Appendix A-2:

Baseline Survey Report

Department of Agriculture
Ministry of Agriculture, Livestock and Irrigation
Republic of the Union of Myanmar

PROJECT FOR PROFITABLE IRRIGATED AGRICULTURE IN WESTERN BAGO REGION (PROFIA), THE REPUBLIC OF THE UNION OF MYANMAR

BASELINE SURVEY REPORT

DECEMBER 2017

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OVERSEAS MERCHANDISE INSPECTION CO., LTD. (OMIC)

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Abbreviations

AMD	Agricultural Mechanization Department
CP or C/P	Counterparts
Core Farmer	Same as "model farmer" or farmers who were expected to be the model farmer at the time of baseline survey.
Control Farmer	Farmers who are not the direct participants of the project activities and their farm plots are located outside of target LCA
DOA	Department of Agriculture
Ks	Currency unit of Myanmar, "kyats"
LCA	Land Consolidation Area
MOALI	Ministry of Agriculture, Livestock and Irrigation
Model Farmer	Farmers who are regarded as main participants of the project activities and establish model plot in their farmland.
NT	Nattalin Township
Ordinary Farmer	Farmers who are not directly target and have farm plot within target LCA.
OUT	Outside of Land Consolidation Area
PD	Paungde Township
PK	Paukkhaung Township
PY	Pyay Township
TG	Thegon Township
TS	Township
ZG	Zegon Township

Unit Conversion

1 bag	1.5 basket
1 bag	29.5 viss
1 bag	16 pyi
1 basket	24 pyi
1 basket (paddy)	20.9 kg
1 basket	16 viss (1.633kg)
1 lb (pound)	2.205 pound
1 pyi	8 tin (1 can)

CHAPTER 1 BACKGROUND

1.1 PURPOSE OF THE SURVEY

The Project has designated model sites in land consolidation area (LCA, hereafter) inside of basins of irrigation canal rehabilitated in six (6) townships named Pyay, Paukkhaung, Thegon, Paungde, Nattalin, and Zigon. A part of producers who possess a plot of farm land inside of the model sites were selected as "Model Farmers" to whom the Project shall provide technical supports, and the rest of producers in the sites were regarded as "Ordinary Farmers". Producers who hardly possess farm land inside of LCA were designated as "Control Farmers". The Project will evaluate the activities through comparison of three category farmer groups at the term of the end.

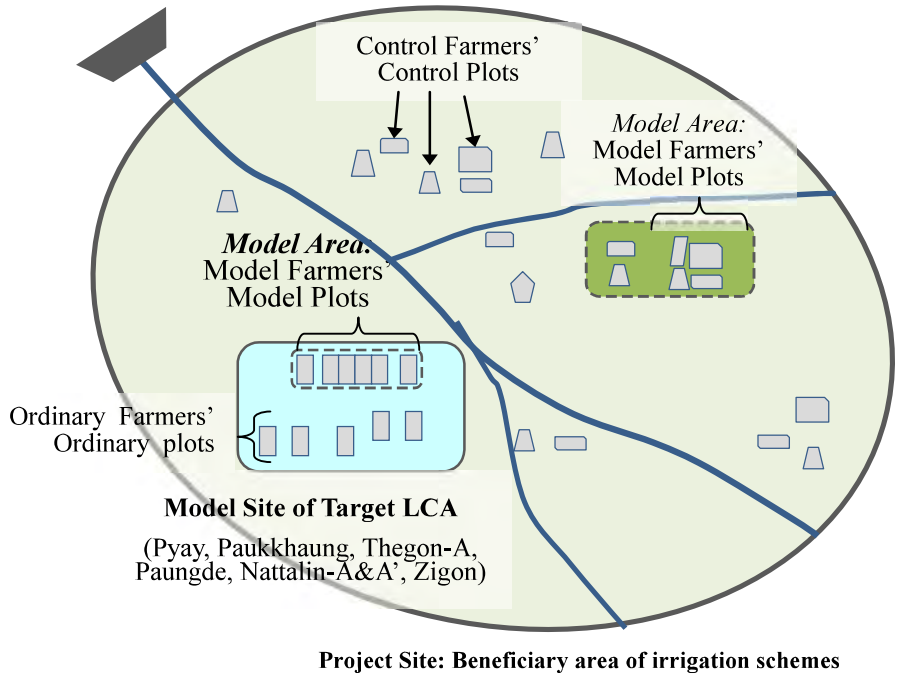


Fig. 1.1.1: Conceptual map of Project Sites

1.2 METHODOLOGY OF THE SURVEY

Sample numbers of household which has a farm in LCA were obtained from the following formula with 90% of credibility in respective townships. All "Model Farmers" informed beforehand were included in the respective sampling groups, and the rests were regarded as "Ordinary Farmers" to be surveyed.

The sample number required (n) from the population (N) at ± a % of error level:

$$n = \frac{N}{\{(a \times 1/100 \times 1/1.96)^2 \times (N-1) / 0.5 (1-0.5)\} + 1}$$

Total sampling number was decided as 400, and total Control farmer number was obtained deducting numbers of Model and Ordinary farmers from 400. The Control Farmer numbers of respective townships were found as proportional numbers based on the household numbers outside of the model

area in each township (Table 1.1.1). Nevertheless, one each of irrigable site by native methods, which is located outside of LCA, was added in Natallin (Natallin-B) and Thegon (Thegon-B) because irrigation water supply was expected impossible in the coming summer cropping season (2017). Only Model Farmers were selected in the newly added sites considering future Project operations. The same problem was also found in Zigon, but nothing was added because of the difficulty of irrigation in all the area. In case of Zigon, farmers cannot access irrigated water constantly, since it locates around the end of Taung Nyo irrigation scheme. As a result of the adjustment, total sample number finally became 376.

Ordinary Farmers and Control Farmers were randomly selected based on respective inhabitant's lists apart from "Model Farmers" nominated by respective townships through their discussion. The sample number proportion of farmland owners in the model areas (Model Farmers and Ordinary Farmers) and non-owners (Control Farmer) was nearly half-and-half in each township.

The survey data were based on the activities from June 2015 to May 2016.

Table 1.1.1: Number of sampled households as model farmer, ordinary farmer, and control farmer in the baseline survey (LCA stands for land consolidation area)

Township	Inside of LCA		Outside of LCA	Total
	Model farmer	Ordinary farmer	Control farmer	
Pyay	10	26	33	69
Paukkhaung	10	25	32	67
Thegon	13	19	22	54
A	*(7)*	*(19)*	*(22)*	*(48)*
B	*(6)*	*(0)*	*(0)*	*(6)*
Paungde	9	17	24	50
Nattalin	25	23	37	85
A	*(10)*	*(15)*	*(22)*	*(47)*
A'	*(10)*	*(8)*	*(15)*	*(33)*
B	*(5)*	*(0)*	*(0)*	*(5)*
Zigon	10	18	23	51
Total	77	128	171	376

1.3 METEOROLOGICAL CONDITION OF PROJECT TARGET AREA

(1) Precipitation

The Project team obtained the data of precipitation and the number of days with rain for ten (10) years (2006-2015), and that of daily minimum and maximum temperature in 2015, from DOA, MOALI.

Annual precipitation in six (6) TSs ranged from 48.5 inches (1,232 mm, Paukkhaung) to 62.1inches (1,576mm, Thegon).(Fig.1.1.2) After having kept maximum precipitation from June to August, it became gradually less and less. Then there was almost no rainfall from December to March, which might have forced farmers to harvest summer crop at the beginning of monsoon season.

The precipitation in Paukkhaung did not fluctuate so largely, and there was a certain amount of rainfall available even in November, which was one of distinguished characteristic of Paukkhaung compared to other TSs. It indicated that not only its location near to water source, but also the characteristic of rainfall pattern in Paukkhaung might lead to a possibility of winter crop cultivation.

Whereas, precipitation in Thegon tended to be relatively higher than other TSs throughout a year, and

precipitation in July was considerably higher than others. In Thegon, it was found that sown paddy seeds were washed away because of heavy rainfall in July, 2016. Same damage was observed in Paungde and Zigon, where precipitation in July was also largest in a year. Such risk of loss seemed to be one of the obstacles for farmers to introduce expensive certified seeds. The number of days with rain per year ranged from 76.7 days (Paukkhaung) to 90.6 days (Pyay), and its fluctuation showed similar tendency with that of precipitation. (Fig. 1.1.3)

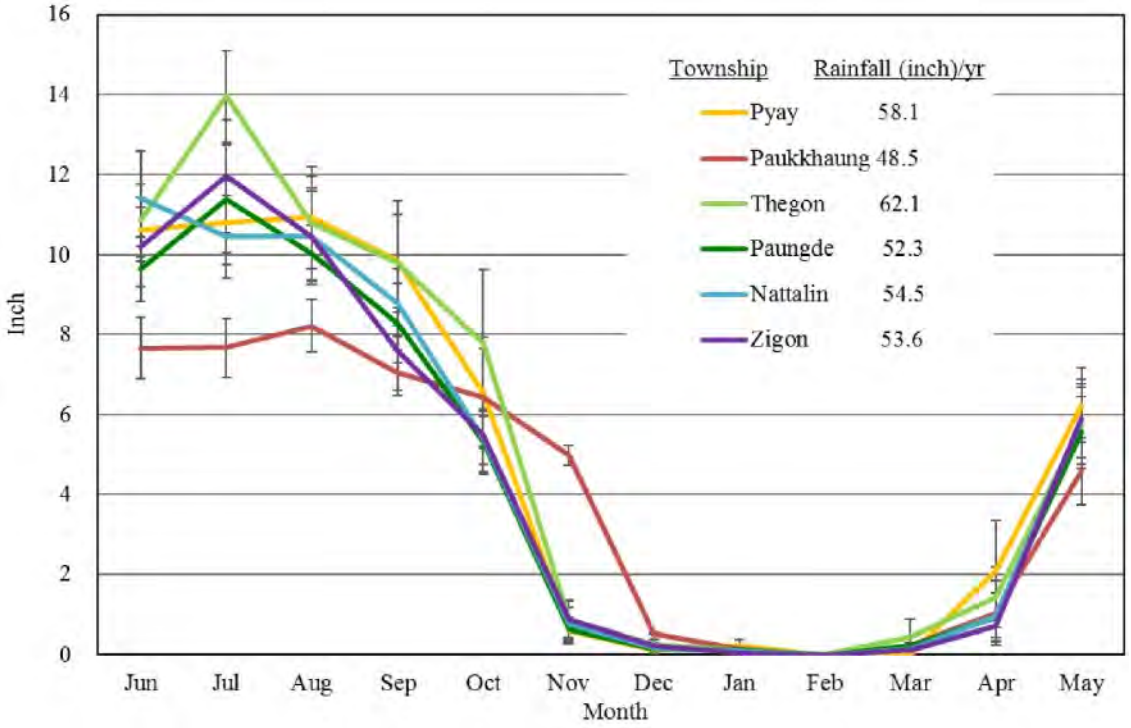


Fig. 1.1.2: Average rainfall of each month (2006 - 2015) in target townships
(Bars indicate standard errors.)

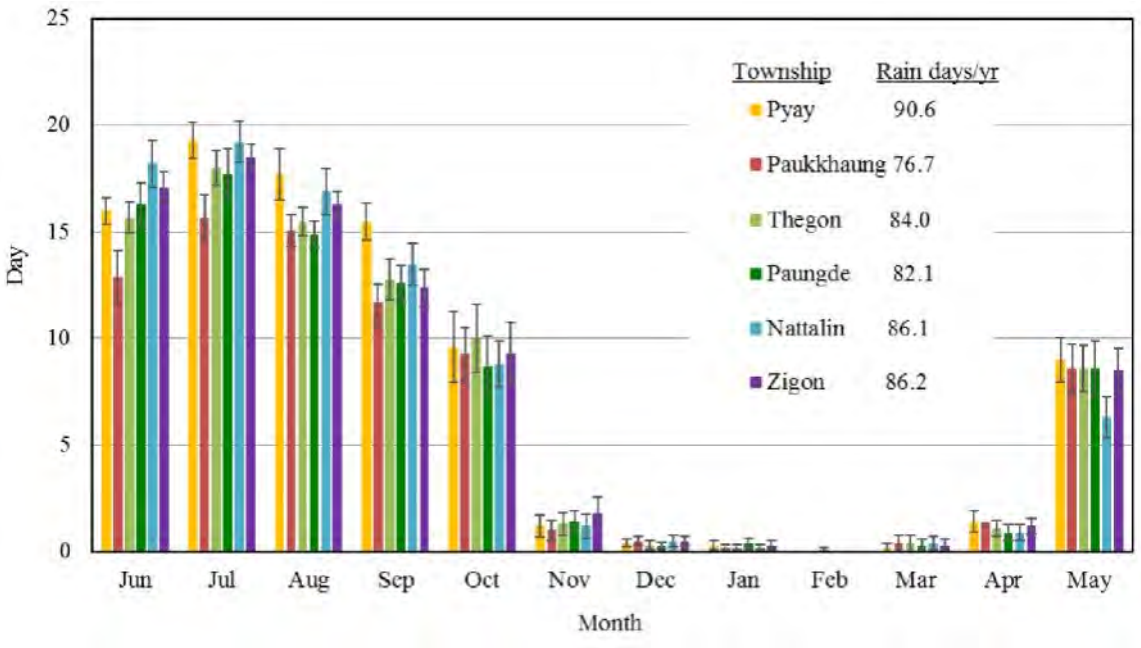


Fig. 1.1.3: Average rain days of each month (2006 – 2015) in the target townships
(Bars indicate standard errors.)

(2) **Temperature**

The lowest temperature in 2015 ranged from 11℃ (10th, May, in Nattalin) to 39℃ (1st, May, in Thegon), and became lower in January and February, and became higher from April to June. (Fig. 1.1.4) The highest temperature ranged from 15℃ (10th, January, in Pyay) to 46℃ (21st, April, in Pyay; 21st, April, 11th and 14th, May, in Nattalin) The highest temperature became lower in December and January, and became higher from March to May. Diurnal temperature range was small from June to October (3-5℃), whereas, it was large from January to April (10-13℃). The average of lowest temperature in Nattalin was lowest (23℃), and that in Paukkhaung was highest (26℃). With regard to the average of highest temperature, that in Pyay was lowest (31℃), and that in Paukkhaung was the highest (34℃).

In general, paddy yield decreases due to high infertility, if temperature become lower than 15℃ at the time of paddy flowering. The days on which temperature was below 15℃ were one (1) day in Pyay, five (5) days in Zigon, and forty (40) days in Nattalin. Even if irrigation in winter season becomes available, it is required to consider cropping season so as to avoid paddy flowering period from being in such period with lower temperature.

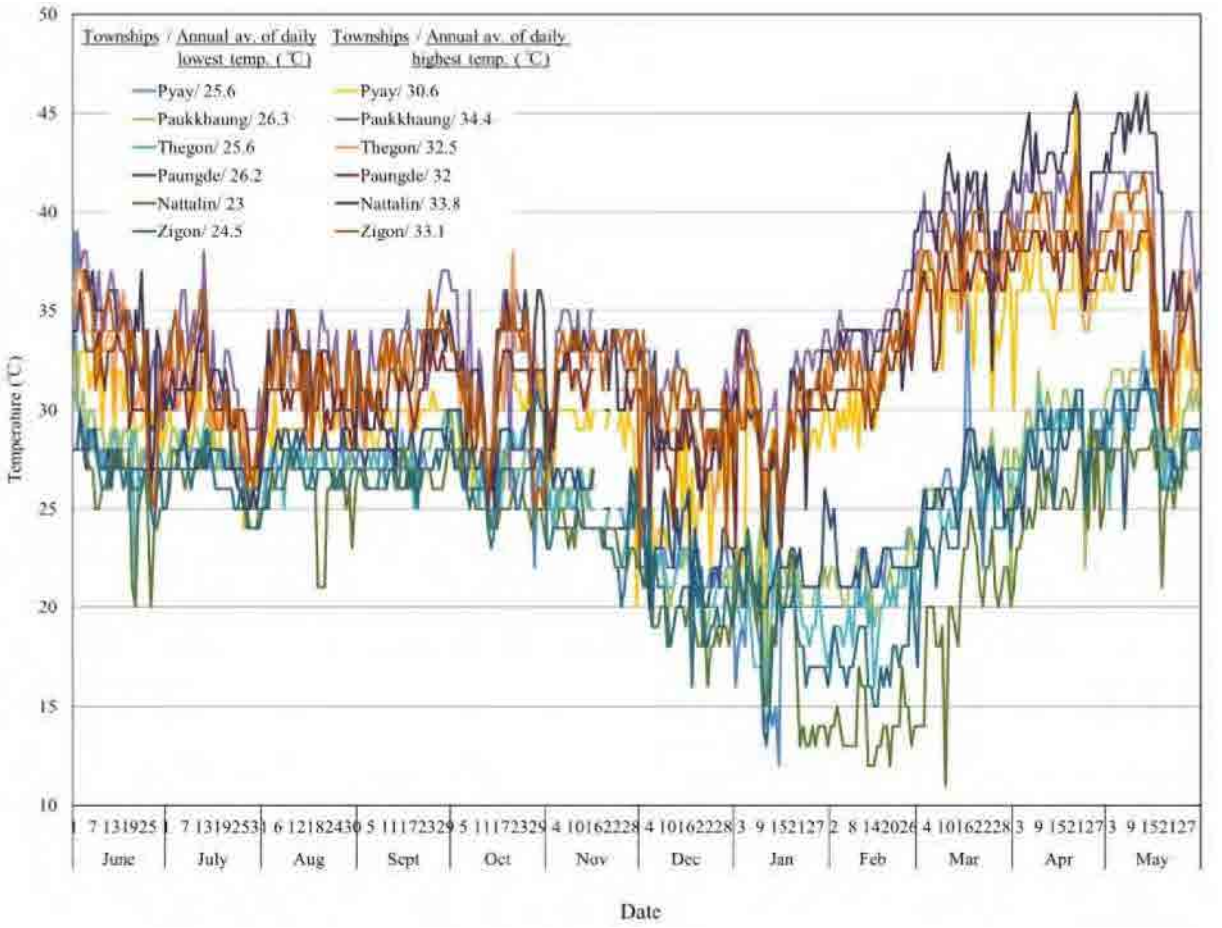


Fig. 1.1.4: The day's lowest and highest temperatures of 2015 in the target townships

CHAPTER 2 RESULTS OF THE SURVERY

2.1 BASE INFORMATION

2.1.1 ATTRIBUTE OF RESPONDENTS

(1) **Age Composition of Respondents**

- Age of the respondents distributed from 21 (Zigon) to 90 years old (Pyay). Major generation of respondents were the age-50s and -40s accounting for 30%, and the age-60s and -20s accounting for 20% had the second largest population.
- The highest population ratio in Nattalin and Pyay was the age-50s, and the 40s in Paungde and Thegon, accounting for 1/3 of the respondents, respectively. The age-40s and 50s were the major respondents in Paukkhaung occupying 1/3 of respondents, respectively. The age-30s, -40s, and -60s accounting for 1/4 of the respondents, respectively, were the major generations in Zigon.

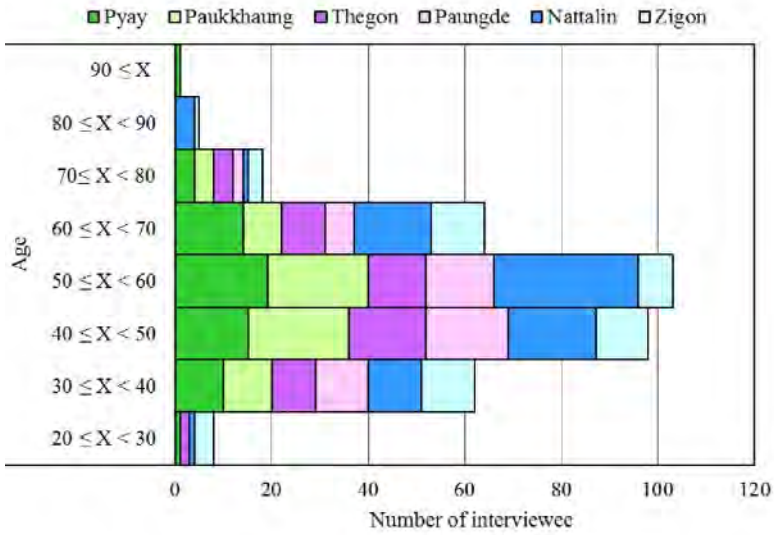


Fig. 2.1.1: Interviewees age distribution in target townships

(2) **Male-female Ratio of Respondents**

- Male occupied 85% of the respondents and most of them were household head.
- Only 40% of the female respondents were household head accounting for 5% of all, which could be assumed as fatherless family.
- Women-headed family ratio was lowest in Paungde (only a few cases), and highest in Pyay (nearly 10%).

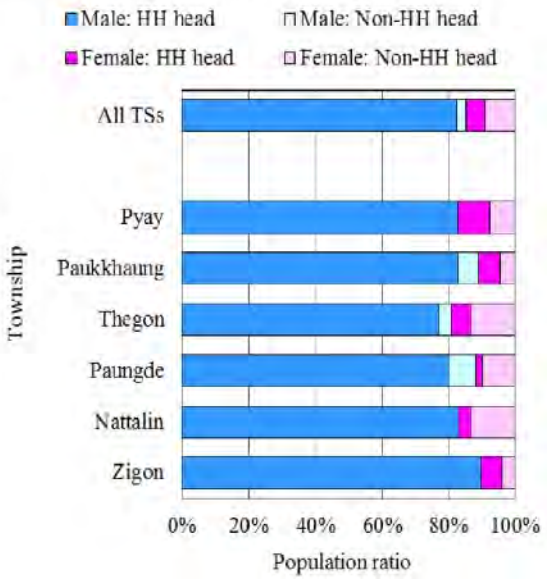


Fig. 2.1.2: Household head ratio in male and female interviewees

(3) Sex Composition of Target Households

- Average family size in the target area was 4.0 persons composed of 1.9 men and 2.1 women, though the sampling number, which ranged from 51 (Zigon) to 85 (Nattalin), which affected the average.
- The family size of respective townships ranged from 3.9 (Paukkhaung) to 4.2 persons (Pyay and Nattalin).
- The female/male ratio ranged from 0.81 (Nattalin) to 1.04 (Pyay). The ratio was lower in the southern four (4) townships accounting for 0.8 to 0.9, and was higher in northern two (2) townships showing equal to or more than 1.0.
- The lower ratio in the southern townships which locate near to Yangon was considered to indicate that high male population originated in the townships worked away from home.

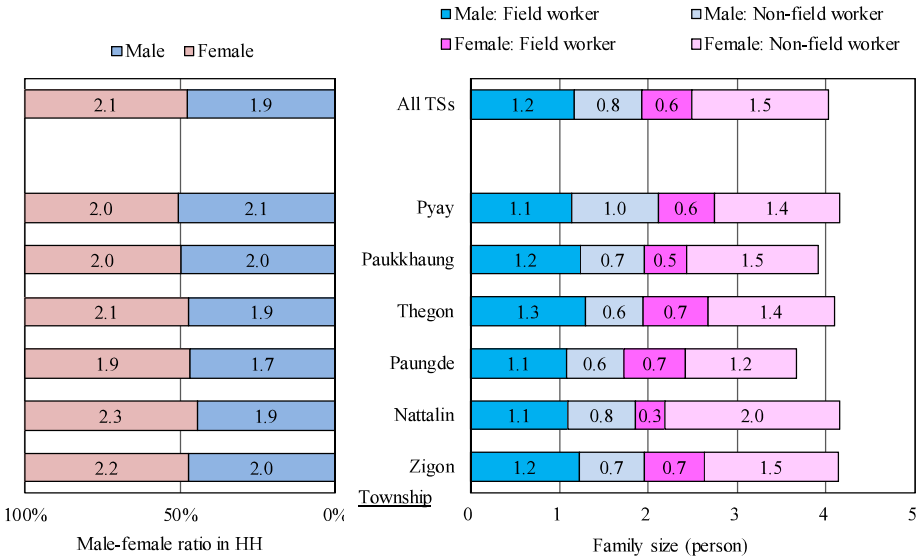


Fig. 2.1.3: Family size and family member who works on a farm (the right), and male-female ratio in household (the left)(Numbers in the figures show personnel/household.)

(4) Educational Background of Respondents

1) Male/Husbands of Female Respondents

- Middle school graduates had the highest population in the male respondents accounting for 45%, and, then, primary and high school graduates occupied 30% and 20%, respectively.
- The middle school graduates in northern (Pyay and Paukkhaung) and central townships (Thegon and Paungde) accounted for 40%, and those in southern townships (Nattalin and Zigon) did for 50%.
- Thegon had the highest ratios of non-educated (5%) and non-regular educated respondents (5%). On the other hand, southern two (2) townships which locates near Yangon had the highest respondents' rate of those who graduated from middle school or higher level of educational organizations.

2) Female Respondents/Wives of Male Respondents

- Primary and middle school graduates had the highest population in the female respondents accounting for nearly 40%, which meant about 10% less of middle school graduates than male.
- The graduate ratios of middle school or more were lowest in central townships (Thegon and Paungde) accounting for 40-50%, were the second lowest (60%) in northern townships (Pyay and Paukkhaung), and were the highest (70%) in southern townships (Nattalin and Zigon).
- The primary school graduate of female was higher than those of male by 10%, and the middle school graduate of female was lower than those of male by the same ratio.
- As a whole the educational background of responded habitants was highest in the southern townships located near to Yangon, and the second highest in the northern townships, and the lowest in the central townships.

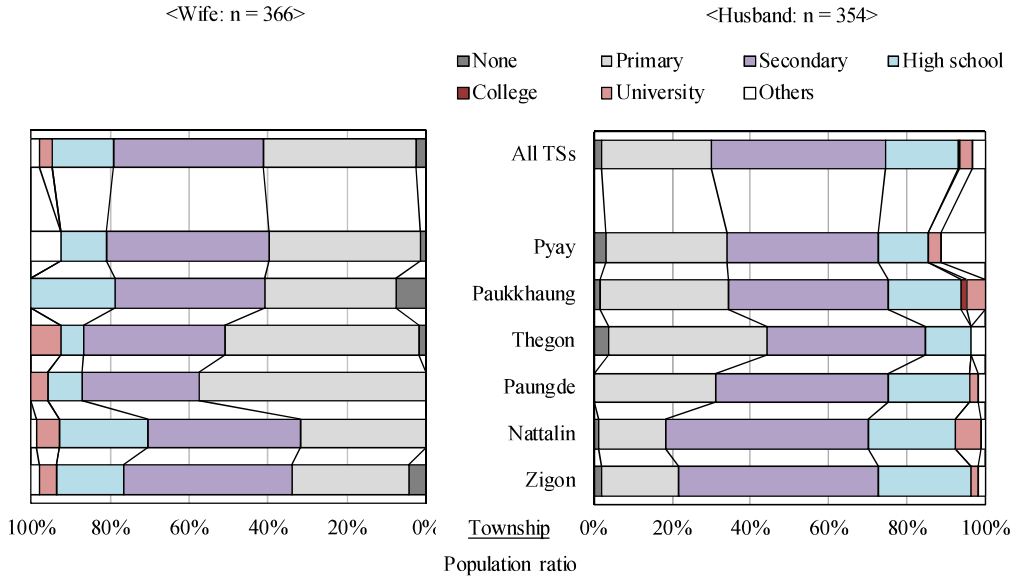


Fig. 2.1.4: Distribution of the education level of the couple in target townships
("n" indicates number of valid response)

2.1.2 COMPOSITION OF FAMILY AND HIRED WORKER FOR FARMING

- Sixty percent of male worked in fields but only 30% of female did in respondent's households, showing the specialization of labor work. Only 10% of female of the households was involved in field works in Nattalin where is most suitable for cropping because of large farmland with high irrigable ratio (Fig. 2.1.3).
- Over 30% of household had permanent employees on average with the variation of 10% (Paungde and Pyay) to 60% (Natallin).
- High labor employment in Nattalin was supposedly caused by the second largest field area (11 acres/HH) and the highest irritability of cultivated fields (over 90%) in the target townships, which enables dual cropping.
- Identically, nearly 40% of households had permanent employees in Zigon where they had medium field area (7 acres/HH) on average and more than 90% of fields were irrigable.
- The largest average field area in Thegon (14 acres/HH) induced more than 30% of permanent employee holding families.
- Not more than 10% of households in northern two (2) townships had permanent employees

because of the smaller average field area and the low irrigable field ratio, seemingly.

- Low household ratio which had permanent employees in Paungde was not known.
- Most of the permanent employees were male accounting for 1.5 persons/HH among all employer households and the female employees were, on the other hand, only 0.1 person/HH.
- Employer households in Paungde, Thegon, and Zigon had about an employee/HH, but those in Pyay and Nattalin had twice of it. Those in Paukkhaung had the average number of employees.
- Pyay had the highest female employees accounting for 0.7 persons/HH among two (2) average employees whereas all employees in Nattalin were male.

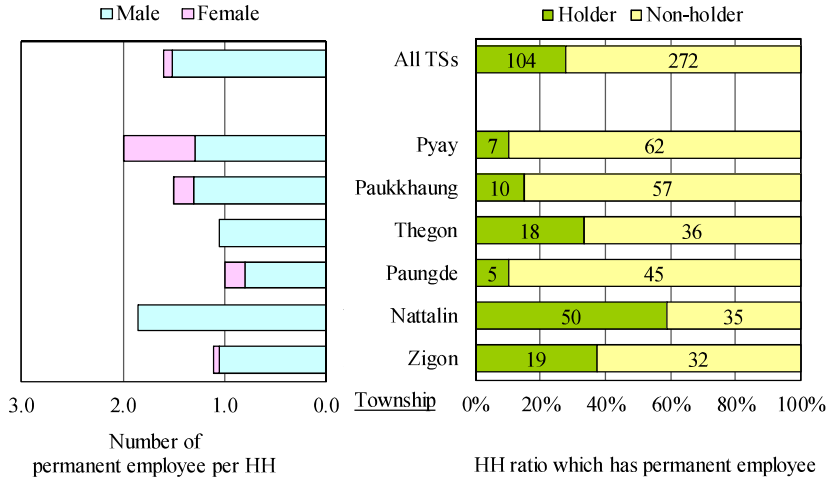


Fig. 2.1.5: Household ratio which had permanent employee(s) (the right), and average number of employee(s) per employer's household (the left) (Numbers in the figure show total household responded.)

2.1.3 FARM LAND AREA AND IRRIGATION

(1) Average Total Farm Land Area

- The average farm land area of the target townships was 9.11±0.39 acres, The smaller area was found in Paukkhaung and Pyay (nearly 7 acres) and the larger one in Nattalin (about 11 acres) and in Thegon (about 14 aces). The areas in Zigon (about 7 acres) and Paungde (about 9 acres) were medium among all.

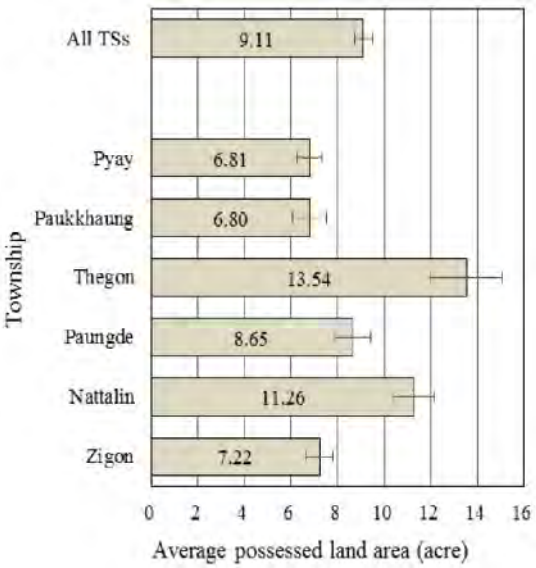


Fig.2.1.6: Average possessed land area in the target townships

(3) Irrigable Land Area and Plot Number of Farm Land

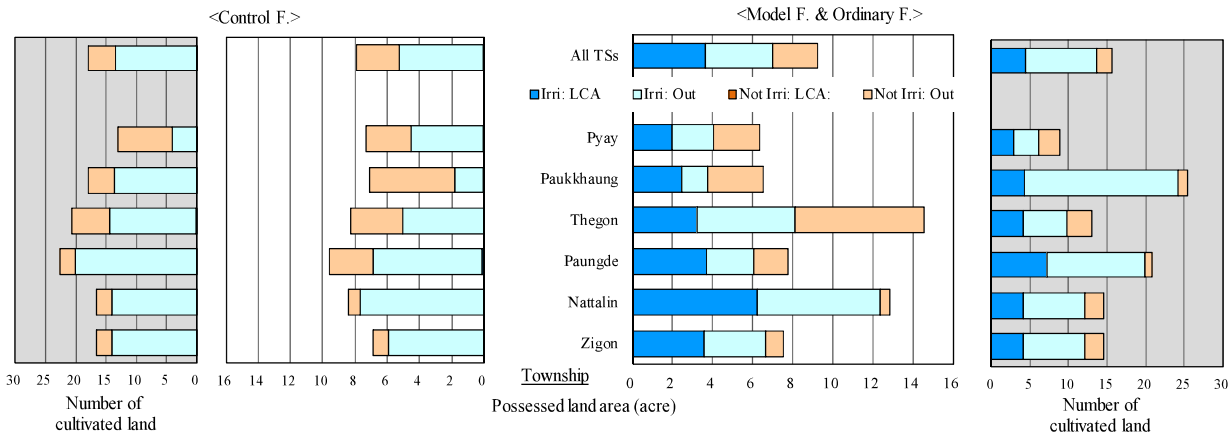


Fig. 2.1.7: Possessed land areas and numbers of cultivated land of farmers inside and outside of the target land consolidation area (Farmers in Thegon-B and Nattalin-B are not included.)

〈Model and Ordinary Farmers〉

The data of Thegon-B and Nattalin-B (11 households in total) where they irrigate the fields by native methods were omitted.

- Average cropping land area of producers who own a part of their land plots in LCA was about nine (9) acres. The smaller area was found in Pyay and Paukkhaung (about 6 acres) and the larger one in Thegon and Nattalin (13-15 acres). The land area inside of LCA where irrigation facilities are provided reached 20 (Thegon) to 50% (Nattalin, Zigon, and Paungde) of their possessed farm land. Irrigable farm land area including one of outside of LCA reached 60 (Thegon, Paukkhaung, and Pyay) to 95% (Nattalin) of their total farm land.
- Producers who possessed a part of their farm land inside of Model area had nine (9) (Pyay) to 25 farm plots (Paukkhaung) in total. Among those, 5 plots, on average, were located inside of LCA including the Model area.
- Therefore, an average of one plot area was as small as 0.6 acres. Especially in Paukkhaung, it was only 0.2 acres/plot, which implied their efforts of land developing seeking advantageous locations. The similar tendency was found in irrigable farm land outside of LCA in Paungde (0.19 acres/plot).
- Producers in Paukkhaung, Paungde and Thegon had not-irrigable large farm land outside of LCA that the average plot area was almost 2 acres.
- The plot area in LCA was largest in Nattalin accounting for 1.5 acres, whereas it was ranged from 0.5 (Paungde) to 0.9 acre (Zigon) in the other townships.
- These findings showed that the model farmers managed many farm plots beside the model fields, and the model fields provided only a part of the model farmers' income. Therefore, the Project should provide appropriate farm management techniques which suit to the target farmer's activities, and the effects should be properly evaluated based on the actual condition.

〈Control Farmers〉

- Average farm land area of farmers who do not possess farm land in model area LCA (Control Farmers) was eight (8) acres/HH which was lower than that of Model and Ordinary Farmers. Nevertheless, the value was similar to those of Model and Ordinary Farmers in the townships except Nattalin and Thegon; the value was affected by large land areas possessed by Model and Ordinary Farmers in Nattalin and Thegon accounting for 1.5 to 1.8 times of those of Control Farmers.
- Irrigable farm land areas possessed by Control Farmers were similar to those of Farmers in the Model areas accounting for 60 (Thegon and Pyay) to 90% (Zigon and Nattalin) of total land area except that in Paukkhaung which accounted for 1/4 of total land area.
- Therefore, difference in effectiveness of mechanization inside and outside of LCA will be presumably a major factor in farming because the other fundamental conditions, farm land area and the irrigable land ratio, are similar between two. The effect of mechanized farming on their income should be warily evaluated.
- The Control Farmers possessed 13 (Pyay) to 23 plots/HH (Paungde) with 0.44 acre/plot on average.
- In Paukkhaung the irrigable plot area of Control Farmers was the smallest in all townships accounting for 0.13 acre as well as that of Model and Ordinary Farmers, which implied their effort to maximize water usage for cropping.

〈Overall views derived〉

- The irrigable farm land ratios were higher in southern three (3) townships than those of northern townships accounting for nearly 70 to 100%.
- Nattalin had advantages in farming such as dual cropping because of the large farm land and high irrigable land area, though the minimum temperature during winter should be cautioned.
- The small farm land and the low irrigable land ratio (30-60%) are disadvantages in northern two townships (Pyay and Paukkhaung). Especially in Paukkhaung, Control Farmers had difficulty in availability of irrigation water, but longer monsoon season mitigated it: monsoon season ends in December, and it is one month longer than in other areas.
- Thegon was specialized with the large upland cropping.

(4) Participation of Respondents to Maintenance of Irrigation Facility

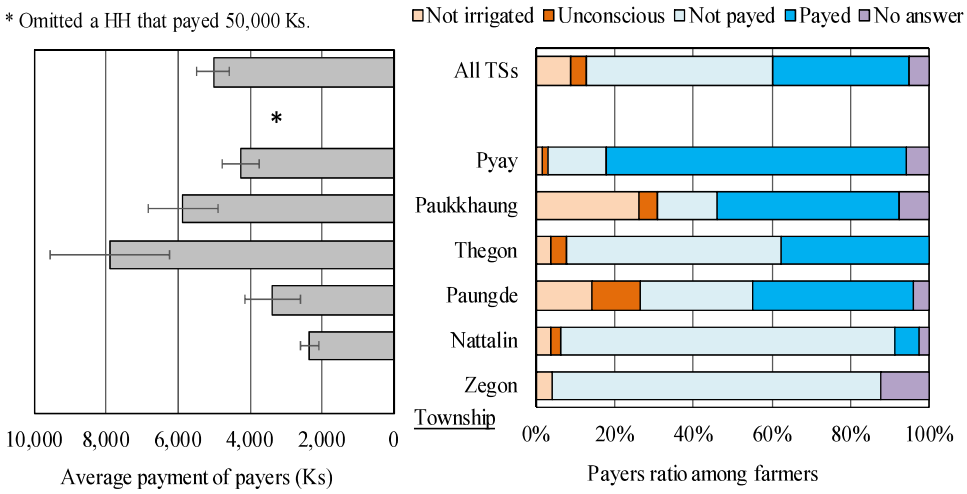


Fig. 2.1.8: Ratios of irrigation fee payers among the surveyed farmers (the right), and the average amount of the payment (the left)

Note1: Bars indicate standard errors.
Note2: 1 HH in Nattalin, which described that he/she paid 5,000 Ks for 25 acres, was omitted since it could not be regarded to be from same population as other respondents.

- Some Control Farmers did not own irrigable field plot, which accounted for nearly 10% of all the respondents. In Paukkhaung, the respondents who owned non-irrigated field(s) accounted for nearly 30%, followed by about 15% in Paungde. In other TSs, the ratio was below 5%. (Fig.2.1.8)
- Only one (1) respondent in Paungde answered that he/she was a member of WUG (Water Users Group), but no specific activity was described in the questionnaire, which had been carried out under WUG in all TSs
- Irrigation water fee, which is 1,950 Ks/acre, is required in general. However, the ratios of respondents who actually paid largely varied from TS to TS. In Pyay and Paukkhaung, which are located in northern part, the ratios of payers were relatively high; namely, 80% and 50%, respectively. In Paungde and Thegon, which are located in the middle part, the ratios were lower than those in TSs in northern part; both were about 40%. Then, in Nattalin and Zigon, which are in southern part, the ratios of payers were considerably low; only 5% of the respondents in Nattalin paid irrigation fee, and no one in Zigon. (Fig.2.1.8)
- Overall average of paid irrigation fee in all TSs was 5,000 Ks/HH, which was calculated only considering those who actually paid irrigation fee (Fig.2.1.8). The irrigation fee paid was from 2,350 Ks/HH (Nattalin) to 7,890 Ks/HH (Thegon). There seemed a certain tendency that the paid amount of irrigation fee in southern part was smaller than those in three (3) TSs in northern part. (Fig.2.1.8)

- The payers' ratio of irrigation fee was not indirect proportion to irrigated area ratio, but actually it was inversely proportion. In other words, more ratio of irrigated area, lower ratios of payers' ratio of irrigated field users and paid irrigation fee per HH. (Fig.2.1.9)
- The above situation indicated that the farmers in north TSs had to shoulder more financial burden for obtaining irrigation water, compared to those in southern part, since northern part, which is located near to central dry zone, had fewer rainfall rather than in southern part. Whereas, the farmers in southern part, where relatively more rainfall was available, used irrigation water with considerably small burden or no burden. The farmers in TSs in the middle TSs, Thegon and Paungde, seemed to be in medium condition between north two (2) TSs and south two (2) TSs

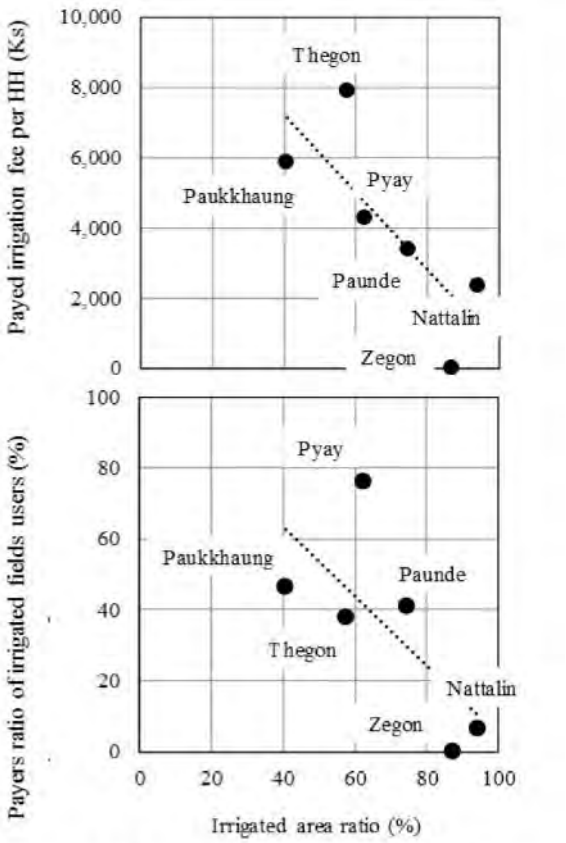


Fig. 2.1.9.: Payers ratio of irrigated field users (the below) and paid irrigation fee per household (the above) in relation to the irrigated area ratio of the surveyed farmers' fields

- Although it might be because a person who had difficulty with obtaining irrigation water was more sensitive to have the benefit of irrigation water, it was also partially related to the situation of irrigation canal improvement (enough irrigation water had not been available) that the farmers have had so far. It is required to investigate the background which led to the condition indicated by Fig. 2.1.9.
- With the present condition, there is no system or practice for irrigation water users to be involved to maintenance and management of irrigation facilities. However, once the prototype how to participate in maintenance and management activities on their own initiative could be established, it would lead to improvement of the current condition such as inappropriate drainage system or no-availability of tertiary canal.

2.2 AGRICULTURAL PRODUCTION

2.2.1 CROPS GROWN IN THE TARGET TOWNSHIPS

DOA in West Bago had surveyed grown crops in the region, and listed 40 crops in Table 2.2.1. Nevertheless, the respondents of the Survey nominated only 15 crops among them.

Table 2.2.1: Grown crops in the target townships listed by DOA, West Bago (Shadowed crops were not grown by the respondents in the Survey.)

1. Paddy	11. Butter bean	21. Garlic	31. Banana
2. Black gram	12. Cow pea	22. Betel leave	32. Coconut
3. Green gram	13. Soybean	23. Flowers	33. Black pepper
4. Sesame	14. Corn	24. Roselle	34. Toddy palm
5. Groundnut	15. Kenaf	25. Okura	35. Betel nut
6. Maize	16. Sunflower	26. Water cress	36. Bastard myrobalan
7. Pigeon pea	17. Niger seed	27. Tomato	37. Guava
8. Chick pea	18. Onion	28. Radish	38. Papaya
9. Lab lab bean	19. Chili	29. Cabbage	39. Bamboo
10. Bocake (Cow pea)	20. Coriander	30. Sugarcane	40. Fire wood tree
			41. Others

Respective crop grower's ratios among two groups each, Model and Ordinary Farmer group and Control Farmer group, in each township were obtained by every cropping season, and the cumulative growers ratios were shown in Fig. 2.2.1.

〈Inside of LCA〉

- Almost all Model and Ordinary Farmers grew monsoon paddy in LCA
- In winter season, black gram was grown in Nattalin (20% of growers) and Zigon (4%), and green gram in Pyay (3%). Nothing was grown in the other townships.
- Paddy was only summer crop in Pyay, Paungde, and Paukkhaung. The growers were nearly 10% or less in Pyay and Paungde, but nearly 70% in Paukkhaung. Cropping was not done in the other townships.
- Only one Control Farmer had a field in LCA, so that it was not appropriate to discuss the trend of cropping.

〈Outside of LCA〉

- Nearly 70 to 80% of Model and Ordinary Farmers grew monsoon paddy, whereas it was grown by almost all Control farmers.
- In northern two townships, Pyay and Paukkhaung, nearly 50 to 70% of respondents grew sesame, and in the two townships and Thegon, 20 to 40% of respondents did groundnuts.
- Otherwise, nearly 30% each of Control Farmers grew green gram in Pyay and pigeon pea in Paukkhaung.
- Black gram was a major winter crop in southern three (3) townships, Paungde, Nattalin, and Zigon, accounting for 30 (Model and Ordinary Farmers in Nattalin) to 80% (Control Farmers in Zigon) of growers.
- In northern townships, growers who harvested sugarcane accounted for 30 (Control Farmers in Paukkhaung) to 40% (Model and Ordinary Farmers in Thegon). The ratio supposed to be nearly double because it generally takes two years until harvest.

- In Pyay where sugarcane growers were not recorded, green gram growers accounted for 15 (Control Farmers) to 30% (Model and ordinary Farmers).
- No respondent grew crop in summer season in Nattalin and Zigon. In the other townships, major summer season crop was paddy, but the grower's ratio was nearly 30% or less.
- Onion was only vegetable recorded, which was grown in summer by 5% of Control Farmers in Thegon.

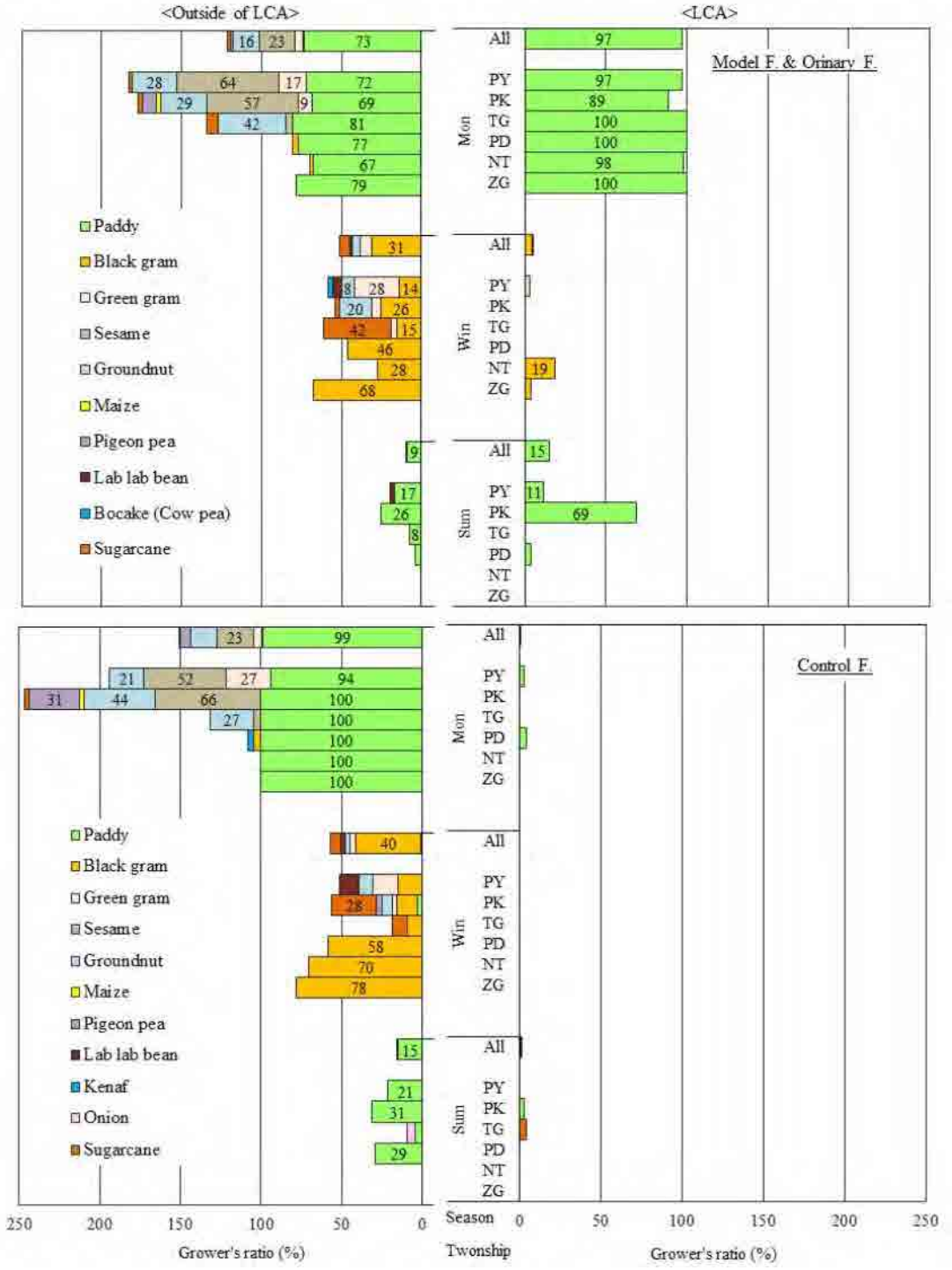


Fig. 2.2.1: Cumulative ratio of respective crop growers in each township in different cropping seasons
(Numbers in bars indicate percentage of growers among all respondents in each township.)

〈**Overall Findings**〉

- In northern two (2) townships, Pyay and Paukkhaung, major summer crops were paddy (over 70% of respondents, and 25%), sesame (50 – 70%), and groundnut (20 – 40%) in descending order.
- In Thegon, over 80% of respondents grew paddy, and the groundnut growers accounted for the second largest ratio (30 – 40%).
- In winter cropping season, sugarcane and green gram were mainly grown in northern three (3) townships, but the growers who harvested them were 40% or less.
- In southern three (3) townships, only winter crop was black gram accounted for 30 – 80% grower's ratio.
- In summer cropping season, major crop was paddy except two southern townships, Nattalin and Zigon, where nothing was cultivated, but the grower's ratio was 30% or less except Model and Ordinary farmers who grew it at the rate of 70% in LCA.

2.2.2 CROPPING AREA OF CULTIVATED CROPS

Average areas of respective cultivated crops per producer in each township were obtained and the cumulative cropping areas were shown in Fig. 2.2.2.

〈**Inside of LCA**〉

- The average area of monsoon paddy was 3.6 acres/HH with variation from 1.0 (a Control Farmer in Pyay) to 6.3 acres/HH (Model and Ordinary Farmers in Nattalin).
- On the other hand, the summer paddy was grown in smaller areas which were 1.0 (Model and Ordinary Farmers in Paungde) to 2.6 acres/HH (Model and Ordinary Farmers in Pyay and Paukkhaung) on average.
- Green gram and black gram were grown as winter crop by a few Model and Ordinary Farmers with the area of 5.0 (in Pyay) and 4.3 acres/HH (in Nattalin), respectively.
- In Thegon, a grower grew sugarcane in LCA with the area of 4.0 acres/HH.

〈**Outside of LCA**〉

- The monsoon paddy was grown with the area from 2.5 (Pyay) to 9.0 acres/HH (Nattalin) on average, and summer paddy with that from 1.5 (Paukkhaung) to 5.3 acres/HH (Pyay).
- Average cropping area of sesame in monsoon season was rather small accounting for 1.9 (Control Farmer in Paukkhaung) to 7.0 acres/HH (Thegon).
- Summer season crops grown in relatively large area other than sesame were black gram (8.0 acre/HH in Nattalin) and groundnut (5.5 acre/HH in Thegon).
- Regarding winter crops, black gram, which was popular especially in southern townships, was grown with the area from 1.0 (Paukkhaung) to 6.8 acres/HH (Nattalin).
- On the other hand, sugarcane was mainly grown in Thegon and Paukkhaung with the average area from 1.5 (outside of LCA in Paukkhaung) to 6.8 acres/HH (outside of LCA in Thegon).

〈Overall Findings〉

- Respective crop areas outside of LCA were mostly larger than those of inside corresponding to possessed land area in each location.
- Crop variation was smallest in Nattalin and Zigon counting only two (2) crops, paddy and black gram, and largest in Paukkhaung where several crops were grown in monsoon and winter seasons.

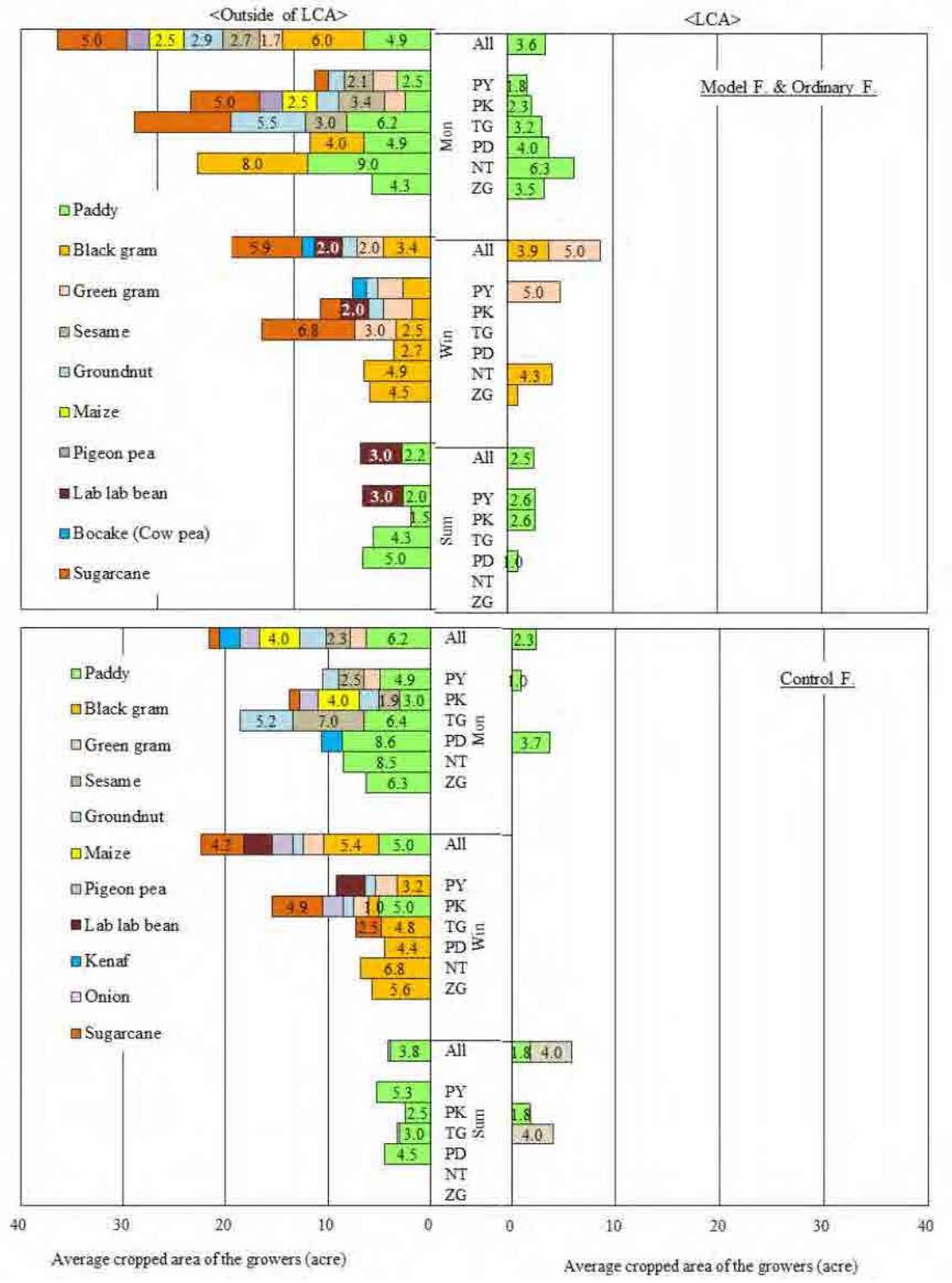


Fig. 2.2.2: Average area of respective crops per grower in each township in different cropping seasons
(Numbers in bars indicate average acreage per grower in each township.)

2.2.3 CROPPING PATTERN

Major grown crops in monsoon, winter, and summer seasons were asked together with required work steps along the time. Then, grower's ratios which accomplished respective work procedures were calculated every half month, and cumulative frequencies of accomplished work steps in each township were figured.

〈Overall Findings〉

- Summer crops were grown in Pay and Paukkhaung in addition to monsoon and winter crops, but only monsoon and winter crops in the other townships.
- That is to say, seven (7) crops were noted as major crops in Pyay and Paukkhaung, three (3) in Thegon, and two (2) in Paungde, Nattalin, and Zigon.
- Each cropping interminably continued up to nine months in the northern townships, and the farther south it was grown, the shorter the term was.
- Therefore, it is presumably harder to control pests and diseases in northern townships than in southern ones.
- Present cropping patterns in northern townships characterized by many crop varieties and interminable cropping terms, indicated they minded to take the risk-hedge in cropping as well as the hardness to make accordance of farmers on uniform cropping for effective irrigation water use.
- All growers harvested all cultivated crops in middle and southern townships, but nearly 20% of growers did not harvest the grown crops in Pyay and Paukkhaung; nearly 20% growers did not harvest monsoon groundnut in Pyay and 20 to 25% of growers did not do summer paddy, monsoon sesame and monsoon paddy in Paukkhaung. Probably, the natural circumstances easily turn to unfavorable cropping conditions in the areas.

〈Pyay〉

- Most of sowing for monsoon paddy started from late June and the harvest finished in late January both inside and outside of LCA. Nevertheless, a few growers started sowing from early February to late March.
- Summer paddy was grown only inside of LCA among the surveyed producers. The crop sowing started in early February and ended in early July: growing term was one and a half months, which was shorter than in Paukkhaung
- Black gram in winter cropping season was sown from early September and the harvest finished in early April: growing season was almost four (4) months, which was longer than in Zigon.
- Green gram had long cropping terms both in monsoon and winter seasons, which meant the plant could be sown as far as some precipitation was available. That is to say, it was sown from late April to early December, so that it could be harvested from early July to early March.
- Sesame was grown in monsoon season sowing from early April to June, and harvesting from late July to late October.
- Groundnut was mostly sown in June and was harvested in early October, though a few grower planted in early November and harvested in early February.

〈Paukkhaung〉

- Sowing (broadcasting and/or transplanting) for monsoon paddy started from late June and the harvest ended in late January in LCA as well as the majority did outside of LCA. Meanwhile, a few producers started sowing from early March. The start of the sowing was similar to that in Pyay. It seemed that the producers grew paddy when the cropping conditions were ready.
- As soon as the monsoon paddy harvest finished, sowing for summer paddy started in early February and the harvest finished in early August, which suggested immediate move to monsoon paddy cropping outside of LCA. Nearly 1/4 of growers did not harvest, which implied the failure of the cropping in the season.
- Monsoon sesame had the second largest growers next to the monsoon paddy outside of LCA. The sowing started in early April and most of growers finished harvesting in late September though a few growers continued it until late January.
- Groundnut and pigeon pea in monsoon cropping were sown nearly in March. The pigeon pea harvest started in late December and finished in late January consuming almost eight (8) months crop duration. Whereas, groundnut mostly finished harvesting in early October though it continued until late January in a few cases.
- Groundnut was grown in winter season, too, which started sowing from early October and finish harvesting in early April though the growers number was small.
- Winter black gram sowing started in late October and the harvest ended in early December as well as in the other townships.

〈Thegon〉

- Cow dung application for monsoon paddy started from early April, but sowing (transplanting or broadcasting) started from late June and the harvest ended in late December to early January.
- Winter black gram sowing started early November and the harvest ended in early April, so that the cropping was longer by a half month than in Paungde, Nattalin, and Zigon.
- Farm work steps for monsoon groundnut cropping was done just before respective farm works for monsoon paddy cropping, which meant that the sowing started in early June and the harvest ended in early October.

〈Nattalin and Paungde〉

- Terms of each field work step for monsoon paddy and winter black gram cropping were similar between inside and outside of LCA.
- Cow dung application for monsoon paddy started from around March, but the sowing (transplanting and broadcasting) started from late June and the harvest ended in late December.
- Winter black gram sowing started from early November and the harvest ended in late March.

〈Zigon〉

- Cow dung application for monsoon paddy started from March, but the sowing (transplanting and/or broadcasting) did from late June and the harvest ended during late November to early January.

- Winter black gram sowing started from late October and the harvest ended in late March.
- Terms of respective steps of farm works for monsoon paddy was longer by a few months in LCA than those in outside of LCA, which probably indicated more irrigation supply in LCA though black gram was not grown in winter season there.

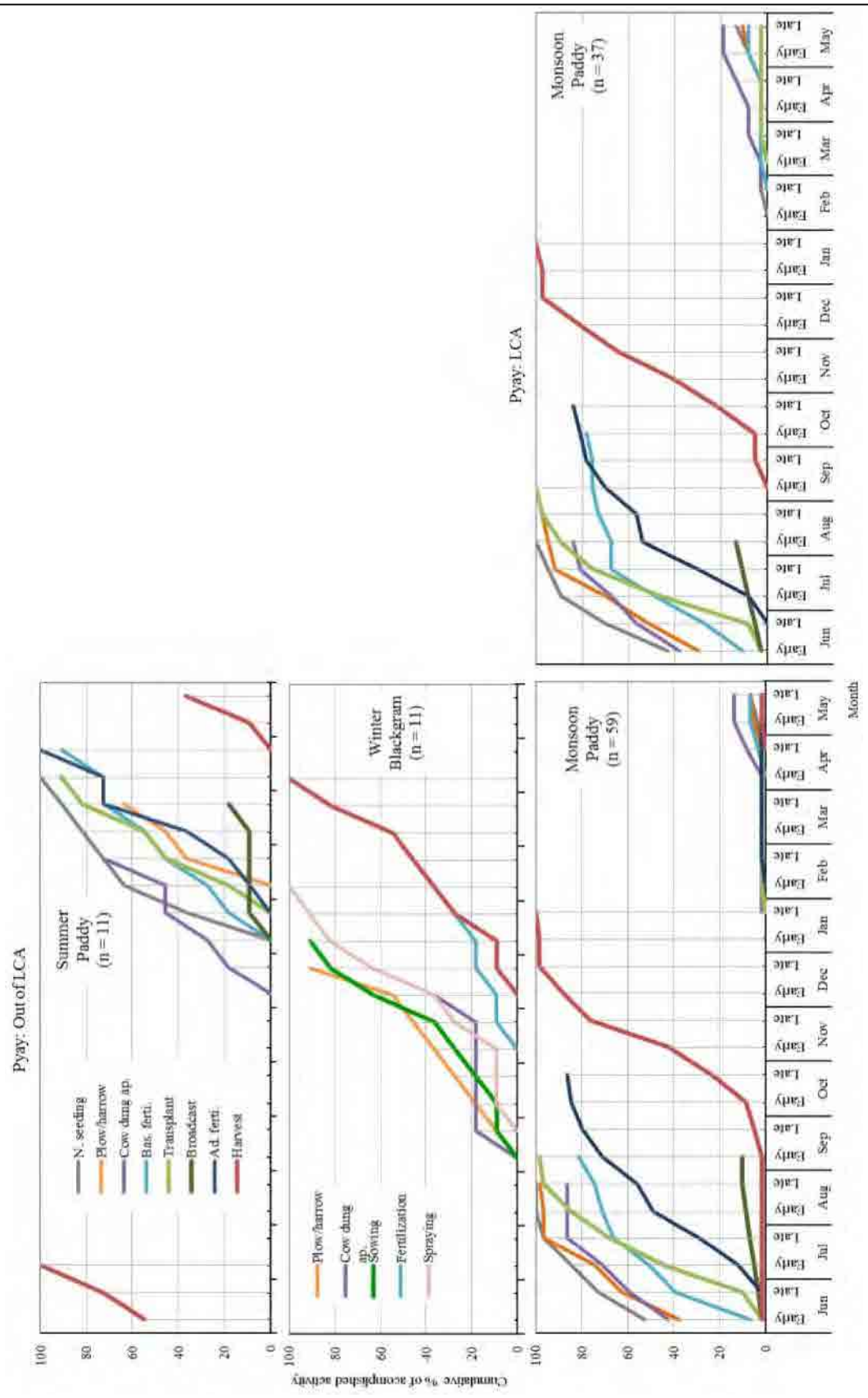


Fig. 2.2.3: Cropping seasons and cumulative frequency of accomplished tasks of each cropping in Pyay
(LCA: Monsoon Paddy)
(Out of LCA: Monsoon Paddy, Winter Black gram, and Summer Paddy)

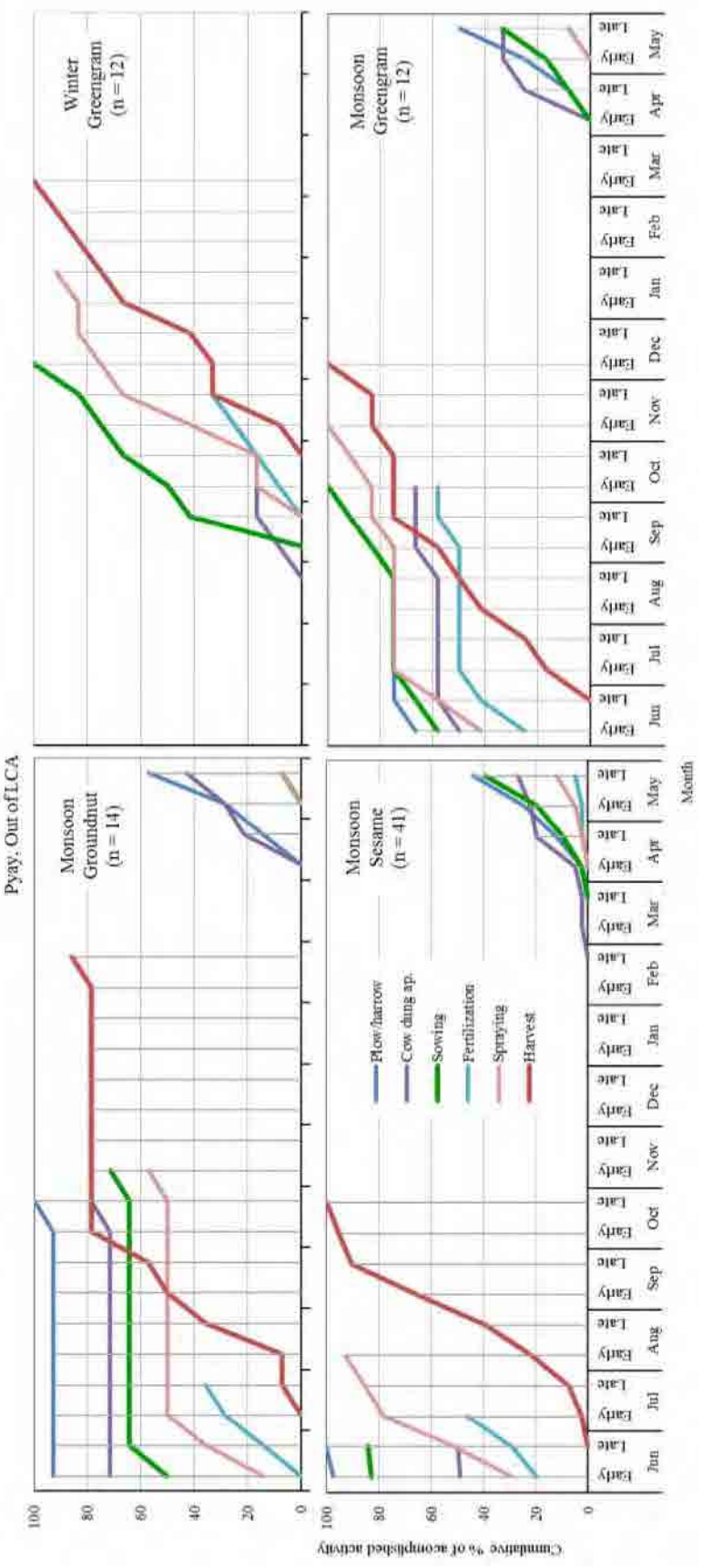


Fig. 2.2.4: Cropping seasons and cumulative frequency of accomplished tasks of each cropping in Pyay (Out of LCA: Monsoon Sesame, Monsoon Groundnut, Monsoon Green gram, Winter Green gram)

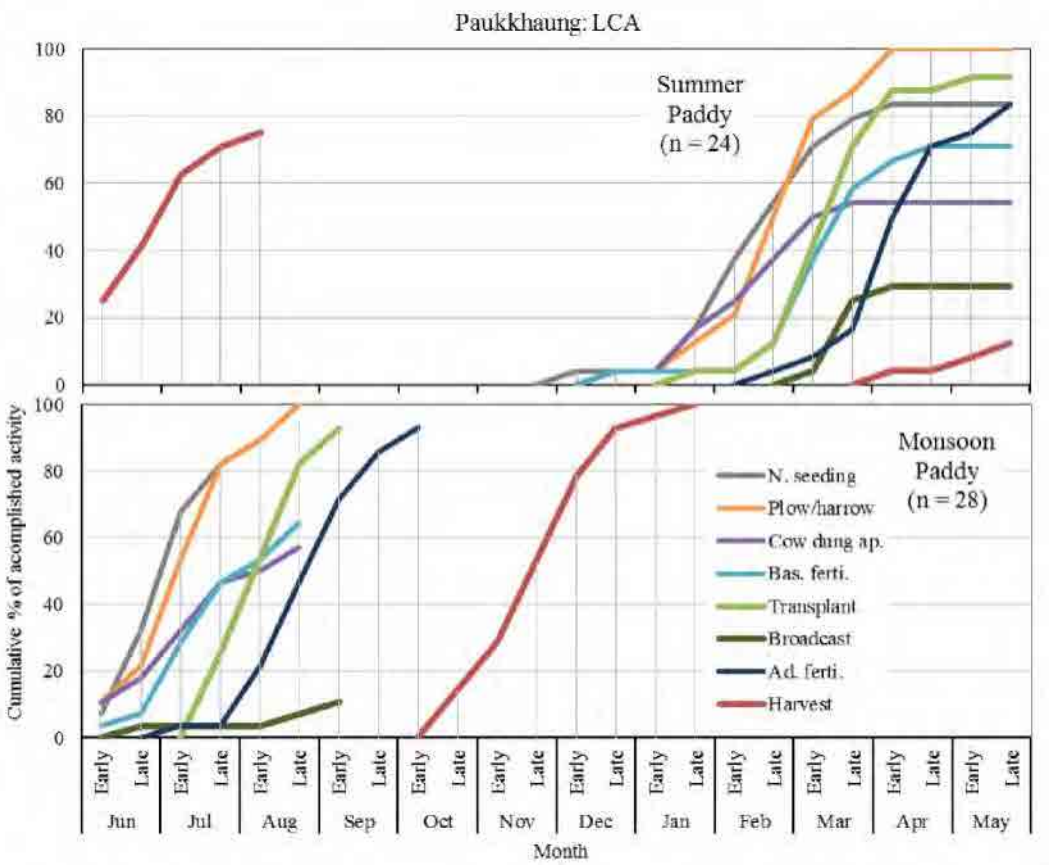


Fig. 2.2.5: Cropping seasons and cumulative frequency of accomplished tasks of each cropping in Paukkhaung (LCA: Monsoon Paddy, Summer Paddy)

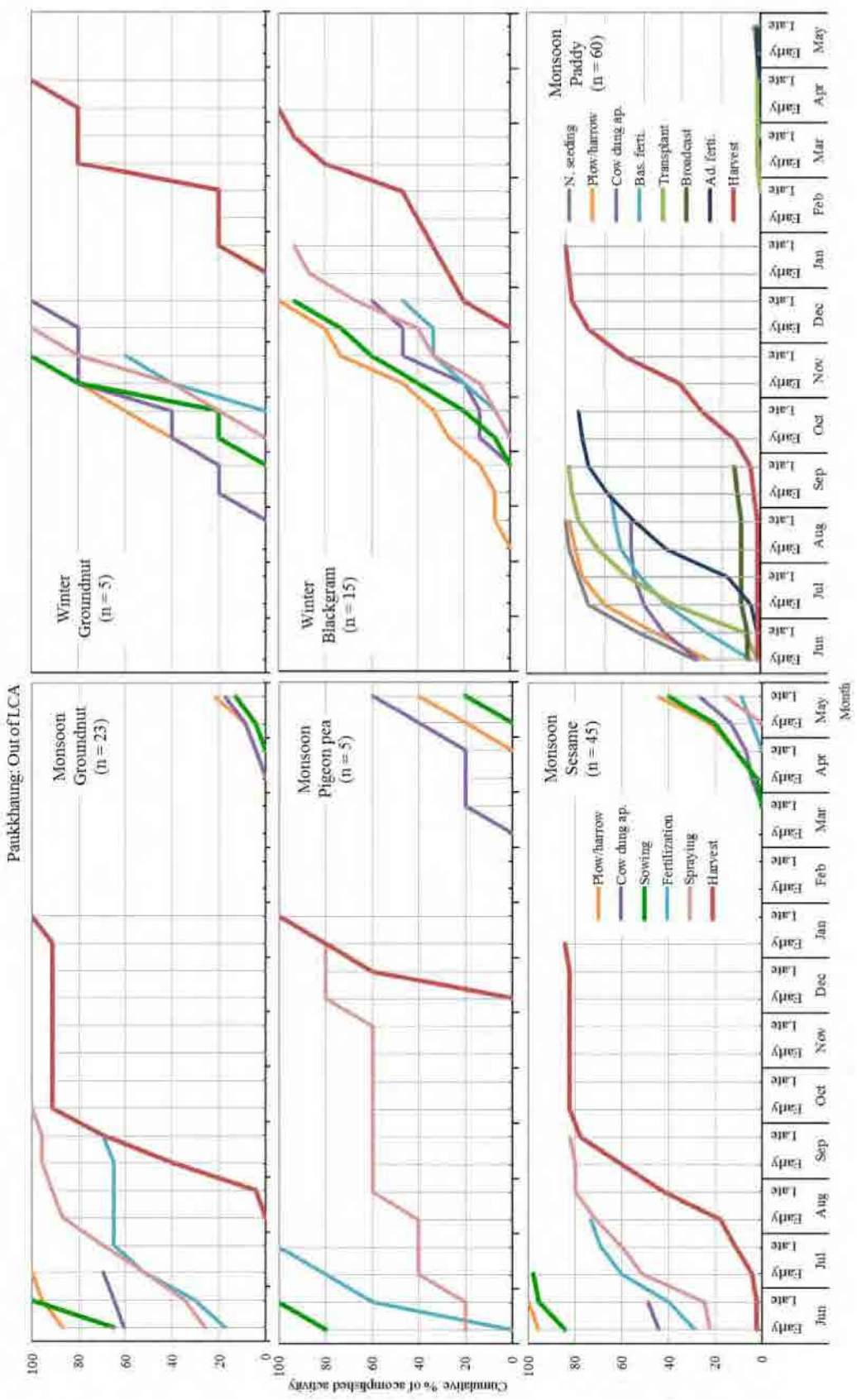


Fig. 2.2.6: Cropping seasons and cumulative frequency of accomplished tasks of each cropping in Paukkhaung (Out of LCA: Monsoon Sesame, Monsoon Pigeon pea, Monsoon Groundnut, Monsoon Paddy, Winter Black gram, and Winter Groundnut)

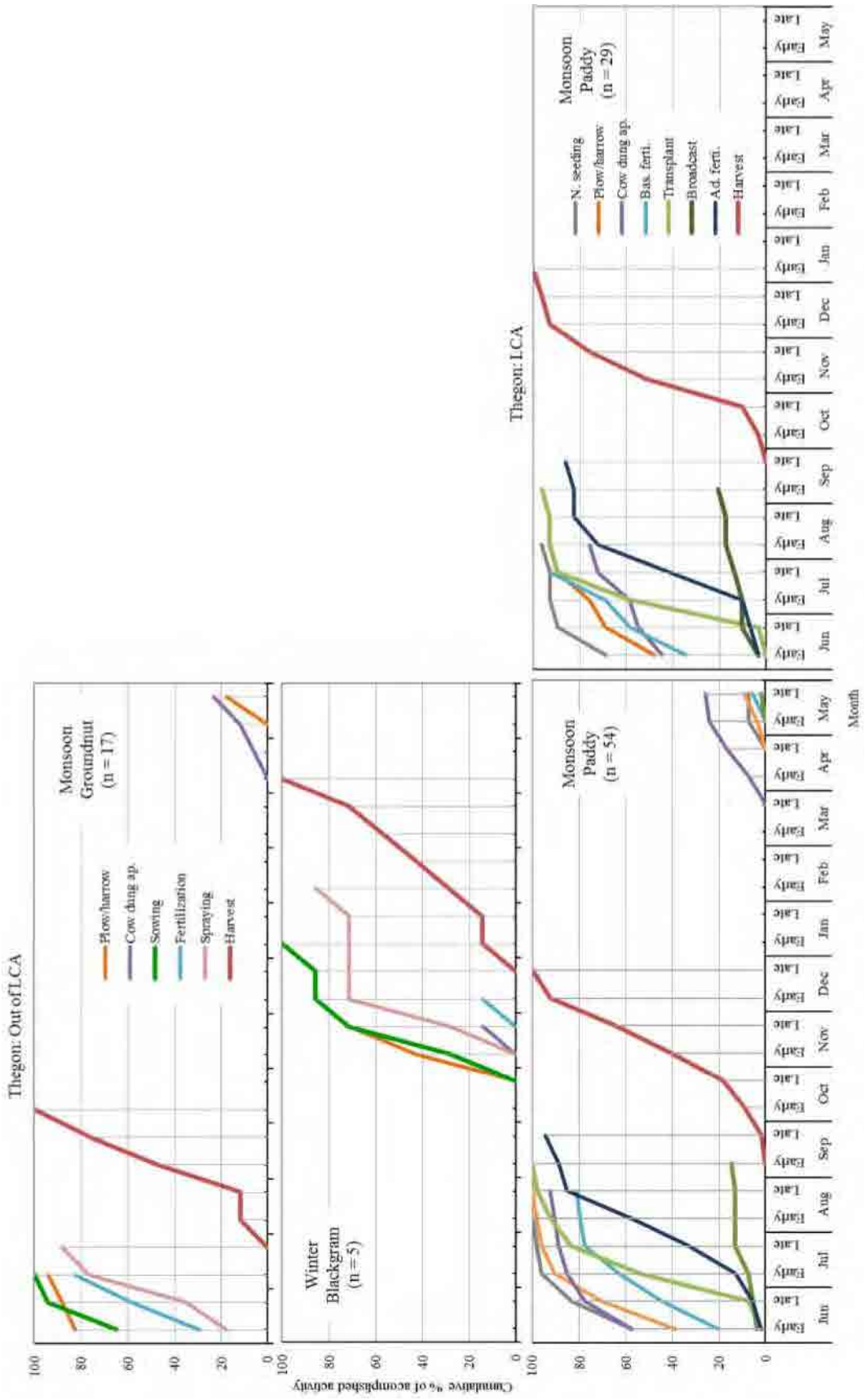


Fig. 2.2.7: Cropping seasons and cumulative frequency of accomplished tasks of each cropping in Thegon (LCA: Monsoon Paddy)
(Out of LCA: Monsoon Paddy, Winter Black gram, and Monsoon Groundnut)

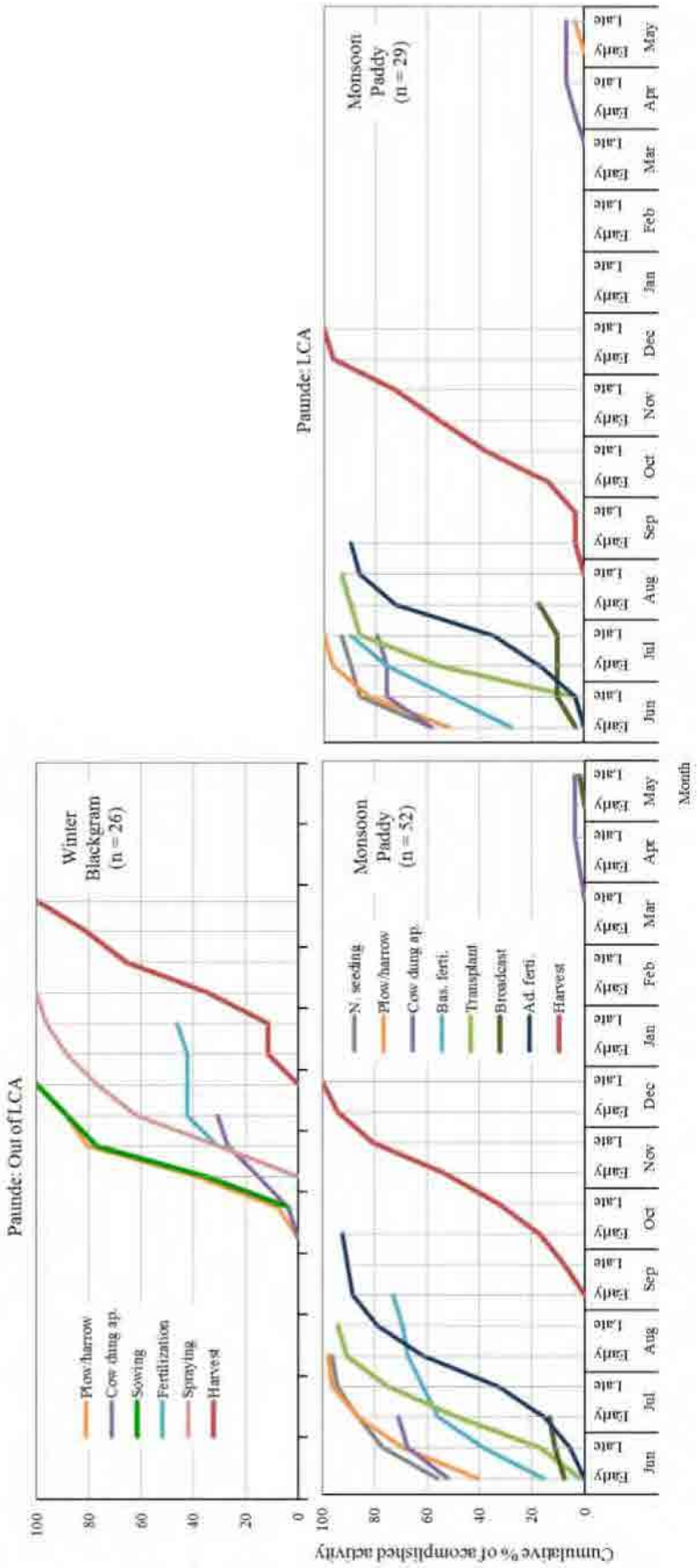


Fig. 2.2.8: Cropping seasons and cumulative frequency of accomplished tasks of each cropping in Paungde
(LCA: Monsoon Paddy)
(Out of LCA: Monsoon Paddy and Winter Black gram)

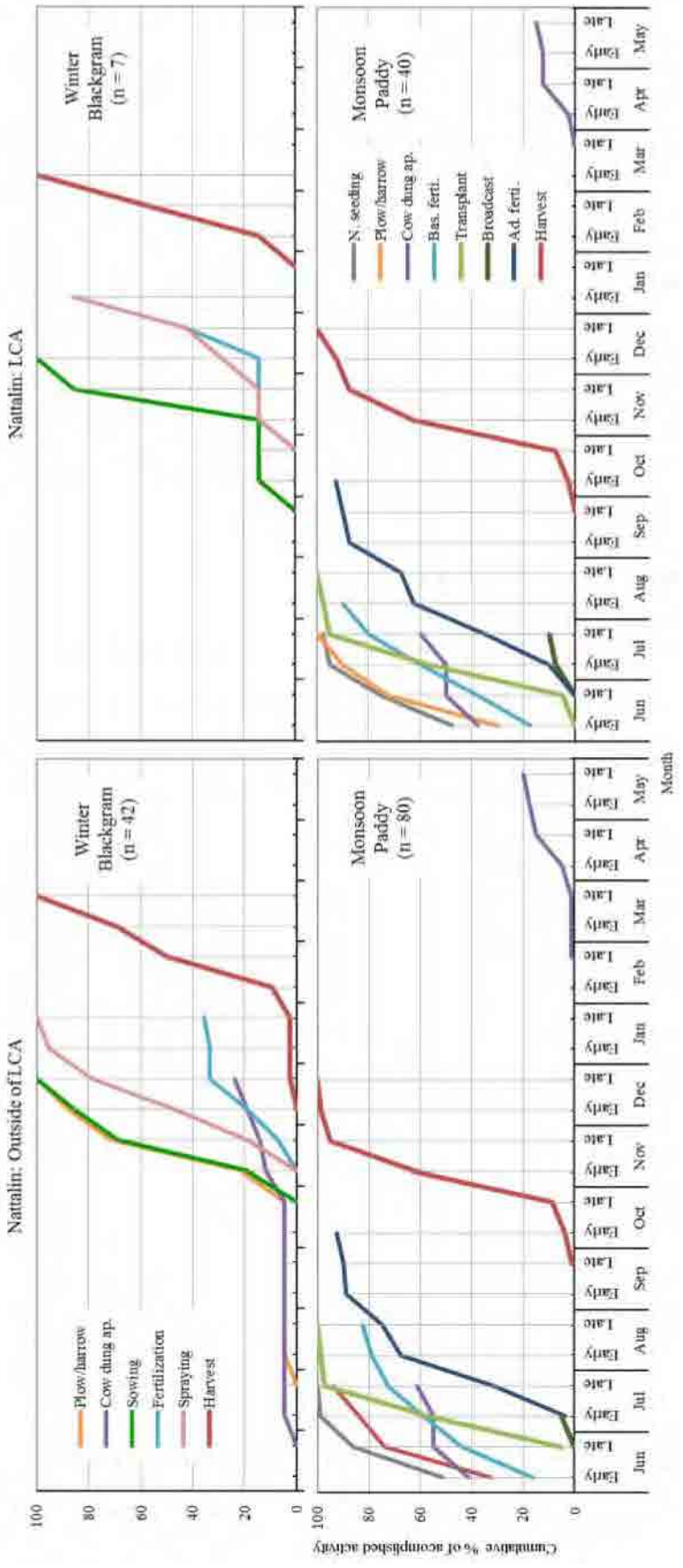


Fig. 2.2.9: Cropping seasons and cumulative frequency of accomplished tasks of each cropping in Nattalin (LCA: Monsoon Paddy and Winter Black gram) (Out of LCA: Monsoon Paddy and Winter Black gram)

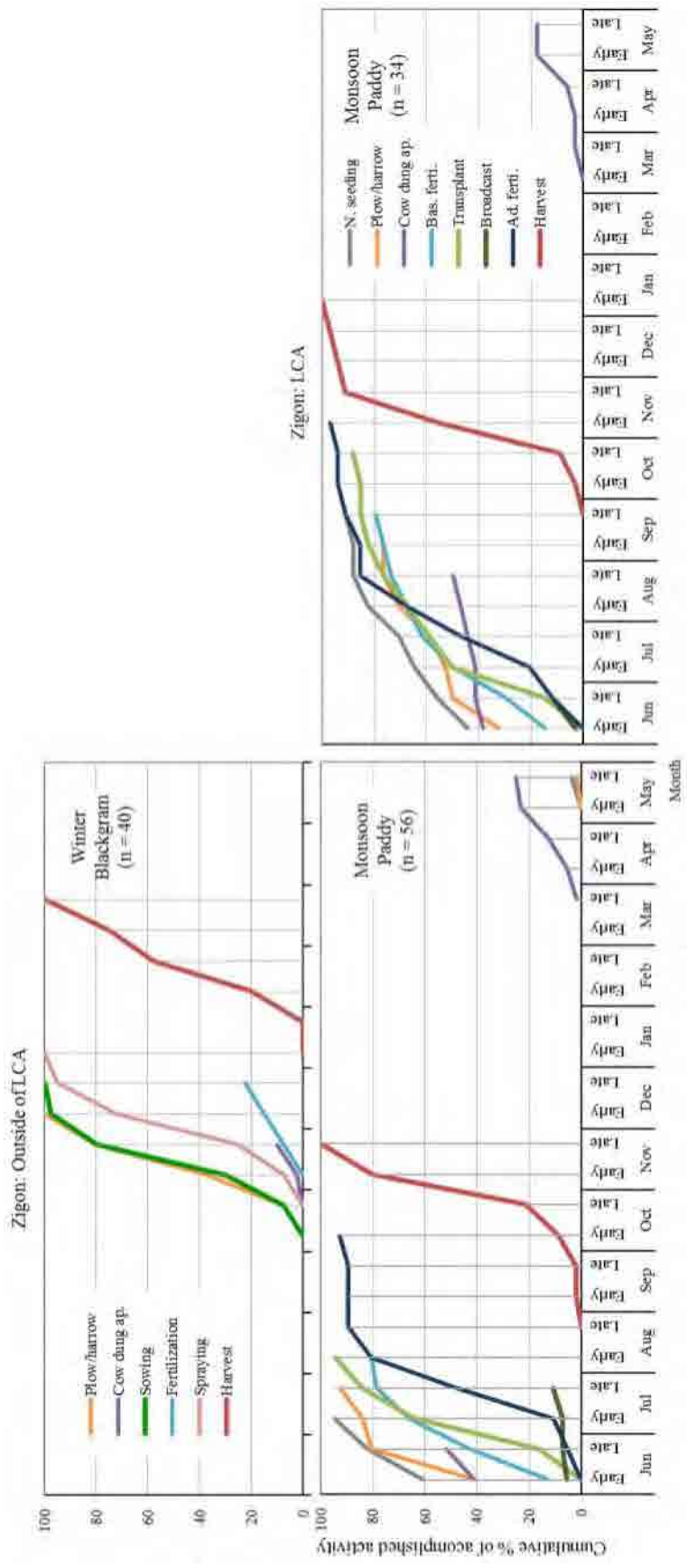


Fig. 2.2.10: Cropping seasons and cumulative frequency of accomplished tasks of each cropping in Zigon (LCA: Monsoon Paddy)
(Out of Monsoon Paddy and Winter Black gram)

2.2.4 MAJOR CROP VARIETY

Crop varieties that the respondents used in the fixed period (June 2015 – May 2016) were surveyed, and each variety's user ratios of respective townships were calculated as percentage of the user number divided by the cumulative grower's number which involves plural variety users counted redundantly, in each site. Cumulative ratios of respective variety users in each township were figured according to cropping season. Some of the variety names are not registered but they are conventionally called among producers as described in the figures.

(1) Paddy

- Thirty tree (33) varieties were used in all.
- Total number of variety users (n) of six (6) townships in monsoon and summer seasons were 557 and 56 persons, respectively. Winter paddy cropping was few (Fig. 2.2.11), and only one respondent (Yadanar toe user) existed.

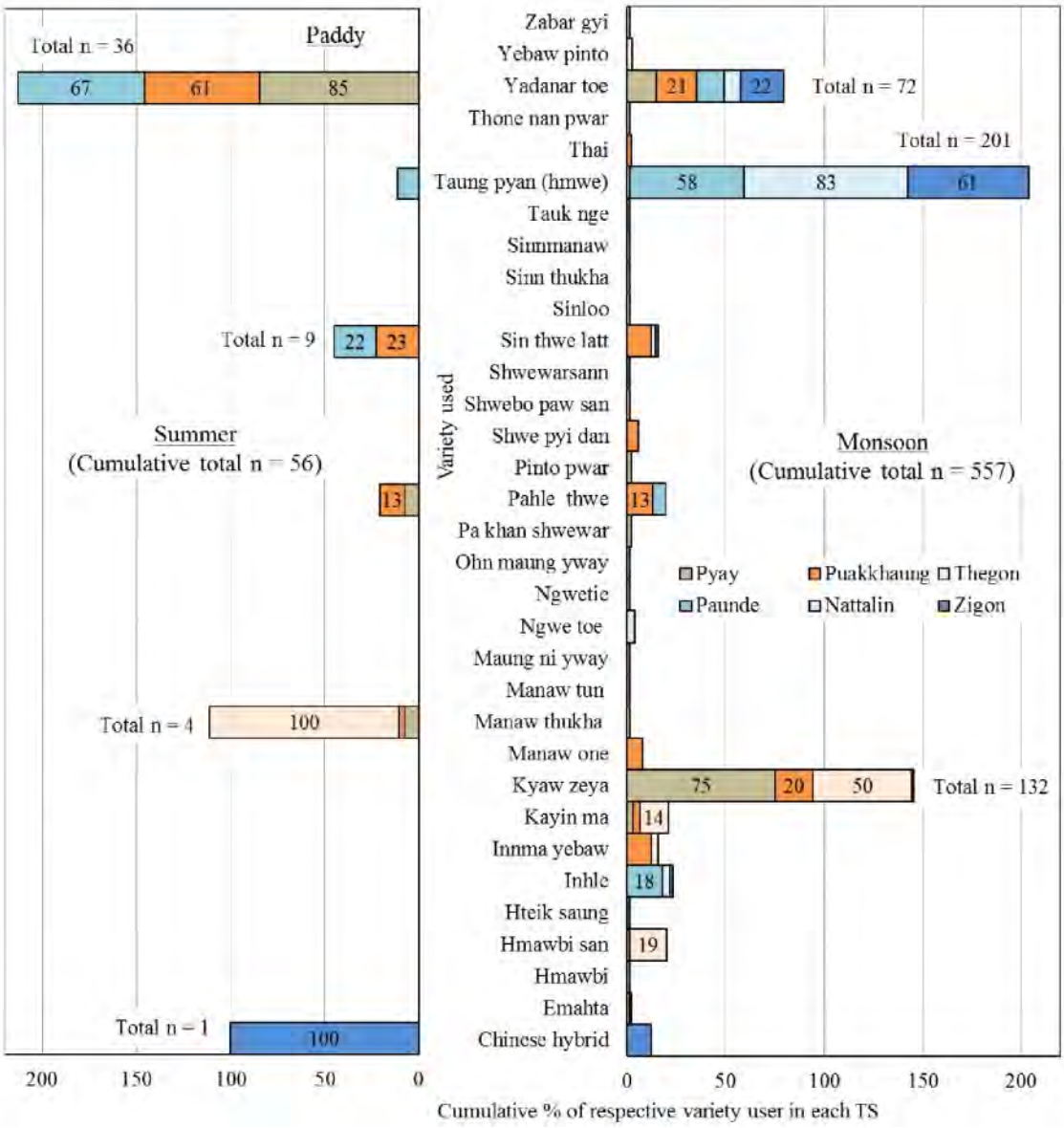


Fig. 2.2.11: Cumulative user ratios of respective paddy varieties used in target townships

- In summer, five (5) varieties were used in Nattalin whereas 13 varieties were used in Paukkhaung and Thegon. In winter, the highest number used was four (4) in Paukkhaung, and the minimum was nil in Nattalin.
- A variety of Taung pyan was mostly grown in monsoon season, and had the largest users (n = 201) in southern three (3) townships (Paungde, Nattalin, and Zigon) accounting for 60 (Zigon) to 80% (Nattalin) of the paddy growers.
- Contrarily, Kyaw zeya was grown only in summer by the second largest users (n = 132) only in northern tree (3) townships (Pyay, Paukkhaung, and Thegon) with variation of 20 (Paukkhaung) to 75% (Pyay) of users.
- Yadanar toe had the third largest users (n = 72) in monsoon season distributed in whole townships except Paukkhaung, and used by 10 (Nattalin) to 20% (Zigon) of growers. It was the most used variety in summer season (n = 36) by 60 (Paukkhaung) to 85% (Pyay) of the growers.
- The rest of varieties were miner counting not more than 16% (Hmawbi san) of growers in each site.

(2) Black Gram

- Black gram was grown only in winter season, and the cumulative total grower number (n) was 134 among the respondents of the survey..
- Pe gazum had the largest users (n = 52) among nine (9) varieties nominated, which were mainly adopted in southern four (4) townships at the rate of 17 (Thegon) to 60% (Nattalin) of growers.
- Twet chun was the second used variety (n = 40) used in all target townships with 9 (Nattalin) to 100% (Pyay) of the user ratios. It was more popular in northern townships.
- Ywet wain and Pin htaung had the same number of users (n = 18), and Ywet wain was popular in Paukkhaung with 46% of user ratio, and Pin htaung was adopted only in southern three (3) townships.
- Kyauk sein had about 30% of user's ratio in Thegon, but those of the other four (4) varieties were less than 10%.

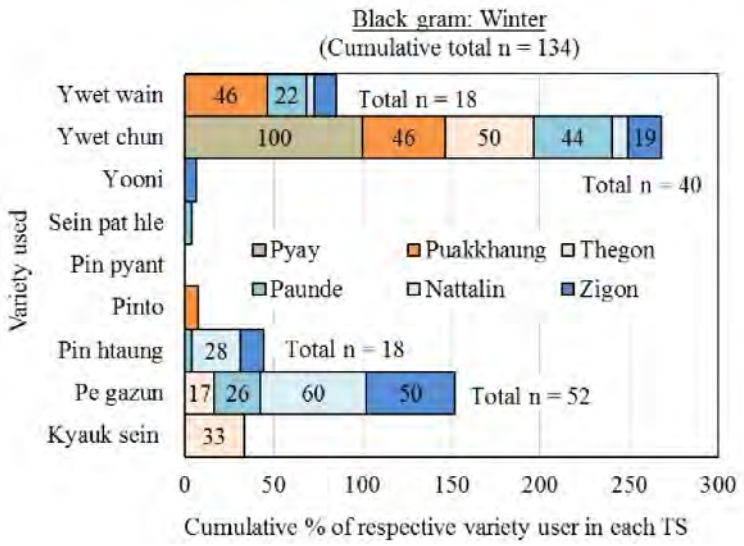


Fig. 2.2.12: Cumulative user ratios of respective black gram varieties in the target townships

(3) Sesame and Groundnut

- Sesame and groundnut were grown only in monsoon season in northern tree (3) townships, Pyay, Paukkhaung, and Thegon, and the cumulative total user number (n) was 82 and 53, respectively.
- Most of the sesame growers adopted Black cumin (n = 68) with the user ratio of 72 (Paukkhaung) to 100% (Thegon). The user ratios of the rest of three (3) varieties were less than 20%.
- In case of groundnut, Magway 15 (white grain, n = 27) and Magway 12 (red grain, n = 20) were two (2) major varieties in the three (3) townships, and the rest of four (4) varieties' user ratios were not more than 12 %.

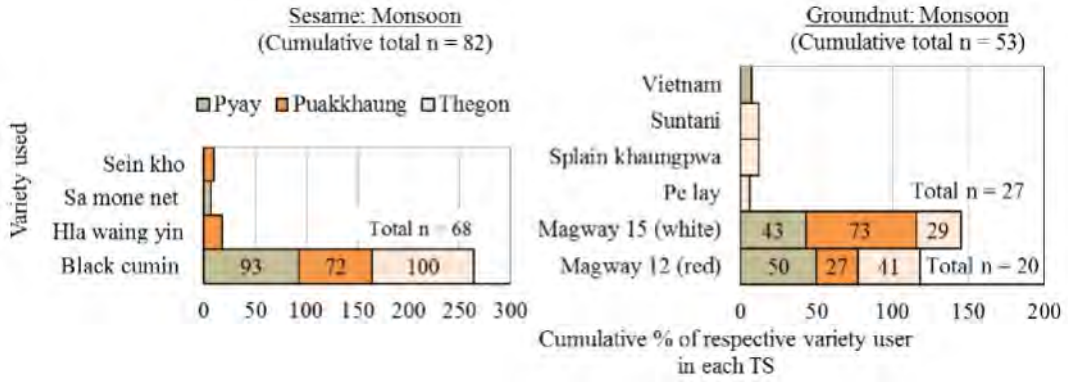


Fig. 2.2.13: Cumulative users of sesame and groundnut varieties in the target townships

(4) Green Gram

- Green gram was grown both in monsoon and winter seasons in northern two (2) townships (Pyay and Paukkhaung), and the obtained users were 13 and 16, respectively.
- Different varieties were adopted in each township, and unknown varieties also used in both townships.
- Kyauk sein was the most used variety in both seasons in Pyay at the user ratio of almost 80%, and the rest was Taiwan (winter) and unknown one (monsoon). The same variety name was found in black gram ones, though the background was uncertain.
- The crop growers obtained were only seven (7) through a year, and Pedi shewah (both seasons) and Swe wash (winter) were the varieties used there together with unknown varieties in monsoon.

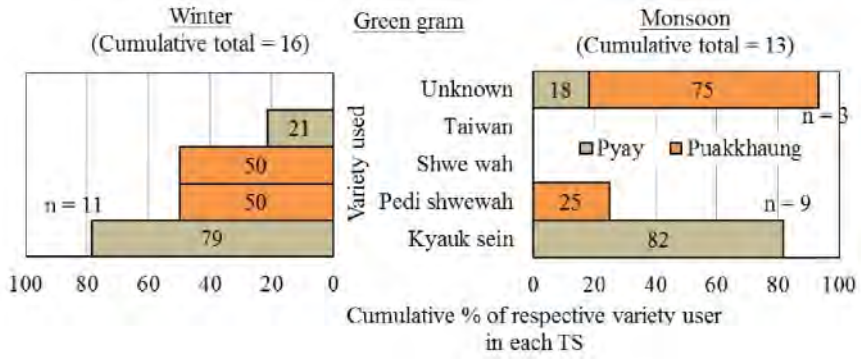


Fig. 2.2.14: Cumulative users of respective green gram varieties in the target townships

2.2.5 YIELD OF MAJOR CROPS

(1) Paddy

Yields of three (3) major varieties, Kyaw zeya, Taung pyan, and Yadanar toe, in each township were obtained.

- The farther south they grew, the higher the yield of Kyaw zeya which was grown in northern townships became higher ranging from 39 (Pyay) to 71 bsk/ac (Thegon),
- The same trend was observed in Yadanar toe grown in monsoon season though it was not grown in Thegon.
- The yield of Yadanar toe in summer season was higher in Paukkhaung than in Pyay, the yield in Pyay was not significantly different from that in Paungde.
- The yield of Taung pyan, which was grown in southern townships, was significantly higher in Nattalin than those in Paungde and Zigon.

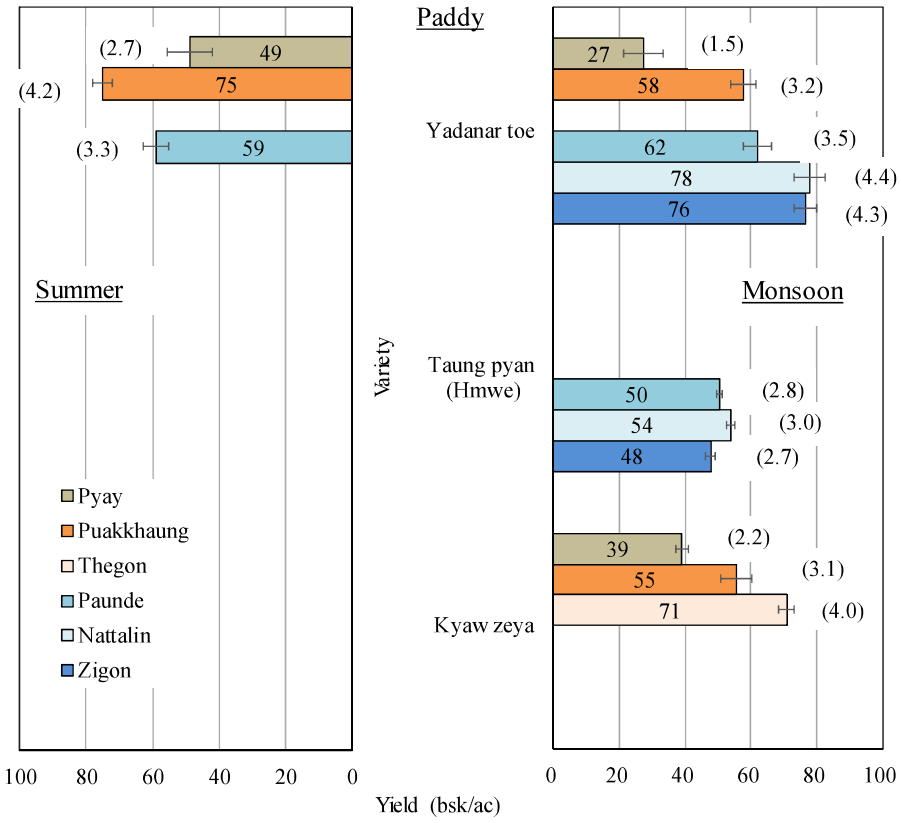


Fig. 2.2.15: Paddy yields of three major varieties in the target townships
(Bars indicate standard errors. One basket contains 50 lbs., and numbers in parenthesis indicate the corresponded yields expressed by t/ha.)

(2) Black Gram

Average yields of two popular black gram varieties in the growers were obtained (Fig. 2.2.16). Pe gazum was mainly grown in the southern three (3) townships though only one grower was found in Thegon. On the other hand, Ywet chun was grown in all target townships. Besides, the relationship between the planted area and the yield of Ywet chun in the target townships were shown in Fig. 2.2.16.

- The yield of Pe gazum(12 bsk/ac) in Nattalin was significantly higher than those in Paungde and Zigon (8 bsk/ac).
- The yields of Ywet chun in Thegon (16 bsk/ac) and Paukkhaung (12 bsk/ac) were significantly higher than those in Paungde (8 bsk/ac) and Zigon (7 bsk/ac), and those in Pyay and Nattalin were in-between of them.
- The yields of black gram grown in smaller areas tended to become higher. It indicated the effectivity of intensive care as well as possible increase of profit by optimization of field management.

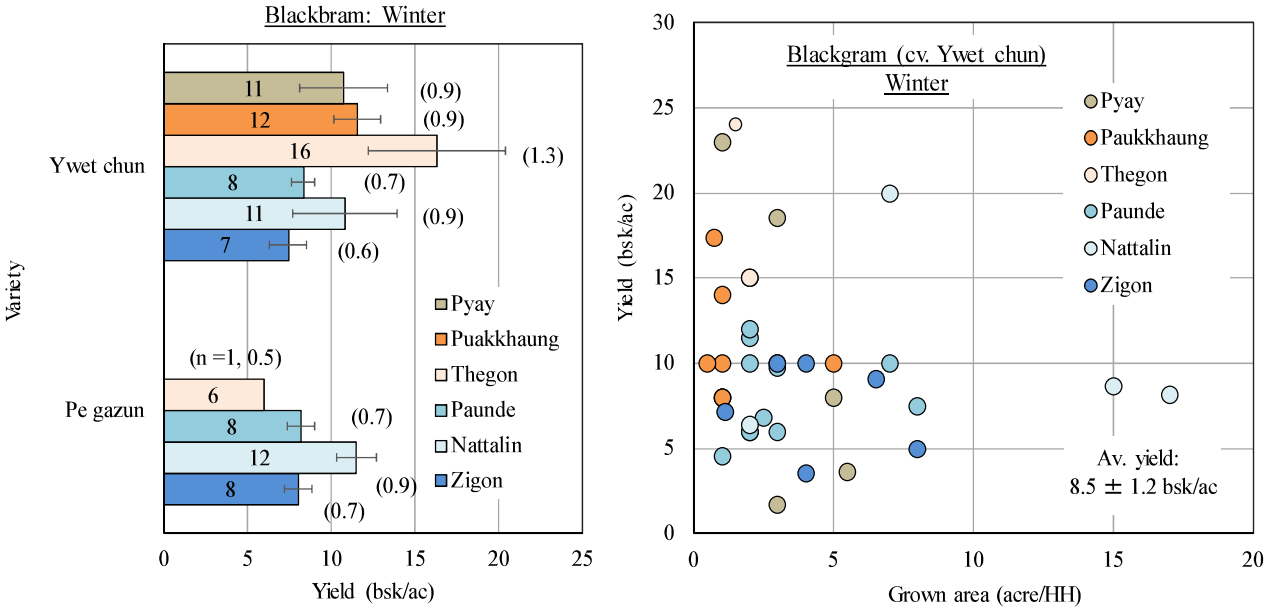


Fig. 2.2.16: Average yields of two black gram varieties (cv. Pe gazun and Ywer chum) (the left) and the relationship between the grown area and the yield (the right) in the target townships
(Bars indicate standard errors. One basket contains 72 lbs., and numbers in parenthesis indicate the corresponded yields expressed by t/ha.)

(3) Sesame

Sesame was grown only in three northern townships, Pyay, Paukkhaung, and Thegon, and the prevailed sesame variety was called as Black cumin. The yield of Black cumin in three townships and the relationship between the planted area and the yield in the areas are shown in Fig. 2.2.17.

- The sesame yield was highest in Paukkhaung, middle in Pyay, and lowest in Thegon, significantly.
- The yield of sesame also tended to decrease as the field area increases (Fig. 2.2.17), and optimization of the field area may increase the farm profit in a view from an entire management.

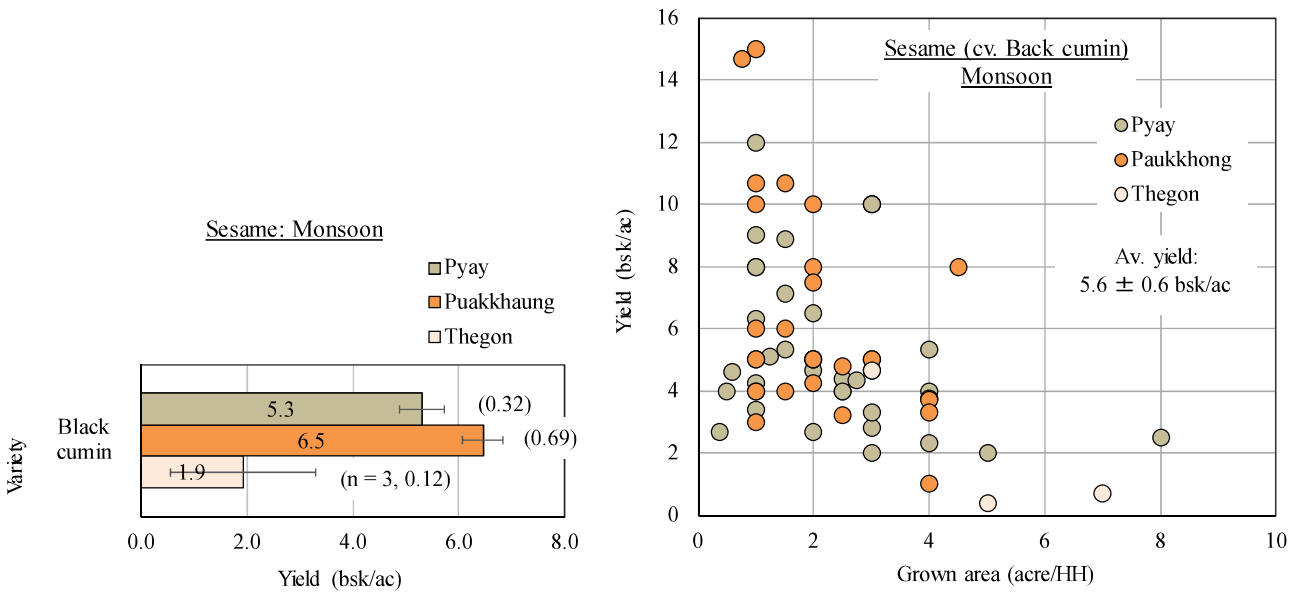


Fig. 2.2.17: Average yields of sesame (cv. Black cumin) (the left) and the relationship between the grown area and the yield (the right) in the cultivation townships
(Bars indicate standard errors. One basket contains 54 lbs., and numbers in parenthesis indicate respective yields converted into t/ha.)

(4) Ground Nut

Groundnut was mainly grown in northern townships, Pyay, Paukkhaung, and Thegon, and the yields of two (2) groundnut varieties (Magway 12 and Magway 15) were obtained as well as the relation of the grown area per household with the yield (Fig. 2.2.18).

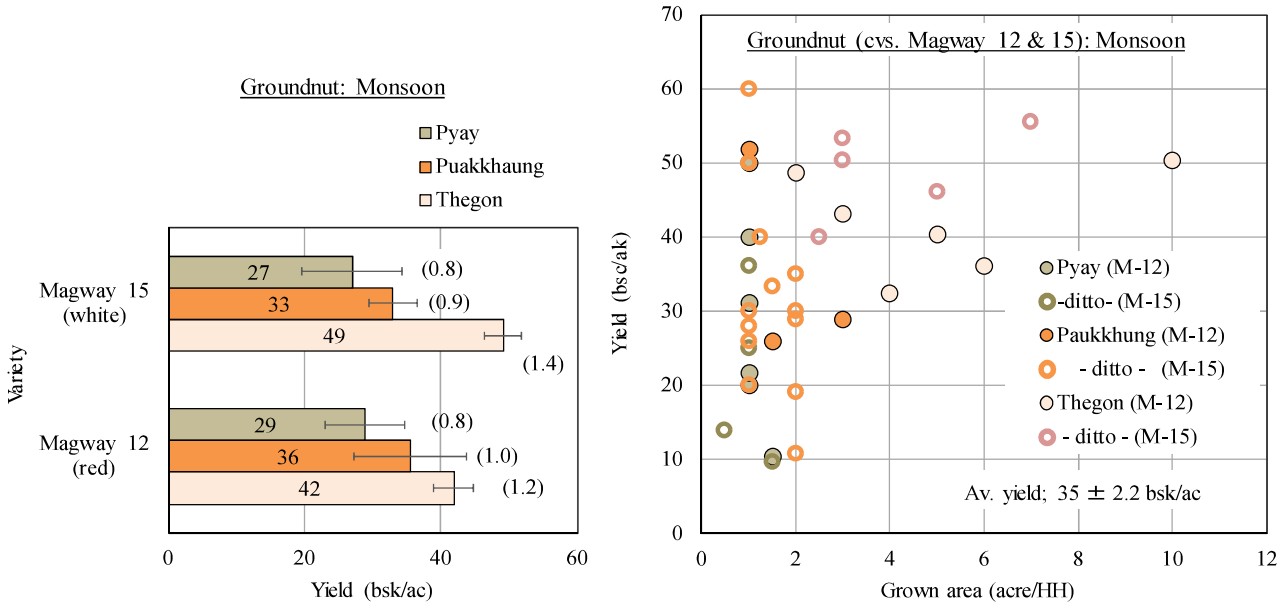


Fig. 2.2.18: Average yields of groundnut (cv. Magway 12 and Magway 15) (the left) and the relationship between the grown area and the yield (the right) in the cultivation townships
(Bars indicate standard errors. One basket contains 54 lbs., and numbers in parenthesis indicate respective yields converted into t/ha.)

- The yield of Magway 12 in Thegon (42 bsk/ac) was significantly higher than that in Pyay (29 bsk/ac), but that in Paukkhaung (36 bsk/ac) did not significantly differ from those two.

- Magway 15 showed significantly higher yield (49 bsk/ac) in Thegon than those in Pyay (27 bsk/ac) and Paukkhaung (33 bsk/ac), but the latter two yields did not significantly differ each other.
- Groundnut yield highly differed in grown areas which were less than 2 acres/HH ranging from 10 to 60 bsk/ac, but 30 bsk/ac or more yield was obtained in grown areas with more than 2 acres/HH. Clear trends were not obtained between yield and grown area per household.

(5) Green Gram

Green gram was mainly grown in Pyay both in monsoon and winter seasons, and the yields in both seasons and the relationship between field area and the yield are shown in Fig. 2.2.19.

- Green gram yields of monsoon and winter seasons (4.8 and 6.3 bsk/ac) did not significantly differ each other.
- Grown areas of green gram per household in monsoon season were less than 2 acres with 6 bsk/ac or less yield.
- On the other hand, those in winter season largely varied from 0.5 to 5 acres/HH with the yield from 1 to 12 bsk/ac.
- In case of green gram, any trends were not find between the grown area and the yield.

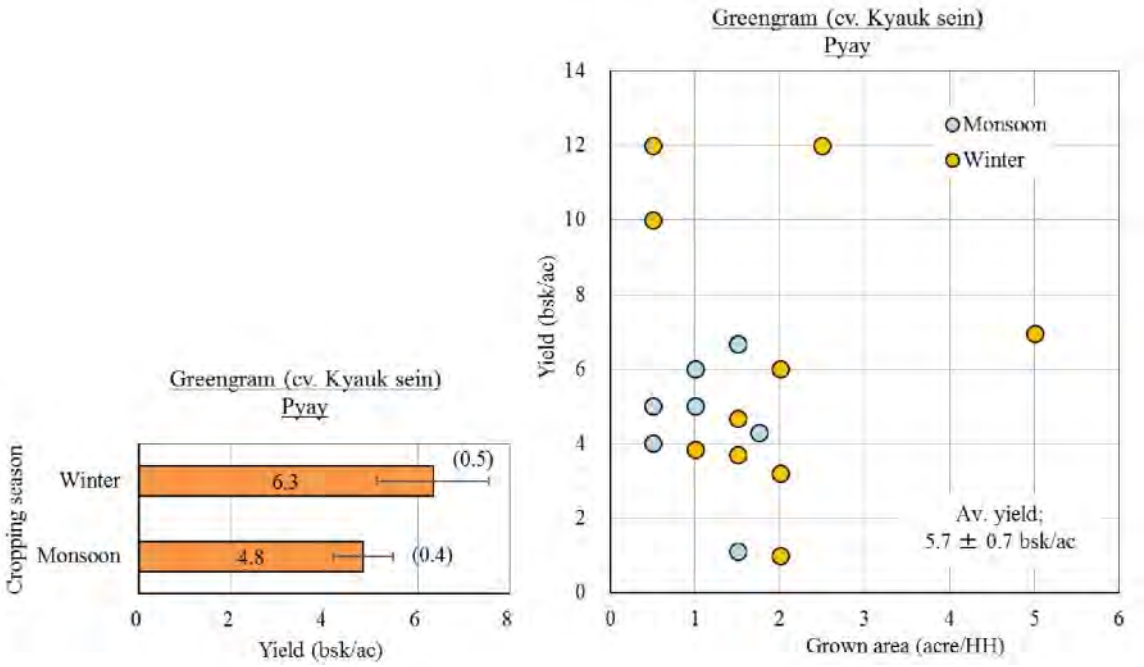


Fig. 2.2.19: Average yields of green gram (cv. Kyauk sein) (the left) and the relationship between the grown area and the yield (the right) in Pyay
(Bars indicate standard errors. One basket contains 54 lbs., and numbers in parenthesis indicate respective yields converted into t/ha.)

2.2.6 AGRICULTURAL MACHINES

(1) Usage Condition of Agricultural Machines

In this section, the usage condition of agricultural machines was examined regarding five (5) major crops, which were identified through the survey; namely, 1) paddy, 2) black gram, 3) sesame, 4) green gram, and 5) groundnuts. The valid response rates of those major crops were 99%, 36%, 9%, 10%,and 5%, respectively.

1) Paddy

- Plowing work was mainly carried out by animal (ox) in north three (3) townships (Pyay, Paukkhaung, and Thegon); the responses' ratios of animal use for plowing were more than 40% in north three (3) townships. Machine users, such as 4-wheels tractor and 2-wheels hand tractor, for plowing varied from township to township. The responses' ratio of such machine users ranged from about 40 to 80%. In south three (3) townships, the responses' ratio of machine users in plowing was higher than north three (3) townships.
- The responses' ratio of machinery user for leveling was lower than that of plowing. The ratios were about 30% in Pyay and Paukkhaung, and those in other four (4) TSs were relatively higher than those in Pyay and Paukkhaung, ranging from 35% to 46%.
- With regard to following farm works; transplanting, weeding and water management, almost all the respondents used labors. However, there was one (1) respondent each in Paukkhaung, Paungde, and Zigon answered that they used rice planter.
- Harvesting was mostly carried out by using labor, and the responses' ratio of labor user for harvesting was about 80 to 90%, except that in Thegon. In Thegon, the responses' ratio of labor user was only 38%, and that of private company's combine harvester user was 59%.
- Threshing was mainly done by using machines in all townships. The responses' ratio of thresher users ranged from 70% to 90%. The majority of those thresher users rent it from private company, and the rest of users owned thresher. There was only one (1) or two (2) %, which answered as to have used animal for threshing.
- Drying work was carried out mostly manually. However, in Thegon, Nattalin, and Zigon, the responses' ratios of drying machine users were 29%, 19% and 20%, respectively. Majority of machine users used private company's service.
- Transportation from farm gate to storage was mainly done by oxcart, and the responses' ratio of oxcart users was from 70 to 80% in townships. The second commonly used way was labor. However, in Nattalin, there was 22% of responses' ratio of machine users for transportation. It was expected that they used trailers attached to hand tractors, since the owner ratio in Nattalin seemed considerably higher than other TSs.
- In general, Nattalin and Zigon, which are located in southern area, seemed to be in an advanced statement of machinery utilization. Whereas, in north townships, such as Pyay and Paukkhaung, farmers who used machine were much less than south townships.

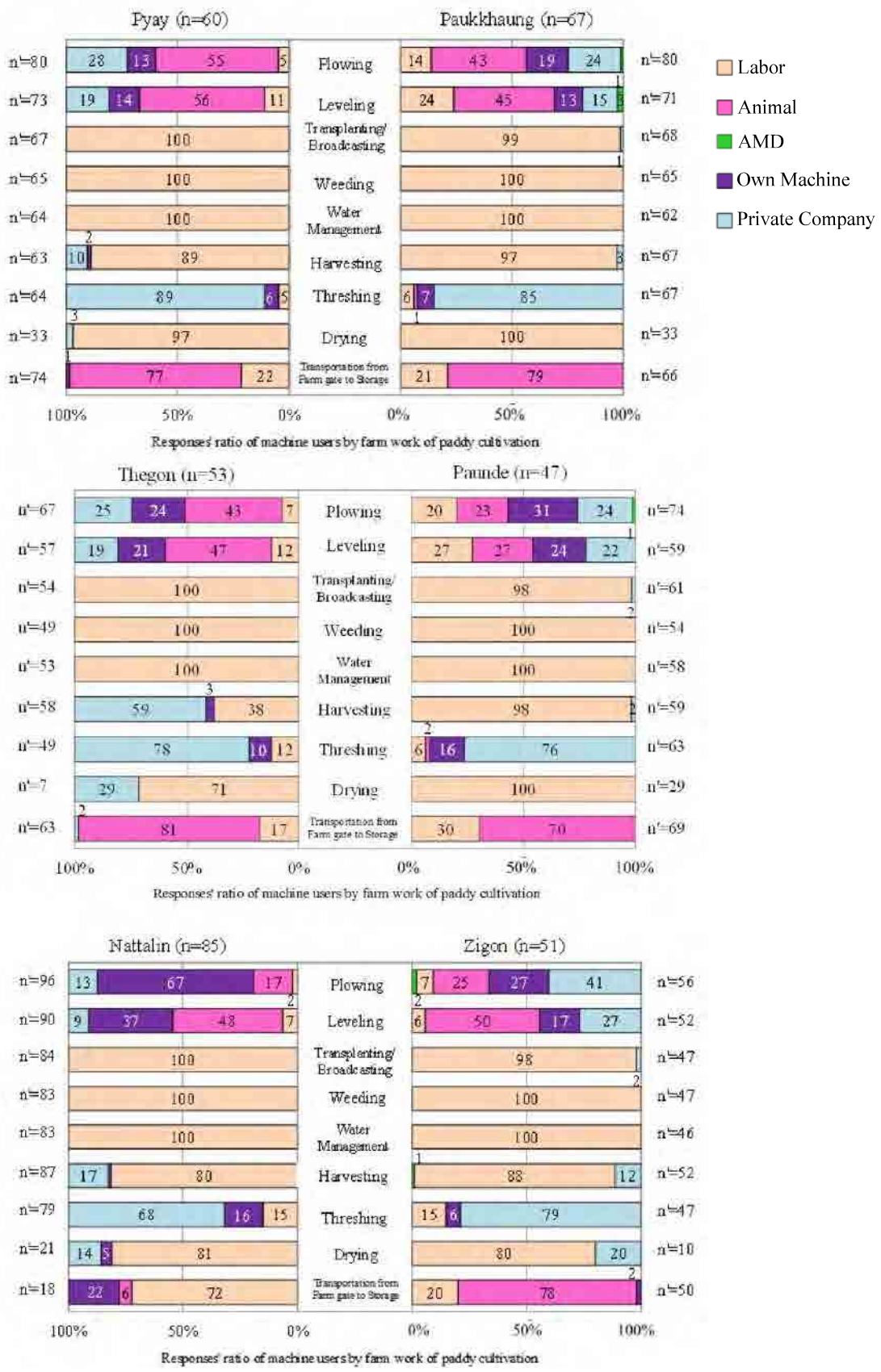


Fig. 2.2.20: Responses' ratio of machine users for farm works of paddy cultivation by township
(Note 1: n in the figure indicates the total number of respondents who gave valid response in each township)
(Note 2: n' in the figure indicates the total number of responses to each field work item)

2) Black Gram

- In three (3) townships in southern part of the area, namely Paungde, Nattalin, and Zigon, the number of valid responses were more than those in other townships in northern part, which accounted for more than 50% of the total respondents in those townships.
- The responses' ratio of machine users for plowing was high in Thegon and Nattalin, 100% and 76%, respectively. However, those ratios in Pyay and Paukkhaung, were low, 33% and 45%, respectively.
- The ratio for leveling showed similar tendency with that for plowing, but it was relatively lower than that for plowing. In Paukkhaung and Paungde, it seemed relatively more farmers in those TSs carried out leveling using labor.
- Nearly 100% of the respondents relied on labor for planting, weeding, water management and harvesting of black gram. However, one (1) respondent in Paukkhaung answered as to have used machine for weeding and one (1) respondent in Nattalin to have used machine for harvesting.
- The number of responses regarding water management of black gram was very limited. Even in townships where black gram cultivation prevails, such as Zigon, the respondents who answered to the question regarding water management were a few.
- Machine use for threshing was common in almost all townships, except Paukkhaung. While the responses' ratio of thresher users ranged from 70(Nattalin) to 92% (Zigon), that in Paukkhaung was only 38%. In general, paddy threshers are widely used also for black gram by changing its separation sieves. The high ratio of paddy thresher usage might lead to high usage of thresher for black gram too. However, such modification of paddy thresher for black gram might be made only by changing sieves to make those suitable for black gram grain size; it may still have room for improvement. It may be required for PROFIA to examine better shape of threshing drum, proper speed of the drum (rpm), etc.
- Most of the respondents used labor or animals for drying and transportation, but one (1) respondent in Thegon and four (4) in Nattalin answered as to have used machine(s) for those works.

Fig. 2.2.21: Responses' ratio of machine users for farm works of black gram cultivation by township
(Note 1: n in the figure indicates the total number of respondents who gave valid response in each township)
(Note 2: n' in the figure indicates the total number of responses to each field work item)

3) Sesame

- There were responses regarding farm works of sesame only in two (2) townships; Pyay and Paukkhaung.
- The responses' ratio of machine users for plowing was 43% in Pyay and 28% in Paukkhaung. The ratio for leveling was relatively lower than that for plowing; 28% and 14%, respectively. Most of the respondents seemed to have used animals for plowing and leveling. Those who used labor for plowing and leveling were observed, and the responses' ratio of labor users for those two (2) works in Paukkhaung was relatively higher than that in Pyay.
- Most of other farm works relied on labor except transportation. The responses' numbers of water management were less than total number of the respondents.
- With regard to threshing, there were 6% and 8% of the responses' ratio of machine users in Pyay and Paukkhaung, respectively. Since the type of machine the respondents used for threshing was not identified through the survey, it is required to investigate it so as to disseminate it.

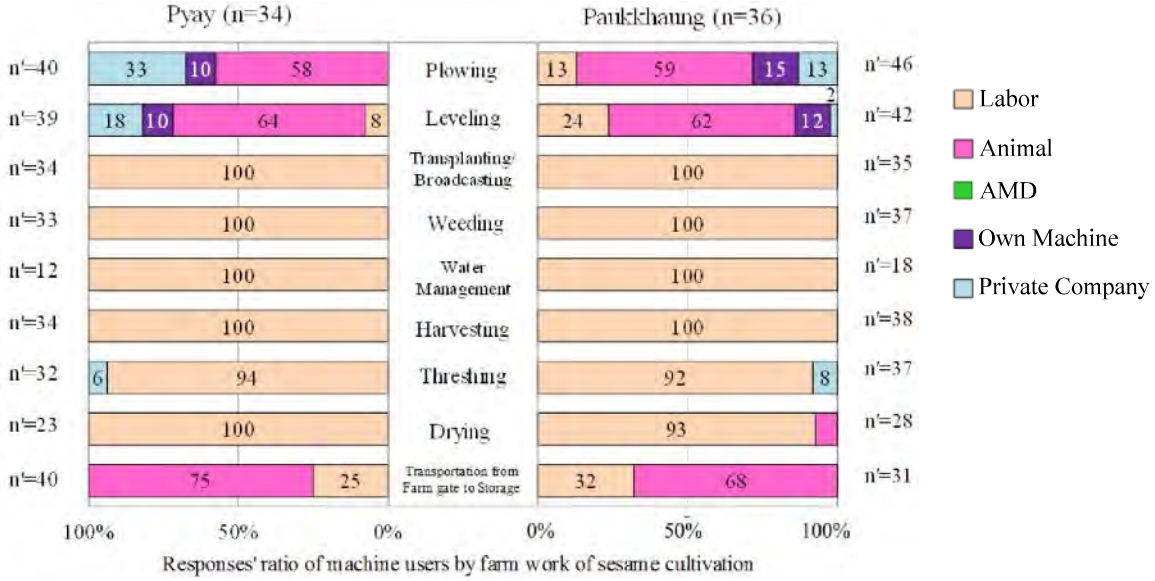


Fig. 2.2.22: Responses' ratio of machine users for farm works of Sesame cultivation by township
(Note 1: n in the figure indicates the total number of respondents who gave valid response in each TS)
(Note 2: n' in the figure indicates the total number of responses to each field work item)

4) Green Gram

- There were responses regarding farm works of sesame only in two (2) townships; Pyay and Paukkhaung, like sesame, although the number of respondents in Paukkhaung was only six (6).
- The responses' ratios of machine user for plowing in those two (2) townships were not so different each other, 41% in Pyay, and 38% in Paukkhaung. Those ratios for leveling were 25% and 20%, respectively. Animals were most mainly used for plowing and leveling.
- Most of other following farm works were carried out by labor, except threshing and transportation.
- The number of responses for water management was much less than total number of respondents in both townships, eight (8) persons out of total respondents(23) in Pyay, and only one (1) person out of six (6) in Paukkhaung. It indicated that water management work for green gram was not very much required.

- The responses' ratio of machine user for threshing was 21% in Pyay, and 33% in Paukkhaung. Labor was the most commonly used. The machine users for threshing used private company service. According to field survey, it seemed that those threshers the respondents used were modified paddy thresher like that for black gram.
- Transportation works were mainly done by animals, followed by labor.

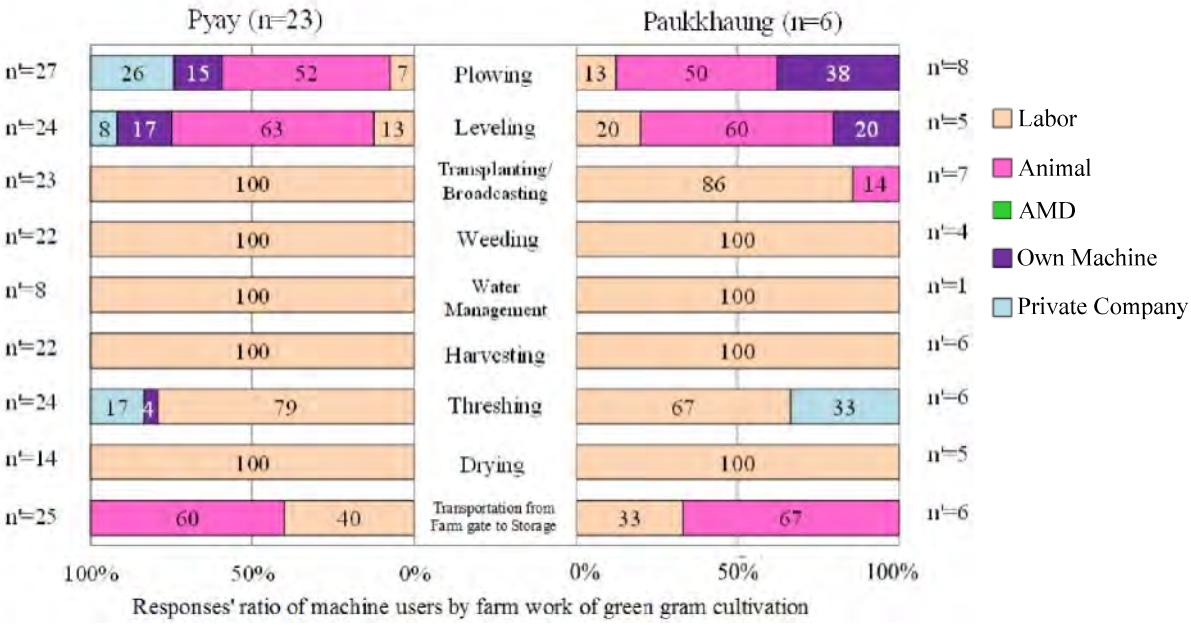


Fig. 2.2.23: Responses' ratio of machine users for farm works of green gram cultivation by township
(Note 1: n in the figure indicates the total number of respondents who gave valid response in each township)
(Note 2: n' in the figure indicates the total number of responses to each field work item)

5) Groundnuts

- Some respondents used machine for plowing and leveling only in Pyay and Paukkhaung, but no in Thegon,
- Other farm works from transplanting/broadcasting to harvesting, all respondents used only labor in three (3) townships.
- With regard to threshing, there were 25% and 23% of the responses' ratios in Pyay and Paukkhaung, however, no respondent used machine for threshing in Thegon.
- There was nearly or more than 50% of responses' ratio of machine users for drying and transportation in Thegon. However, no one used machine for those works in Pyay and Paukkhaung.

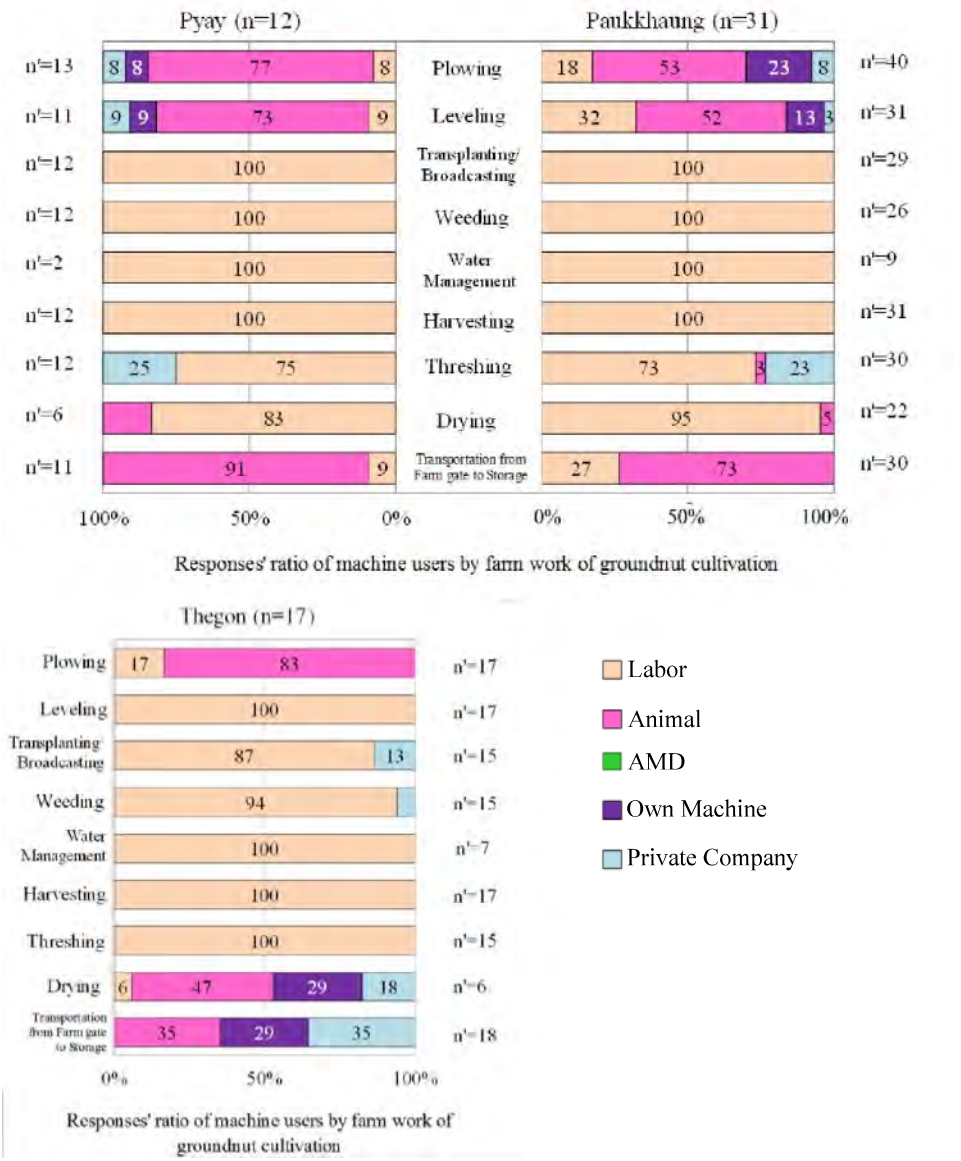


Fig. 2.2.24: Responses' ratio of machine users for farm works of groundnuts cultivation by township
(Note 1: n in the figure indicates the total number of respondents who gave valid response in each township)
(Note 2: n' in the figure indicates the total number of responses to each field work item)

(2) Use of AMD Service and Its Appraisal by Users

- There were only nine (9) households (2.7%) replied that they had used AMD's services excluding borrowing machine. The AMD's service users were the most in Paukkhaung, and it was five (5) households, which accounted for 8.3% of total valid responses in Paukkhaung. In other townships, no respondents or only one (1) to two (2) respondents answered to have had experience of AMD's service use.
- The main services of AMD to farmers are harrowing/ plowing service using large size tractors and harvesting service using combine-harvesters. The services of AMD except rental of agricultural machine, such as training, consultation, had significantly few users.

Table 2.2.2: Experience of AMD service, excluding machine rental service and comparative evaluation of AMD and Private service provider

Experience of AMD Service, except borrowing machine only							Which is better (AMD or Private)	
TS	Yes	No	No Answer	Yes Training	Yes Consultation	Yes Others	AMD	Private
PY	1	61	7	0	0	0	2	8
PK	5	55	7	0	0	1	6	6
TG	0	47	7	0	0	0	0	13
PD	2	36	12	0	0	0	1	11
NT	1	75	9	0	0	0	2	19
ZG	0	46	5	0	0	0	0	19
Total	9	320	47	0	0	1	11	76

There were 87 respondents who gave valid responses regarding evaluation on rental services of AMD's and Private company including farmer service providers. Only 12.6% (11 respondents out of 87 respondents) regarded AMD was better, and 87.6% (76 respondents) regarded Private service providers was better than AMD.

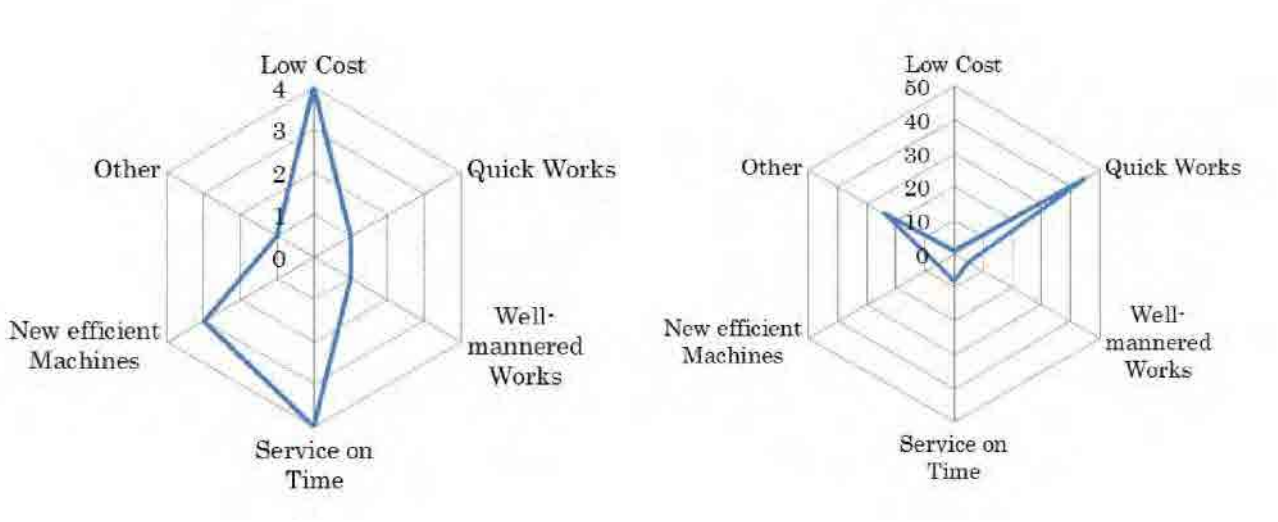


Fig. 2.2.25: Merit point of AMD and Private sector services

- For the respondents who preferred AMD's service, its "low cost" and "service provision on time" were most commonly regarded as a merit of AMD's service, although total number of those who regarded AMD's service is more preferable than Private service was limited. Some answered that availability of new efficient machines was a merit of AMD's service.
- With regard to those who preferred Private sectors' service, those quick works was most commonly regarded as a merit of private sectors' service. It might imply that AMD's service required much time to go through processes such as payment or field inspection before actually having its operation in field.

(3) Ownership of Agricultural Machine

Table 2.2.3 shows the number of the respondents who owned major machine(s), such as Thresher , Hand Tractor, 4-Wheel Tractor, Combine Harvester, and Rice Transplanting machine.

Table 2.2.3: Owners number of major agricultural machines in townships

TS	Total no. of respondents	Thresher		Hand Tractor		4-Wheel Tractor		Combine Harvester		Rice Transplanting machine	
		Owner	%	Owner	%	Owner	%	Owner	%	Owner	%
PY	69	2	2.9%	18	26.1%	3	4.3%	2	2.9%	1	1.4%
PK	67	1	1.5%	18	26.9%	1	1.5%	0	0.0%	0	0.0%
TG	54	2	3.7%	21	38.9%	2	3.7%	1	1.9%	0	0.0%
PD	50	8	16.0%	12	24.0%	4	8.0%	0	0.0%	1	2.0%
NT	85	17	20.0%	70	82.4%	5	5.9%	0	0.0%	0	0.0%
ZG	51	2	3.9%	20	39.2%	0	0.0%	0	0.0%	0	0.0%
All TSs	376	32	8.5%	159	42.3%	15	4.0%	3	0.8%	2	0.5%

- Hand tractor was most commonly owned by the respondent in all townships, which accounted for 42.3% of total respondents in six (6) TSs. However, its ownership ratio varied from township to township. The owners' ratio in Nattalin was the highest, accounting for 82.4%. Whereas, those ratios in Pyay, Paukkhaung and Paungde were lower than 30%.
- With regard to thresher, which was second commonly owned among the respondents, 8.6% of all the respondents owned thresher. The owners' ratio in Nattalin was highest, 20.0%, followed by that in Paungde, 16.0%. However, those ratios in Pyay and Paukkhaung were low, 2.9% and 1.5%, respectively.
- 4-wheel tractor owners were not so many, accounting for only 4.0% of all the respondents in six (6) townships. The owners' ratios in Paungde and Nattalin were relatively higher, which were 8.0% and 5.9%, respectively.
- Combine Harvester and Rice Transplanting machine were owned by a few respondents. Three (3) and two (2) respondents owned those machines in all TSs, respectively.

Table 2.2.4 shows the owner number of each machine and the number of those who lent out their machine to others.

Table 2.2.4: Number of respondents who lent out agricultural machine owned to others in townships

TS	Total no. of respondents	Thresher		Hand Tractor		4-Wheel Tractor		Combine Harvester		Rice Transplanting machine	
		Owner	Rent	Owner	Rent	Owner	Rent	Owner	Rent	Owner	Rent
PY	69	2	2	18	3	3	1	2	1	1	1
PK	67	1	1	18	7	1	0	0	0	0	0
TG	54	2	2	21	2	2	1	1	1	0	0
PD	50	8	4	12	2	4	0	0	0	1	0
NT	85	17	6	70	1	5	3	0	0	0	0
ZG	51	2	1	20	1	0	0	0	0	0	0
All TSs	376	32	16	159	16	15	5	3	2	2	1
Renting Rate			50.0%		10.1%		33.3%		66.7%		50.0%

- 10.1% of Hand Tractor owners lent out their machine to others, and its ratio was the lowest among others.
- With regard to other machines, the ratio of those who lent out their machine ranged from about 30% to 65%.

Table 2.2.5 shows the average rental fee that the respondents charged when they lent out their own machine to others, and the average annual maintenance cost for owned machine(s).

Table 2.2.5: Rental fee the respondents charged to others and Annual maintenance fee of major agricultural machines

TS	Thresher				Hand Tractor			
	Rental fee charged (Ks/basket)	(n)	Maintenance Cost (Ks/year)	(n)	Rental fee charged (Ks/acre)	(n)	Maintenance Cost (Ks/year)	(n)
PY	200	(2)	60,000	(1)	9,333	(3)	150,000	(6)
PK	200	(1)	80,000	(1)	13,000	(7)	75,500	(14)
TG	200	(1)	180,000	(1)	13,500	(2)	96,500	(10)
PD	163	(4)	141,667	(6)	10,000	(2)	111,750	(8)
NT	193	(6)	99,583	(12)	20,000	(1)	88,977	(44)
ZG	120	(1)	475,000	(2)	10,000	(1)	75,313	(16)
Average	182	(15)	144,130	(23)	12,250	(16)	91,184	(98)
TS	4-Wheel Tractor				Combine Harvester			
	Rental fee charged (Ks/acre)	(n)	Maintenance Cost (Ks/year)	(n)	Rental fee charged (Ks/acre)	(n)	Maintenance Cost (Ks/year)	(n)
PY	10,000	(1)	267,500	(2)	40,000	(1)	200,000	(1)
PK	-	-	-	-	-	-	-	-
TG	30,000	(1)	100,500	(2)	40,000	(1)	-	-
PD	-	-	300,000	(1)	-	-	-	-
NT	10,000	(3)	250,000	(3)	-	-	-	-
ZG	-	-	-	-	-	-	-	-
Average	14,000	(5)	223,250	(8)	40,000	(2)	200,000	(1)
TS	Rice Transplanting machine							
	Rental fee charged (Ks/acre)	(n)	Maintenance Cost (Ks/year)	(n)				
PY	8,000	(1)	200,000	(1)				
PK	-	-	-	-				
TG	-	-	-	-				
PD	-	-	90,000	(1)				
NT	-	-	-	-				
ZG	-	-	-	-				
Average	8,000	(1)	145,000	(2)				

Note 1: (n) indicates the number of respondents who gave valid response.
Note 2: Averages shown in the table above were calculated using only valid responses.

- Rental fee the respondents charged at the time of lending out thresher was 182 Ks/basket on average. The rental charge did not vary so largely from township to township, ranging from 120 Ks/basket (Zigon) to 200 Ks/basket in northern three (3) townships.
- Although hand tractor's rental fee relatively varied from township to township, its average in six (6) TSs was 12,250 Ks/acre. The average rental fee of 4-Wheel Tractor was 14,000 Ks/acre.

- However, one (1) respondent's answer was 30,000 Ks/acre, and it might because the fee included operator fee, and other respondents might be also confused regarding this point.
- According to field survey, rental service fee of AMD in 2016 was 64,500 Ks/acre including provision of operator. AMD used 18 discs off-set harrow, and that service using rotary tiller was 15,000 Ks/acre. Whereas, those by private sector were 10,000 Ks/acre and 20,000 Ks/acre, respectively.
- The only one (1) who answered rental fee of rice transplanting machine described it was only 8,000 Ks/acre. However, according to the interview to AMD, rental fee of rice transplanting machine provided by AMD was 60,000 Ks/acre including all required expenses such as operator, quality seed and seedling provision, which was considerably more expensive than 8,000 Ks/acre. The service fee by private sector in Shwedan Township was 65,000 Ks/acre, including all required expenses.

2.2.7 SEED REGENERATION

(1) Seed Regeneration of Grown Varieties

- Interval of seed renewal by producers was surveyed, and the responses about 22 varieties among planted 33 (Fig. 2.2.26) were obtained.
- More than 100 producers responded about Taung pyan, Kyaw zeya, and Yadanar toe in all townships, reflecting the popularity of them, but those of the other varieties were less than 25 producers.
- Taung pyan, which is local brand rice but the heredity composition is not clear, had the largest respondents (191) but over 60% of them had not regenerated the seeds, nearly 20% had done every year, and the rest had done it with two (2) to more than three (3) years' interval.
- Therefore, self-reproduction (70%) and procurement from relatives/neighbors (30%) were means of renewal of the variety, and the rest sources were few.
- Major renewal intervals of Kyaw zeya were two (2) (35%) or three (3) years (25%), and the main seed sources were self-reproduction (45%) and relatives/neighbors (30%), too. However, over 10% of the producers had purchased from DOA.
- The seed renewal ratio of the producers was highest in Yadanar toe among three (3) major varieties accounting for nearly 90%. About 40% of them had regenerated it every two (2) years and around 20% had done every year or every three (3) years.
- The major mean of Yadanar Toe regeneration was self-reproduction (35%), too, but the DOA as the source (30%) was larger than that of relatives/neighbors (20%) reflecting the DOA seed multiplication project.
- Seed regeneration with heritable reliability is still miner but the governmental seed multiplication project has started showing the effect on producers.
- Private company's regenerated seeds have not prevailed, yet.

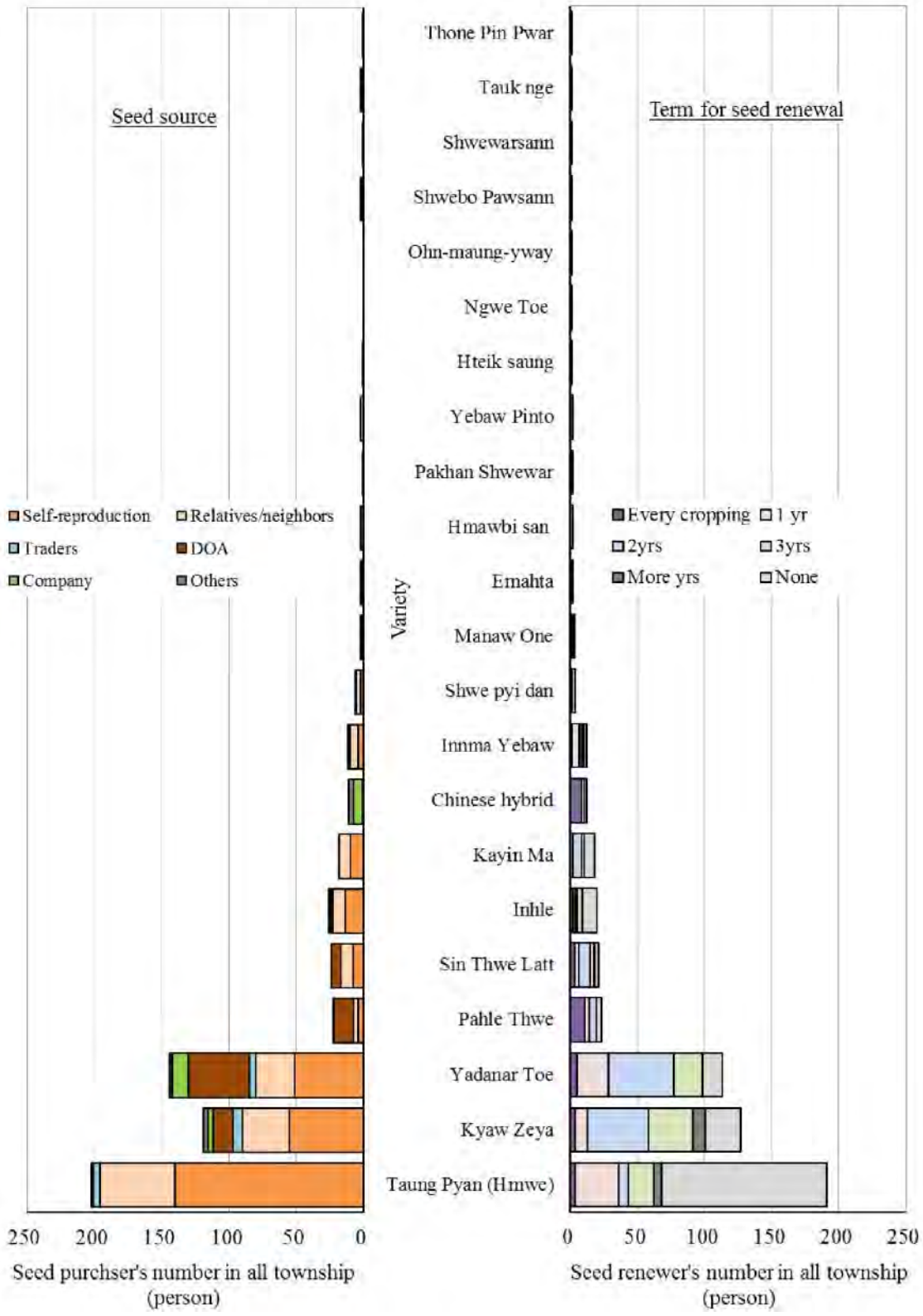


Fig. 2.2.26: Terms of respective paddy variety renewal and the seed sources

(2) Present Situation of Seed Renewal in the Target Townships

Intervals of seed renewal, every cropping, 1, 2, and 3 years, more than 3 years, and no renewal, were asked. Producer ratios that renewed each variety seed in respective townships were shown based on each interval. Likewise, Producer ratios who obtained regenerated seeds from different sources (self-reproduction, relatives/neighbors, traders, DOA, companies, and others) were shown by sources. Total numbers of producer ratios in each township were over 100% in each case because of users who used plural varieties.

- In northern townships, Pyay, Paukkhaung, and Thegon, two (2) years interval for seed renewal was most popular among the above-mentioned alternatives, which were practiced by 40 (Pyay) to over 70% (Paukkhaung) of producers.
- The rest of intervals were taken by nearly 5 – 30% of producers.
- Although self-reproduction and relatives/neighbors were major regenerated seeds methods/sources (over 30 – 70%), DOA had certain share as seed source among the producers accounting over 10 (Pyay) to 50% (Paukkhaung) of producers.
- In the southern townships, Zigon, Nattalin, and Paunde, where native brand variety (Taung pyan) was mainly grown in monsoon season, nearly 60 (Paunde) - 90% (Zigon) of producers had not renewed seeds, and most of them used seeds obtained by self-reproduction or from relatives/neighbors. Besides, 10 to 30% of producers renewed seeds every one (1) to three (3) years.

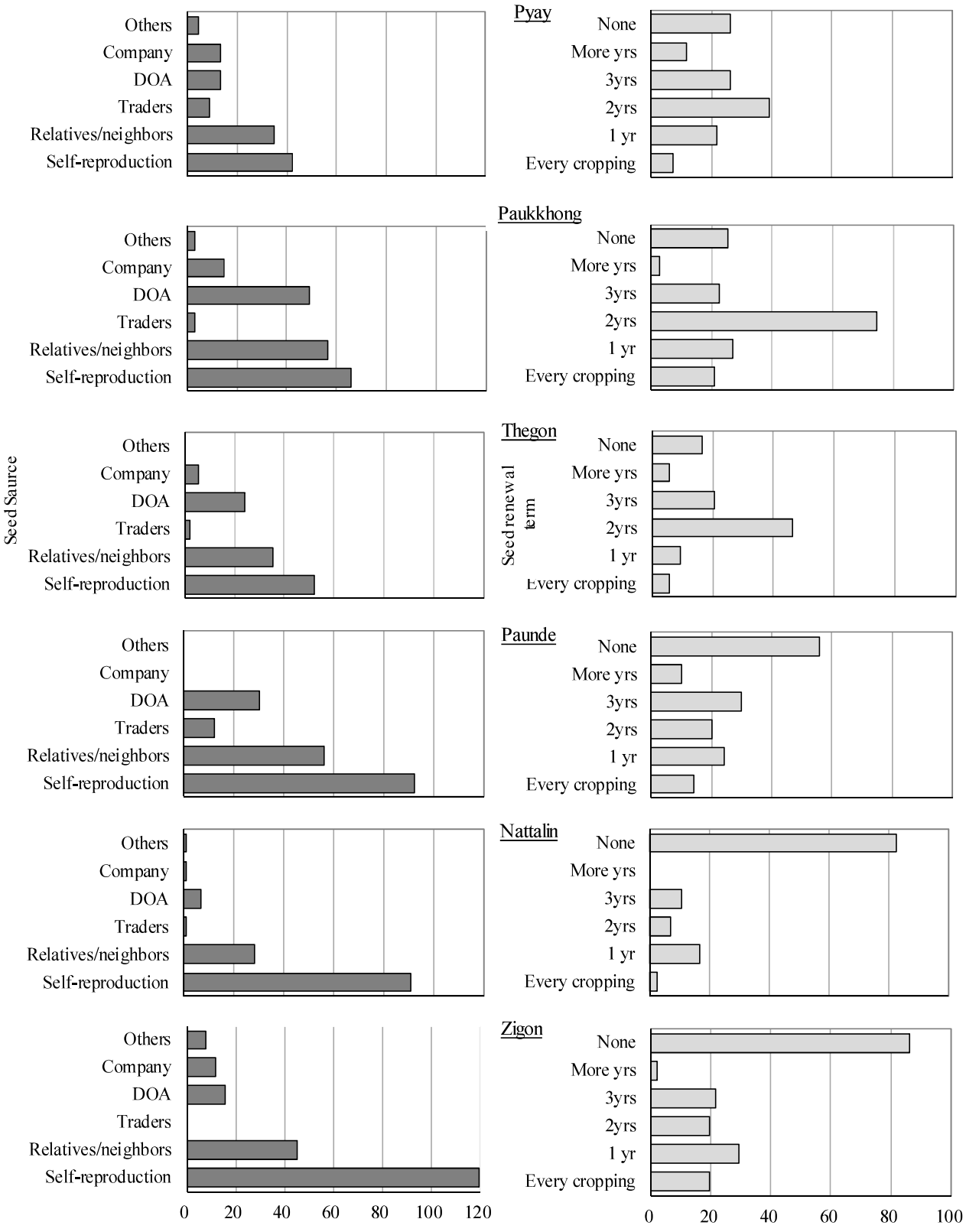


Fig. 2.2.27: Producer ratios which renewed seeds with respective intervals (right) and those which obtained seeds from respective sources (left) in the target townships

(3) Certified Seed (CS) Users in the last ten (10) years

The survey asked how many times they had used CS during these ten years (June 2006 – May 2016). Registration seeds (RS) are used as well as CS at present situation and the difference between them are sometimes not recognized by producers. Therefore, CS in this section presumably involves RS, too.

- Over 30% of respondents had experience to use CS with variation of 30 (Paungde) to 50% (Paukkhaung).
- The largest number of users purchased CS one time during the period accounting for over 50% of them, secondly each 25% of users did two (2) to three (3) times, and over 10% of them did five (5) times, on average. The rest of the purchased times were less than 10%.
- On the other hand, reasons of non-users were mostly caused by insufficient knowledge (40% of respondents). The rest of reasons, which were uncertain superiority, high price, and insufficient seed sources, were not more than 10% of respondents though a total of other reasons (others) counted for over 30%.

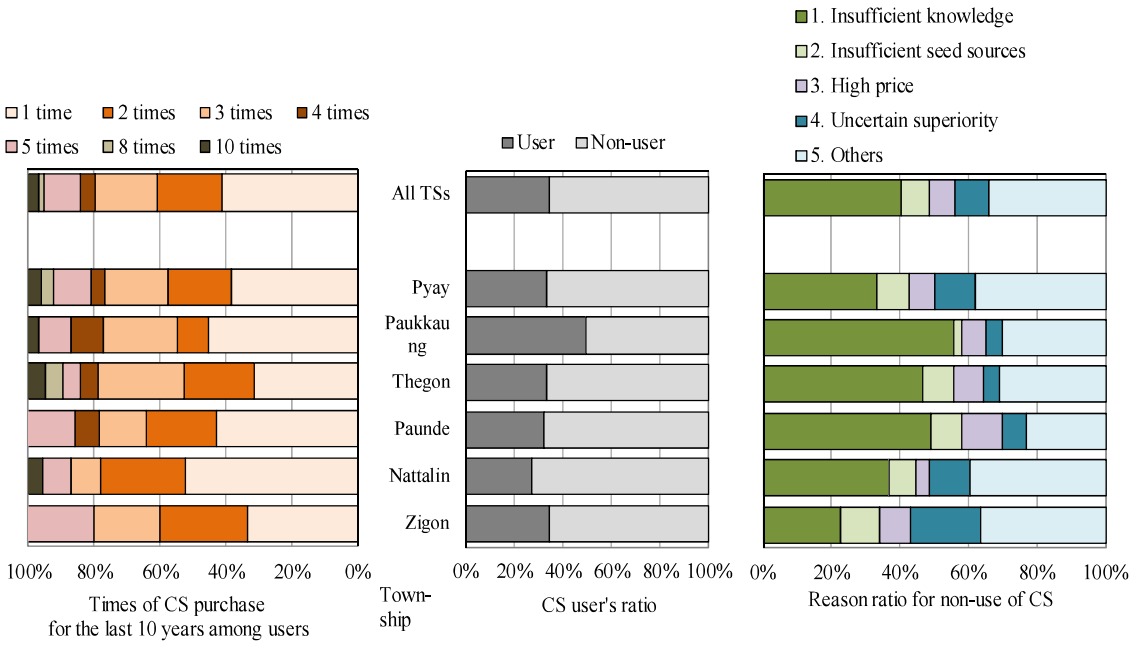


Fig. 2.2.28: Frequency of certified seed renewal and reasons for not adopting certified seed

(4) Respective Varieties Certified Seed (CS) Sources and Users in the Last Ten (10) Years

- The CS varieties that had more than five (5) customers among the respondents of all townships were only five (5) among twelve (12) nominated varieties, which were Yadanar toe (68 customers, hereafter), Pahle twe (22), Kyaw zeya (18), Sin Thwe Latt(13) , and Manaw Thukha (6), in descending order. The other varieties customers were a few.
- DOA was a major CS supplier having more than 70% of customers in the above-mentioned varieties, and companies supplied it to 10 -20% of the customers. The rest of sources were miner.

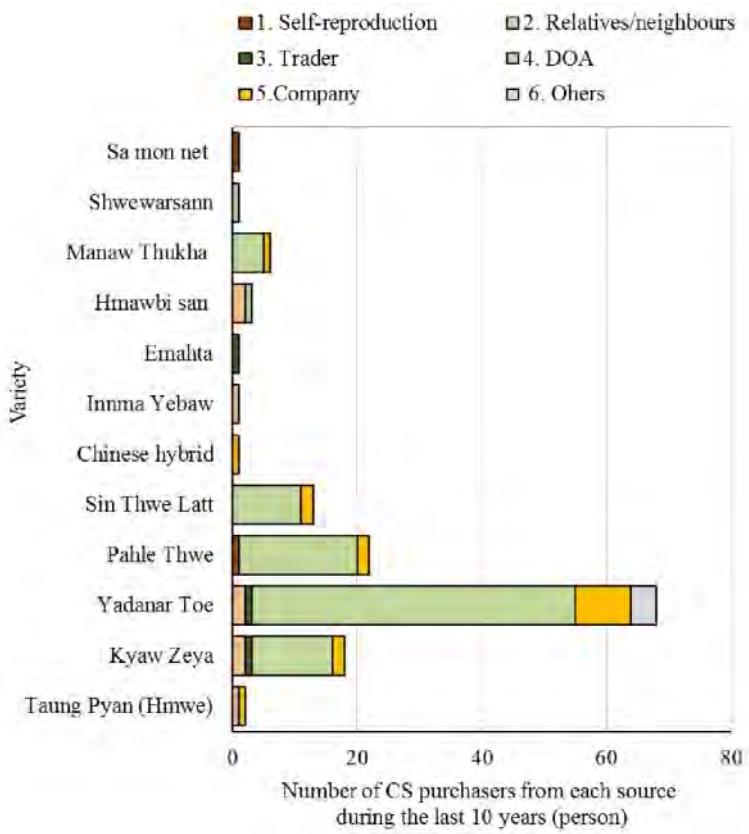


Fig. 2.2.29: Number of respective certified seed user and the sources

2.2.8 STORAGE AFTER HARVESTING

(1) Overall Situation of Storage after Harvesting

- Except Thegon and Zigon, in which only 40.7% and 34.6% of the respondents had storage facility respectively, more than half of the respondents had storage facility for keeping agricultural product. (Fig. 2.2.30)
- The ratio of the respondents who had storage facility in Nattalin was the highest; 77.4 %, followed by those of Pyay, Paungde, and Paukkhaung.(Fig. 2.2.30)

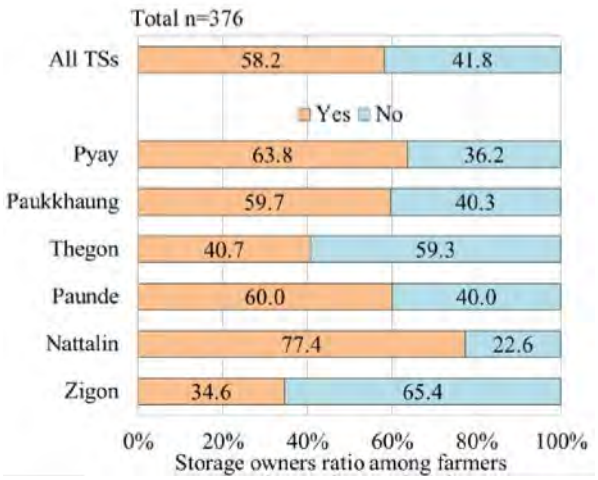


Fig. 2.2.30: Ownership ratio of storage facilities
Note 1: "Total n" indicates total number of respondents who gave valid response.
Note 2: The ratio in the figure was calculated using total valid responses as denominator.

- In the townships where the ratios of the respondents who have storage facility were relatively lower, namely Paukkhaung, Thegon, and Zigon, no respondent use chemical for protect their agricultural product in their storage. In Paungde, the ratio of those who use storage chemical was the highest (7.1 %), followed by that in Nattalin (4.9%), and Pyay (3.3%). (Fig. 2.2.31) Some respondents in Nattalin described example of storage chemical they used, such as Rat killer, big tablet to kill insect which damages black gram.

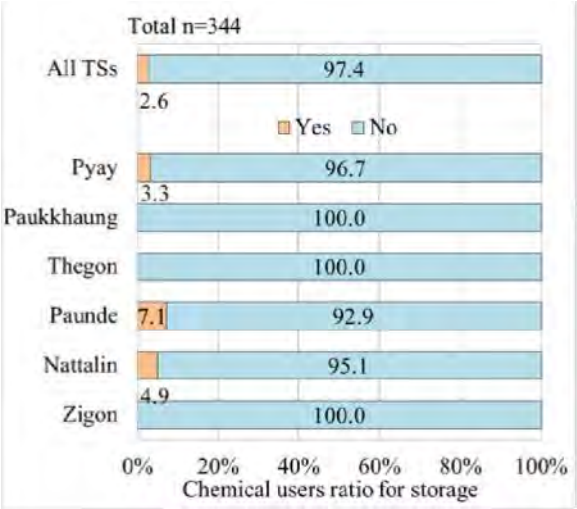


Fig. 2.2.31: Ratio of the respondents who use storage chemicals
Note 1: "Total n" indicates total number of respondents who gave valid response.
Note 2: The ratio in the figure was calculated using total valid responses as denominator.

Fig. 2.2.32: Ownership ratio of each storage facility
Note 1: "Total n" indicates total number of respondents who gave valid response.
Note 2: The ratio in the figure was calculated using total valid responses as denominator.

- The most major storage facility the respondents owned was warehouse in all townships Bin was second frequently used for storage of agricultural product, except Thegon. However, the ratio of the respondents who own bin for storage was less than 10.0% of all the respondents in each TS, except Paungde, in which the ratio was 16.0% of all the respondents. No respondent borrowed storage facility from outside. (Fig.2.2.32)

- With regard to the difficulty during the storage, the more respondents owned storage facility, the more respondents recognized the difficulty during the storage. (Fig.2.2.30 and Fig. 2.2.33)
- In Nattalin, where the ratio of those who had storage facility was the highest, 47.6% of the respondents recognized the difficulty during the storage, and it was the highest among the townships. (Fig.2.2.30 and Fig. 2.2.33)
- Although there were a few respondents who did not have facility and recognize the difficulty regarding the agricultural products' storage, the majority of those who regarded they had the difficulty was the respondents who owned the facility. (Fig.2.2.33)

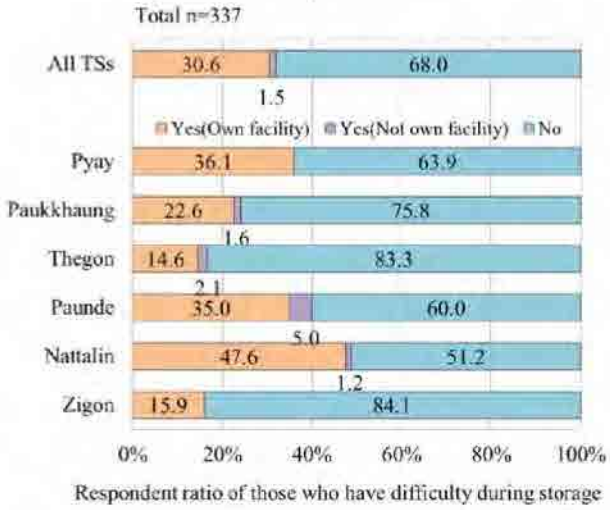


Fig. 2.2.33: Ratio of the respondents who recognized the difficulty during the storage

Note 1: "Total n" indicates total number of respondents who gave valid response.
Note 2: The ratio in the figure was calculated using total valid responses as denominator.

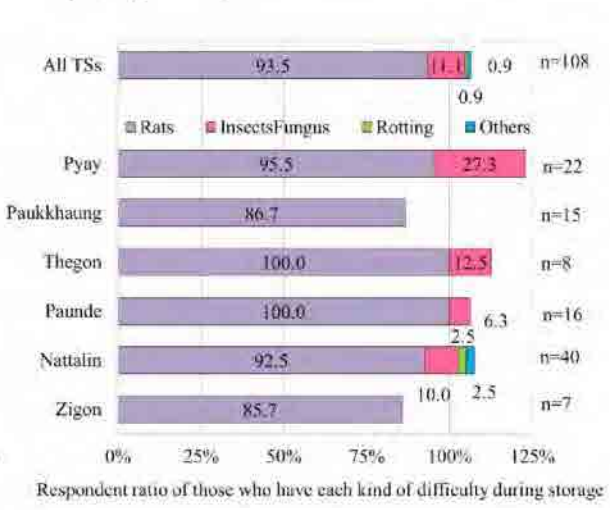


Fig. 2.2.34: Ratio of the respondents who recognize each item as specific problem during the storage

Note 1: "n" indicates the number of respondents who recognized the difficulty during the storage.
Note 2: the ratio in the figure was calculated using "n" as denominator.

- The most major specific problem during the storage the respondents had was rat. More than 80% of the respondents, who regarded that they have certain difficulty during the storage, pointed out rat as the problem, which damages stored agricultural produce. (Fig. 2.2.34)
- The second major problem was insects and fungus, which was pointed out by the respondents in townships, except Paukkhaung and Zigon. In Pyay, the ratio of the respondents who regarded insect and fungus as problem during the storage was the highest (27.3%), followed by those in Thegon, Nattalin, and Paungde; 12.5%, 10.0%, and 6.3%, respectively. Only in Nattalin, some respondents regarded rotting and other items were causing damage to their agricultural product during the storage. (Fig.2.2.34)
- It was expected the storing situation of seed was similar to above mentioned for a long time. If seed stored under high temperature in dry season (38-43℃) until start of monsoon season: between the beginning of March to June, germination rate would be remarkably decreased in July due to its heat damage, although it could be expected to have good germination rate in January. Additionally, seed damage caused by pest in warehouse would happen under such storage condition.

(2) Storage of Paddy

- Regarding the storage of monsoon paddy that the respondents sold, about a half of the respondents in townships, except those in Zigon, stored monsoon paddy after harvesting for a certain period. On the other hand, only 16.7% of the respondents in Zigon stored their monsoon paddy produced after harvest.(Fig.2.2.35)
- The ratio of whether stored the produce or not in the townships had similar tendency to that of storage facility ownership. Since the monsoon paddy is the main crop for the respondents of the survey, owning storage facility or not seemed to be reflected to whether the respondents stored monsoon paddy or not. (Fig.2.2.30 and 2.2.35)
- Looking summer paddy, even though the number of valid response was not so large, less respondents stored their harvest compared to monsoon paddy. Overall average ratio of the respondents who stored summer paddy after harvest was only 15.8%. (Fig. 2.2.35)
- According to the field survey, paddy in the Project area had been cultivate twice a year: summer and monsoon. Therefore, it has not been required to store paddy grain in warehouse for a long time since farmers generally sell their product to collector immediately after harvesting. The point to be improved is drying process after harvesting before selling.
- The average duration days of storage were from 95 to 174 days. In Nattalin, the average duration days of storage were longest, followed by Paukkhaung and Thegon, which were longer than 150 days. The average of duration days of storage in Pyay, Paungde, and Zigon was around 100 days. Although the number of valid responses about summer paddy was very few, the duration days of storage of summer paddy seemed to be shorter than that of monsoon paddy. (Fig. 2.2.36)

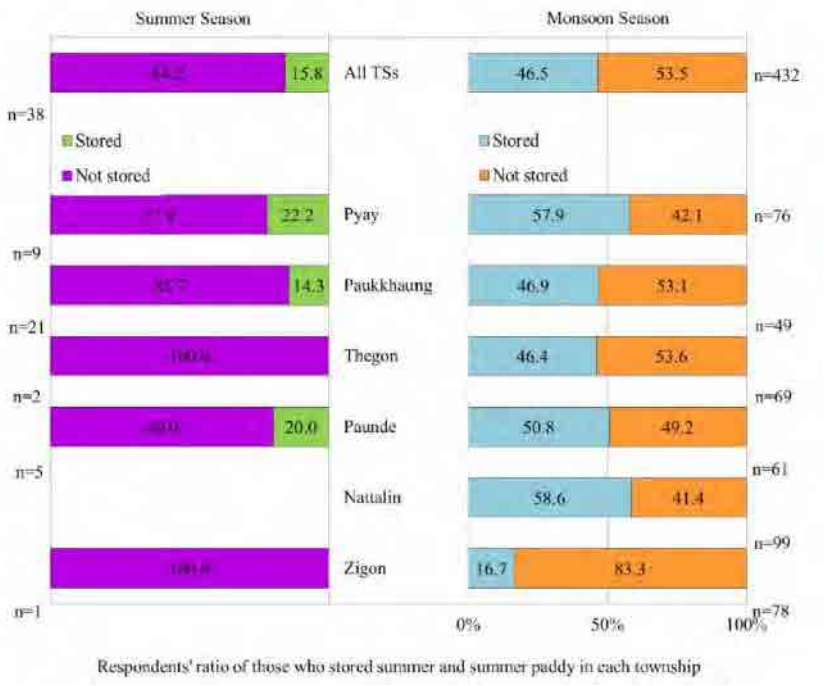


Fig. 2.2.35: Ratio of the respondents who stored paddy (monsoon & summer) for a certain period
("n" indicates the number of respondents who gave valid response to each item.)

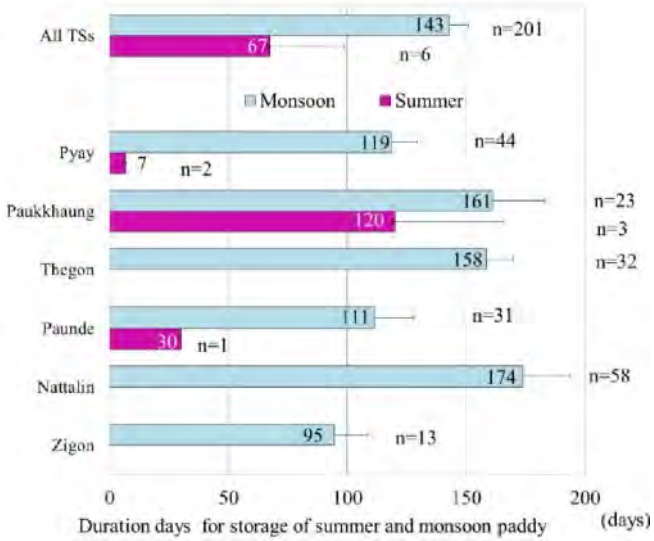
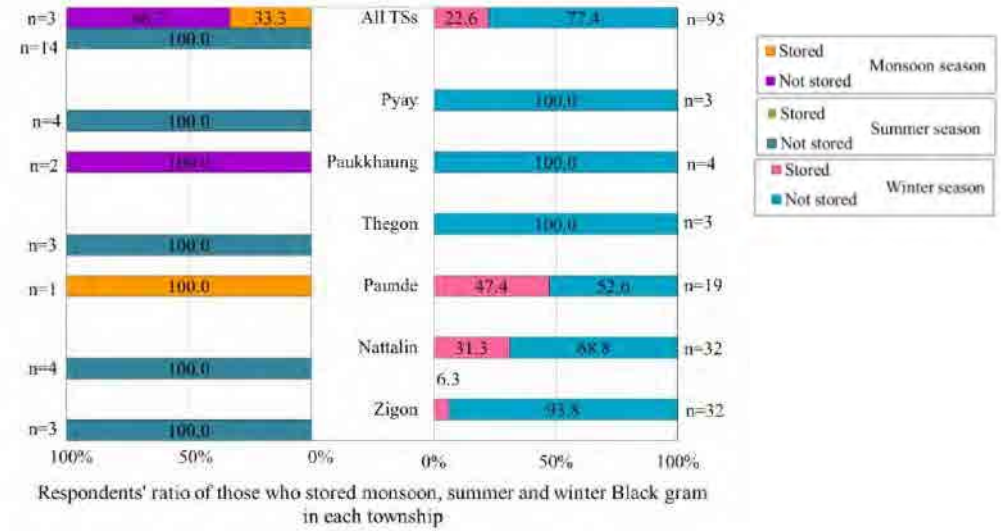


Fig. 2.2.36: Average duration days of storage of monsoon and summer paddy
("n" indicates the number of respondents who gave valid response to each item, and bars indicate standard errors.)

(3) Storage of Black Gram

- There were very few valid responses of black gram which was cultivated in monsoon and summer season, while there were relatively larger number of respondents who cultivated black gram in winter, in Paungde, Nattalin, and Zigon, which are located in southern part of the project area. (Fig.2.2.37)
- Looking those cultivated in monsoon and summer seasons, few respondents stored their harvested black gram before selling for a certain period. There were also very limited number of the respondents who stored their products, which accounted for 22.6% of the respondents overall. Among three (3) townships, which had relatively larger number of respondents; Paungde, Nattalin, Zigon, Zigon had lower percentage of the respondents who stored their produce compared to other two (2) townships, accounting for only 6.3%. (Fig.2.2.37)
- The average duration of storage in winter was 95 days on the whole. Among three (3) townships, the average duration of storage in Nattalin was the longest, followed by Zigon, and Paungde. (Fig.2.2.38)



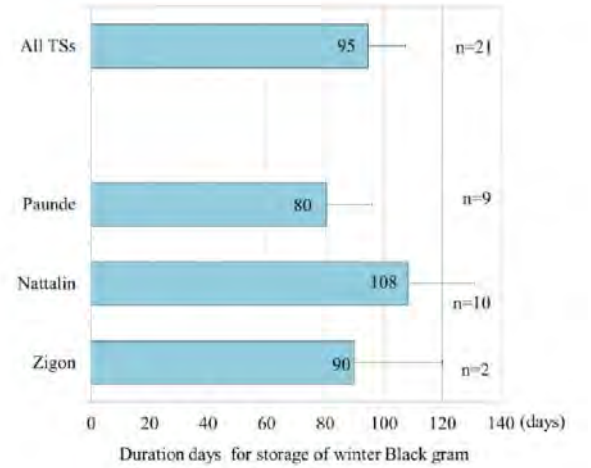


Fig. 2.2.38: Average duration days of storage of winter black gram
("n" indicates the number of valid response, and bars indicate standard errors.)

(4) Storage of Sesame

- There were some respondents in Pyay and Paukkhaung, and a few in Thegon, answered. The majority of those respondents were those who cultivated sesame in monsoon season. (n=54) (Fig.2.2.39)
- Only one (1) respondent each in Pyay and Paukkhaung respectively, who cultivated sesame in monsoon season, stored their product. One in Pyay stored their product for 30 days using a bin for storage, while another stored for 210 days. There was one (1) respondent who mentioned sesame cultivated in winter season, and he/she did not store it too.

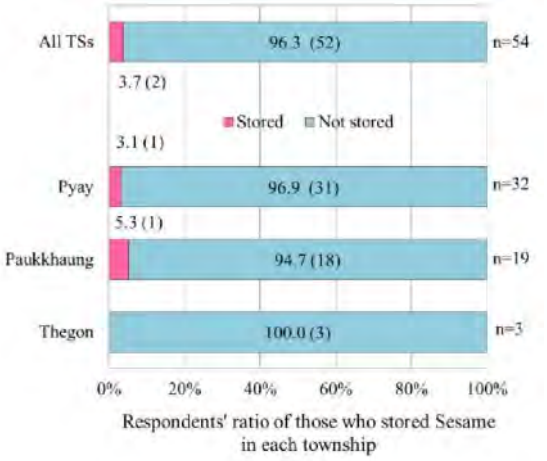


Fig. 2.2.39: Ratio of the respondents who stored sesame (monsoon) for a certain period (%)
Note1: "n" indicates the number of respondents who gave valid response.
Note2: the number with brackets indicates the number of responses

(5) Storage of Groundnut

- There were more respondents who cultivated groundnut in monsoon season (n=39) rather than those in winter season. (n=9) (Fig.2.2.40)
- In monsoon season, only one respondent in Paukkhaung stored his/her product for a certain period, accounting for only 2.6% of the respondents overall. In winter season, only one (1) each in Pyay and Paukkhaung stored their product, respectively. (Fig.2.2.40)

- Two (2) respondents who stored their groundnut in Paukkhaung owned warehouse as a storage facility, and both of them stored it for 30 days, while that of the respondent in Pyay was 130 days.

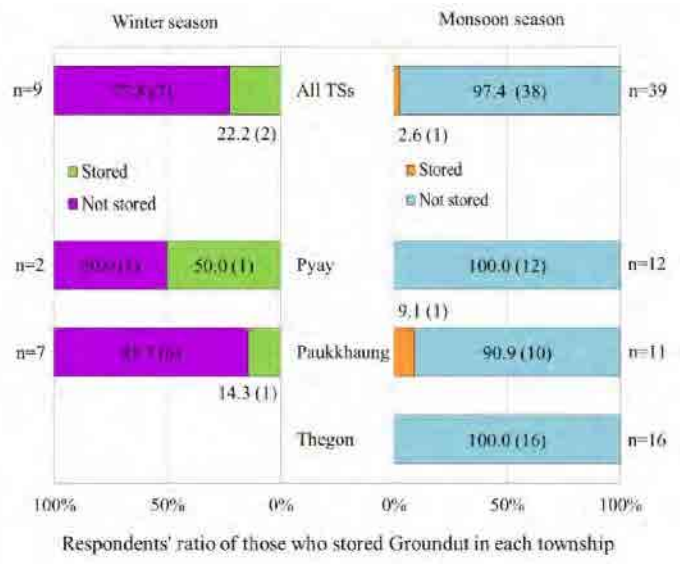


Fig. 2.2.40: Ratio of the respondents who stored groundnut (monsoon and winter) for a certain period (%)
Note1: "n" indicates the number of respondents who gave valid response to each item.
Note2: the number with brackets indicates the number of responses.

2.2.9 RICE STRAW USE

〈Monsoon Paddy Straw〉

- Rice straw was mainly used as cattle feed accounting 40 (Paukkhaung) to 60% (Pyay) except in Thegon, and the rest of 10 – 20% buried or burned it in fields.
- In Thegon, straw user ratios in respective manners (burry, burn, cattle feed, mulch, manure, medium, roofing, and others) were similar. Various cropping patterns derived from high population of vegetable growers probably caused diversified straw uses.

〈Summer Paddy Straw〉

- Summer paddy are not grown in Nattalin and Zigon.
- The uses in Thegon was equal to those of monsoon paddy straw.
- In the other townships, the use rate as cattle feed decreased to 10 (Paungde) to 30% (Pyay and Paukkhaung) because of grass weed supply with rainfall.
- Instead, the use rate as manure increased at the rate of 10 (Paukkhaung) to 20% (Pyay).
- It was mainly burnt in Paungde (70%).

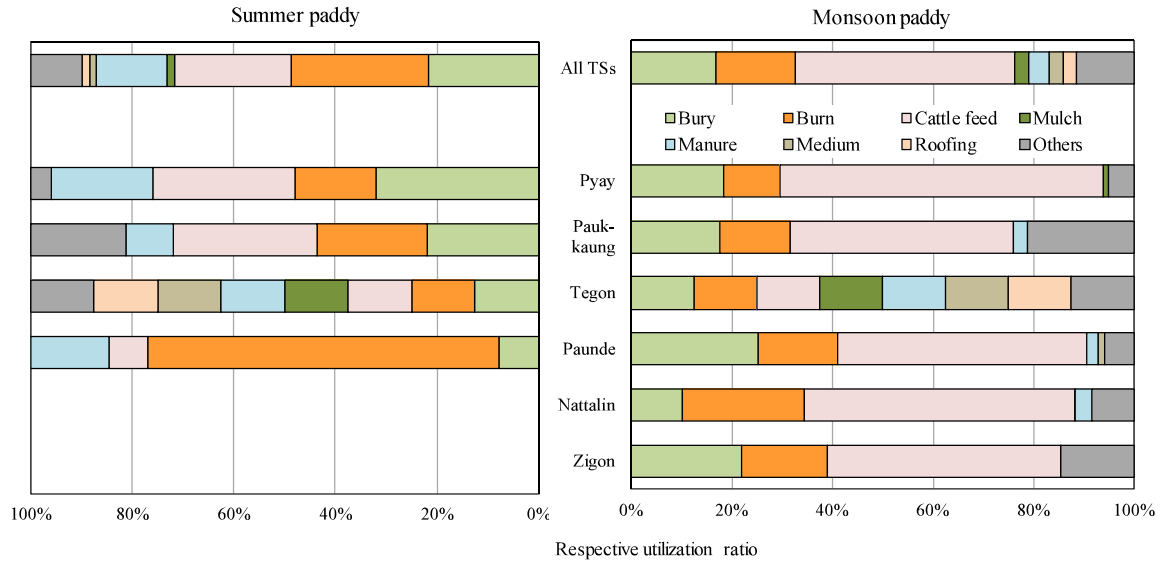


Fig. 2.2.41: Respondents' ratio by usage of paddy straw by township in monsoon and summer seasons

2.2.10 CROPS FOR SALE AND MARKET TO SELL

Grown crops were asked and the producers' ratios who sold each crop in different cropping seasons were calculated.

Table 2.2.6: Producers' ratio who sold respective crops in the target townships
(Shadowed numbers were less than 90%. Only one Control Farmer had a plot in LCA.
Some of the ratios of sugarcane are in parenthesis because it mostly needed two years until harvest.)

Cropping season	Location / Crop / Township	LCA				Outside of LCA											
		Paddy	Black gram	Green gram	Sugar-cane	Paddy	Black gram	Green gram	Sesame	Groundnut	Maize	Pigeon pea	Lab lab bean	Bocake (Cow pea)	Kenaf	Onion	Sugar-cane
Model Farmer & Ordinary Farmer																	
Mon	All TSs	91	-	-	-	96	100	89	91	97	100	100	-	-	-	-	100
	Pyay	80	-	-	-	96	-	100	100	90	-	-	-	-	-	-	100
	Paukkhaung	77	-	-	-	88	-	67	80	100	100	100	-	-	-	-	100
	Thegon	100	-	-	-	100	-	-	100	100	-	-	-	-	-	-	100
	Paungde	96	-	-	-	95	100	-	-	-	-	-	-	-	-	-	-
	Nattalin	98	-	-	-	100	100	-	-	-	-	-	-	-	-	-	-
	Zigon	100	-	-	-	100	-	-	-	-	-	-	-	-	-	-	-
Win	All TSs	-	100	100	-	-	98	92	-	90	-	-	100	100	-	-	(42)
	Pyay	-	-	100	-	-	100	90	-	67	-	-	100	100	-	-	-
	Paukkhaung	-	-	-	-	-	100	100	-	100	-	-	-	-	-	-	100
	Thegon	-	-	-	-	-	100	100	-	-	-	-	-	-	-	-	(36)
	Paungde	-	-	-	-	-	100	-	-	-	-	-	-	-	-	-	-
	Nattalin	-	100	-	-	-	100	-	-	-	-	-	-	-	-	-	-
	Zigon	-	100	-	-	-	95	-	-	-	-	-	-	-	-	-	-
Sum	All TSs	76	-	-	-	78	-	-	-	-	-	-	100	-	-	-	-
	Pyay	100	-	-	-	100	-	-	-	-	-	-	100	-	-	-	-
	Paukkhaung	71	-	-	-	56	-	-	-	-	-	-	-	-	-	-	-
	Thegon	-	-	-	-	100	-	-	-	-	-	-	-	-	-	-	-
	Paungde	100	-	-	-	100	-	-	-	-	-	-	-	-	-	-	-
	Nattalin	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	Zigon	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Control Farmer																	
Mon	All TSs	100	-	-	-	89	0	100	100	100	100	100	-	-	100	-	100
	Pyay	100	-	-	-	77	-	100	100	100	-	-	-	-	-	-	-
	Paukkhaung	-	-	-	-	72	-	-	100	100	100	100	-	-	-	-	100
	Thegon	-	-	-	-	95	-	-	100	100	-	-	-	-	-	-	-
	Paungde	100	-	-	-	100	0	-	-	-	-	-	-	-	100	-	-
	Nattalin	-	-	-	-	100	-	-	-	-	-	-	-	-	-	-	-
	Zigon	-	-	-	-	96	-	-	-	-	-	-	-	-	-	-	-
Win	All TSs	-	-	-	-	100	97	83	-	100	-	100	100	-	-	-	(55)
	Pyay	-	-	-	-	-	100	80	-	100	-	-	100	-	-	-	-
	Paukkhaung	-	-	-	-	100	100	100	-	100	-	100	-	-	-	-	(56)
	Thegon	-	-	-	-	-	100	-	-	-	-	-	-	-	-	-	(50)
	Paungde	-	-	-	-	-	100	-	-	-	-	-	-	-	-	-	-
	Nattalin	-	-	-	-	-	92	-	-	-	-	-	-	-	-	-	-
	Zigon	-	-	-	-	-	100	-	-	-	-	-	-	-	-	-	-
Sum	All TSs	100	-	-	100	100	-	-	-	-	-	-	-	-	-	100	-
	Pyay	-	-	-	-	100	-	-	-	-	-	-	-	-	-	-	-
	Paukkhaung	100	-	-	-	100	-	-	-	-	-	-	-	-	-	-	-
	Thegon	-	-	-	100	100	-	-	-	-	-	-	-	-	-	100	-
	Paungde	-	-	-	-	100	-	-	-	-	-	-	-	-	-	-	-
	Nattalin	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	Zigon	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-

- Most producers sold nominated all crops except black gram grown by Ordinary Farmers in monsoon season which presumably resulted from few produce by few producers.
- Green gram and groundnut were grown in northern three (3) townships for sale both in monsoon and winter seasons, but a part of it was probably used for self-consumption.
- Sesame was grown in northern three (3) townships in monsoon season as cash crop for all producers except a case of monsoon sesame in Paukkhaung; 20% of Model and Ordinary Farmers who grew it outside of LCA probably used it for self-consumption.

- Sugarcane was grown in northern three (3) townships for sale, and the cases shown less than 50% of sellers were probably caused by young plants not grown for two years yet.
- The other nominated crops, maize, pigeon pea, lab-lab bean, cowpea, kenaf, and onion, were sold by all producers.

(1) Paddy

- The most major distribution channel to sell paddy was to middle man at farm gate in townships, except Pyay. In Pyay, only 15% and 12% of respondents in each category, namely "Model+Ordinary" and "Control" in Pyay were sold to middleman.
- The second major ways of selling was to take it to a middleman, selling it to neighboring rice miller and selling it to neighbor, on the whole.
- However, no respondent in Nattalin and Zigon sold paddy to neighboring rice miller, and no respondent in Nattalin to neighbor.
- In Paungde, selling to neighbor was relatively more common rather than other townships.
- It seemed that the respondents in Nattalin sold paddy with relatively more limited choice of place to sell, compared to other townships.
- Almost no respondent sold their paddy rice to local market, except Control Farmers in Pyay.
- The respondents in Pyay seemed to have relatively more various choices compared to those in other townships, and the most common choice of selling way was to take to a middle man.
- The options such as taking to a middleman, selling to neighboring rice miller, and selling to export company/ rice millers were expected to be more frequently selected as the way of selling by the respondents in Pyay.

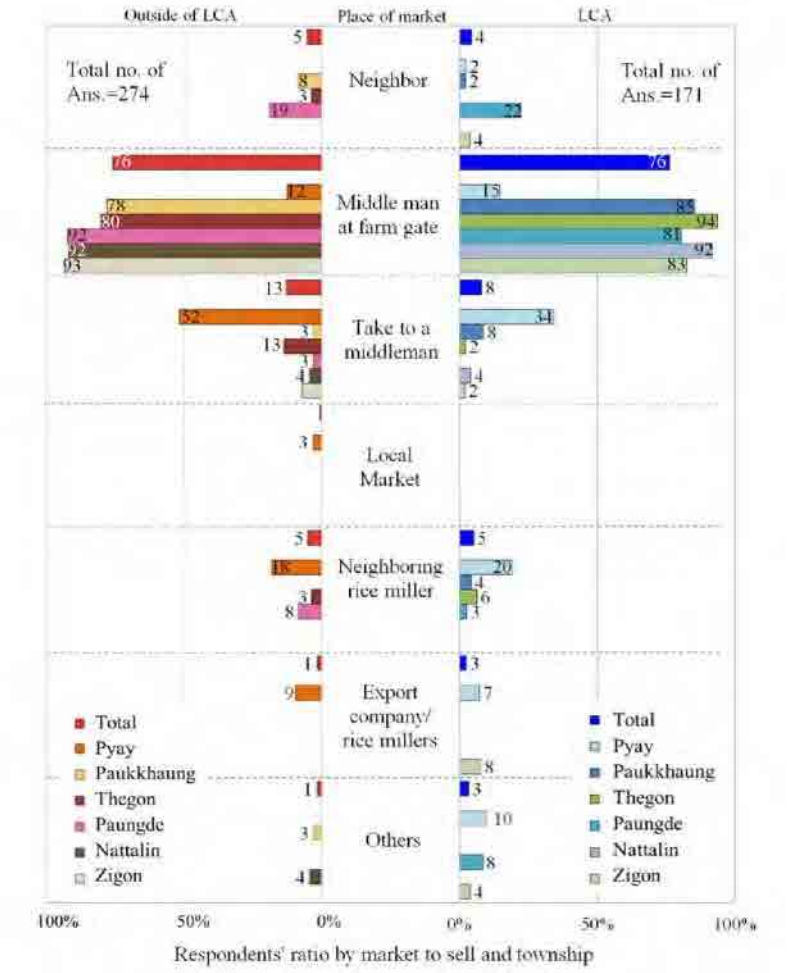


Fig. 2.2.42: Ratio of market the respondents sold paddy rice
Note 1: "Total no of Ans." indicates total number of valid responses.
Note 2: The ratio in the figure was calculated using total valid responses as denominator.

- Among those who took their produce to a person to sell, the respondents in Pyay answered more various market places compared to other townships, since more respondents Pyay took their produce to somewhere, but the less sold to neighbor or middleman at farm gate. (Fig. 2.2.43)
- Aung Lan market is located in Magway region, about 65km away from Pyay city, and some of the respondents brought their paddy product there. Other markets to which the respondents in Pyay brought their product were almost all located in Pyay township; namely Wet Htee Kan, Hletawgyi, and Pyay, except Paungtale, which is located in Paungtale township next to Pyay. (Fig. 2.2.43)
- From the respondents' field to Aung Lan market is about 32km according to the survey and the farthest among the market the respondents in Pyay accessed, followed by Pyay and Hletawgyi, which are about 19 and 18km away, and the nearest was Wet Htee Kan, 3km away on average.
- To Aung Lan, the more used public transportation or big truck to bring the product, and to the relatively nearer market, small truck were the most popular way of transportation. On the other hand, to the nearest, Wet Htee Kan, Trawlargyi was most popularly used. (Fig. 2.2.44)
- Among those who in Pyay took product to the market above, more than a half of the respondents brought it to a middleman at those markets. (Fig. 2.2.43)
- A few respondents from Paukkhaung and Thegon brought their product to the market in Pyay, although more respondents brought it to the markets which are located in each township; namely Paukkhaung and Fan npa pin in Paukkhaung Township and Sin Myee Swel in Thegon township. (Fig. 2.2.43)
- In the market to which the respondents in Paukkhaung and Thegon brought the product, the respondents sold it both to a middleman and rice miller there. (Fig. 2.2.43)
- Paukkhaung market and Fan npa pin were about only 2-3 km from the respondents' field, and small / big truck and trawlargyi[1] were used as ways of transportation. (Fig. 2.2.44)
- Since Zigon and Nattalin markets are very close to the respondents' field; about 3-4km away, major way of transportation was trawlargyi. (Fig. 2.2.44)
- The majority of all the respondents regard middleman as main price making factor, and the second factor was not described as choices in the questionnaire. (Fig.2.2.45)
- In all townships, a certain ratio of the respondents regarded production quality as price making factor. (Fig.2.2.45)

[1] Tawlargyi is a kind of motorbike with luggage carrier, which is commonly used in the project area.

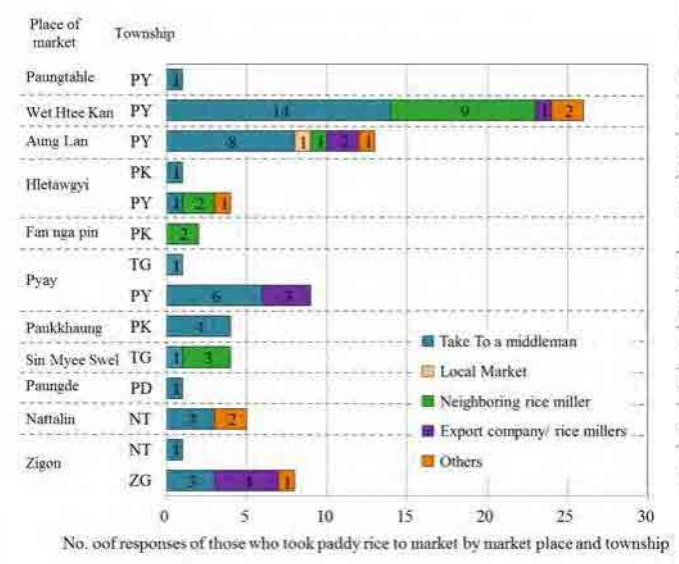


Fig. 2.2.43: The number of responses of those who took paddy rice to market by market place, township, and person to have sold

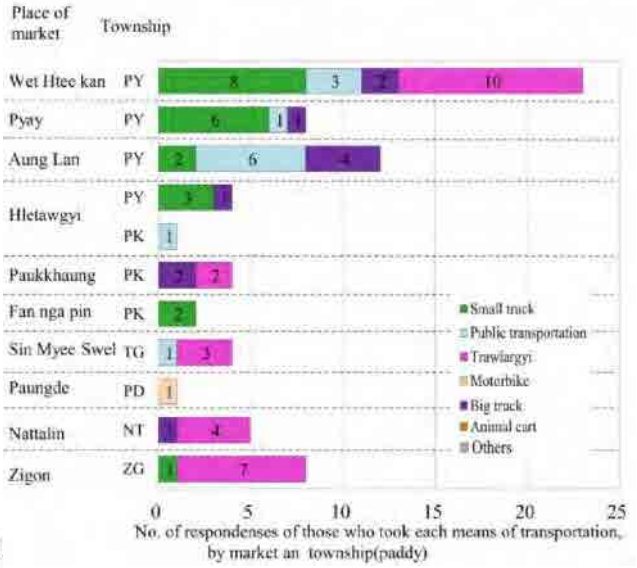


Fig. 2.2.44: The number of responses of those who took each mean of transportation, by market and township

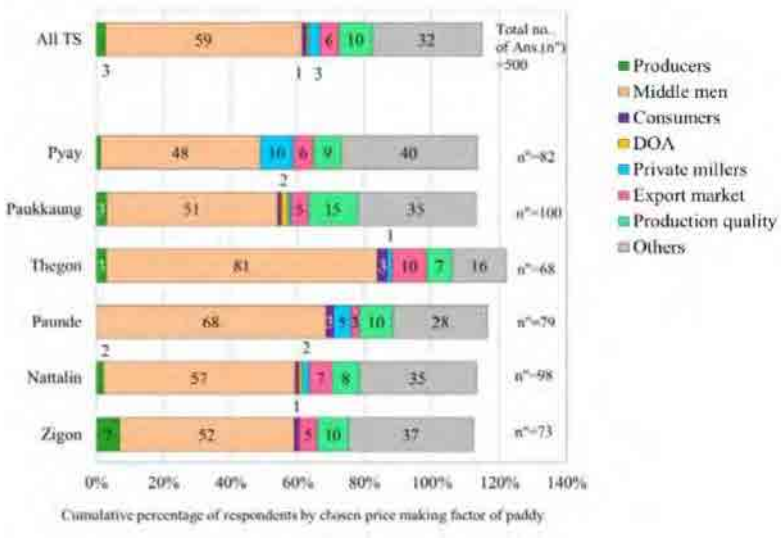


Fig. 2.2.45: Cumulative percentage of respondents who chose each factor as price making factor

Note1 n" indicates the number of answers.
Note2: Some respondents chose multiple factors and answered by variety.

(2) Black Gram

- Among the respondents in model and ordinary category, taking to a middleman was the most major way of selling black gram on the whole, followed by selling to middle man at farm gate, on the other hand, it was vice versa among those in control group.
- For the respondents in Pyay, both of the two categories; model and ordinary, and control, taking to a middle man was the major choice as way of selling black gram.
- For the respondents of model and ordinary group in Paukkhaung, taking to a middle man was the

most commonly selected way, while nobody sold middle man at farm gate. On the other hand, among the respondents of control category in Paukkhaung, selling to middle man at farm gate was the most major way, while taking to a middle man was the second common choice.

- In Thegon, among the model and ordinary group, selling middle man at farm gate was the most major, and the second was taking to a middle man. On the other hand, in control group, nobody sold by taking their produce to a middleman, although the major way was selling to middle man at farm gate too, same as the model and ordinary group.
- In Paungde, those who took their produce to a middleman were relatively fewer than other townships, and those who sold to a middleman at farm gate were the most.
- Among the respondents in control category, the most commonly used way of selling was to sell to a middle man at farm gate, followed by taking the produce to a middle man and selling it to local market. Whereas, among those who in Model and Ordinary category, taking to a middleman was major way of selling and those who sold it to middle man at farm gate was not so commonly chosen.

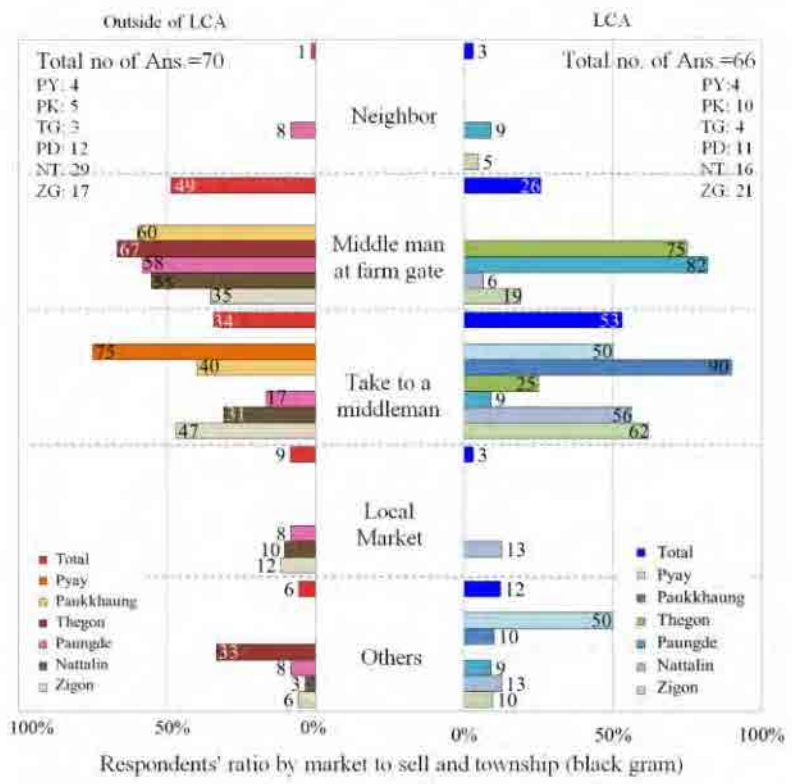


Fig. 2.2.46: Ratio of market the respondents sold black gram
Note 1: "Total no of Ans." indicates total number of valid responses.
Note 2: The ratio in the figure was calculated using total valid responses as denominator.

- The number of markets which were described as market to sell black gram were less than that of paddy. (Fig. 2.2.47)
- In Nattalin and Zigon, where the respondents' number were larger than other townships regarding black gram marketing, a middleman in Nattalin market and Zigon market was the most popular person to deal with for the respondents. (Fig. 2.2.47)
- The major way of transportation of black gram in Nattalin and Zigon was trawlargyi, same as paddy. (Fig. 2.2.48)

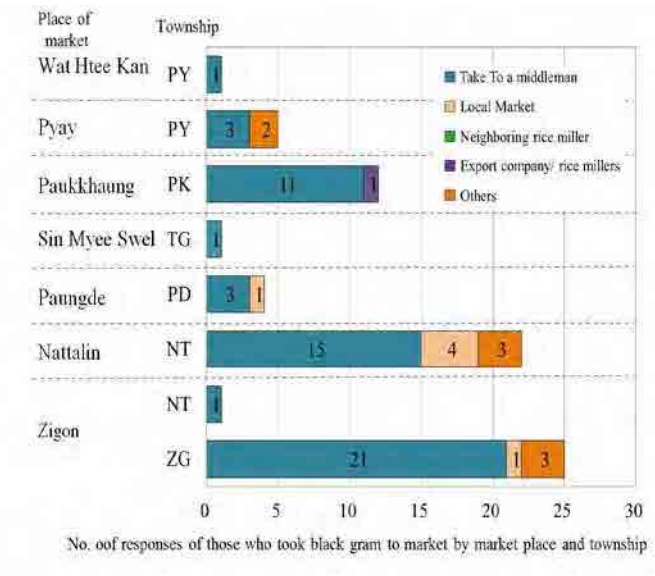


Fig. 2.2.47: The number of responses of those who took black gram to market by market place, TS, and person to have sold

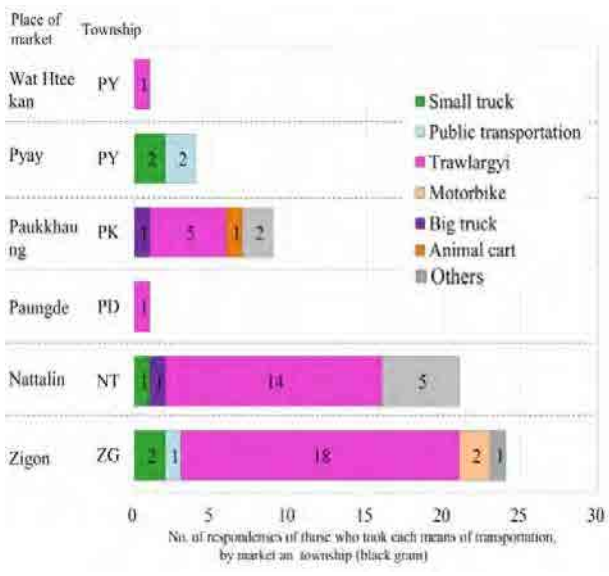


Fig. 2.2.48: The number of responses of those who took each mean of transportation, by market and township (black gram)

(3) Green Gram

- There was no answer regarding green gram in Paungde, Nattalin, and Zigon.
- In both of the categories; model and ordinary, and control, those who sold green gram by taking to a middle man was major way in Pyay and Paukkhaung,
- In Pyay, other way of selling which was not shown in the questionnaire was the second commonly chosen. However, it was not clarified in the survey.

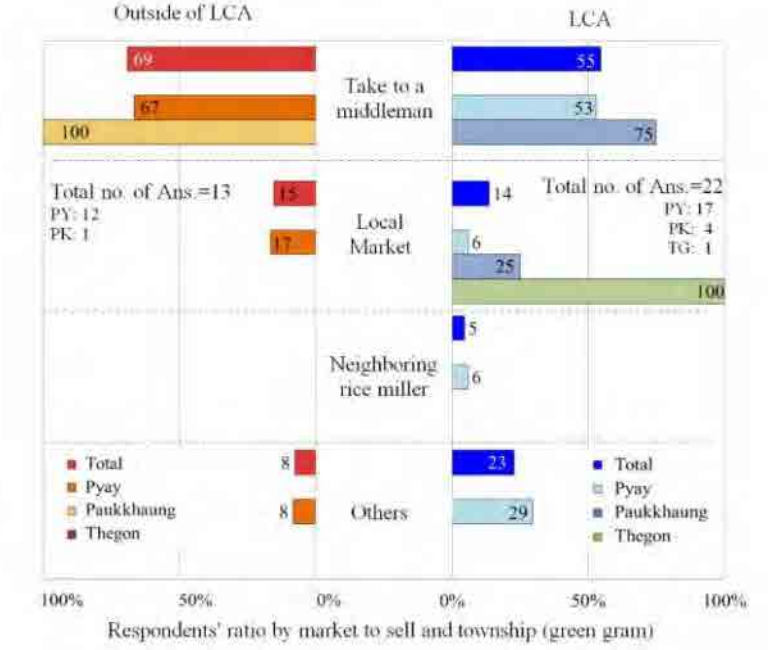


Fig. 2.2.49: Ratio of market the respondents sold green gram

Note 1: "Total no of Ans." indicates total number of valid responses.
Note 2: The ratio in the figure was calculated using total valid responses as denominator.

- Green grams grown in Pyay were sold to a middleman in several markets, Aung Lan, Wet Htee Kan and Pyay, and that in Paukkhaung were sold to Paukkhaung market middlemen. (Fig. 2.2.50)
- To Aung Lan the respondents used public transportation and big truck like paddy, and to nearer

market like Wat Htee kan, small truck and trawlargyi were used. To Pyay market, it was relatively farther than Wat Htee kan, public transportation was also used.

- To Paukkhaung market, to which green gram grown in Paukkhaung was sold, small truck, trawlargyi and motor bike were used for transportation.

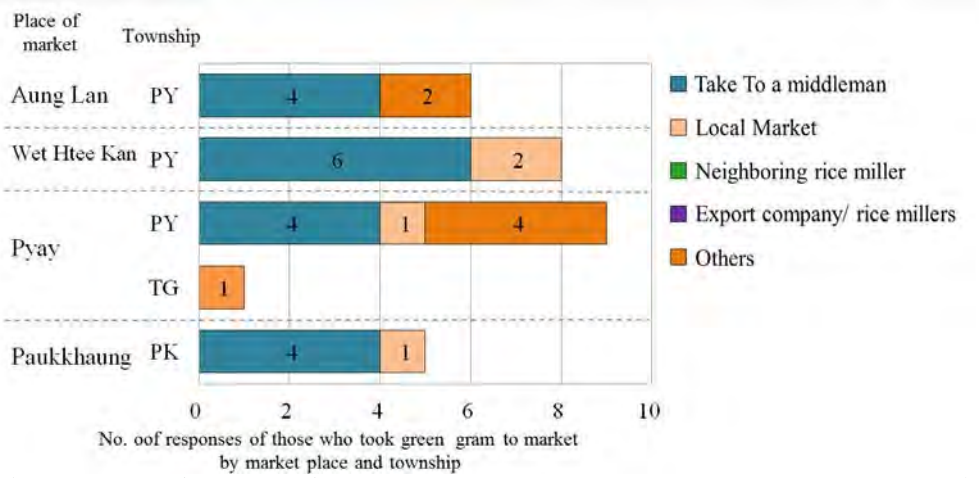


Fig. 2.2.50: The number of responses of those who took green gram to market by market place, township, and person to have sold

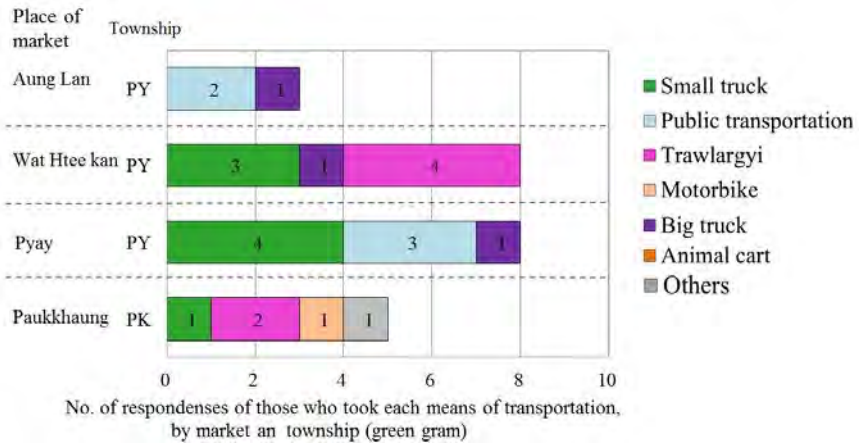


Fig. 2.2.51: The number of responses of those who took each mean of transportation, by market and township (green gram)

(4) Groundnut

- There was no response regarding market which the respondents sold groundnut to in Paungde, Nattalin, and Zigon.
- Taking to a middleman was popular in both categories; Model and Ordinary, and Control.
- The second major way in Control category was selling to a middle man at farm gate in Paukkhaung and Thegon, while nobody from both of two categories in Pyay.

- In Model and Ordinary category, the second major way of selling was not described in the questionnaire, but it has not been clarified.
- While nobody in Control category sold groundnut to local market, there was a certain number of the respondents who did in Model and Ordinary category in Paukkhaung and Thegon.
- On the other hand, there were some who sold their produce to export company in Control category in Paukkhaung.
- The markets at which the respondents in Pyay who sold groundnut were almost same as those of green gram. (Fig.2.2.53)
- Some respondents in Thegon TS brought groundnut to markets in neighboring townships such as Pyay and Paukkhaung townships, and the number of respondents regarding groundnut were relatively larger than that of other crops in Thegon township. (Fig. 2.2.53) Among those respondents, those who sold their product at Pyay market was the most.
- Paukkhaung market is very close to the field location of the respondents in Paukkhaung; about only 2km away on average, therefore, many of respondents used trawlargyi as way of transportation. (Fig. 2.2.54)

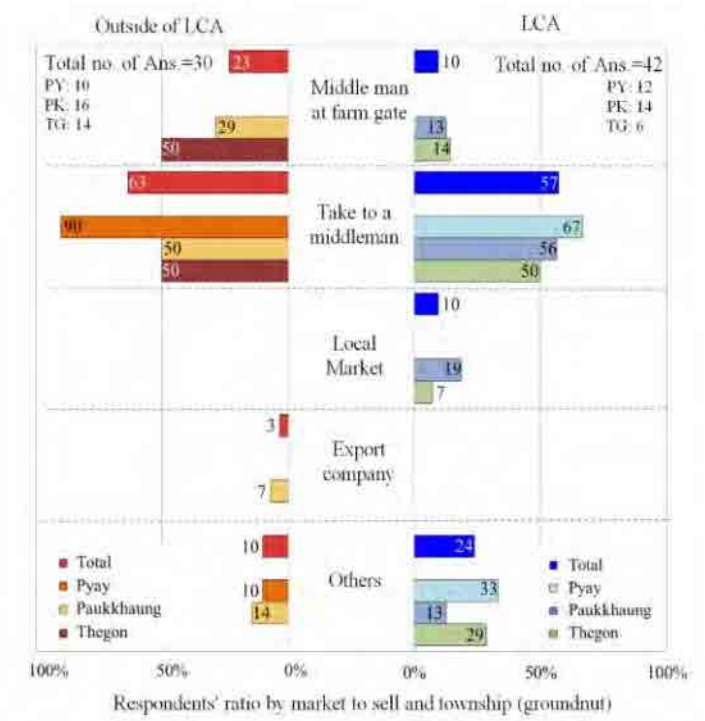


Fig. 2.2.52: Ratio of market the respondents sold groundnut
Note 1: "Total no of Ans." indicates total number of valid responses.
Note 2: The ratio in the figure was calculated using total valid responses as denominator.

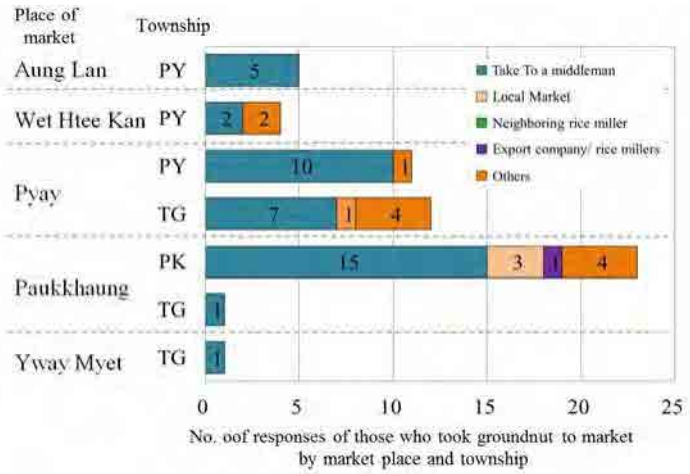


Fig. 2.2.53: The number of responses of those who took ground nut to market by market place, township, and person to have sold

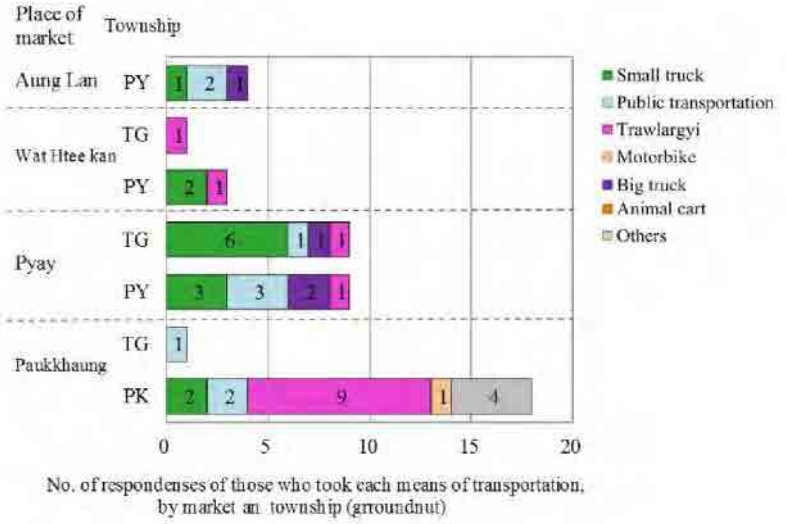


Fig. 2.2.54: The number of responses of those who took each mean of transportation, by market and township (groundnut)

(5) Sesame

- Those who sold sesame by taking it to a middle man were the most.
- There were the respondents who sold sesame to a middle man at farm gate only in Paukkhaung, but no in other townships.
- Local market was second common choice for the respondents of Control category in Pyay, and those of Model and Ordinary category in Paukkhaung.

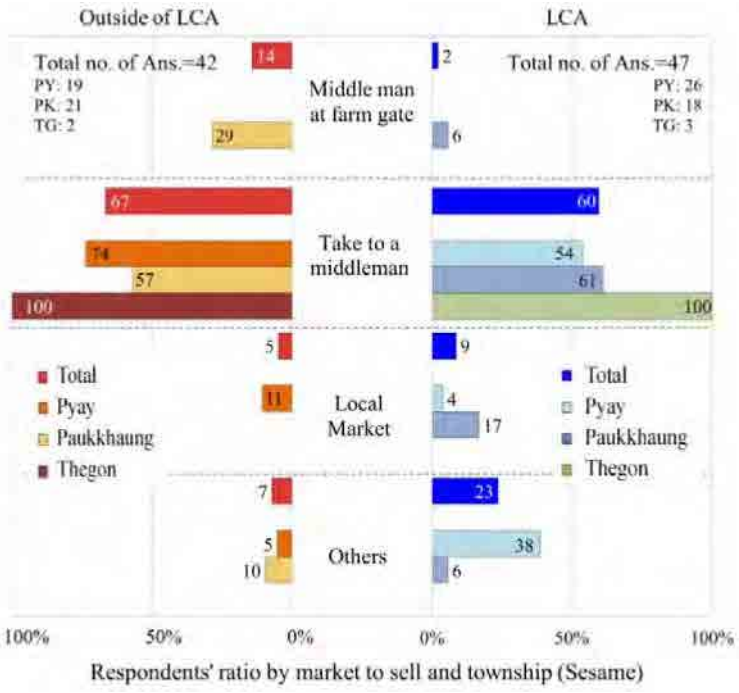


Fig. 2.2.55: Ratio of market the respondents sold sesame
Note 1: "Total no of Ans." indicates total number of valid responses.
Note 2: The ratio in the figure was calculated using total valid responses as denominator.

- Many of the respondents in Pyay sold their product in Aung Lan, even though it was the farthest among the market at which the respondents in Pyay sold sesame. In Wet Htee Kan and Pyay, the number of the respondents who sold at those markets was fewer than that of Aung Lan. (Fig. 2.2.56)
- In Aung Lan and Pyay, major person to sell was a middleman. (Fig. 2.2.56)
- To Aung Lan and Pyay, which are located relatively farther than Wat Htee Kan, the respondents used small / big truck or public transportation.(Fig.2.2.57)
- In Paukkhaung Township, Paukkhaung market was only described and many of the respondents sold their product to a middleman. (Fig. 2.2.56) Since Paukkhaung market was only about 2km away from the respondents' fields, many of the respondents used trawlargyi to transport their product. (Fig.2.2.57)

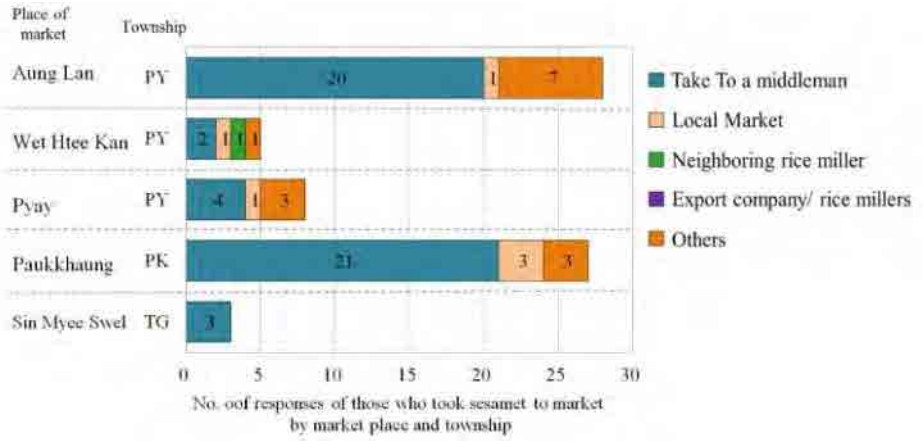


Fig. 2.2.56: The number of responses of those who took sesame to market by market place, township, and person to have sold

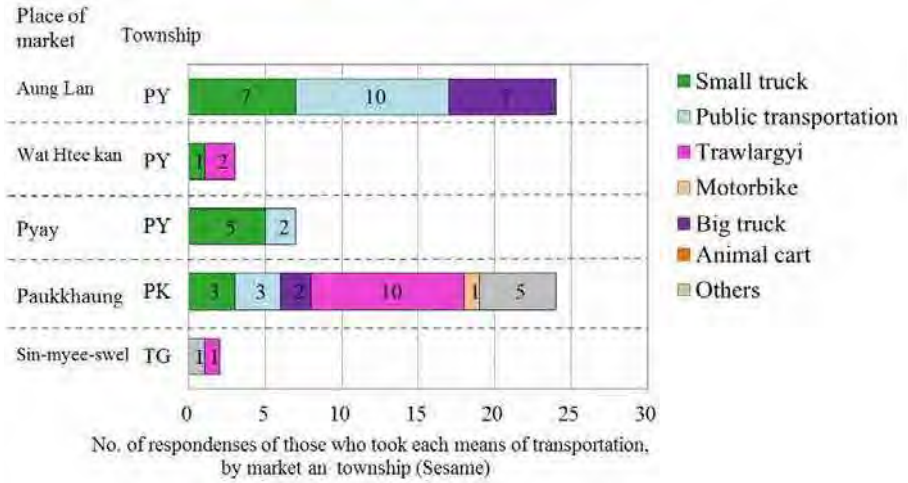


Fig. 2.2.57: The number of responses of those who took each mean of transportation, by market and township (sesame)

(6) Market to Sell Other Crops

- With regard to Pigeon Pea grown in Paukkhaung, Selling it to a middle man at farm gate and taking it to a middle man were the most as a mean of selling. (Fig.2.2.58)
- Among those who sold Lab Lab Bean in Pyay, those who took their produce to a middle man to sell were the most. (Fig.2.2.58)
- The most popular way among the respondents who sold sugarcane was not shown in the choice of the questionnaire. However, according to the field survey, it was expected that many of the respondents sold their produce to sugar factory under contract farming. The second common way of selling was to sell it at local market. (Fig.2.2.58)

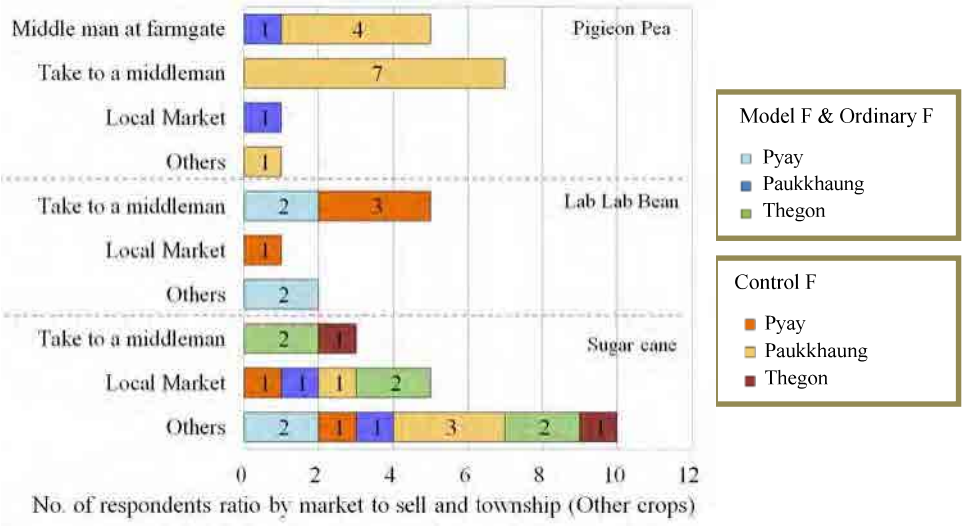


Fig. 2.2.58: The number of responses by market / way of selling and crop

- The respondents in Paukkhaung who grew Pigeon Pea sold their product at Paukkhaung market, and the respondents in Pyay who grew Lab Lab Bean sold at Wet Htee kan and Pyay market, which are located in Pyay township. (Fig. 2.2.59)
- Mya Village Sugar Mill and Pyay market were the major markets for sugarcane producers in three (3) townships, Pyay, Paukkhaung and Thegon. (Fig. 2.2.59) In-ngar-gwa is located in Paukkhaung TS.

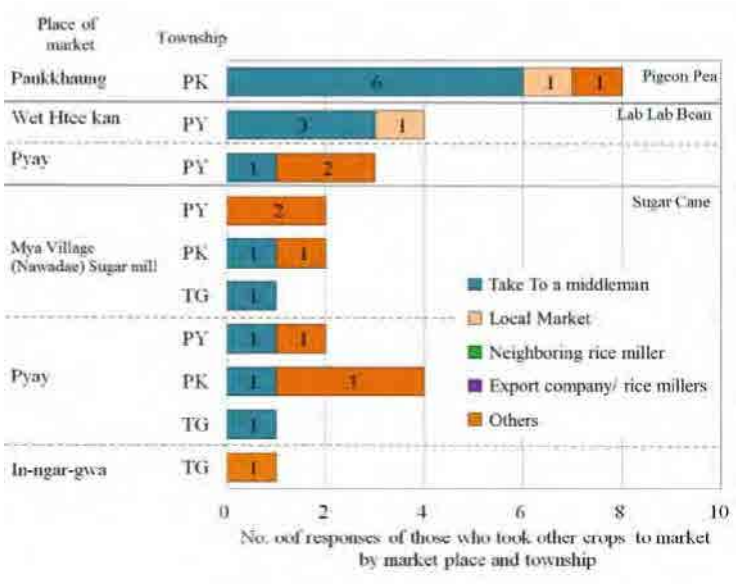


Fig. 2.2.59: The number of responses of those who took pigeon pea, lab lab bean, and sugarcane to market by market place, township, and person to have sold

- The respondents who sold sugarcane chose small/big truck as transportation, and it is expected to be because of large and long plant body of sugarcane. (Fig. 2.2.60)

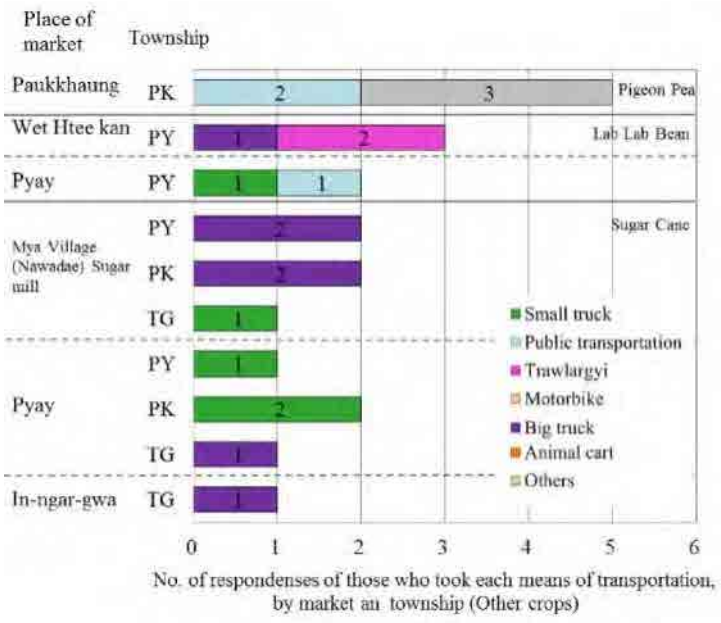


Fig. 2.2.60: The number of responses of those who took each mean of transportation, by market and township (pigeon pea, lab lab bean, and sugarcane)

2.2.11 LIVESTOCK RAISING

- The ox for working was most widely raised among all the respondents. The overall average of household ratio which owned ox (en) for working was 72.1%. (Fig. 2.2.61)
- As for the average of ownership ratio by township, those of Paukkhaung and Zigon were the lowest, 62.7%, followed by those of Paungde, Thegon and Nattalin. The highest was that in Pyay, and 84.1% of the respondents in Pyay owned ox (en). (Fig. 2.2.61)
- The average number of owned oxen per household of all TS was 2.4 heads per household, and those of townships did not so widely differ from each other, although those who owned ox (en) in Pyay seemed to raise relatively larger number of oxen and those in Paungde seemed smaller than other townships. (Fig. 2.2.62)
- The ox (en) owned by the respondents was expected to be used in farm management. Plowing, leveling and transportation were the farm management in which domestic animals were the most utilized. In case of monsoon paddy, which is the most major crop among all the respondents, more respondents in Pyay utilized domestic animals for plowing and leveling rather than other townships. (Fig. 2.2.63-1~2.2.63-3)
- However, the ownership ratio and the number of oxen per household did not clearly correspond to the use of domestic animal for farm management of monsoon paddy. (Fig. 2.2.61, 2.2.62, 2.2.63-1~2.2.63-3)
- The second popularly raised domestic animal was chicken followed by pig in all townships. Overall, 36.7% and 18.9% of total respondents in all six (6) townships owned chickens and pig(s)
- In Pyay, Paukkhaung and Paungde, almost a half of the respondents in the three (3) TSs owned chickens, and the household ratios which owned pig (s) in the townships were also relatively higher than other three (3) townships. (Fig.2.2.61)
- The average number of owned chickens per household was from 12.9 to 16.8, and overall average number was 15.4. That of pig overall was 2.6 heads per household, and that in Nattalin was the largest (6.4), while those in other townships were from 1.4 to 2.5. (Fig. 2.2.62)
- With regard to other domestic animals like horse, duck and milking cow, very limited number of households were raising those animals, less than 5% of all respondents' households overall, except those who owned duck (s) in Nattalin, which accounted for 8.2% of the respondents. No respondents owned either goat or sheep.

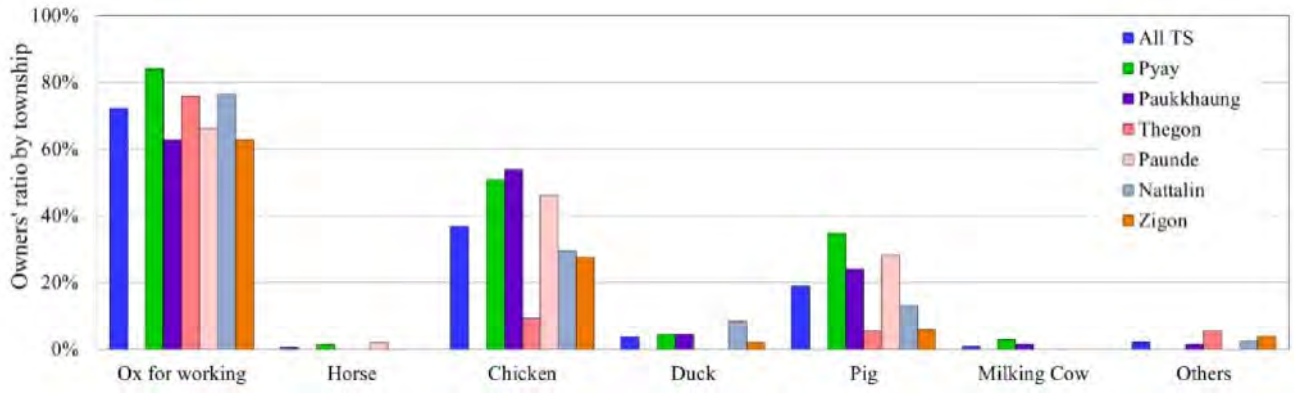


Fig. 2.2.61: Household ratio which owned each livestock

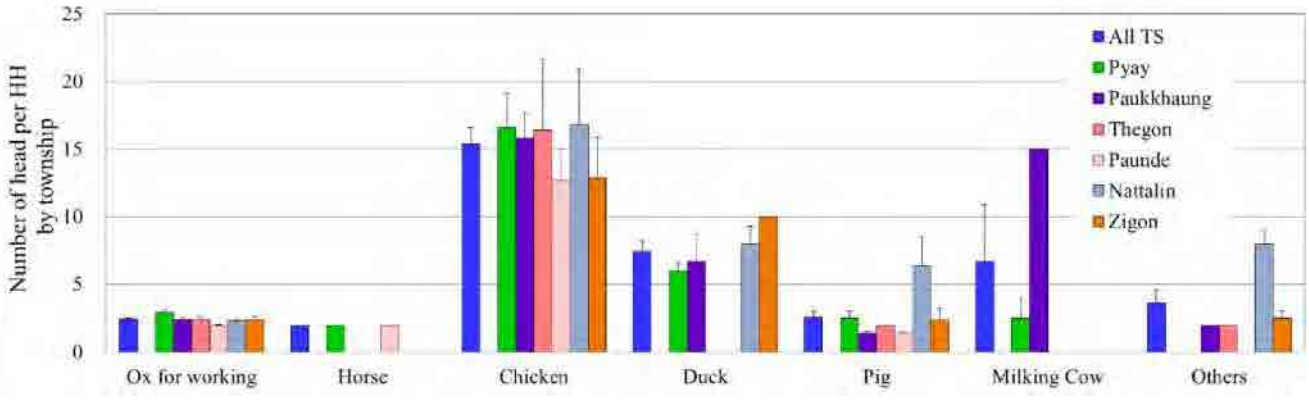


Fig. 2.2.62: Number of owned livestock per household
(Bars indicate standard errors, and each average was calculated based on the data of those who own each livestock)

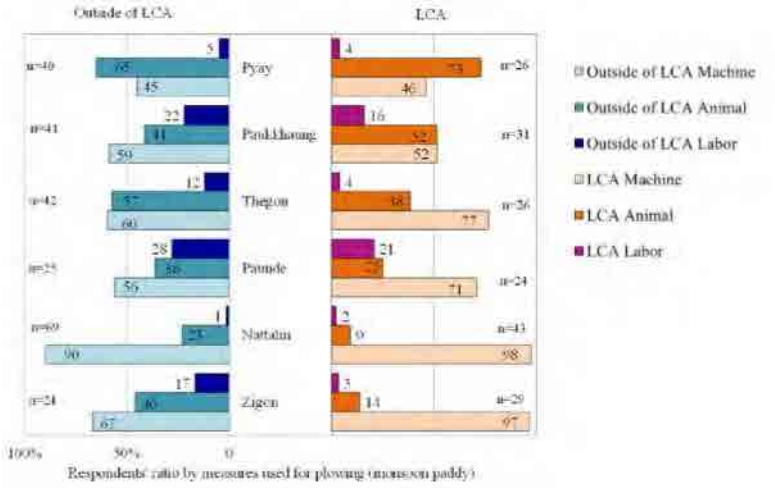


Fig. 2.2.63-1: Respondents' ratio by measures used for plowing of monsoon paddy
Note 1: "n" indicates total number of valid response.
Note 2: The ratio in the figure was calculated using total valid responses by township and categories of place (LCA / Outside of LCA) as denominator.

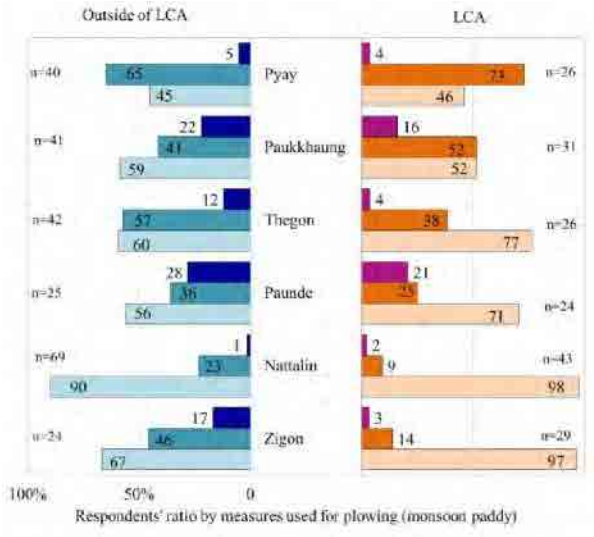


Fig. 2.2.63-2: Respondents' ratio by measures used for Leveling of monsoon paddy
Note 1 and Note2 are same as Fig.2.2.63-1.

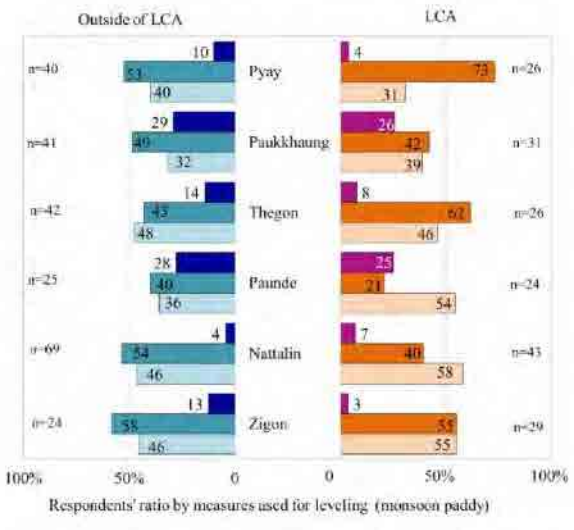


Fig. 2.2.63-3: Respondents' ratio by measure used for Transportation of monsoon paddy
Note 1 and Note2 are same as Fig.2.2.63-1.

- The following table summarizes the raising cost for respective domestic animals, the sold number and income from sold amount. (Table 2.2.7)
- Many respondents did not mention any cost for keeping, which might be because the respondents did not recognize how much they spent or did not convert self-supplied cost like feed or family labor into outsourced one.
- Among the breakdown of total cost for keeping major domestic animals such as ox, chicken, and pig, feeding was the most costly and more respondents recognized and described how much they spent for feeding.
- On the other hand, there were only a few respondents, who answered numerical labor cost for keeping.
- Regarding veterinary service cost, there was also very limited number of respondents, who described it in the questionnaire, although about one third of the all respondents who owned ox (en) spent cost for veterinary service. It indicated that ox, which is the most major domestic animal for the respondents, was taken care more carefully rather than other domestic animals.
- The physically bigger animals like ox, pig and milking cow required higher cost for keeping, but those sell at higher price too. The selling price of ox per head was the highest.

Table 2.2.7: Overall average of raising cost, sold amount and income from sold amount

	Ox	n_1=271		Horse	n_1=2	
	Ave. (n_1)	Ave. (n_2)	n_2	Ave. (n_1)	Ave. (n_2)	n_2
Cost for keeping						
Labor (Ks/month/HH)	797	(21,600)	10	n.a.	n.a.	0
Feed (Ks/month/HH)	11,211	(18,525)	164	n.a.	n.a.	0
Veterinary (Ks/year/HH)	1,983	(5,375)	100	n.a.	n.a.	0
Income from animal						
Sold amount (head)		(2.2)	21		(20)	1
Income from sold amount (Ks/year/HH)		(1,123,333)	21		(110,000)	1
Income from sold amount (Ks/head)		(499,802)	21		(5,500)	1

	Chicken	n_1=138		Ducks	n_1=14	
	Ave. (n_1)	Ave. (n_2)	n_2	Ave. (n_1)	Ave. (n_2)	n_2
Cost for keeping						
Labor (Ks/month/HH)	44	(3,010)	2	0	n.a.	0
Feed (Ks/month/HH)	1,112	(6,140)	25	786	(5,500)	2
Veterinary (Ks/year/HH)	326	(45,000)	1	0	n.a.	0
Income from animal						
Sold amount (head)		(13.2)	62		(8.0)	3
Income from sold amount (Ks/year/HH)		(46,088)	62		(34,167)	3
Income from sold amount (Ks/head)		(3,940)	62		(3,730)	3

	Pig	n_1=71		Milking Cow	n_1=3	
	Ave. (n_1)	Ave. (n_2)	n_2	Ave. (n_1)	Ave. (n_2)	n_2
Cost for keeping						
Labor (Ks/month/HH)	747	(13,251)	4	15,000	(45,000)	1
Feed (Ks/month/HH)	22,396	(24,463)	65	0	n.a.	0
Veterinary (Ks/year/HH)	556	(3,292)	12	21,667	(32,500)	2
Income from animal						
Sold amount (head)		(3.1)	34		(2.5)	2
Income from sold amount (Ks/year/HH)		(425,111)	34		(405,000)	2
Income from sold amount (Ks/head)		(183,879)	34		(195,000)	2

Note: n_1 and n_2 indicate the number of those who own each animal, and that of those who spent each cost or sold their animals, respectively. Average (n_1) and average (n_2) were calculated based on the corresponding data following the above definition.