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COMPARATIVE ANALYSIS OF SYSTEM OF RICE INTENSIFICATION AND TRADITIONAL SYSTEM OF RICE PRODUCTION IN ABI L.G.A, CROSS RIVER STATE, NIGERIA

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ABSTRACT: *This study compared the System of Rice Intensification and Traditional System of Rice Production in Abi L.G.A, Cross River State, Nigeria. The specific objectives included the description of socio-economic characteristics of rice farmers in Abi L.G.A, determination of the rate and levels of adoption of SRI, etc. Data were obtained from primary and secondary sources. Two-stage sampling technique was used in the selection of 100 respondents. Descriptive statistics, t-test and Likert scale were employed for analysis. The major findings of the study shows that, majority (78%) were males and 88% of respondents has rice farm sizes ranging from 1-5ha. The rate of adoption was 50% with 4 levels of adoption of the principles of SRI. The t-test analysis revealed t-calculated value of 8.40 greater than t-tabulated. Meaning that adoption of SRI enhanced the income of the adopters. It is recommended that participation of rice farmers during SRI demonstration be encourage.*

KEYWORDS: Production, Income, Adoption.

INTRODUCTION

One important crop that has attained a staple food status in the state and has also become a major source of calories for the people of Cross River State is rice. Generally, lowland is cultivated by majority of the farmers in the state in view of its peculiar ecology. However, for some years now farmers have been operating significantly below capacity, with inefficient resource use. However, effort is being made by the state to move rice production from subsistence to commercial level through provision of improved production inputs and collaboration under the Public Private Partnership (PPP) initiative of the state. Thus, all government agencies, Community-Based Organizations (CBOs), Non-governmental Organizations (NGOs) that have rice as their value chain in the state were empowered to mobilized and trained rice farmers on agronomic practices using System of Rice Intensification (SRI).This to achieve enhanced rice productivity that could lead Cross River State to self-sufficiency in rice production. Therefore, the System of Rice Intensification (SRI) was demonstrated in all part of the state including Abi Local Government Area.

The System of Rice Intensification (SRI) is a way of harmonizing the elements of soil, water, light and plant to allow the plant to achieve its fullest potential, which is often hidden when inappropriate techniques are used (Zotoglo, 2011). SRI, as opposed to traditional rice production, involves alternate wetting and drying (AWD) of rice fields (Kepha, Bancy and Patrick, 2014). Research and demonstration plots in several tropical countries have shown SRI techniques as productive resource-saving and environmentally benign when compared to conventional or traditional rice production (Namara, et al., 2004:Sato and Uphoff, 2007; Sinha and Talati, 2007). Under the traditional method of rice production water is the most important component of sustainable rice production. In the traditional method of growing rice, the rice fields are continuously flooded during vegetative growth of the crop with draining of water

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during grain ripening stage (Uphoff, 2006, Satyanarayana, Thiyagarajan and Uphoff, 2007; Chapagain and Yamaji, 2010; Kunimitsu, 2006).

SRI differs from TSRP practices by giving the plant all opportunities to achieve its full production potential. The methodology develops a better root system, a longer amount of vegetations, and maximum paddy production. It saves time more than 80% in seeds and fertilizer, uses about 35% water, saves more than 70% in hand wedding and hoeing cost, and has a much shorter production cycle-two to three weeks. The results are a 35 to 100% increase in product yield. This improved productivity translates into a more marketable production with more income for the producer and increased sustainable land use (Zotoglo, 2011; Chapagain, Riseman and yamaji, 2011; Amod, et al., 2014).

However, SRI and traditional method of rice production are similar in the area land preparation with require good tilling and mudding. There are six principles guiding SRI, these are:

- Seedlings get transplanted at a much younger age
- Only single seedling, instead of a handful of seedlings get planted in each hole
- Plants are spaced wider apart and in a square pattern
- Increased use of organic fertilizer to enhance soil fertility
- Intermittent water application to increase wet and dry soil conditions, instead of continuous flood irrigation.
- Rotary weeding to control weeds and promote soil aeration.

All these principles were incorporated in all the demonstration plots in all the three rice clusters of Abi Local Government Area of Cross River State, Nigeria.

Statement of the Problem

Several efforts were made over the years to increase the production of rice in Nigeria. These efforts aimed at actualizing the dreams of Nigeria to achieve self-sufficient in rice production. Currently, the country spends a huge amount of money daily on rice importation. In time past, many government agencies, community development organization (CBOs), non-governmental organization, etc. conducted trials and demonstrations in Abi Local Government Area of Cross River State, Nigeria. These demonstrations aimed at encouraging rice farmers' adoption of SRI. However, the rural rice farmers are still faced with low rice yield as well as rural incomes which are lower than twenty years ago (Cross River State projects/Programmes Monitoring and Evaluation Unit, 2012).

In Cross River State, for instance some agencies were identified to be involved in rice related activities in Abi L.G.A including training and demonstration of SRI. These agencies are Commercial Agriculture Development Project (CADP), Fadama III Project, IFAD/FGN/ Community-based Natural Resource Management Programme (CBNRMP), Sasakawa, National Food Security Programme (NFSP), Green Earth Implementation Initiatives (GEIDI), etc. All these intervention from these agencies do no seem to have yielded desirable results as the rice farmers remain poor with low productivity. This study therefore, attempts to conduct comparative analysis of System of Rice Intensification (SRI) and Traditional System of Rice Production (TSRP).

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Objectives of the Study

The main objective of this study is to conduct comparative analysis of System of Rice Intensification (SRI) and Traditional System of Rice Production (TSRP) in Abi L.G.A of Cross River State, Nigeria. The specific objectives are to:

(i) describe the socio-economic characteristics of rice farmers in Abi L.G.A

(ii) determine the rate and levels of adoption of System of Rice Intensification (SRI);

(iii) analyze the differences in incomes of adopters and non-adopters of SRI in the study area

(iv) identify the problems militating against the adoption of SRI in the study area.

To achieve objective four is hypothesized thus: There is no significant difference between the incomes of the adopters and non-adopters of SRI.

LITERATURE/THEORETICAL UNDERPINNING

Modern rice farming requires innovation, which systematically adapts scientific knowledge to rice farming. Innovation is an idea, method, object which is regarded as new by an individual (Rogers, 1995, Singh and Mishra, 2007; Peter, et al., 2012). According to Rogers (1995) adoption is a decision to incorporate a new practice into existing practices. It is a mental process consisting of learning, deciding and acting over a period of time.

A farmer is more inclined to accept (and participate in) a recommended practice if the practice is profitable, compatible with existing farming system, divisible, simple to use, has relevance for his labour use, farm inputs, marketing, credit, community values and crop situation (Agwu, 2004; Ekong, 2008). Other factors as mentioned by Bose et al. (2012) include farm size, value of farm products sold, farming experience, leadership role, empathy and availability of farm credit.

METHODOLOGY

The study was carried out in Abi Local Government Area of Cross River State, Nigeria. Abi Local Government Area is located in the Central Senatorial District of the state and is a riverside local government area with River, Cross River passing through the local government area. It shares borders with Obubra L.G.A to the North, in the East by Yakurr L.G.A, West by Ebonyi State and to the South by Biase L.G.A of Cross River State. Communities in Abi L.G.A are endowed with abundant swamps suitable for swamp rice cultivation. This accounted for why rice farming is a major livelihood in the area.

The people are engaged in farming, trading, fishing, hunting, post-harvesting processing, etc. Other crops grown include yams, cassava, vegetables, bush mango (*Irvingia spp*), etc. Livestock such as poultry, sheep, goats, etc. are kept in all the community which survive by scavenging around the homestead and nearby bush. Customary festival pertaining to farming

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activities are observed in most parts of the local government area annually to celebrate the rich harvest season (Ndifon and Bassey, 2008).

The population of this study was made of 150 rice farmers drawn 50 rice farmers from each of the three rice clusters in Abi L.G.A. The 150 rice farmers were those trained on System of Rice Intensification (SRI) and participated at various stages of the demonstration. A two stage sampling technique was employed for the selection of the sample size of 100 rice farmers consisting adopters and non-adopters of SRI. In stage one, simple random sampling was adopted to select 50 adopters and 50 non-adopters from the list of adopters and non-adopters of SRI compiled by Cross River State Agricultural Development Programme Extension Unit in 2013. Stage 2, purposive sampling technique was employed to select 10 adopters that adopted all the six principles and agronomic practices associated with SRI, 15 adopters that adopted four principles of SRI and associated agronomic practices and 25 adopters that adopted three principles of SRI and associated agronomic practices.

Data for this study were obtained from two sources, namely primary and secondary sources. Primary data were obtained through the use of a structured questionnaire which was used as interview guide. Secondary data were obtained through the use of relevant literature, Journals, official documents, publications, etc.

Method of Data Analysis

Data relating to socio-economic variables of the farmers, rate of adoption and levels of adoption of the six principles of SRI were analyzed using frequencies and percentages, while t-test was employed to analyze the differences in mean income of adopters and non-adopters. Problems militating against the adoption of SRI were analyzed using Four-point Likert scale with 2.5 mean decision rule.

Rate of adoption was determined by the total number of adopters over the sample size expressed as a percentage. Thus:

$$\text{Rate of adoption} = \frac{\text{Number of adopters x } 100\%}{\text{Sample size.}}$$

Level of adoption was measured on the basis of the number of principles of SRI that a particular farmer adopt out of the six principles of SRI adopted in the study area.

$$\text{Level of adoption} = \frac{\text{Number of SRI principles adopted by each rice farmer}}{\text{Number of SRI Principles adopted in the study area}} \times 100$$

The model specification for the analysis of the mean income difference is stated below:

$$t = \frac{\bar{X}_1 - \bar{X}_2}{\sqrt{\frac{S_1^2}{n_1} + \frac{S_2^2}{n_2}}}$$

Where

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t = T – test statistic = t-calculated
$\overline{X}_1$ = Mean income of adopters
$\overline{X}_2$ = Mean income of non-adopters

S^2_1 = Variance of adopters

S^2_2 = Variance of non-adopters

n_1 = Total number of adopters

n_2 = Total number of non-adopters
df = Degree of freedom $n_1 + n_2 - 2$

If t-cal is greater than t-tab, we reject the null hypothesis and accept the alternative hypothesis.

The likert formula = $X = \frac{\sum f}{n}$

Where: X = Critical mean score

f = Total scale score (That is 4, 3, 2 and 1), n = scale points.

The four-point likert scale of strongly agreed, agreed, disagreed and strongly disagreed were scored as follows: Strongly agreed = 4, Agreed = 3,Disagreed = 2 and strongly disagreed = 1.

RESULTS/FINDINGS

This section focuses the outcomes of the analysis of the objectives formulated for this study.

Socio- economic Characteristics of Respondents.

Table 1 reveals that 78% of the respondents are males, while 22% are females. Majority (28%) of the respondents are within the age range of 41-50years, 26% are within the age range of 31-40years, 22% are 51 years and above, while 16%, 8% are respondents within the age ranges of 21-30 years and below 21 years respectively. With respect to household size, 38% have household size of 6-10persons, 24% have 1-5 persons, 17% have 11-15persons as their household size, 11% of the respondents have household size of 16-20persons, while 6% and 4% have household sizes of 21-25 persons, 26persons and above respectively. Ninety-eight percent of the respondents have formal education. Also, 98% are into rice farming as part time business, while 2% are full time rice farmers.

Majority (81%) of the respondents are married, while 19% are single. Ninety-four percent of the respondents are members of local organizations available in the study area, 82% reported having annual income less than N1m Naira, 18% have annual income ranging from N6m – N9m naira. No responses were recorded for other categories of annual income (N6m – N9m and $\geq$N10m). Also, table 1 reveals that, 88% of the respondents have rice farm sizes1ha – 5.9ha, 11% have rice farm sizes ranging from 6ha – 9.9ha, while only 1% have 10ha and above. Majority (98%) have access to agricultural extension services relating to system of Rive Intensification.

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Table 1: Socio-Economic Characteristics of Respondents

Variable	Frequency	Percentage (%)
Gender		
Male	78	78.00
Female	22	22.00
Total	**100**	**100**
Age (Years)		
Below 21	8	8.00
21-30	16	16.00
31-40	26	26.00
41-50	28	28.00
51and above	22	22.00
Total	**100**	**100**
Household size		
1-5	24	24.00
6-10	38	38.00
11-15	17	17.00
16-20	11	11.00
21-15	6	6.00
26 and above	4	4.00
Total	**100**	**100**
Level of Education		
Informal education	2	2.00
Primary school	39	39.00
Secondary school	41	41.00
Tertiary Institution	18	18.00
Total	**100**	**100**
Nature of Rice Farming		
Part time	98	98.00
Full time	2	2.00
Total	**100**	**100**
Marital Status		
Single	19	19.00
Married	81	81.00
Total	**100**	**100**
Membership of local organizations		
Yes	94	94.00
No	6	6.00
Total	**100**	**100**
Annual Income (₦M)		
<1	82	82.00
1 – 5	18	18.00
6 – 9	0	0.00
≥10	0	0.00
Total	**100**	**100**
Rice Farm Size (ha)		
1 – 5.9	88	88.00
6 – 9.9	11	11.00
10 and above	1	1.00
Total	**100**	**100**
Access to Agricultural Extension Services Relating to SRI		
Have Access	98	98.00
No Access	2	2.00
Total	**100**	**100**

Source: Field Survey, 2014.

Rate and Levels of Adoption of SRI

Table 2 shows that, 50% of the respondents are adopters of SRI, while 50% are non-adopters. Out of the 50% adopters, 10% adopted SRI as a complete package involving the six principles

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of SRI in addition to basic agronomic practices. Also, 15% adopted SRI partially involving 4 principles of SRI and basic agronomic practices, while 25% adopted SRI partially involving 3 principles of SRI. Also, Table 2 reveals that sum of the number of SRI principles adopted by respondents was 195, while sum of the number of SRI principles adopted in the study area was 300. This mean that, the levels of adoption expressed as a percentage for the six principles of SRI was 4. This implies that in every sample size of 100 respondents taken from Abi L.G.A, Cross River State, all things being equal, there is the likelihood tha respondents will adopt 4 out of 6 principles of SRI, since the level for adoption is 4.

Table 2: Rate and Levels of Adoption of SRI

Variable	Frequency	Percentage (%)
Adoption of SRI		
Yes	50	50.00
No	50	50.00
Total	**100**	**100**
Levels of Adoption of SRI		
Complete Adoption involving 6 principles of SRI	10	20.00
Partial Adoption involving 4 principles of SRI	15	30.00
Partial adoption involving 3 principles of SRI	25	50.00
Total	**50**	**100**

Source: Field survey, 2014.

Differences in Income of Adopters and Non-adopters of SRI

Table 3 reveals that the mean income of adopters of SRI was N382, 824.00 while that of non-adopters was N217, 997.00. The higher mean income of adopters over that of non-adopters of SRI can be attributed to the adoption of SRI. The level of significance of the mean disparity was tested by applying t-test.

The result of the analysis revealed t-calculated value of 8.40 which was greater than the t-tabulated value of 1.645 at 0.05level of significance. Given the fat that the t-calculated value was greater than t-tabulated or critical value, the hypothesis of no significant difference was rejected. This shows that adoption of SRI enhanced the income of adopters.

Table 3: Result of T-test Analysis of Difference in Mean Income of Adopters and Non-adopters of SRI

Variable	n	$\overline{X}$	S^2	t-cal
Adopters of SRI	50	382,824	9,446,527,180	
			`	8.40
Non-adopters of SRI	50	217,997	10,027,214,045.10	

Source: Field Survey, 2014.

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Problems Militating Against the Adoption of SRI in the Study Area.

Tale 4 shows the problem militating against the adoption of SRI in the study area. The results show that, five out of the six issues raised were rated as problems impeding the adoption of SRI. However, high cost of labour for transplanting in rows under SRI was ranked first with mean value of 3.29, non-participation during SRI demonstration was ranked second with mean value of 3.01. Non-access to supporting agricultural extension services, inadequate credit facilities were ranked third and fourth respectively. Their mean values were 2.81 and 2.69 respectively.

Also, table 4 reveals that, non-availability of supporting farm equipment/inputs to enhance adoption was ranked fifth with value of 2.66, while complex production processes was ranked sixth with mean value of 2.31 far below the decision rule mean of 2.50. This mean that complex production processes is not a problem to adoption of SRI. This implies that the production processes in SRI are simple.

Table 4: Problems Militating Against the Adoption of SRI in the study Area (Using 4-point likert scale with 2.5 mean decision rule)

Problems		SA (4)	A (3)	DA (2)	SDA (1)		CUM	CA	R
Non-Participation During SRI Demonstration		40 (160)	30 (90)	21 (42)	9 (9)		301	3.01	2nd
Non Access to Supporting Agric Extension services		(104)	26 (93)	31 (82)	41 (2)	2	281	2.81	3rd
High cost of Labour for Transplanting		52 (208)	32 (96)	9 (18)	7 (7)		329	3.29	1st
Non-availability of Supporting farm Equipment/inputs to Enhance adoption	(120)	30	28 (24)	20 (40)	22 (22)		266	2.66	5th
Inadequate credit Facilities	28	(112)	32 (96)	21 (42)	19 (19)		269	2.69	4th
Complex production Process	21	30 (84)	8 (90)	41 (16)	(41)		231	2.31	6th

Source: Field Survey, 2014

The figures in parentheses are the sum of frequency and the scale

CUM = Cumulative, CA = Cumulative average and R=Ranking.

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DISCUSSION

The result of the socio-economic variables indicates that the majority (78%) of the respondents are males, 22% are females. This implies that men dominate rice production in the study area. Majority (28%) fell within the age range of 41-50years. This indicates a young population that guarantees the labour supply for agricultural activities in the study area. With respect to household size, majority (38%) have household size of 6-10 persons.

The educational status of the respondents revealed that, high percentage of them have formal education (98%), an observation which tends to disprove the purported rate of illiteracy common in rural communities in Nigeria (Ijere, 1992). This possible reason for this outcome is that, Abi L.G.A is a riverside local government area in Cross River State with River, Cross River passing through the area. The River (Cross River) was the major entry point for the early Scottish missionaries into the inter land of Cross River State spreading Christianity and western education and therefore afforded the people of the study area the opportunity for early western education that is likely handed down to subsequent generations.

This is further explained by the total number of mission schools in the study era. The inference from this is that, educational attainment is expected to affect positively the productivity of rice farmers as educated farmers are more likely to adopt modern agricultural practices (Binswanger, 1989). The nature of rice farming was confirmed by majority (98%) to be on part-time basis. This is because rice farming in the study area is dominated by small and medium scale rice farmers that their farming activities cut across different crops in the area.

Married heads accounted for 81%. Majority (94%) of the respondents are members of local organizations found in the study area. This stresses the importance of local organizations in the rural Nigeria setting as a major platform for social mobilization, enforcing discipline, community work, rural development, etc. (Ebong, 2006). Results of the study revealed that, 82% of the respondents earn less than 1 million Naira, 18% earn 1-5million Naira. Eighty-eight percent of the respondents have rice farm sizes ranging 1-5.9ha, while 11% have rice farm sizes between 6-9.9ha. With respect to access to agricultural extension services relating to SRI, 98% have access, while 2% do not have access. Access to extension services is known to influence adoption of modern farm technologies (Bose, et al., 2012).

The adoption rate of SRI in the study area was 50% with 4 levels of adoption, meaning that, in every sample size of 100 respondents taken from Abi L.G.A, Cross River State, all things being equal there is the likelihood that the respondents will adopt 4 out of the 6 principles of SRI, since the level of adoption is 4. The t-test analysis of the mean income difference revealed t-calculated value of 8.40 greater than t-tabulated or critical value of 1.645. Meaning that, the adoption of SRI influenced the yield and income of adopters of SRI. Five out of the six issues raised on problem that are militating against the adoption of SRI in the study area were scored above 2.5 mean decision rule on a four-point Likert Scale.

These problems in order of their ranking are, high cost labour for transplanting under SRI, non-participation during SRI demonstration, non-access to supporting agricultural extension services, inadequate credit facilities, non-availability of supporting equipment/inputs to enhance adoption. Complex production processes was rated as not a problem to SRI adoption.

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IMPLICATION TO RESEARCH AND PRACTICE

Apart from adding to existing literature on development of rice value chain in Cross River State and the country as a whole, this study was motivated by the desire to ascertain the influence of adoption of SRI in income of adopters by carrying a comparative analysis of System of Rice Intensification (SRI) and Traditional System of Rice Production (TSRP) in Abi L.G.A, Cross River State, Nigeria. The results will help agricultural policy makers to determine the most effective approach for SRI adoption with a view to redirecting and reinforcing training and demonstration of SRI for optimal adoption. This is necessary as the country move to self-sufficient in rice production.

CONCLUSION

The assessment of socio-economic characteristics of rice farmers in the study area revealed that 78% were males and 28% were of age range of 41-50 years with 98% having formal education. This study has also shown that 98% of the respondents were part time rice farmers, while 2% were full time rice farmers. It also reveals that 81% are married heads, 94% of the respondents are members of local organizations found in the study area. Also, 82% of the respondents have <N1million naira annually and majority (88%) of the respondents have rice farm sizes between 1-5.9ha. On access to agricultural extension services relating SRI, 98% have access, while 2% do not have access to agricultural extension services relating to SRI.

Adoption rate of SRI was 50% with 4 levels of adoption of the six principles of SRI. The t-calculated value for mean income difference between adopters and non-adopters of SRI was 8.40 greater than t-tabulated value of 1.645. Meaning that SRI adoption enhances the income of adopters while high cost of labour for transplanting in rows under SRI was ranked first as a problem militating against the adoption of SRI. This study therefore makes the following recommendations:

- Production cost reducing technologies such as rice seeder, rotary rice weeder, etc. that can enhance SRI adoption be made available to Rice Farmers.
- Participation of rice farmers during SRI demonstration be encourage
- Agricultural extension services be step-up on SRI
- Credit facilities be made available to rice farmers at a low interest rate, etc.

FUTURE RESEARCH

Several factors in addition to the six issues under this study may be responsible for some rice farmer not adopting SRI in the study area and therefore need to be further investigated. The study reveals the dominance of men in rice production than women in the study area, there is need for further investigation or research. Also, future research may addressed the influence of socio-economic characteristics on the adoption of SRI

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APPENDIX

Field Data on Yields and incomes of Adopters of SRI

S/N	X(Yield MT)	$X-X_1$	$(X-X_1)^2$	X(Income ₦)	$X-X_1$	$(X-X_1)^2$
1	4.00	-2	-4	260,000	-130,840	-17,119,105,600
2	5.00	-1	-1	325,000	-65,840	-4,334,905,600
3	4.40	-1.6	-2.56	286,000	-104,840	-10,991,425,600
4	8.00	2	4	520,000	129,160	16,682,305,600
5	8.00	2	4	520,000	129,160	16,682,305,600
6	8.00	2	4	520,000	129,160	16,682,305,600
7	6.00	0	0	390,000	-840.00	-705,600
8	8.00	2	4	520,000	129,160	16,682,305,600
9	4.10	-1.9	-3.61	260,000	-130,840	-17,119,105,600
10	5.00	-1	-1	325,000	-65,840	-4,334,905,600
11	6.10	0.1	0.01	396,500	5,660	32,035,600
12	7.20	1.20	1.44	468,000	77,160	5,953,665,600
13	6.00	0	0	390,000	-840.00	-705,600
14	8.30	2.3	5.30	539,500	148,660	22,099,795,600
15	4.20	-1.3	3.24	273,000	-117,840	13,886,265,600
16	5.00	-1	-1	325,000	-65,840	-4,334,905,600
17	5.00	-1	-1	325,000	-65,840	-4,334,905,600
18	6.00	0	0	390,000	-840.00	-705,600
19	8.00	2	4	520,000	129,160	16,682,305,600
20	4.00	-2	-4	260,000	-130,840	17,119,105,600
21	6.00	0	0	390,000	-840.00	-705,600
22	5.00	-1	-1	325,000	-65,840	-4,334,905,600
23	4.00	-2	-4	260,000	-130,840	-17,119,105,600
24	6.00	0	0	390,000	-840.00	-705,600
25	8.00	2	4	520,000	129,160	16,682,305,600
26	8.00	2	4	520,000	129,160	16,682,305,600
27	5.00	-1	-1	325,000	-65,840	-4,334,905,600
28	6.01	0.01	0.000	390,650	-190.00	-36,100
29	5.10	-0.9	0.81	331,500	-59,340	-3,521,235,600
30	7.00	1	1	455,000	64,160	4,116,505,600
31	3.40	-2.6	-6.76	221,000	-169,840	-28,845,605,600
32	6.00	0	0	390,000	-840.00	-705,600
33	5.00	-1	-1	325,000	-65,840	-4,334,905,600
34	8.10	2.1	4.41	526,500	135,660	18,403,635,600
35	4.00	-2	-4	260,000	-130,840	-17,119,105,600
36	6.00	0	0	390,000	-840.00	-705,600
37	9.00	3	9	585,000	194,160	37,698,105,600
38	6.00	0	0	390,000	-840.00	-705,600
39	4.00	-2	-4	260,000	-130,840	-17,119,105,600
40	5.20	-0.8	-0.64	338,000	-52,840	-2,792,065,600

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41	4.40	-1.6	-2.54	286,000	-104,840	-10,991,425,600
42	5.00	-1	-1	325,000	-65,840	4,334,905,600
43	6.00	0	0	390,000	-840.00	-705,600
44	8.01	2.01	4.0	520,650	129,810	16,850,636,100
45	5.02	-0.98	-0.96	326,300	-64,540	-4,165,411,600
46	6.00	0	0	390,000	-840.00	-705,600
47	5.04	-0.96	-0.90	327,600	-63,240	-3,999,297,600
48	6.00	0	0	390,000	-840.00	-705,600
49	6.00	0	0	390,000	-840.00	-705,600
50	8.00	2	4	520,000	129,160	16,682,305,600

Field Data on Yields and Incomes of Non-adopters of SRI

S/N	X	$X-X_2$	$(X-X_2)^2$	X	$X-X^2$	$(X-X^2)^2$
1	2.35	-0.96	-0.92	152,750	-62,649	-3,924,897,201
2	2.60	-0.71	-0.50	169,000	-46,399	-2,152,867,201
3	2.42	-0.89	-0.79	157,300	-58,099	-3,375,493,801
4	2.80	-0.51	-0.26	182,000	-33,399	-1,115,493,201
5	3.00	-0.31	-0.096	195,000	-20,399	-416,119,201
6	3.00	-0.31	-0.096	195,000	-20,399	-416,119,201
7	4.00	0.69	0.48	260,000	44,601	1,989,249,201
8	2.20	-1.11	-1.23	143,000	-72,399	-524,115,201
9	1.80	-1.51	-2.28	117,000	-98,399	-9,652,363,201
10	3.50	0.19	0.036	227,500	12,101	146,434,201
11	2.85	-0.46	-0.21	185,250	-30,149	908,962,201
12	2.48	-0.83	-0.69	161,200	-54,199	-2,937,531,601
13	3.01	-0.3	-0.09	195,650	-19,749	-390,023,001
14	4.10	0.79	0.62	266,500	51,101	2,611,312,201
15	2.46	-0.85	-0.72	159,900	-55,499	-3,080,139,001
16	2.10	-1.21	-1.46	136,500	-78,899	-6,225,052,201
17	2.80	-0.51	-0.26	182,000	-33,399	-1,115,493,201
18	2.00	-1.31	-1.72	130,000	-85,399	-7,292,989,201
19	4.00	0.69	0.48	260,000	44,601	1,989,249,201
20	3.20	-0.11	-0.012	208,000	-7,399	-54,745,201
21	3.40	0.09	0.0081	221,000	5,601	31,371,201
22	2.01	-1.3	-1.69	130,650	-84,749	-7,182,393,001
23	2.40	-0.91	-0.83	156,000	-59,399	-3,528,241,201
24	2.00	-1.31	-1.72	130,000	-85,399	-7,292,989,201
25	6.00	2.69	7.24	390,000	147,601	30,485,509,201
26	8.00	4.69	22.00	520,000	304,601	92,781,769,201
27	3.10	-0.21	-0.044	201,500	-13,899	-193,182,201
28	3.00	-0.31	-0.096	195,000	-20,399	-416,119,201
29	2.00	-1.31	-1.72	130,000	-85,399	-7,292,989,201

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30	2.40	-0.91	0.83	156,000	-59,399	-3,528,241,201
31	2.50	-0.81	-0.66	162,500	-52,899	-2,798,304,201
32	5.00	1.69	2.86	325,000	109,601	12,012,379,201
33	4.01	0.7	0.49	260,650	45,251	2,047,653,001
34	4.20	0.89	0.79	273,000	57,601	3,317,895,201
35	2.80	-0.51	-0.26	182,000	-33,399	-1,115,493,201
36	3.10	-0.21	-0.044	201,500	-13,899	-193,182,201
38	4.68	1.37	1.88	304,200	88,801	7,885,617,201
39	4.30	0.99	0.98	279,500	64,101	4,108,938,201
40	8.00	4.69	21.99	520,000	304,601	92,781,769,201
41	6.00	2.69	7.24	390,000	174,601	30,485,509,201
42	8.10	4.79	22.94	526,500	311,101	96,783,832,201
43	2.10	-1.21	-1.46	136,500	-78,899	-6,225,052,201
44	2.80	-0.51	-0.26	182,000	-33,399	-1,115,493,201
45	4.60	1.29	1.66	299,000	83,601	6,989,127,201
46	3.28	-0.03	0.0009	213,200	-2,199	-4,835,601
47	2.14	-1.17	-1.37	139,100	-76,299	-5,821,537,407
48	2.00	-1.31	-1.72	130,000	-85,399	-7,292,989,201
49	2.80	-0.51	-0.26	182,000	-33,399	1,115,493,201
50	2.10	-1.21	-1.46	136,500	-78,899	-6,225,052,201

Mean (X) = ΣX

Variance (S^2) = $\frac{(X - X)^2}{n}$

$$t = \frac{382,824 - 217,997}{\sqrt{\frac{9,446,527,180}{50} + \frac{10,027,214,045.10}{50}}} = \frac{164,827}{19,735.12} = 8.40$$

df = $n_1 + n_2 - 2$ = 118. T– table value = 1.645 at 0.05 level of significance.

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