The Economic Performance and Management Practices of Mungbean Production Systems in Belu, West Timor

Fred Benu[13], RCN Rachaputi[2], Col Douglas[3]

[1] *Nusa Cendana University, Kupang, Indonesia,*
[2] *DEEDI, J. Bjelke-Petersen Research Station, Kingaroy Qld 4610*
[3]*DEEDI, Hermitage Research Station, Warwick, Qld 4370*
[3]*Corresponding author:* benufred@yahoo.com

INTRODUCTION

Pulses occupy more than half of cropped area and play a significant role in dry land agriculture in West Timor. Among the pulses, peanut and mungbean are the important ones. The scoping study conducted by Rachaputi *et. al*. (2007) noted that yield of peanut and mungbean in Indonesia was significantly lower than that achieved in Australia (up to > 6 tonnes for peanut and > 1 ton/ha for mungbean). Irrespective of the fact that in Indonesia these two pulses are commonly intercropped with other crops, it is a possibility to increase mungbean production to fulfil domestic consumption as well as export.

Belu District is one of the mungbean production centres in West Timor, East Nusa Tenggara province (NTT). In this area, mungbean has been cultivated by local farmers for many years. Indeed, farmers in Belu have good practices of mungbean cultivation with a local prime cultivar of mungbean known as Fore Belu.

Secondary data show that mungbean is grown on 23,000 ha annually with an average yield of 800 kg/ha in this district. Of total mungbean production, only 16% is allocated for family consumption and 74% is sold for for cash. The remaining 10% of production is allocated for social purposes.

Based on the secondary data collected in the survey, there are about 656 ha of land in South Belu used for mungbean cultivation every year. The productivity of Fore Belu cultivar is about 0.6 ton/ha in average and the total production of this area is about 394 tonnes per year.

Some important issues that have to be addressed in relation to improving the productivity and profitability of mungbean growers in West Timor are timely access to good quality seed, improvement of varieties and management practices, production costs and industry partnership. For this crop timely access to good quality seed is a major problem for smallholders. Limited studies conducted by Garuda Foods demonstrated that peanut yields could be increased up to 20% by use of good quality seed, suggesting an opportunity does exist for yield improvement.

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The first priority in the cultivation process of mungbean is availability of seed at the time of planting (wet season). In West Timor, the problems of seed availability and land preparation for mungbean cultivation are the crucial issues. Local farmers are usually facing the problem of lack of seed availability in the beginning of wet season every year. This is because the largest part of production is consumed and sold to earn cash income during the harvest season.

Although Fore Belu has been released as a prime cultivar at the national level local farmers have no information about the comparison of production performance between Fore Belu and other national prime cultivars such as Vima, Murai, and Sriti. Mungbean and maize intercropping is common in West Timot but there has been little work on optimizing inter-row and crop spacing. Narrow intercrop (e.g. rows of mungbean to row of maize) may have significant influences on growth and yield due to competition for light, water and nutrients.

The objective of this research was to determine the economic performance of mungbean in relation to the productivity of the existing mungbean cultivar (Fore Belu) and management practices conducted by the local farmers. This study covers gross margin analysis of Fore Belu cultivar and comparison of the results of the analysis to those of the introduced prime ones, i.e. Vima, Murai, and Sriti.

RESEARCH METHODS

This study used a multistage sampling method in selecting sample villages and farmers. The first stage was to decide sample villages by using a purposive sampling technique. The four sample villages were Kletek, Bakiruk, Umanen Lawalu and Kakaniuk. These four villages were selected since they are the production centres of mungbean in the Belu District. The second stage was to decide farmers as respondents by using a disproportionate random sampling technique. A number of 10 farmers were selected for each village, adding up to 40 sample farmers in total.
The analysis of mungbean production system was done for the existing production system conducted by farmers around trial locations. A comparative analysis of mungbean production system between the treatment (trial) and the existing system has been done based on the information gathering from both sides (existing and trial), especially in accordance with cost of production and revenue created by the two kinds of practices.

There are three treatments of mungbean cropping patterns introduced as a comparison to the existing mungbean cropping pattern, i.e. (i) Improved intercropping of maize and mungbean (Vima and Fore Belu); (ii) Improved Monocropping of introduced cultivar (Vima, Murai & Sriti) -*Low cost technology*; and (iii) Existing Monocropping of introduced cultivars (Vima, Murai & Sriti).

The main analysis of economic aspect of mungbean production system conducted by farmers in the trial location has been done based on the analysis of gross margin. In relation to descriptive analysis of mungbean production system, the study also covers some other important aspects, including cropping system, production and productivity, and cropping pattern, etc.

RESULTS

Cropping system is about combination of crops and cultivation practices in a one cropping season. Cropping system is closely related to cropping pattern that is about planting of different crops and use of different cultivation practices in relation to space and time – more than one cropping season.

Local mungbean cultivar Fore Belu is cultivated on both the off-season rice field and dry land. The mungbean farming scale of the off-season rice field is about 0.58 ha per household in average or 74% of total owned land per household (0.76 ha). Although only about 37.5% of farmers have rice fields, almost all of them have dry land for mungbean cultivation. Almost all of rice field farming activities depend on rainfall. At the same time the average of dry land farming scale is 0.66 ha or 68% of total dry land property per household (0.97 ha).

The greater part of farmers cultivate Fore Belu cultivar of mungbean, 10% cultivates Walet cultivar and the rest 5% cultivate Betet cultivar. Farmers usually cultivate local landraces of maize. Based on empirical data collected in the survey, 62.5% of farmers chose local landraces of maize, 35% chose cultivar Bisma and 2.5% chose cultivar Lamuru. At the same time, the dominant perennial crops planted in the house yard are arecca nut, coconut, papaya, bananas, etc. In some cases, farmers also cultivate food crops in their house yard, among which maize and cassava are the most common.

Generally, based on the experiences that have been practiced for many years, farmers are practicing a semi-modern farming system by combining both manual and mechanized cultivation techniques. Farmers usually use hand-tractors for land preparation on rice paddies. Planting is done manually on both paddy field and dry land. Other manual practices include weeding, watering, and ‘hilling’ around individual crops. Maize will be left to dry off in the field before harvesting and the harvest will be hung at the ceiling of the traditional round house (“ume kbubu”) and smoked to prevent the grain being destroyed by weevil, notably *Sitophilus* spp. On the other hand, almost all farmers will leave cassava in the field to be harvested only during the period of starvation (October-December). This makes economic valuation of cassava difficult. The results of the survey showed that mungbean will be harvested after all of their leaves turn to yellowish. The results of the survey also showed that most farmers practiced the traditional cropping pattern in which individual crops were planted without any clear row arrangement and spacing.

Cropping pattern is "*a stable and unique structuring of farming where a family of farmer will conduct their farming based on the response of physical, biological, and social economy factors*...." (Shaner 1982).

Generally, paddy land will be cultivated twice a year, depending on the availability of water. However, non-irrigated paddy field will be cultivated only once in the wet season and will be used to cultivate maize together with other crops during the dry season.

Dry land cultivation in South Belu is carried out twice a year due to the bimodal pattern of rainfall in the area from the southeastern monsoon. During November-March, maize, peanut, cassava and sorghum are generally mix inter-cropped. This will be followed with a relay cropping of maize and mungbean during the April-August. This relay cropping is practiced with maize providing protection to mungbean against the strong wind during this monsoonal season. Maize is sown prior to mungbean after the maize has grown to such a height that it is capable of functioning as a wind break for the mungbean at its flowering stage. For this function, maize is planted in a longer between-row spacing compared to that planted during the November-March rainy season. There are three food crops cropping patterns that exist in Belu District of West Timor i.e. (i) Paddy; (ii) Maize 1 + Peanut + Sorghum + Cassava (November – March); (iii) Maize 2 + Mungbean (May – August).

Production, Cost of Production and Gross Margin

Generally, farmers will allocate a small portion of yield of paddy, maize and peanuts for seed to be used in the next planting season. A large portion of the yield will be used for consumption and only occasionally a small portion will be sold for cash income. For mungbean a large portion of the crop will be sold for cash income rather than for consumption or saved as planting seed.

There are three cropping patterns exist in Belu District of West Timor i.e. (i) Paddy; (ii) Maize 1 + Peanut + Sorghum + Cassava (November – March); (iii) Maize 2 + Mungbean (May – August). At the same time, three introduced mungbean cropping patterns are (iv) Improved intercropping of maize and mungbean (Vima and Fore Belu); (v) Improved Monocropping of introduced cultivars

(Vima, Murai & Sriti) -*Low cost technology*; and (vi) Existing Monocropping of introduced cultivars (Vima, Murai & Sriti).

In terms of production cost, paddy is the highest, followed by Improved intercropping of maize and mungbean, improved monocropping of introduced cultivars (Vima, Murai and Sriti), existing cropping pattern 2 and existing monocropping of introduced cultivars (Vima, Murai and Sriti), respectively.

The total variable cost alocated for all cropping patterns was between AU $350 – AU $600 per ha. The highest total variable cost was commited for the Improved Intercropping of maize and mungbean and the lowest for the existing monocropping of introduced varieties (Vima, Murai and Sriti). Indeed, the largest portion of varble cost is labour. Almost 50 % of the vaiable cost was allocated for labour while other allocations were individually not more than 20 %.

It should be noted that although one of the introduced cropping pattern was dealing with low cost technology, total variable cost of this kind of introduced technology was higher than the existing monocropping. In fact, low-cost technology deals only with land preparation. Traditionally land was prepared without any labour cost for cultivation or weeding. The introduction of the technology package of herbicide and zero tilage has introduced labour costs for land preparation. However, this kind of technology contains also some extra costs for input packages of fertilizer and pesticide.

In relation to cultivation practices, information gathered from the survey shows that 34.5% farmers use fertilizer for farming practices in cropping pattern 2, but only 10% farmer has the same practices in cropping pattern 3. At the same time, all farmer use fertilizer for paddy cultivation practices (cropping pattern 1). Indeed, all farmers use hand tractor for land preparation in cropping pattern 1 (paddy cultivation) and only 52.5% of farmers use hand tractor for land preparation in cropping pattern 2. At the same time, farmers practice zero tillage for land preparation in cropping pattern 3.

Production and productivity of crops in each cropping pattern can be seen in Table 1. As shown in the table, productivity of mungbean is about 0.35 ton/ha. Productivity figures from all cropping patterns are lower than the average productivity at national level and may be attributed to the low-yielding Fore Belu local cultivar and to poor management practices.

Table1 Farming productivity (kg/ha)

Cropping Systems	Production (kg/ha)				
	Mungbean	Paddy	Maize	Peanut	Sorghum
Cropping Pattern 1	-	2380.8	-	-	-
Cropping Pattern 2	-	-	1598.9	74.66	108.77
Cropping Pattern 3	346.26	-	769.81	-	-
Improved Intercropping Trial					
• Vima	942.3	-	-	-	-
• Local Belu	841.5	-	-	-	-
Improved Monocropping Trial – Low cost					
• Vima	1234	-	-	-	-
• Murai	1111	-	-	-	-
• Sriti	1230	-	-	-	-
Improved Monocropping Trial – Existing					
• Vima	641	-	-	-	-
• Murai	709	-	-	-	-
• Sriti	1182	-	-	-	-

Source: Primary Data Analysis

Where:

Pattern 1: Paddy

Pattern 2: Maize 1 + Peanut + Sorghum + Cassava (November – March)

Pattern3: Maize 2 + Mungbean (May – August)

Improve Intercropping of Vima Varietas and Fore Belu

Improved Monocropping of Vima, Murai & Sriti (*Low cost technology*);

Existing Monocropping of Vima, Murai & Sriti (*Existing = introduced new varietas*)

It can be seen in Table 1 that maize productivity in cropping pattern 3 is lower than maize productivity in cropping pattern 2. In fact, this level of productivity is caused by cropping pattern practiced by local farmers. A large portion of land has been allocated for maize cultivation in cropping pattern 2 compared to that in cropping pattern 3. Indeed, because of planting a wider distance, the total population of maize in cropping pattern 3 is smaller than that cropping pattern 2. Farmers used a wider planting distance of maize in cropping pattern 3 (2 m x 0.5 m) than that in cropping pattern 2 because they need to put 3 or 4 rows of mungbean between the rows of maize.

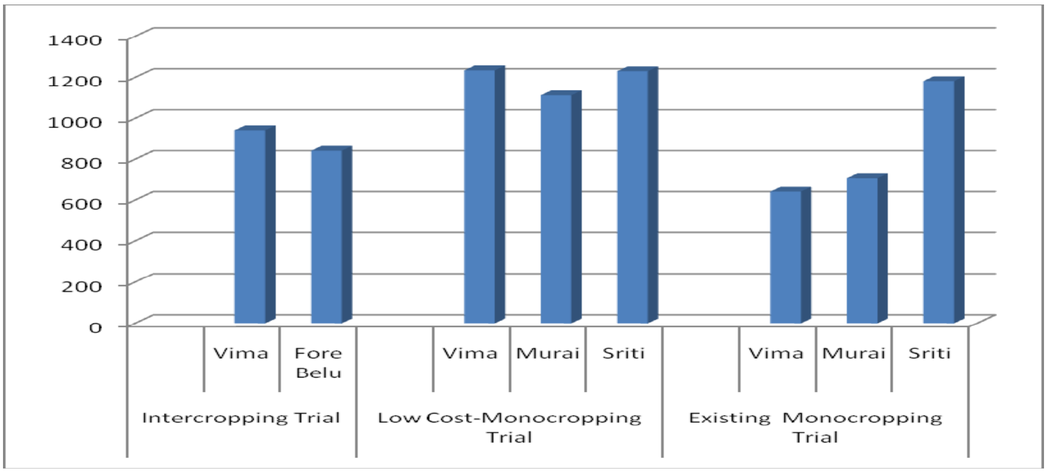

Figure 1 A Comparison of mungbean productivity among all cropping systems (kg/ha).
Source: Primary Data Analysis

The survey shows that paddy yield is exclusively allocated for consumption. By contrast, 87% of mungbean yield and 44% of yield of other crops (maize, sorghum and peanut) are sold. Information collected from household survey shows that almost all households obtain cash from selling mungbean.

Table 1 and Figure 1 show that the highest production was obtained from Vima cultivar (1234 kg/ha), followed respectively by Sriti (1230 kg/ha) and Murai (1111kg/ha), both with a low cost monocropping technology. A high production was also obtained from the monocropped Sriti cultivar with low cost technology as well as from the intercropped Vima cultivar.

Cultivar Fore Belu has markedly lower than other national cultivars, especially Sriti and Vima. This means that these cultivars result could be recommended to all local farmers in an effort to incourige them to improve their cultivation practices. However, the performace of profitability of all varieties has to be calculated using Gross Margin alaysis.

Table 2 Gross margin ($AUD/ha)

Items	Total Revenue ($AUD)	Total Variable Cost ($AUD)	Gross Margin ($AUD)
Cropping Pattern 1	595.20	313.69	281.51
Cropping Pattern 2	390.29	292.10	98.19
Cropping Pattern 3	303.27	135.06	168.21
Improved Intercropping Trial			
• Vima	588.94	536.47	52.47
• Local Belu	525.94	477.92	48.02
Improved Monocropping Trial – Low cost			
• Vima	771.25	437.67	333.58
• Murai	694.38	437.67	256.70
• Sriti	768.75	437.67	331.08
Existing Monocropping Trial			
• Vima	400.63	358.55	42.08
• Murai	443.13	358.55	84.58
• Sriti	738.75	358.55	380.20

Source: Primary Data Analysis

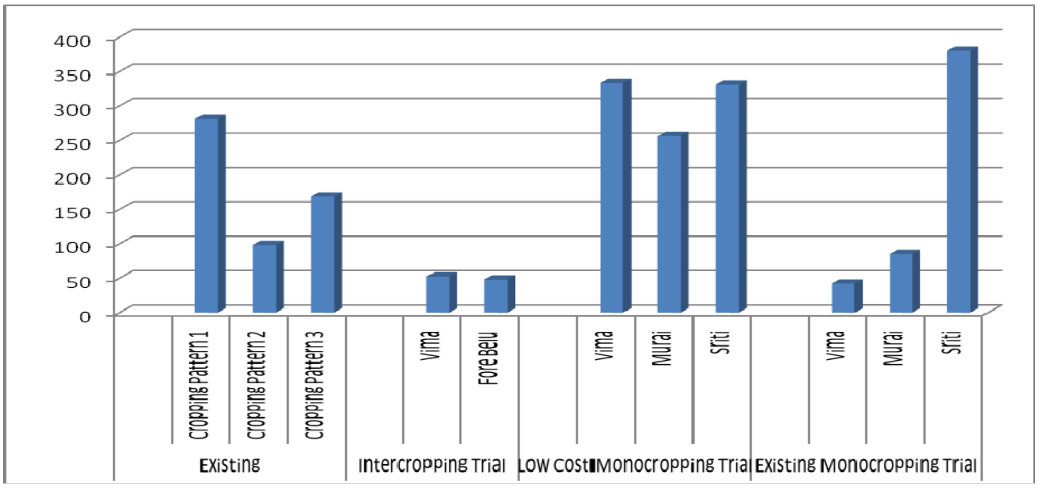

Figure 2 A comparison of gross margin among all cropping systems ($AUD/ha).

Table 2 shows that paddy production in cropping pattern 1 generates a gross margin to farmers for about $AUD 281.51 per ha. As it has been mentioned above, paddy yield is allocated exclusively for daily consumption.

Maize cultivation in cropping pattern 2 provides lowest household revenue (only $AUD 98.19 per ha). This low revenue is caused by the low price of the product at the farm gate. Data shows that some farmers sold their maize at the farm gate for about $AUD $0.16/kg. It should be noted that the highest price of maize about $AUD 0.38/kg is reached only during the period of food scarcity.

Farmers' income that can be generated from maize + mungbean cultivation in cropping pattern 3 is about $AUD 168.21 per ha.

Figure 2 above indicates that Sriti has a highest Gross Margin than other mungbean cultivars. The result is due to the fact that this variety produces more yield than other cultivars, either using low cost technology or existing monocroping technology. Vima and Murai cultivars can produce a high yield as well, but only by using low cost technology and not by improving monoculture technology. The result indicates that except for Sriti cultivar, the two other cultivars (Vima and Murai) require a high inputs of technology such as fertilizer, pesticide, herbicide, etc. to produce a high quantity of yield.

Figure 2 shows that the best performance of Gross Margin was shown by low cost technology for three main national cultivars, i.e. Vima, Murai and Sriti. These three varieties generate gross margin for about $AUD 333.58/ha; $AUD 256.70/ha and $AUD 331.08/ha, respectively. Although the total variable cost spent for this package of technology was high, it has created more gross margin than the other technology packages.

In some cases, farmers may have a huge negative income of mungbean cultivation ($AUD 287.5/ha) because of harvest failure. Mungbean cultivation can be very sensitive and harvest failure causes a huge drop in the productivity of the crop. This has to be seriously considered by policy makers in handling the issue of improving farmer's capability in adopting new, higher cost technologies.

Based on the result of gross margin analysis above, it can be said that there are a number of factors determine the rate of income for farmers. They are: (i) Crop productivity as a result of cultivation practices and input of technologies that include land preparation, seeds and fertilizer, pesticide, insecticide, etc, (ii) Crop productivity that depend on the annual presipitation as the indicator of water availability for crops and the indicator for time of planting, harvesting and absolutely crops production, (iii) A large portion of working capital that has to be spent for planting and transport cost, and (iv) The price of crop product at the farm gate.

CONCLUSIONS

1. Based on the experiences that have been practiced for many years, farmers in South Belu have practiced a semi-modern farming system by combining manual and mechanized techniques. Dry land cultivation in South Belu is usually conducted twice a year. The first cultivation would be in the period of November – March during which farmers practice an inter-cropping of maize, peanut, cassava and sorghum. The second cultivation will be in the period of April - August during which farmers practice a relay cropping system of maize and mungbean.
2. Relay cropping system is practiced for the maize to serve as the wind break for mungbean during its sensitive flowering stage against strong wind during the planting season of April-August south-eastern monsoonal rainfall.
3. The existing average mungbean productivity in the sample villages is 0.35 ton/ha. It is clear that productivity of mungbean in all research sites is lower than that of the average productivity at national level (0.75 ton/ha). This is due to the fact that farmers cultivate the low-yield Fore Belu local cultivar of which maximum production is only 0.6 ton per ha.
4. Total variable cost alocated for mungbean cultivation is between AU $350 and AU $600 per ha. The highest total variable cost was allocated for the technology of improved intercropping of Vima cultivar. At the same time, the lowest total variable cost was allocated for the existing monoculture of Vima, Murai and Sriti cultivars.
5. Sriti cultivar produces a highest Gross Margin than other varieties. In relation to the increase in Gross Margin of other cultivars, especially Vima and Murai, the cultivation practice needs a high inputs of technology, icluding fertilizer, pesticide, and other practices such as tillage and weeding.
6. The best performance of Gross Margin was indicated by low cost technology for three main national cultivars, including Vima, Murai and Sriti. These three cultivars create gross margin for about $AUD 333.58/ha; $AUD 256.70/ha and $AUD 331.08/ha, respectively. Although total variable cost that has been spent for this package of technology was high, it has created more gross margin than other technology packages.

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