea* opened a new horizon of farming and a new source of income and forage. By integrating *Clitoria ternatea* farmers were able to: (i) improve corn productivity performance, (ii) receive additional income from selling forage and seed, and (iii) obtain high-quality forage source to feed livestock (goat, pig, and chicken). In 2019, farmers planted *Clitoria ternatea* on 0.25 ha after harvest of corn (in February) and sold 30 kg of clitoria seed at 30-35 thousand rupiahs/kg, and feeding forage as additional feed portion to chicken and pigs. In 2019/2020 farmers planted 3.13 ha, either in monoculture or in a relay, and sold 168 kg of Clitoria seed at 30 thousand rupiahs/kg. In early 2020 the farmers started to raise goats, and also keep on feeding the forage to chicken and pigs. Farmers noticed an improvement in the corn plant performance on the plot previously planted with Clitoria, and harvested more corn grain without even fertilized.

1. **Introduction**  
The main problem in East Nusa Tenggara (ENT) on agriculture farming is the low the productivities of corn and ruminant livestock. Low productivity of corn was related to poor soil quality and lack of technology application, such as not using a proper fertilizer dosage at the right time. While the low productivity of ruminant livestock was related to the poor quality of native pasture grasses, as the dominant fodder source, and lack of knowledge in animal nutrition requirements in relation to the availability of forage and feed. On the other hand, the efforts to introduce improved forage legumes in ENT has identified the species of *Clitoria ternatea* as having quite wide adaptation to the soils and climate of East Nusa Tenggara [1, 2]. As a legume species, *Clitoria ternatea* provides high quality fodder for ruminant livestock (about 23% crude protein) compared to that of native grasses in the region (ranging from 5 to 10% crude protein), has the ability to fix free N$_2$ from the air which than can be used by the plant itself as well as improving soil nutrition and thus productivity of crops grown after the legume [3].

Not only for ruminants, *Clitoria ternatea* fresh forage can also be given as green feed supplement
for single stomach animals such as chickens and pigs. *Clitoria ternatea* also has long been used as medicinal plants, such as for treatments of Diabetes [4], and other medicinal purposes.

The use of the legume in overcoming low productivity of cattle in NTT has demonstrated that *Clitoria ternatea* forage has positive impacts in: (i) reducing calf mortality in Bali cattle in West Timor; (ii) Maintain Body Condition Score of Sumba Ongole cows, thus able to reduce the length of calving interval; and (iii) Improve body weight gain of fattening [2, 5].

These benefits of the legume induce the need of providing sufficient number of high-quality seed, which can be conducted by building a collaboration with farmer group to produce the mentioned seed required. Thus, an effort to start a seed production system was initiated in the village of Oebelo in Central Kupang District, by working with farmer group.

2. Oebelo village’s agriculture

2.1. Soil and climate

Soil of the farmer group at Oebelo Village mostly consisted of light vertisol used for growing the legume *Clitoria ternatea* integrating with corn, while most of the village also consisted of Alfisol soils. Rainfall of the village averages between 1000 to 1500 mm annually as most of the sub-districts in Kupang, West Timor [6].

2.2. Food crops cultivation

Food crops in the village are mostly grown during the rainy season (December to March), which may consist of: corn, beans and peas (mung bean, cow pea, pigeon pea, and peanut), and pumpkin. Corn may be planted in monoculture or be integrated with one or several of the above mentioned crops. Sometime farmers grow onion when sufficient water available from the wells within the village. Pumpkin green shoots and green fruits are sold during the growing (wet season) to Kupang City market and the mature fruit during the end of the wet season to the mid of dry season (May to July).

3. Forage and seed production of Clitoria

3.1. Forage production and feeding

In 2019, farmers were introduced to herbaceous legume *Clitoria ternatea* and its benefits. Thus, planting was conducted after harvest of green corn in February. The legume seeds were planted between the rows of standing hay plants of corn at planting arrangement of 20 cm x 20 cm. During April to June 2019, farmers were able to obtain forage from Clitoria plot, while collecting seed on daily basis harvests. Forage was harvested and fed fresh to livestock owned by the individual farmers. As there were no ruminant animals owned by the participating group, the forage then, was fed to the chicken (native free range) and to their pigs in pens.

From these new practices, farmers witnessed that the native chicken were observed to lay more eggs compared with no additional feed as the existing practice. Similarly, pigs fed with fresh forage obtained from the plot showed improved body condition performance, and famers noticed that pigs were not making much noises as usual and attributed this to the impact of feeding the fresh Clitoria forage. These findings confirm with the fact that Clitoria contained anti-depressant, anti-anxiety and other medicinal purposes components that may affect the animal to feel calm and easiness [7]. Not only to feed their livestock, Clitoria forage was also purchased by people from outside the village to feed to cattle at the price of 350 to 500 thousand rupiahs per a pick-up car. Thus, Clitoria cultivation opens up several opportunities: (i) Provide cash income from seed and forage; (ii) Improved the growth and grain production of corn planted in rotation; (iii) Provided additional green feed for non-ruminant animals, such as chicken and pigs; (iv) Provided high quality forage for ruminant animals, such as cattle and goat.

In 2019/2020 planting season farmers expanded the legume cultivation up to a total of 3 ha, half area planted in monoculture and half integrated with corn (figure 1). The integrated legume was planted when the corn plants reached the height of an adult knee. In 2020 harvests, forages were also fed to goats that
were obtained in that year by the farmer group, beside selling to outside village buyers. Feeding Clitoria forage to chicken and pigs was also continued.

![Figure 1. Clitoria ternatea planted in monoculture and in relay with corn in Oebelo Village for seed production (A) and forage (B)](image)

Although no proper measurements of forage production were conducted in both planting seasons (2019 and 2019/2020), as a start of forage legume cultivation farmers have shown their high interests in growing the legume, and hope that more farmers in the area will adopt the habit of growing forages to change the traditional systems of livestock farming by mainly let the ruminant animals (goat and cattle) to free grazing. Indication of increasing interests of farmers in adopting the growing of legume may be seen by increasing number of farmers from outside the group who demanded for seeds to be planted in their sites in the next planting season (2020/2021).

The quality of Clitoria forage from previous experiments in West Timor and Sumba indicated its high nutrition content, as well as what was recorded in some references (table 1), which can also an interesting aspect in further promoting of the legume cultivation, besides other benefits as mentioned above.

**Table 1. Nutrition content of *Clitoria ternatea* forage**

| Reference (Location) | CP (%) | CF (%) | EE (%) | Ash (%) | NFE (%) |
|----------------------|--------|--------|--------|---------|---------|
| [8] Kabul            | 17-18  | 25-33  | 1-3    | 7-12    | 39-45   |
|                      |        |        |        | OM      | GE      |
|                      |        |        |        |         | (MJ/kgDM) |
| [5] Kupang and Sumba, NTT | 22.6-23.9 | 27.6-33.1 | 89.8-92.8 | 16.2-16.9 |

Note: CP = Crude Protein; CF = Crude Fiber; EE =Ether extract; NFE=Nitrogen free extract; OM = Organic Matter; GE= Gross Energy

**3.2. Seed Production**

From the first-year planting in 2019, farmers were able to sell 30 kg of seed harvested from the plots, not including the seed harvested by individual farmers for their own seed stock for planting in the next wet season of 2019/2020. In 2020, farmers were able to sell 168 kg of high-quality seed beside some stored seed by individual farmers for the 2020/2021 planting season. The seed obtained for selling in both plantings was only as much of what the farmers were able to harvest in their free time, thus there was much seed left on the planting sites that were not able to be harvested. *Clitoria ternatea* may produce > 350 kg of seed from 0.25 ha land [2]. Farmers may need a better management for seed harvesting, such as hiring labor for harvests, and this may need some kind of capital to pay the labor for manually picking the seed and processing and packaging. Seed obtained during the harvests was considered as of high-quality seed (clean from unwanted materials and shiny seeds) (figure 2) with > 90% germination capacity.
4. Corn production after clitoria
No measurements were taken on corn grain production of 2019/2020 planting, however looking visually at the plants condition at the growing and harvesting stages, farmers were excited and witnessing that they have proven that by growing Clitoria ternatea on their corn plot it improved the performance of corn plants’ growth and corn grain production even with no application of fertilizer.

5. Conclusion and recommendation

5.1. Conclusion
Introduction of the legume forage Clitoria thus has opened a new horizon of farming for the farmers in the village, where additional income can be achieved from selling seed and forages, while provide also a new source of high-quality feed for livestock.

5.2. Recommendation
These initial activities of growing legume integrating with corn thus showed the worthiness and the need to continue encouraging the farmer group in the village of Oebelo in Central Kupang District in West Timor, especially in the provision of high-quality seed of Clitoria ternatea for continuation of cultivation and development in East Nusa Tenggara and may also supply to demand from other provinces in Indonesia.

A new management approach may need to be introduced to the farmers in the group, such as managing of seed harvest to be conducted not just by the members in the group but can be conducted by paid labor for harvesting, processing up to packaging, so that the whole seed production capacity can be taken all from the plot and to avoid wasting of the high quality produced during the planting season and harvest time.

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References
[1] Nulik J, Dalgliesh N, Gabb S and Cox K 2013 Integrating herbaceous legumes into crop and livestock systems of Eastern Indonesia ACIAR Monograph No. 154
[2] Nulik J and Kana Hau D 2020 Legum Herba, Pakan Andalan dan Berkualitas Mendukung Pengembangan Sapi Potong di Lahan Kering (Jakarta: Penerbit Indo Agro Mandiri)
[3] Giller K E 2001 Nitrogen Fixation in Tropical Cropping Systems (2nd Ed) (Wallingford: CABI Publishing)
[4] Daisy P, Santosh K and Rajathi M 2009 Antihyperglycemic and antihyperlipidemic effects of Clitoria ternatea Linn. in alloxan-induced diabetic rats African J of Microbiol. Res. 3 (5) 287-291.

[5] Mayberry D, Kana Hau D, Dida P R, Bria D, Praing J, Mata A D, Budisantoso E, Dalgliesh N, Quigley S, Bell L and Nulik J 2020 Herbaceous legumes provide several options for increasing beef cattle productivity in eastern Indonesia Animal Production Science (in press)

[6] BPS 2019 Rainfall of Kabupaten Kupang Kabupaten Kupang Dalam Angka

[7] Gollen B, Mehla J and Gupta P 2018 Clitoria ternatea Linn: A herb with potential pharmacological activities: Future prospects as therapeutic herbal medicine J. Pharma Reports 3 1-8

[8] Mahala A G, Amasiab S O, Monera, Yousif A and Elsadig A 2012 Effect of plant age on DM yield and nutritive value of some leguminous plants (Cyamopsis tetragonoloba, Lablab purpureus and Clitoria (Clitoria ternatea) Int. Res. J. Agric. Sci. Soil Sci. 12 (2) 502-508