INTRODUCTION

Having revised and restructured several occasions, the original curriculum of the BSc (Agriculture) Degree program which was introduced in 1978, the Faculty of Agriculture, University of Ruhuna has launched a new Degree program; BSc (Agricultural Resource Management and Technology) along with two more new degree programs, in 2013. The first cohort of students of each of the above programs was enrolled in 2012 and graduated in 2016.

Regular adjustments in curriculum and assessment of the programmes are among the vital
components of a teaching-learning environment of a progressive higher educational institute. Apart from stakeholder opinion, analysis of students’ academic performance can also serve as a valuable tool in making adjustments in curriculum and assessments. In general, good exam results encourage students (Artino et al. 2010; Abdulghani et al. 2012) while increasing their opportunities for employments and higher studies and after-graduation earnings (Smith et al., 2000; Smith and Naylor 2001). Meanwhile, undergraduate level academic performance are influenced by a range of factors including university entrance level qualification, gender, socio-economic background of the students, students personal commitments, learning style, etc. (Smith and Naylor, 2001). In a comprehensive study in the UK, across many disciplines, Smith and Naylor (2001) showed that undergraduate performance is positively correlated with A/L results. McKenzie and Schweitzer (2001) showed that performance at university entry accounted for 39% of the variance in undergraduate performance.

In Sri Lanka, admission of students to state universities is based on A/L performance as determined by Z score. Students who followed either Biology or Agriculture stream can apply for all the Agriculture and related degree programs including AT, GT and AB. Since subject combination of two streams differs markedly, knowledge at the time of university entrance can also be expected to be vary depending on the A/L stream followed. Moreover, due to the complex selection process, the variation among the students as indicated by Z score could also be huge. The objective of the present study was to analyze the undergraduate academic performance of three new degree programs as affected by A/L stream of study, subject performance and gender. Since one cohort of students completed the whole program of the respective degrees, it is expected that analysis would assist to fine-tune the curriculum and assessment procedures of these degree programs.

MATERIALS AND METHODS
The study was conducted at the Faculty of Agriculture, University of Ruhuna, Sri Lanka. Drop-out rate, semester-wise academic performance and overall grade point average of undergraduates who followed GT (n=48), AB (n=49) and AT (n=142), along with respondents’ gender and GCE (A/L) subject-wise gradings were subjected to analysis. Sample characteristics are given in Table 3. Many students failed to recall their Z score. Furthermore, students’ subject-wise marks at the A/L examination were not accessible. Therefore, subject-wise academic performance in A/L was considered. A, B, C and S grade were given score of 4, 3, 2 and 1, respectively. Total academic performance was calculated as the sum of scores for all three subjects. For example, a total of 11 points was assigned to a student who had obtained A grades for two subjects and a B grade for the other subject. The contributions of the subject with A, A and B to the total performance were considered 36.36 (=4/11 X 100), 36.36 and 27.28 %, respectively. GT and AB programs were completely new degree programs while AT program can best be regarded as a restructured, revised, renamed version of the previous BSc (Agriculture) degree program. A detailed description of the three programs is available on www.ruh.agri.ac.lk. A summary of the course structure and other basic features are given in Table 1. Up to 4th semester, many courses were common for AB and AT programs. In the 6th semester, AT students mainly engage in farm practice course. Farm practice course is offered as an optional course for AB students. At the end of the 6th semester, students select their specialization areas. Departmental level specialization programs are commenced at the 7th semester followed by a research and dissertation submission in the 8th semester. During the 7th semester, students follow courses offered by his or her specialization areas along with some common courses.
Semester Grade Point Average (SGPA) is calculated using the following formula and students will have grades based on their SGPA (Table 2).

\[ \text{SGPA} = \frac{\sum C_i \cdot G_i}{\sum C_i} \]

Where,
- \( C_i \) is the number of credits for \( i^{th} \) course
- \( G_i \) is the grade point obtained for the \( i^{th} \) course

The Overall Grade Point Average (OGPA) will be calculated at the end of each semester using the formula;

\[ \text{OGPA} = \frac{\sum C_{ij} \cdot G_i}{\sum C_{ij}} \]

Where,
- \( C_{ij} \) is the number of credits for the \( i^{th} \) course in the \( j^{th} \) semester.
- \( G_i \) is the grade point obtained for the \( i^{th} \) course.

Data were statistically analyzed using Minitab V 14. One sample and two sample t tests, one proportions and two proportions tests were conducted where applicable. SPGA and GPA among three degree programs were analyzed using ANOVA. Means were compared using

### Table 1: A summary of the course structure, teaching, and evaluation procedures of the three degree programs studied

| Item                              | GT               | AB               | AT               |
|-----------------------------------|------------------|------------------|------------------|
| Minimum no of course credits per semester | 22               | 22               | 22               |
| Total number of compulsory course credits | 104              | 95               | 114              |
| Minimum requirement of elective course credits | 8                | 18               | 6                |
| Specialization semesters          | 7th and 8th semester | 7th and 8th semester | 7th and 8th semester |
| Common courses                    | ICT, Statistics, Career guidance | ICT, Statistics, Career guidance | ICT, Statistics, Career guidance |
| Industrial training credit number | 6                | 2                | 2                |
| Research credits                  | 6                | 6                | 6                |
| Minimum total credits             | 124              | 121              | 128              |
| Departments involve in teaching   | Mainly Agric Engineering and some other Departments for common courses | Mainly Agric Economics and some other Departments for Common courses | All the departments |
| Specialization selection of students | Mainly Agric Engineering | Mainly Agric Economics | All departments |
| Research involvement              | Mainly to Agric Engineering | Mainly to Agric Economics | All departments |
| Availability of Optional Courses  | From 3rd semester onward | From 5th Semester onward | From 5th Semester onward |
| Farm practice course              | No               | Optional         | Compulsory; 17 weeks |
| Assessments                       | Continuous assessment + end semester assessment | Continuous assessment + end semester assessment | Continuous assessment + end semester assessment |
| End semester examinations         | Written tests (MCQ, essays), practical/spot tests, Viva | Written tests (MCQ, essays), practical/spot tests, Viva | Written tests (MCQ, essays), practical/spot tests, Viva |
| Contribution from continuous evaluation component | Vary from 20-50 | Vary from 20-50 | Vary from 20-50 |
Turkey test. Categorical variables were analyzed using chi-square test. Linear, quadratic, and cubic relationships between SGPAs of each semester and OGPA were determined. The best relationship was chosen based on the significance level and the $r^2$ value.

RESULTS AND DISCUSSION

Table 3 presents the academic performance of undergraduates of three degree programs as affected by gender, A/L stream, and subject performance. There was a good gender balance among the students of GT and AB programs while in AT program, the percentage of female students was significantly higher than males (Table 3). A similar female dominancy in Agricultural undergraduate degree programs has been reported in USA as well (Archibeque-Engle, 2016). Gunawardena (2015) showed that the percentage of female undergraduates in Sri Lankan universities increased during last three decades reaching up to 60% in 2013. In all three programs, the percentages of students who followed Biological science stream were significantly higher than those followed Agriculture stream in their advanced level. A study in Rajarata University (Karalliyadda, 2017) also reported that 74% of the BSc Agriculture undergraduates had followed Biology stream in A/Ls. A majority (62%) of the students who followed Agriculture stream had been selected to AT programs while 30% and 8% of them had been enrolled to AB and GT degree programs, respectively (Chi square $p<0.01$). For many of the Districts, minimum Z scores of GT and AB programs were higher than that for AT program (www.ugc.lk). However, due to the selection procedure, Z score varied widely even within the students of a given degree program. The minimum cut-off Z scores in the first round of selection for GT, AB, and AT programs varied with a side range; from 1.0759 to -0.1595 for AT program, from 1.1459 to -0.1748 for AB program, and from 1.1893 to -0.5175 for GT program. However, it should be noted that some of the students having high Z scores had left the course opting to follow other courses according to their selection option in the university entrance and new students with lower Z scores have been admitted in subsequent rounds of selection. Therefore, the Z-scores of the students who followed the courses could be much lower than what is represented by the initial minimum cut-off Z scores. Meanwhile, GCE (A/L) performance as determined by the performance for each subject showed no significant difference among the students selected to each program. Complexity in the university selection process that involves selection of students from different A/L subject streams, and district quota system could be the reason for above discrepancies. Following sections

**Table 2: Scheme of SGPA and GPA calculation**

| Marks (%) (Out of 100) | Grade | Grade Points | SGPA | Designation of classes according to OGPA |
|-----------------------|-------|--------------|------|----------------------------------------|
| >=85                  | A+    | 4.0          |      | OGPA >= 3.70                           |
| 80 - 84               | A     | 4.0          |      | 3.30 <= OGPA < 3.70                    |
| 75 - 79               | A-    | 3.7          |      | 2.70 <= OGPA < 3.30                    |
| 70 - 74               | B+    | 3.3          |      | 2.00 <= OGPA < 2.70                    |
| 65 - 69               | B     | 3.0          |      | OGPA < 2.00                           |
| 60 - 64               | B-    | 2.7          |      | Pass                                  |
| 55 - 59               | C+    | 2.3          |      | Fail                                  |
| 50 - 54               | C     | 2.0          |      |                                        |
| 45 - 49               | C-    | 1.7          |      |                                        |
| 40 - 44               | D     | 1.3          |      |                                        |
| 40 >                  | F     | 0            |      |                                        |
Table 3: Academic performance of undergraduates of three degree programs as affected by gender, A/L stream, and subject performance

| Item | Degree program | Total | Stat          |
|------|----------------|-------|---------------|
|      | GT             | AB    | AT            |                |
| Total no | 48          | 49    | 142           | 239            |
| Female (%) | 51        | 54    | 62            | 57             |
| A/L Stream |             |       |               |                |
| Agriculture (%) | 9∗      | 27∗   | 30∗           | 24∗            |
| Biological Science (%) | 91     | 73    | 70            | 76             |
| A/L performance |         |       |               |                |
| (median) | 6.81±0.28 | 6.91±0.17 | 7.12±0.12 | 7.00±0.11 |
| (mean) | ns (Kruskal Wollis) | ns (ANOVA) | ns (Kruskal Wollis) | ns (ANOVA) |
| % contribution of each subject | Agriculture | Biological science | ns (Kruskal Wollis) | ns (ANOVA) |
| Physics | 0 | 30 | 30 | 30 |
| Chemistry | 22 | 33 | 33 | 33 |
| Biology | 34 | 37 | 37 | 37 |
| Agriculture | 44 | 0 | 0 | 0 |
| Total (%) | 100 | 100 | 100 | 100 |

Undergraduate level performance

| Parameter | GT | AB | AT | Total |
|-----------|----|----|----|-------|
| Mid way drop out (%) | 6 | 24 | 14 | 22 | 20 |
| Pass | 14 | 22 | 21 | 21 |
| First class | 16 | 46 | 6 | 29 | 21 |
| Second Upper | 42 | 35 | 21 | 32 | 32 |
| Second Lower | 22 | 35 | 32 | 21 | 21 |
| Total (%) | 100 | 100 | 100 | 100 |

Academic Performance

| A/L stream | Agriculture | Biological Science | Academic performance vs A/L Stream | Chi Square = 0.03 |
|------------|-------------|---------------------|-----------------------------------|-------------------|
| Referred | 26 | 12 | 26 | 12 | 26 | 12 |
| Pass | 29 | 16 | 29 | 16 | 29 | 16 | 29 | 16 |
| First class | 3 | 14 | 12 | 14 | 12 | 14 |
| Total (%) | 100 | 100 | 100 | 100 |

Academic Performance

| Gender | Male | Female | Academic performance vs gender | Chi Square =0.01 |
|--------|------|--------|--------------------------------|-------------------|
| Referred | 55   | 45   | 55 | 45 | 55 | 45 | 55 | 45 |
| Pass | 63   | 37   | 63 | 37 | 63 | 37 | 63 | 37 |
| Second Upper | 46   | 54 | 46 | 54 | 46 | 54 | 46 | 54 |
| Second Lower | 35   | 65 | 35 | 65 | 35 | 65 | 35 | 65 |
| First class | 13   | 87 | 13 | 87 | 13 | 87 | 13 | 87 |
| Total (%) | 100 | 100 | 100 | 100 |

Gender

| OGPA | Male | Female | Whole batch | Gender effect | Degree program | A/L stream effect |
|------|------|--------|-------------|---------------|----------------|-------------------|
|      | 3.20±0.09** | 3.09±0.09* | 2.87±0.07* | 3.05±0.05** | Gender effect | P=0.00 |
|      | 3.45±0.09 | 3.34±0.08 | 2.22±0.05 | 3.34±0.04 | Degree program |          |
|      | 3.32±0.06a | 3.22±0.06ab | 3.05±0.04ab | 3.05±0.03 |                | A/L stream effect |
| A/L Stream | Agriculture | 3.30±0.23 | 3.05±0.12 | 2.97±0.08 | 3.02±0.04 |          |
| Biological Science | 3.34±0.07 | 3.29±0.07 | 3.14±0.05 | 3.23±0.07* |                |
discusses a number of negative implications arisen from the above situation.

Main difference of the subject combinations of A/L Agriculture and Biology stream is the Agriculture students’ omission of Physics in place of Agriculture. Differences between above subject combinations and the contribution of each subject to the final A/L performance on which university selections are determined, highlighted a number of important issues. The contributions of Physics, Chemistry and Biology to the final A/L performance of the students who followed Biology stream being 30, 33 and 37 % were found to be well balance. Contrary, among those who had followed Agriculture, the contribution of Chemistry, Biology and Agriculture were 22, 34 and 44 %, respectively. Apart from no contribution from Physics, the contribution of Chemistry was also significantly lower among Agriculture stream students (22 %) than Biology students (32 %). Having contributed 44 % to the final A/L performance, the subject Agriculture seems to be disproportionately benefited to the students who had followed Agriculture in A/L for the university entrance. Consequently, some of the better students who have done Biology stream which includes Physics as a subject might have missed the opportunity of university entrance due to easiness of the Agriculture paper and/or the subject combination of the Agriculture stream; i.e. opting out of Physics.

McKenzie and Schweitzer (2001) showed that university entry performance accounted for 39 % of the variance in university GPA. Meanwhile, studies done in Faculties of Agriculture in Rajarata University of Sri Lanka (Weerahewa et al., 2013) and Ruhuna University (Mudalige et al., 2008) found that the performance at the Advanced Level examination, as measured by the Z score, had no influence on undergraduate academic performance. However, results of the present study revealed that, though the students had studied subject Agriculture for two years during their A/Ls, academic performance of the students who followed Agriculture stream was lower than that of Biology stream students (Table 3 and Fig 1). This suggests that compared to Agriculture, A/L Biology stream better prepares students to effectively follow the three programmes considered. Hazari et al. (2007) showed a strong relationship between the level of high school Physics knowledge and undergraduate performance. Omission of Physics and lower performance in Chemistry may place the students who follow Agriculture stream at a disadvantageous position in following the GT, AB and AT degree programs which require a sound understanding in Physics and Chemistry. Poor undergraduate-level performance of the students who got selected through A/L Agriculture stream suggest the need of revisions for A/L Agriculture curriculum.

Undergraduate level performance
As high as 14 and 11 % of the AB and GT students have dropped the respective programs after sitting examinations in one or even three semesters. Although, such mid-way drop outs were low (7 %) among AT students, the overall drop-out rate was around 9 %. Contrary to Sonnert and Fox (2012) who pointed out that students with high SGPA at initial semester are less likely to drop out the courses, among those who dropped-out, there were students having both good as well as very low SGPA values. Given that enrolment for the Agricultural and Science-based courses are reported to be substantially lower than their capacities, results of this study emphasizes the need of interventions to retain those who have enrolled. Reasons for drop outs are complex and diverse (Willging and Johnson, 2009). Apart from personal and academic counseling mechanisms, careful curricula designing and assessment methods both in university and in GCE (A/L) examinations are important.

In a comprehensive study considering a wide range of degree programs in the UK, Smith and Naylor (2001) showed that the percent-
ages of first classes, second uppers, second lowers, third classes and failures were 8, 40, 27, 4 and 13 %, respectively. In line with above reports among GT, AB and AT students, the percentage of graduates with a class was 78, 65 and 56 %, respectively. An analysis done by Mudalige et al. (2010) on the academic performance of the BSc (Agriculture) program (a predecessor of the present AT program) showed even higher percentage (71 %) of graduates with a class. The percentage of first classless among GT students was two times higher than the level reported by Mith and Naylor (2001).

Twenty percent of the undergraduates have failed to complete the courses within four year period. Since no repeat examinations are conducted, those repeat students have to wait at least another year to graduate. Such repeating students are high among AB (24 %) and AT students (22 %) than GT (6 %) cohorts. Furthermore, repeaters were significantly higher among those who followed Agriculture in A/L (26 %) than among those who followed Biology stream (12 %). This observation further supports the argument that there exists a mismatch between knowledge and skills that A/L Agriculture syllabus imparts and what University expects at the enrollment.

Smith and Naylor (2001) showed that academic performance of female Agriculture undergraduate students was significantly lower than that of male students. Contrary to them, across all three degree programs and eight semesters, female outperformed male students. Among students who secured either first or second uppers 87 and 65 %, respectively were females. Among repeaters also, majority were male students. Since many competitive employments and postgraduate opportunities require second upper or first classes, poor academic performance of male graduates may have numerous implications in their future careers and thus needs to be addressed.

In line with the situation in Agricultural Technology and Management degree programs, offered by the Faculty of Agriculture, University of Peradeniya (Weerahewa et al., 2012), among students who secured either first or second uppers 87 and 65 %, respectively were females. Among repeaters also, many were males. Fox (2012) also showed that in a range of degree programs, female undergraduates achieved higher GPA values than male students. SGPA values of all three degree programs were numerically higher among the students who followed Biology stream than those followed Agriculture. When averaged across all three degree programs, those who followed Biology have achieved higher OGPA value compared to those who did Agriculture.

SGPA values of the students in all eight semesters are shown in Figure 1. First semester SGPA values of all three programs were significantly higher than that Rajarata University Undergraduates (2.2117) reported by Karaliyadda (2017). Suggesting a marked increase in undergraduate performance, the first semester SGPA values reported in this study for all three degree programs were significantly higher than that of the BSc Agriculture degree program (2.4834) offered by the same Faculty, back in 2008 (Mudalige et al., 2012). SGPA values of the students following three degree programs were significantly different in the first semesters. Meanwhile, SGPA values in 6th and 8th semesters were not statistically different among three degree programs. It is interesting to note that irrespective of the marked differences in academic performance in other semesters, performance in 6th and 8th semesters, during which they mainly engage in field/on farm trainings and research projects, respectively were similar.

GT students’ SGPA values over the eight semesters could best be described as a significant quadratic relationship. Among GT students, SGPA reduced during first three semesters, then increased in the fourth semester and maintained at a more or less similar level dur-
ing 5th and 6th semesters. During 7th and eighth semester, SGPA values were increased again. Despite a peculiar increase in the 3rd semester, AB students showed significant linear increase in their SGPA values as they progress the semesters. AT students’ SGPA value showed a significant quadratic relationship with the progression of academic program. Both among AT and AB students, there was a clear increase in SGPA values from 4th semester onward eventually resulting in a similar SGPA values among the students of all three programs studied.

Interestingly, irrespective of the degree program, students performed extremely better in their research component; i.e. 8th semester. Almost 50% of the students had achieved A+ or A while another 30% had achieved A- for their research project. A+ or A grading for research project was higher among AT students (44%) than among GT (19%) or AB students (29%). Significant linear relationships were observed between OGPA and the fourth semester SGPA for GT (OGPA = 0.8908 + 0.7248 SGPA Sem 4), AB (OGPA= 1.066 + 0.6966 SGPA Sem 4) and AT (OGPA = 0.8908 + 0.7248 SGPA Sem 4) programs ($r^2=0.90$, $p=0.000$).

**CONCLUSION**

Results of the present analysis conclude that the students who followed Agriculture stream in Advanced Level examination get an advantage in university entrance. However, poor performance in Chemistry and the omission of Physics in advanced level were found to have negative impact on their undergraduate level performance. High mid-way drop-outs and low rate degree completion at the first attempt and the poor academic performance of the male undergraduates were the major issues to be addressed. In conclusion, results of the present study emphasize the need of close collaboration between universities and secondary education sector in curriculum designing, assessments, and university selection process.

![Figure 1: SGPA values of the students in all eight semesters](image-url)
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