Impact of Forage Programme on Cattle Body Condition Score of Smallholder Farmers in Cambodia

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Abstract: The survey was conducted in the target provinces, Kampong Cham and Pursat province, of Beef for Market Project funded by ACIAR, Australia, in January and July 2016. Survey was designed with three different types of farmers such as adopted farmer, exposed farmers and non-exposed farmers. The objective of the study is to evaluate the impact of the introducing forage on cattle production of smallholder farmers supported by the project. The adopted farmers, who have involved in the project, planted the forage to supplement their cattle, got higher BCS (Body Condition Scoring) and total income than exposed and non-exposed farmers. However, the BCS varied with season and gender of cattle as well, when in the raining season male cattle produced higher BSC than dry season and female cattle respectively. However, further study on impact of converting cropland into forage planting should be deeply analyzed, since there was competition of land use.

Key words: Types of famers, season, BCS, income.

1. Introduction

The major constraint limiting the development of livestock production in many developing countries is inadequacy of animal feed resources, which is most often the crucial factor [1]. Feed shortages, both quantitatively and qualitatively, are limiting livestock productivity. During ploughing of crop fields, these shortages seriously affect working ability of oxen and they depress the production of dairy and meat units managed by small-scale commercial farmers. Beef for Market project funded by ACIAR has introduced the forage into the project farmers in Kampong Cham and Pursat province from 2013-2016 in order to promote fattening cattle for better price for market with supplementing planted forage. Forage production and technology has been successfully introduced into smallholder cattle systems in Cambodia as an alternative feed source to the traditional rice straw and native pastures, improving animal nutrition and reducing labour requirements of feeding cattle [2]. It was agreed with other researchers, who addressed that providing improved forage quality and increased quantity to cattle resulted in gains of liveweight and animal value, and time savings for searching feed or care for animals grazing rice stubble [3]. In general, planting forage can provide an economical source of livestock feed, reduce labor requirements, build soil tilth and fertility, reduce erosion, and reduce invasions of noxious and poisonous weeds. While the opportunities to expand the area of forage crops are limited due to the competition with field crops for land and water resources, increases in forage production may be possible through intercropping, alley cropping, or integration of legumes via crop rotation [4].

The hypothesis for research and testing is that the project farmers practicing forage plantation and supplementing their forage to cattle will get highest body scoring of cattle. Raining season will have
available communal grazing area and providing good condition for growing forage will bring better body scoring of cattle.

2. Material and Methodology

2.1 Study Area and Period

This second survey has been conducted at two provinces (Pursat and Kampong Cham) after the preliminary data of baseline survey. There were 2 districts in Pursat, and 1 district in Kampong Cham that were selected as the target study. The study has been conducted two times, middle dry season in January 2016 and middle raining reason in July 2016.

2.2 Sample Selection

The total number of interviewed farmers was 90 households with the proportion of 30 project participants (adopted farmers), 30 non-project participants in target village (exposed farmers) and others 30 non-project participants from other villages (non-exposed) (Table 1).

2.3 Data Collection

Data collection has been made two times, middle dry season in January 2016 and middle raining reason in July 2016. The questionnaire has been designed for two forms to get the primary data.

Firstly, the questionnaire was designed to interview the household farmers who were selected, in Kampong Cham and Pursat. The questionnaire focused on the common practice of the farmers in managing the cattle, what type of cattle farmer have, what kind of the feed farmers supplement to the cattle before selling.

Secondly, the questionnaire was designed for cattle assessment including breed type, sex, age, color and body condition score, the interviewer will assess this work with farmers in Pursat and Kampong Cham. BCS (Body Condition Scoring), was adopted from DEFRA [5], and was assessed on a scale of 1-5, in which score 1 is extremely thin and score 5 is extremely fat.

Table 1  The number of farmer selected for the interviewing.

| Province     | District | Commune | Villages | Type of farmer | No farmer |
|--------------|----------|---------|----------|----------------|-----------|
| Kampong, Cham| Prey Chhor | Tropang Preh | Koh Svay | Adopted | 5 |
|              |          |         | Tropang Pil | Exposed | 5 |
|              |          |         | Toek Noem | No-exposed | 5 |
|              |          | Chrey Vean | Koh Taphem | Adopted | 5 |
|              |          |         | Mean | Exposed | 5 |
|              |          |         | Khloy Tie 3 | No-exposed | 5 |
| Sub-total    |          |         |          |        | 45 |
| Pursat       | Sampov Meas | Chamrein Pal | Toul Kros | Adopted | 5 |
|              |          |         | Ou Thkov | Exposed | 5 |
|              | Roleap   |         | Roleap | No-exposed | 5 |
|              |          |         | Prey Oy mal | Adopted | 5 |
| Krokor       | Kbal Trach |         | Krolanh | Exposed | 5 |
|              |          |         | Tul Trear | No-exposed | 5 |
| Sub-total    |          |         |          |        | 45 |
| Total        |          |         |          |        | 90 |

Adopted farmers: Project farmers.
Exposed Farmers: Non-project farmers, but they are living close to or in the project target villages.
Non-exposed farmers: Non-project farmers, but they are living far away from the project target villages.
2.4 Data Management and Data Analysis

The collected data will be edited to detect the errors and omission and each questionnaire has been coded for facilitating the analyzing process, then will be entered in excel. Excel or SPSS program has been used for data analysis.

3. Result and Discussion

3.1 Family Member

The average members (Table 2) in each household of those three types of farmers in both provinces are not significantly different, however in Pursat province the group of adopted farmers seems to have less members than other groups.

3.2 Cattle Number

Through Table 3 it was shown that there were no significant differences for the average number of cattle in each farmer group, even in the different season, however adopted farmer groups of both provinces seem to have higher number of cattle than other two groups (Fig. 1).

The research result, in Fig. 2, has shown that there were no significant correlations found between household member and number of cattle; however

Table 2  Family member in each household.

| Type of farmer       | Kampong Cham | Pursat | p-value  |
|----------------------|--------------|--------|----------|
| Adopted farmer       | 5.47         | 4.50   | 0.629    |
| Exposed farmer       | 5.70         | 5.43   |          |
| Non exposed farmer   | 5.20         | 5.40   |          |
| SE Mean              | 0.33         | 0.40   |          |
| p-value              | 0.629        | 0.186  |          |

Table 3  Number of cattle in each village.

| Type of farmer         | Rainy season Kampong Cham | Pursat | Average | Dry season Kampong Cham | Pursat | Average |
|------------------------|---------------------------|--------|---------|--------------------------|--------|---------|
| Adopted farmer         | 5.87                      | 9.07   | 7.47    | 6.73                     | 10.1   | 7.73    |
| Exposed farmer         | 6.67                      | 6.94   | 6.81    | 4.60                     | 6.07   | 5.73    |
| Non exposed farmer     | 5.64                      | 6.50   | 6.10    | 6.20                     | 8.20   | 7.80    |
| SE Mean                | 0.76                      | 0.98   | 0.64    | 0.71                     | 1.15   | 0.71    |
| p-value                | 0.608                     | 0.162  | 0.319   | 0.081                    | 0.06   | 0.071   |

Fig. 1  Average number of cattle per household.
there was about 32% of number of cattle in household which has negative relationship with household numbers, it meant the lower member in household, the higher number of cattle will be occupied, while 68% came from other factors.

### 3.3 Planting Area

For the total of 30 project farmers, adopted farmers in Tables 4-6, used the plot area to plant the forage which has highly varied with the household, and the maximum plot was 6,000 m² for raining season and 2,400 m² for dry season, while the minimum size was almost similar for those two seasons. In addition, the average size of plotting area also varied depending on season, especially there were more plating areas in raining season than dry season; but there was no different size between those two provinces (Fig. 3).

### 3.4 Types of Planting Grass

The project has supported the seed of five varieties of grass to farmers, in Table 7, such as Stylo, Mulato II, Symoung, Russie and Paspalum. However, Russie
grass seems to be less interesting for farmers in Kampong Cham in raining season while, Stylo is type of legume that has been applied to plant by about 80% of farmers in Kampong Cham.

3.5 BCS

The number of male and female cattle of these three types of farmers selected for BCS was not significantly different, it meant that those farmers had similar percentage rate of male and female cattle, which could not affect our study (Table 8).

Through result in Table 9, the frequency of BCS in both provinces found that the adopted farmers occupied the highest percentage of BCS #3, accounting for 19.1% and 7.72% in Kampong Cham and Pursat of those 2 seasons respectively followed by exposed farmers; in contrast, the adopted farmers occupied the lowest percentage of BCS #1.

For BCS of cattle, in general there were relationships with the gender of cattle, male cattle had higher body scoring than female. If we compared BCS of cattle with the age, we found that, cattle at age of 1-3 years old has higher BCS than other, and is followed by age under 1 year and over 3-5 years old, yet when cattle became older than 5 years old they made the BCS lower, shown in Table 10 and Fig. 4.

The BCS of cattle in Kampong Cham province was higher than in Pursat and the average of both seasons was 2.24 and 1.96 respectively. It was similar when comparing by seasons in Kampong Cham where the BSC varied with the season, however, there was no difference for Pursat province. In general, the BSC has varied depending on season, in raining season, the cattle had higher BSC than in dry season, indicated in Table 11 and Fig. 4.

The adopted farmers had better BCS of cattle than exposed and non-exposed farmers, in average they were 2.56 in Kampong Cham and 2.15 in Pursat. Even in different seasons, the adopted farmers had also

![Fig. 3  Plotting area of project participants.](image)

| Type of grass | Raining season | Kampong Cham | Pursat | Raining season | Kampong Cham | Pursat |
|--------------|----------------|--------------|--------|----------------|--------------|--------|
|              | Number | % | Number | % | Number | % | Number | % |
| Stylo        | 13     | 86.7 | 15     | 100 | 12     | 80.0 | 15     | 100 |
| Mulato II    | 15     | 100  | 15     | 100 | 14     | 93.3 | 13     | 86.7 |
| Symoung      | 15     | 100  | 15     | 100 | 13     | 86.7 | 15     | 100 |
| Russie       | 9      | 60.0 | 15     | 100 | 14     | 93.3 | 13     | 86.7 |
| Paspalum     | 15     | 100  | 15     | 100 | 14     | 93.3 | 13     | 86.7 |
### Table 8  Number of cattle estimated the BCS.

Kampong Cham Province

| Parameter               | Raining season | Dry season | Average |
|-------------------------|----------------|------------|---------|
|                         | Male | Female | Male | Female | Male | Female | Male | Female |
| No. head                | %    | %      | %    | %      | %    | %      | %    | %      |
| Adopted farmer          | 40   | 34.5   | 76   | 65.5   | 28   | 27.7   | 73   | 72.3   |
| Exposed farmer          | 21   | 23.1   | 70   | 76.9   | 17.5 | 23.3   | 58   | 76.7   |
| Non exposed farmer      | 15   | 18.8   | 65   | 81.3   | 19   | 23.0   | 64   | 77.0   |
| Chi-square              | 6.81 | 1.74   | 0.68 | 0.078  | 0.627| 0.878  |
| p-value                 | 0.078|        |      |        |      |        |

Pursat Province

| Adopted farmer          | 28   | 34.1   | 54   | 65.9   | 37   | 34.9   | 69   | 65.1   |
| Exposed farmer          | 32   | 35.2   | 59   | 64.8   | 27   | 30.1   | 61.5 | 69.9   |
| Non exposed farmer      | 25   | 30.9   | 56   | 69.1   | 19   | 26.6   | 53   | 73.4   |
| Chi-square              | 0.38 |        |      | 0.944  | 0.152| 0.696  |
| p-value                 | 0.944|        |      |        |      |        |

### Table 9  Frequency of cattle with different types of BCS.

| Province       | Type of farmers | Body score | 1 | 2 | 3 | 4 | p-value |
|----------------|-----------------|------------|---|---|---|---|---------|
|                |                 | Freq. | %  | Freq. | %  | Freq. | %  | Freq. | %  |
| Raining season |                 |       |    |       |    |       |    |       |    |
| Kampong Cham   | Adopted farmer  | 1     | 0.35| 49    | 17.1| 58    | 20.2| 8     | 2.79|
|                | Exposed farmer  | 7     | 2.44| 64    | 22.3| 20    | 6.97| 0     | 0.00< 0.001|
|                | Non exposed farmer | 7   | 2.44| 65    | 22.6| 8     | 2.79| 0     | 0.00|
|                | Pursat          |       |    |       |    |       |    |       |    |
|                | Exposed farmer  | 22    | 8.66| 54    | 21.3| 15    | 5.91| 0     | 0< 0.001|
|                | Non exposed farmer | 31 | 12.2| 43    | 16.9| 7     | 2.76| 0     | 0|
| Dry season     |                 |       |    |       |    |       |    |       |    |
| Kampong Cham   | Adopted farmer  | 1     | 0.43| 44    | 19.1| 41    | 17.8| 0     | 0|
|                | Exposed farmer  | 6     | 2.61| 42    | 18.3| 11    | 4.78| 0     | 0< 0.001|
|                | Non exposed farmer | 19 | 8.26| 54    | 23.5| 12    | 5.22| 0     | 0|
|                | Pursat          |       |    |       |    |       |    |       |    |
|                | Exposed farmer  | 8     | 2.89| 99    | 35.7| 23    | 8.30| 0     | 0|
|                | Non exposed farmer | 12 | 4.33| 72    | 26.0| 1     | 0.36| 0     | 0< 0.001|
| Combined two seasons |   |       |    |       |    |       |    |       |    |
| Kampong Cham   | Adopted farmer  | 14    | 5.05| 41    | 14.8| 7     | 2.53| 0     | 0|
|                | Exposed farmer  | 13    | 2.51| 106   | 20.5| 31    | 6.00| 0     | 0.00< 0.001|
|                | Non exposed farmer | 26 | 5.03| 119   | 23.0| 20    | 3.87| 0     | 0.00|
|                | Pursat          |       |    |       |    |       |    |       |    |
|                | Exposed farmer  | 9     | 1.69| 162   | 30.5| 41    | 7.72| 0     | 0.00|
|                | Non exposed farmer | 34 | 6.40| 126   | 23.7| 16    | 3.01| 0     | 0.00< 0.001|

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Table 10  Body scoring of cattle comparing with gender of cattle.

| Gender | Unite | BCS1 | BCS2 | BCS3 | BCS4 | p-value |
|--------|-------|------|------|------|------|---------|
|        |       |      |      |      |      |         |
|        | Head  | 52   | 249  | 76   | 3    |         |
| Female | Percentage (%) | 13.68 | 65.53 | 20.00 | 0.79 | 0.005   |
| Male   | Head   | 17   | 89   | 50   | 5    |         |
|        | Percentage (%) | 10.56 | 55.28 | 31.06 | 3.11 |         |
|        |        |      |      |      |      |         |
| Raining season |       |      |      |      |      |         |
| Female | Head  | 54   | 262  | 58   | 0    |         |
|        | Percentage (%) | 14.44 | 70.05 | 15.51 | 0.00 | 0.001   |
| Male   | Head   | 6    | 90   | 37   | 0    |         |
|        | Percentage (%) | 4.51  | 67.67 | 27.82 | 0.00 |         |
| Dry season |       |      |      |      |      |         |
| Female | Head  | 106  | 511  | 134  | 3    |         |
|        | Percentage (%) | 14.06 | 67.77 | 17.77 | 0.40 | < 0.001 |
| Male   | Head   | 23   | 179  | 87   | 5    |         |
|        | Percentage (%) | 7.82  | 60.88 | 29.59 | 1.70 |         |

Fig. 4  BCS by gender and age of cattle.

Table 11  BCS.

| Parameters | BSC | SE Mean | BSC | SE Mean | BSC | SE Mean |
|------------|-----|---------|-----|---------|-----|---------|
|            |     |         |     |         |     |         |
| BCS by province |       |         |     |         |     |         |
| Provinces  |       |         |     |         |     |         |
| Kampong Cham | 2.30 | 0.033   | 2.16 | 0.036   | 2.24 | 0.026   |
| Pursat     | 1.95 | 0.035   | 1.96 | 0.033   | 1.96 | 0.025   |
| p-value    | < 0.001 |        | < 0.001 |        | < 0.001 |        |
| BCS by season |       |         |     |         |     |         |
| Season     |       |         |     |         |     |         |
| Raining season | 2.30 | 0.036   | 1.95 | 0.033   | 2.14 | 0.026   |
| Dry season  | 2.16 | 0.040   | 1.96 | 0.044   | 2.05 | 0.027   |
| p-value    | 0.021 |         | 0.352 |        | 0.045 |         |

* The significant in column, if p ≤ 0.05.
Table 12  BCS of cattle with different parameter.

| Type of farmer       | Kampong Cham | Pursat | Raining season | Dry season | Combination |
|----------------------|--------------|--------|----------------|------------|-------------|
|                      | BSC  | SE Mean | BSC  | SE Mean | BSC  | SE Mean | BSC  | SE Mean | BSC  | SE Mean | BSC  | SE Mean |
| Adopted farmer       | 2.56 | 0.051   | 2.15 | 0.036   | 2.46 | 0.042   | 2.26 | 0.036   | 2.35 | 0.028   |
| Exposed farmer       | 2.12 | 0.057   | 1.90 | 0.040   | 2.03 | 0.043   | 1.96 | 0.044   | 2.00 | 0.031   |
| Non-exposed farmer   | 1.96 | 0.061   | 1.78 | 0.044   | 1.86 | 0.046   | 1.91 | 0.043   | 1.88 | 0.032   |
| p-value              | < 0.001 | -     | < 0.001 | -      | < 0.001 | -     | < 0.001 | -     | < 0.001 | -     |

* The significant in column, if p ≤ 0.05.

better BCS than exposed and non-exposed farmers as well, accounting for 2.46 and 2.26 in raining and dry season respectively. In general, the adopted farmers had highest BCS followed by exposed farmers, then non-exposed farmers who had lowest average of BCS, in Table 12.

3.6 Correlation of BCS with Other Variation

The result of Fig. 5 below, has shown non-correlation between cattle number with BCS, even the average household member also has no relationship to higher or lower BCS; thus it would be affected by other factors.

3.7 Selling Cattle of the Last 2 Years

Through the interviewing, most of the correspondents have sold their cattle in the last 2 years and there were no significant differences among those three types of farmers, and in general accounted for 70% to 83.3%, as Table 13 shows.
Table 13  Number of household that sold cattle in the last 2 years of the project life.

| Types of farmer | Kampong Cham | Pursat | Combination of provinces |
|----------------|--------------|--------|-------------------------|
| #HH  | %   | #HH  | %   | %  |
| Adopted farmer | 12 | 80.00 | 13 | 86.67 | 83.3 |
| Exposed farmer  | 9  | 60.00 | 12 | 80.00 | 70.0 |
| Non-exposed farmer | 11 | 73.33 | 11 | 73.33 | 73.3 |

* Note: HH = Household.

Table 14  Number of cattle sold in the last 2 years of each province.

| Variable | Adopted farmer | Exposed farmer | Non-exposed farmer | SE | Mean | p-value |
|----------|----------------|----------------|--------------------|----|------|---------|
| Kampong Cham | 2.13 | 1.20 | 0.73 | 0.393 | 0.047 |
| Pursat | 1.67 | 1.33 | 1.40 | 0.383 | 0.809 |
| Combination of provinces | 1.90 | 1.27 | 1.07 | 0.274 | 0.087 |

The significant in row, if p ≤ 0.05.

Table 15  Comparing of number of cattle sold.

| Province | Cattle | SE Mean | p-value |
|----------|--------|---------|---------|
| Kampong Cham | 1.36 | 0.224 | 0.727 |
| Pursat | 1.47 | | |

Table 16  Price of cattle of each type of farmer.

| Variable | Price per head (Riel × 10^6) | p-value |
|----------|-------------------------------|---------|
|         | Adopted farmer | Exposed farmer | Non-exposed farmer |
| Riel | SE Mean | Riel | SE Mean | Riel | SE Mean |
| Kampong Cham | 3.10 | 0.371 | 2.78 | 0.43 | 2.93 | 0.387 | 0.851 |
| Pursat | 2.62 | 0.216 | 2.1 | 0.225 | 2.08 | 0.235 | 0.158 |
| Combination of provinces | 2.85 | 0.216 | 2.39 | 0.235 | 2.51 | 0.230 | 0.317 |
| Total income (Riel × 10^6) | 8.42 | 1.254 | 5.04 | 1.45 | 2.93 | 1.310 | 0.017 |
| Pursat | 5.12 | 1.057 | 3.3 | 1.10 | 4.45 | 1.149 | 0.492 |
| Combination of provinces | 6.71 | 0.83 | 4.05 | 0.91 | 3.69 | 0.89 | 0.029 |

The significant in row, p<0.05.

Exchange rate to USD: 1 USD = 4,000 Riels.

The average number of cattle that have been sold by farmers in Kampong Cham was significantly different from those types of farmers, it meant that adopted farmers sold more cattle than exposed and non-exposed farmers did. However, there were no significant differences for Pursat province and for combination of those two provinces, although adopted farmers seem to be sold the cattle a bit higher number than others did. It was the same when comparing with province in Tables 14 and 15.

Selling price per head of cattle was not different significantly from those farmers and selling price ranged from $2.39 \times 10^6$ to $2.85 \times 10^6$ Riels. However, the total income from the total cattle that have been sold was different significantly from those types of farmers in Kampong Cham, and different as well for combination of those 2 provinces; it meant that the adopted farmers got higher income from selling cattle in the last two years than others. In general the adopted farmers got $6.71 \times 10^6$ Riels and were followed by exposed farmers, $4.05 \times 10^6$ Riel, then non-exposed farmers $3.69 \times 10^6$ Riels, shown in Table 16.

If comparing with provinces, the price of cattle per head got by farmer in Kampong Cham was higher than in Pursat province, accounting for $2.95 \times 10^6$ Riels and $2.28 \times 10^6$ Riels respectively. However,
Table 17  Cattle price of province.

| Variable         | Kampong Cham |          | Pursat  |          | p-value |
|------------------|--------------|----------|---------|----------|---------|
|                  | Riel × 10⁶   | SE Mean  | Riel × 10⁶ | SE Mean  |         |
| Price per head   | 2.95         | 0.183    | 2.28    | 0.173    | 0.01    |
| Total income     | 5.58         | 0.761    | 4.31    | 0.718    | 0.228   |

* The significant in row of table, if p ≤ 0.05.
Exchange rate to USD: 1 US$ ≈ 4,000 Riels.

there were no significant differences for total income from selling total cattle of those two provinces, in the last two years (Table 17).

4. Discussion

The developing perennial forage plots close to households have reduced the amount of labor and time that farmers spend on supplying cut-and-carry forage to their animals. In addition, the growing of forages can meaningfully reduce the grazing pressure on common grazing lands, thereby lowering the potential for environmental degradation [6]. The establishment of forage plots in high-intervention project villages provided an improvement in average daily liveweight gain of cattle and saved farmers up to 2 h labour per day [3]. This result is similar to authors’ finding that adopted forage farmers had better BCS and income than those who were not involved; however, the exactly time spent among those types of farmers should be further studied.

5. Conclusion

In general, authors conclude that the introduction of planting forage will contribute to improving BCS of cattle; moreover, season, gender and age of cattle also affect the BCS of cattle as well; in addition, it had provided higher income as well. However, the study on the economics of converting cropland to forage plot should be deeply studied, since there are competitions of land using.

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