Adoption and Performance of Rice Varieties in Guyana from 2009 to 2019

Bissessar Persaud[1], Mahendra Persaud[2], Gomathinayagam Subramanian[1], and Narita Singh[3]

1. Faculty of Agriculture and Forestry, University of Guyana Berbice Campus, Tain, Guyana
2. Plant Breeder, Guyana Rice Development Board, Burma Rice Research Station, Guyana
3. Faculty of Natural Science. University of Guyana Turkeyen Campus, Georgetown Guyana

Abstract:

Rice (Oryza sativa L.) production has been the pillar of the agriculture sector in Guyana and is the staple food for its people. It is currently the largest agricultural industry in the country, which serves as the bedrock for the Guyanese economy and is by far the most important constituent of the livelihoods of its people. The production of paddy has increased over the last decade, with the highest recorded in the First Crop 2019 of 525,649 Metric tons (Mt) at 6 t/ha. Over one hundred and seventy thousand (170,000) families benefit directly or indirectly from the rice industry. The Guyana Rice Development Board (GRDB) through its Research and Extension program, play a pivotal role in improving rice yields thus increasing the revenue earned. (www.grdb.gy). The adoption of technology is to make full use of an innovation as the best course of action available. The adoption of technology is consisted of the need of a new technology, creating awareness of a new technology, the interest the farmers have over a new technology, the deliberation the farmers have in accepting it, the willingness to try and evaluate a new technology and finally to adopt a technology for commercial purposes. Therefore, the objective of this study is to determine the extent of farmers' "adoption and performance of rice varieties from 2009 to 2019. Over the last decade the GRDB would have released seven local high yielding varieties mainly the GRDB 9, GRDB 10, GRDB 11, GRDB 12, GRDB 13, GRDB 14 and GRDB 15. Prior to release, these varieties would have tested by the various departments at the Research Station for pest and disease tolerance/resistance, fertilizer and crop nutrition response and mainly the yield obtained. These varieties were further tested using the Advance Yield Trial (AYT) at the Research Station and in small plot of pilot farmers (plot size of 9m2). After two crops of AYT, these varieties were further tested in innovators field as an On Farm Trial (OFT) plot size of 45m2. Each variety was tested using the OFT with at least 30 innovators (lead farmers) of the various rice growing districts. The main parameter taken during the OFT were, plant height, plants/m2, flowering data, response to plant nutrients, fill and unfilled grains per panicle, 1000 grain weight and lodging. At the end of the trial a Farmer Field Day was held in each rice growing Region to evaluate the performance of these varieties. These varieties were well adopted by farmers across the various rice growing Regions, and due to their high yielding ability, variety such as the GRDB 10 occupied approximately 40% of the total cultivation while the GRDB 15 occupied approximately 10% at the moment.

Keywords: Oryza sativa L, GRDB, Varieties, Advance Yield Trial, Adoption,

INTRODUCTION

Rice (*Oryza sativa* L.) production has been the pillar of the agriculture sector in Guyana and is the staple food for its people. It is currently the largest agricultural industry in the country, which serves as the bedrock for the Guyanese economy and is by far the most important constituent of

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Rice varieties such as the GRDB 10, GRDB 12, GRDB 13, GRDB 14 and GRDB 15 have gained acceptance and widely cultivated in the rice growing regions in Guyana. These varieties are known for producing high yield that is forty bags plus per acre and are tolerant to lodging, they occupied over 80% of the total cultivation in Guyana. The average productivity in Guyana for 2019 is 5.85 t/ha with GRDB 10 as the most dominant variety, which occupied approximately 40% of the total acreage cultivated (www.grdb.gy).

The adoption of certified and improved high-yielding rice varieties is an important avenue for increasing agricultural productivity and improving the standard of living of the farmers in developing countries. It's an option for the farmers to get rid of hunger and food insecurity by improving crop productivity, reducing food price and making more food accessible for the poor households. Further, promoting the adoption of improved crop varieties in a sustainable manner helps to improve welfare of the households (Asfaw et al, 2012).

The determinants to the adoption of rice varieties have been investigated for various countries including India (Kumar et al, 2016), Malaysia (Adedoyin et al, 2016), the Philippine (Mariano et al, 2012), Nepal (Ghimire et al, 2015), Bangladesh (Hossain et al, 2006), Benin (Dandedjrohoun et al, 2012), Nigeria (Ologbon et al., 2012), Ethiopia (Asmelash, 2012) and Kenya (Okello et al, 2016). Some studies conducted in Pakistan mainly focus on adoption of rice varieties and technical efficiency of rice production and impact of institutional credit on rice productivity (Khalid Bashir and Mehmood 2012). No study was done in Guyana to examine the adoption and performance of the GRDB varieties therefore, this paper aimed to fill this gap of the adoption and performance of rice varieties from 2009 to 2019.

MATERIALS AND METHOD
Over the last decade the GRDB would have released seven local high yielding varieties mainly the GRDB 9, GRDB 10, GRDB 11, GRDB 12, GRDB 13, GRDB 14 and GRDB 15. Prior to the release, these varieties were known as promising lines and would have tested by the various departments at the Research Station for pest and disease tolerance/resistance, fertilizer and crop nutrition response and yield obtained. These lines were further tested using the Advance Yield Trial (AYT) at the Research Station and in small plot of pilot farmers (plot size of 24m²). After two crops of AYT, these lines were further tested in innovators fields using the On Farm Trial (OFT) with plot size of 225m². Each variety was tested using the OFT with 30 innovators (lead farmers) of the various rice growing districts in Guyana. Data were collected by both Extension officers and the plant breeding team, the data collected include, plant height, plants/m², flowering data, response to plant nutrients, fill and unfilled grains per panicle, 1000 grain weight and lodging. Data were

analyzed using the simple statistical tool that include frequency, average, mean etc. At the end of the cropping season a Farmer Field Day was held in each of the rice growing Region to evaluate the performance of the Candidate variety. Once the necessary requirements were fulfilled, these lines were then released and named as varieties by GRDB for commercial cultivation by the farmers. Over the decade these varieties mentioned above were adopted by farmers mainly for their high yielding ability, tolerance to pest/disease and lodging, crop duration and low input cost. These varieties occupied over 80% of the total acreage cultivated.
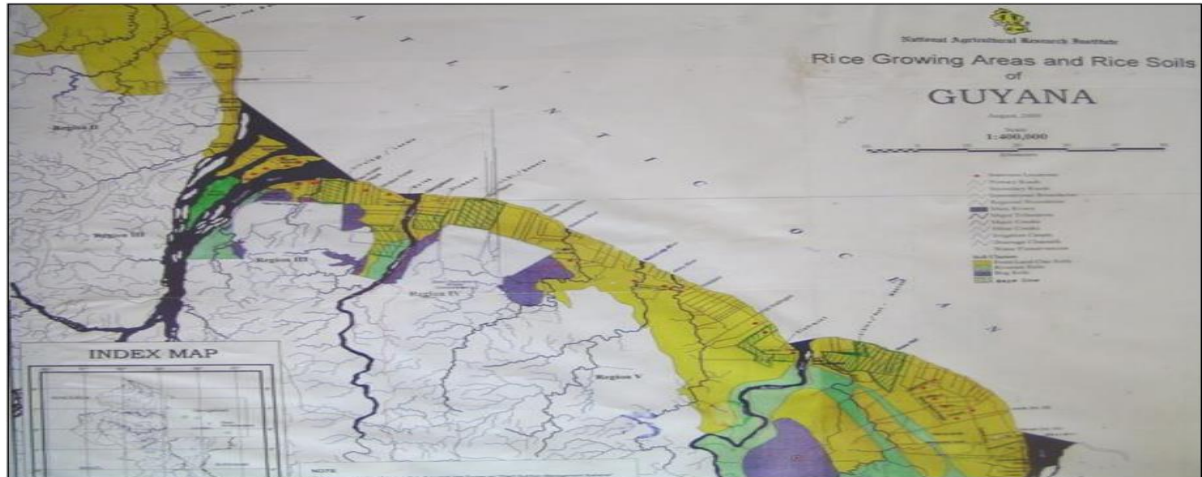

Figure 1. The yellow area represents the rice growing regions on the low coastal plain of Guyana
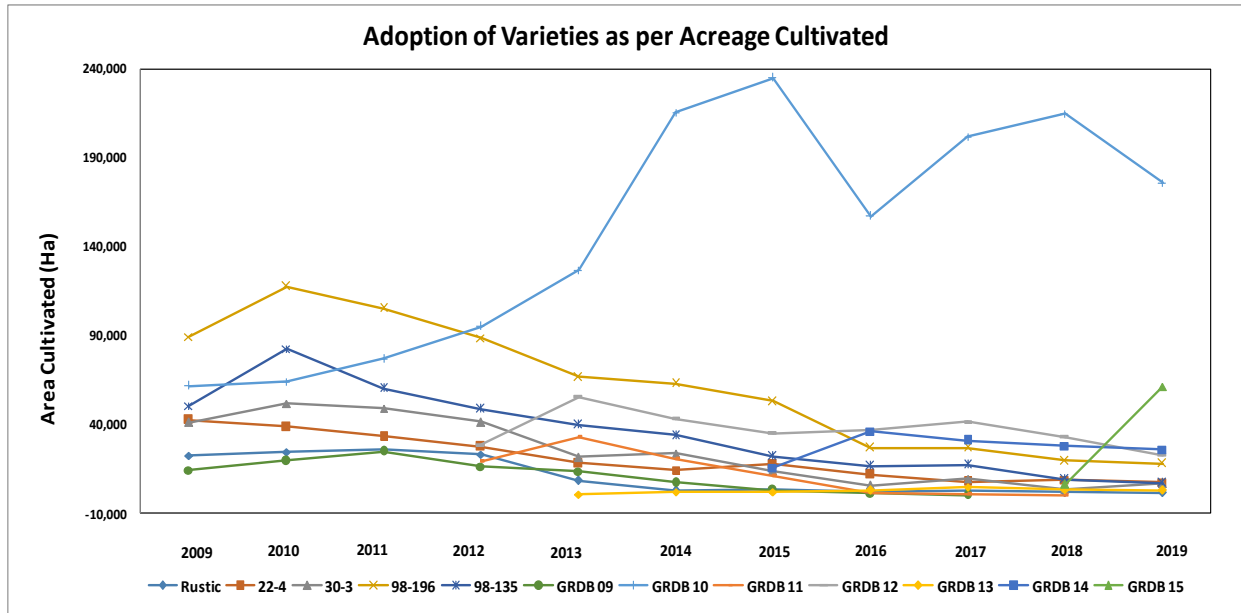
RESULTS AND DISCUSSION

Figure 1

Varieties such as GRDB 10, G98-196, G98-135, G98-30-3 and G98-22-4 were highly adopted as per the acreage cultivated from 2009 to 2012. The GRDB 10 variety was the most outstanding variety as per acreage cultivated; to date it occupied approximately 40% of the total cultivation. The Rustic and GRDB 9 were lesser adopted as per the acreage cultivated during the same period (2009 to 2012). It can be seen from the figure that, when a new variety is introduced for

cultivation, there is a reduction of the older rice varieties. For instance, during the year of 2012, when the variety GRDB 12 was introduced, there was a drastic reduction in the cultivation of variety G98-30-3 and Rustic. The same occurred during the year of 2015 when GRDB 14 was first cultivated the older varieties kept reducing as per acreage cultivated. The GRDB 10 variety reaches its peak of cultivation in 2015. The variety GRDB 15 was introduce for cultivation in 2018 and as of 2019, there was a massive increase in the cultivation of the variety but at the same time there was a decrease in the cultivation of variety GRDB 10. It is clearly note that the adoption of improved rice varieties leads to increased output. This is consistent with the findings of (Wiredu et al. 2010).
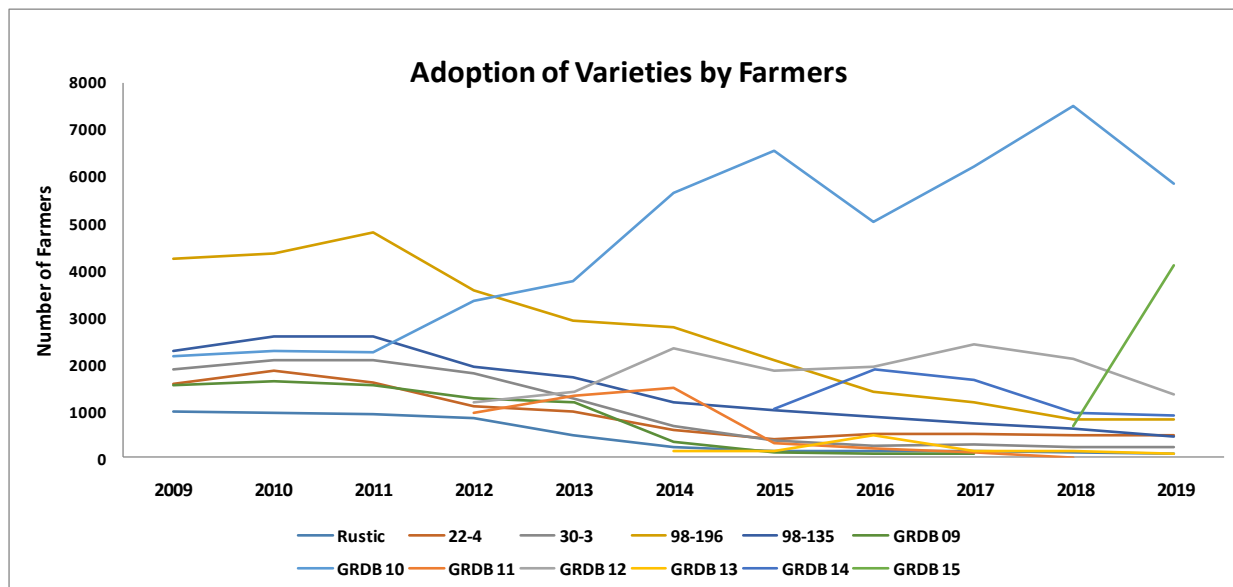

Figure 2

There are similarities between Figure 1 (Adoption of Rice Varieties as per Acreage Cultivated) and Figure 2 (Adoption of Rice Varieties by Farmers) for the ten (10) year period. This is obvious since it was the varieties that were cultivated by the farmers. Varieties such as GRDB 10, G98-196, G98-135, G98-30-3 and G98-22-4 were highly adopted by farmers between the years of 2009 to 2012. The GRDB 10 variety was the most dominant throughout the ten (10) year period among farmers. While the Rustic and GRDB 9 were submissive among farmers cultivated during the same period. Currently, variety GRDB 15 has hiked up from 1,000 farmers to 4,000 farmers while variety GRDB 10 has reduced from approximately 7,500 to 6,000 farmers. This is coincide with the study of (Khanal et al, 2016) who stated that farmers who continue to grow old and obsolete varieties do not gain the benefits they could get from growing newer ones. Gender difference is found to be one of the factors influencing adoption of new technologies. Due to many socio-cultural values and norms males have freedom of mobility and participation in different meetings and consequently have greater access to information and subsequently adoption of new varieties (Tadesse, 2008).
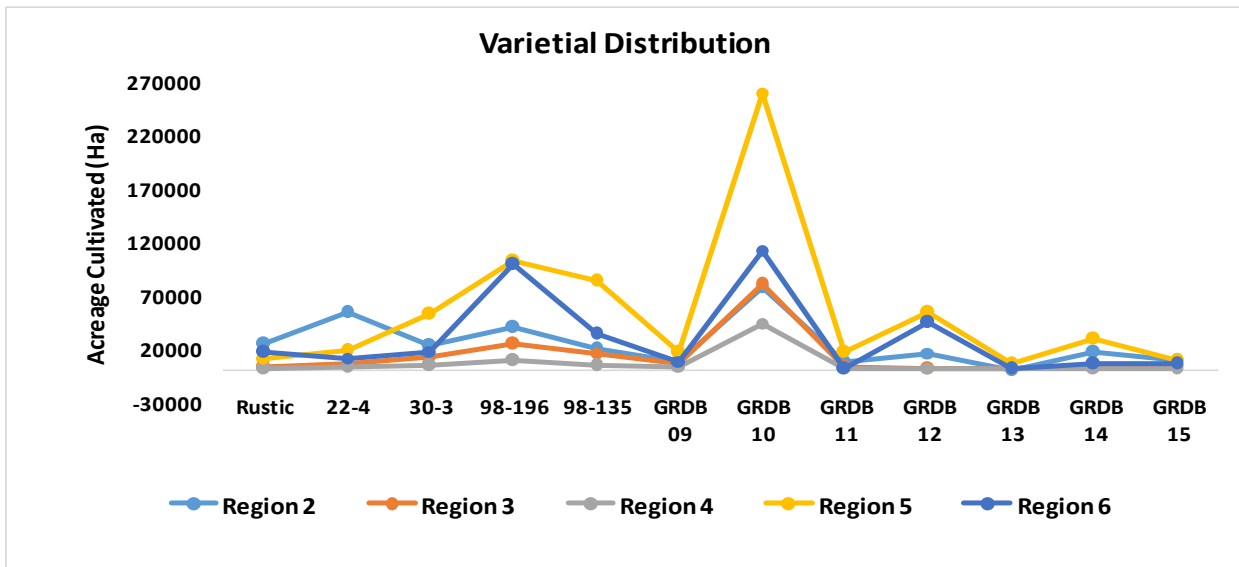
Figure 3

Administrative Region number five (5) is known for the highest rice producing Region in Guyana. Therefore, this region cultivated the highest amounts on all of the rice varieties except Rustic and 22-4. The highest cultivated rice variety of region number five is variety GRDB 10 (approximately 260,000 hectares for the 10 years period) while the lowest were GRDB 13 and Rustic (approximately 1,500 hectares for the same period). Region number four is the lowest cultivating Region amongst all. For this region, variety GRDB10 was the highest cultivated (approximately 4,500 hectares or 70% of its total cultivation) and varieties Rustic, 22-4, GRDB 9, GRDB 12, GRDB13, GRDB 14 and GRDB 15 were marked the lowest cultivated varieties for the period. From the data collected it was noted that the variety GRDB 10, GRDB 12 and G98-196 were highly distributed in region 6.
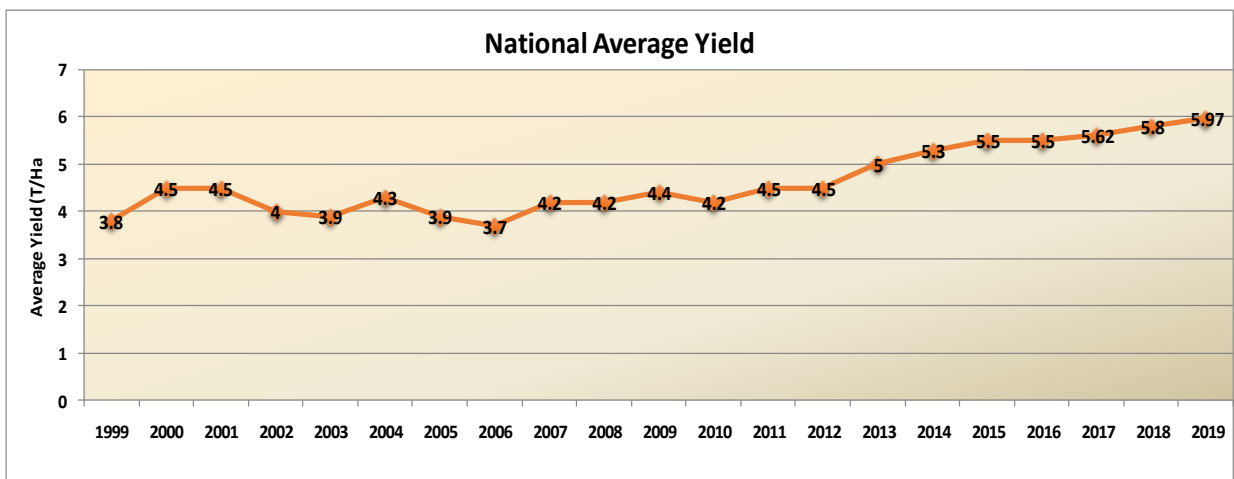

Figure 4

Over the past twenty (20) years, the national average yield has increased from 3.8 tons per hectare (T/Ha) in 1999 to 5.8 T/Ha in 2018. From the year of 2010, there has been a persistence increase of average yield to present (from 4.2 to 5.97 T/Ha respectively. The older varieties show no significant difference in average yield from 1999 to 2009. However, there was significant

difference of average yield from 2010 to 2019, this is because of the introduction and adoption of newer varieties along with an Improved Agronomic Practice Package.
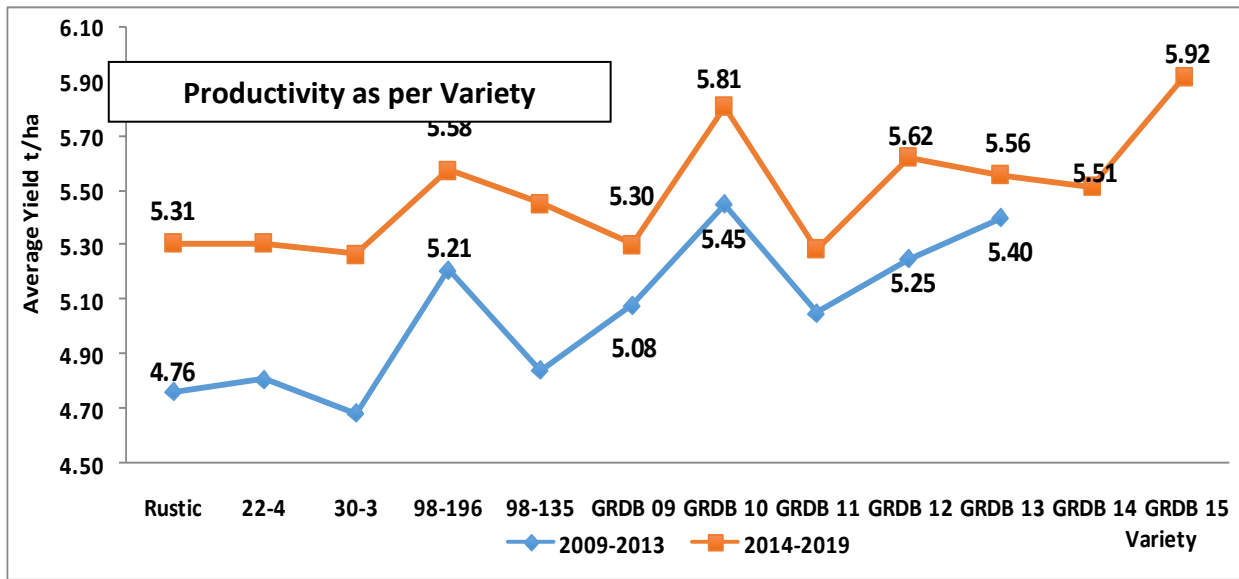

Figure 5

As compared to the years of 2009 to 2013, the total productivity as per variety is extremely higher during the years of 2014 to 2019 for all rice varieties. The productivity was at its highest (5.92 t/ha) for rice variety GRDB15 and at its lowest (4.76 t/ha) for rice variety Rustic. Productivity ranged from 4.76 to 5.40 t/ha during the years of 2009 to 2013 while it ranged from 5.31 to 5.92 t/ha during the years of 2014 to 2019.
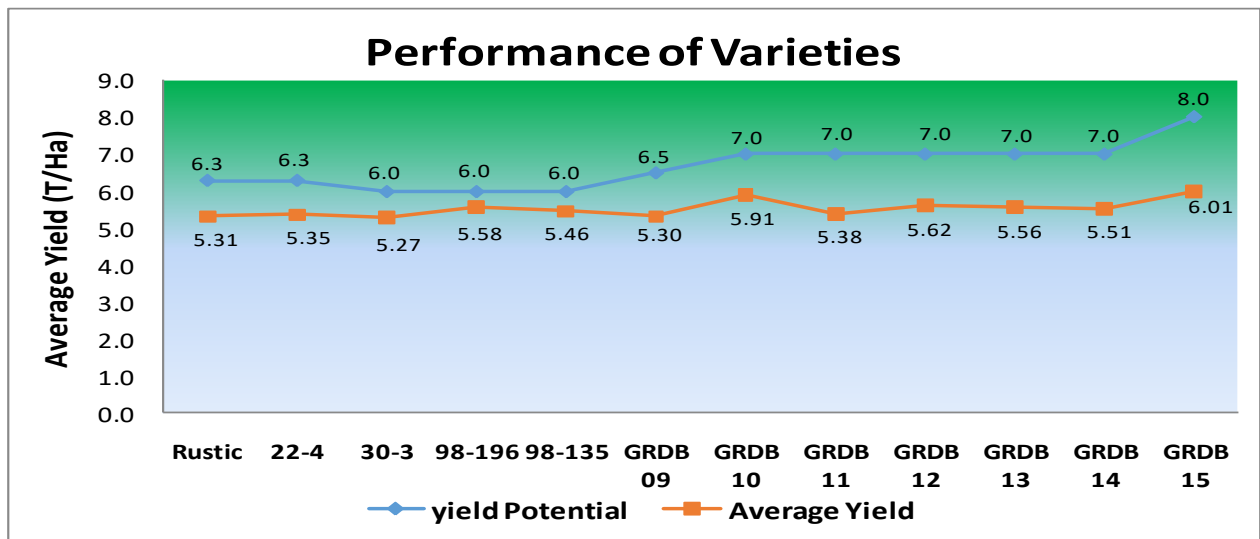

Figure 6

The yield potential is the maximum average yield that can be produced by the rice varieties. As can be seen, the average yield (actual average yield) produced was lower than the yield potential for all rice varieties. The yield potential and actual average yield came the closest for rice variety G98-196 (having a difference of about 0.5 t/ha) but came the furthest for rice variety GRDB 15 where the actual yield was 6.01 /ha as against the yield potential of 8.0 t/ha (having a difference

of about 2.0 t/ha). The use of new and high yielding rice varieties along with the best Agronomic Management farmers practices narrow the yield gap, this is coincided with the work done by (Ghimire et al, 2015)

CONCLUSION

The study assessed adoption and performance of rice variety in Guyana from 2009 to 2019. The following are the major conclusions drawn from the findings of this study: The level of adoption of variety GRDB 10, GRDB 15 and G98-196 as per acreage cultivated and farmers cultivating same is highly correlated. The older varieties showed a lower level of adoption by both farmers and acreage cultivated from 2009 to 2012 ad has positive correlation with the yield of the corresponding period. It is clearly shown that the newer rice varieties introduced for cultivation gave a higher output in terms of the actual average yield. Although there is a yield gap, that exist between the potential of the variety and the actual average obtained by farmers, varieties such as GRDB 10 and GRDB 15 achieved that potential in region 4 and Region 6 by innovators who were not resistant to change.

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