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RELATIONSHIP BETWEEN SOCIOECONOMIC FACTORS, INCOME AND PRODUCTIVITY OF FARMERS: A CASE STUDY ON PINEAPPLE FARMERS

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ABSTRACT

Pineapple which is scientifically known as *Ananas comosus* and locally recognized as *nanas* is one of the well-known tropical fruits besides banana, mango and papaya. This unique fruit is being cultivated extensively in many parts of the world including Malaysia and commonly consumed fresh or in processed form. In Malaysia, the related agencies had been implementing various development activities to uplift the pineapple industry in the country. These included in activities to help the small-scale pineapple farmers in improving their income level. Socioeconomic characteristics of farmers have been proven to give significant impacts on their income and productivity. Thus, this study was conducted to determine the relationship between socioeconomic factors, income and productivity of pineapple farmers in Samarahan, Sarawak. The survey was conducted from July to August 2012 with total of 55 respondents using structured questionnaire as the research instrument. Both descriptive statistics and inferential statistics were involved in this study. Factor analysis was used to identify the main factors affecting the productivity of the respondents based on 21 Likert-scaled items used in this study. The factor analysis revealed that there were two factors affecting their productivity which are input and awareness factor and farm background factor. Logistic regression analysis revealed that the land size factor or specifically, the total area of pineapple farming was the only factor identified having significant effect on the monthly income of pineapple farmers in Samarahan ($B=.492$, $p<.05$). The study has successfully analyzed the relationship between socioeconomic factors, income and productivity of paddy farmers in the studied area. These findings could be used as a baseline data by the relevant parties or agencies involve in the development of pineapple industry in improving the pineapple farmers' productivity and income.

KEYWORDS: Socioeconomic, Income, Productivity, Pineapple, Farmer

INTRODUCTION

Known scientifically as *Ananas comosus*, pineapple or nanas is a monocotyledonous plant with short stem and rosette of long spiny leaves. This unique fruit is being cultivated extensively in many parts of the world including Malaysia and commonly consumed fresh or in processed form. Malaysia was listed number 15 of the world fresh pineapple exporter, while for canned pineapple Malaysia was listed as number 9. The export trend for Malaysia's canned pineapple was decreasing, while that of fresh pineapple the export volume had increased (Raziah, 2009). In 2010, Malaysia exported RM 78 million worth of fresh and canned pineapple to the United States, Japan, United Kingdom and Middle East. However, the amount was insufficient to meet the export demands. Thus, in order to fulfill the high demands of pineapple for export, Malaysia must plan strategies to increase pineapple production from time to time.

Socioeconomic characteristics of farmers have been proven to give significant impacts to their income and productivity. In previous studies on socioeconomic characteristics of farmers affecting their income, Sultan Ali et al. (2004) proved that income of small farmers in Pakistan were affected by family, labour and input cost. Mohammad Samaun (2005) found that income of farmers was influenced by education, area of land, livestock holding and family size. Based on Moloi (2008), the factors determining the livestock farmers' income were farm size, access to finance, age of household head, membership to farmers' organization and government support. In addition, horticultural farmer's factors that affect their income were farm size, age of household head, land type and extension contact. Besides that, Serin et al. (2009) found that formal education and practical education or extension contact could increase the farmers' income level. Ghafoor et al. (2010) reported that academic qualification, land holding, agricultural expenditures and number of family members involved in agricultural activities affected the income.

Consolidation of smaller farms into bigger scale was the right decision to improve farms' productivity and efficiency. Small scale growers should focus on producing pineapple for fresh market that can be sold at higher price (Raziah, 2009). Abdul Rahman et al. (2005) proved that the pineapple farmers' productivity influenced by their cultivation practice, knowledge and farm recording. Besides that, in a past study conducted by MARDI (2010), the productivity of pineapple farmers' was affected by socio-economic factors, such as, high income in other agriculture activity, land size, age, household size, education level and capital source. Meanwhile, Md. Mahmudul et al. (2011) stated that the paddy farmers' race, education level, availability of machines in agriculture activity, secondary occupation, ratio of non-agriculture to agriculture income had significant impact to their productivity. Mbam and Edeh (2011) reported that smallholder rice farmers education years, fertilizer application and improved variety affect their productivity in producing rice.

All those factors mentioned above had been identified as factors which gave impacts on the income and productivity among their target groups. These findings were used as references in this study on pineapple farmers in Samarahan, Sarawak. The main objective of this study was to determine the effects of socioeconomic factors on the income and productivity of pineapple farmers in Samarahan, Sarawak

In Sarawak, Samarahan is one of the pineapple cultivation project areas. This was previously implemented by Integrated Agriculture Development Area (IADA) Samarahan and had been taken over by Malaysian Pineapple Industry Board (MPIB). Samarahan was identified as a strategic and advantageous area for pineapple planting which had deep peat soil, average rainfall of 3,400 mm per year and average temperature of 27°C to 30°C making it as one of the main key players of pineapple production in Sarawak. Four pineapple varieties Samarahan well known of include Moris or locally known as Sarikei, Josephine, the hybrid of Nanas Johor and Sarawak, Gandul, N36 and also Sarawak or Paun. Generally, pineapple cultivation in Sarawak was small scale and only catered for domestic market, but not for export purpose (Abdul Rahman et al, 2005). Therefore, in order to boost the pineapple cultivation in Sarawak and Malaysia on the whole, this study on socioeconomic factors affecting the income and productivity of pineapple farmers was conducted in Samarahan.

MATERIAL AND METHODS

A survey method through face-to-face interview by using structured questionnaire was used to collect data from a total of 55 pineapple farmers in Samarahan, Sarawak, Malaysia. The survey was conducted from July to August 2012.

Samarahan is the largest pineapple cultivation area compared to other districts in Sarawak with a total area of approximately 766.6 hectares, out of the total 2,183.7 hectares for the whole of Sarawak (Agricultural Statistics of Sarawak, 2013). It is a district with the area of 593.9 km square coordinated at 1°27'34'' North 110° 29' 56'' East. Samarahan was, therefore, chosen for the study area. The specific areas or villages in the Samarahan district selected for the study were Meranek, Niup, Naie Baru, Melayu, Sungai Mata, Empila, Mang, Tanjung Parang, Asajaya, Lubuk Punggo and Tambey. The respondents were selected by using simple random sampling method. The questionnaire consisted of three sections of A, B and C. Section A comprised of questions on pineapple farm background. Section B was on perception of pineapple farmers to the factors that affecting their productivity and Section C was the demographics or pineapple farmers' background. Data analysis was done using software to run the statistical analysis. This study used Statistical Package for the Social Sciences or SPSS version 20. Both descriptive statistics and inferential statistics were involved in this study.

RESULTS AND DISCUSSIONS

Table 1 shows the pineapple farmers' or the respondents' background. A total number of 30 respondents or 55 percent were in age group of 41 to 60 with mean age of 48 years old. Of all the initial cohort of 55 respondents, 33 respondents or 60 percent were male and 22 respondents or 40 percent were female. Besides that, 48 respondents or 87 percent were married. A total of 29 respondents or 53 percent had household size more than five person followed by 26 respondents or 47 percent with household size between one to five person. Majority of the respondents numbering 25 respondents or 46 percent completed primary school. Only 10 respondents or 18 percent had not obtained any formal education.

Table 2 shows the pineapple farming experience and status by the respondents. The mean for experience in pineapple farming was two years. A total of 25 respondents or 46 percent reported that their experience ranged from six to ten years. Other responses were experience from one to five years with 14 respondents or 26 percent. This was followed by experience of 11 to 15 years with five respondents or 9 percent and experience more than 15 years with 11 respondents or 20 percent. More than half of the respondents numbering 21 respondents or 62 percent were full time pineapple farmers.

Table 3 shows the monthly income from pineapple farming and also the land size of their farm. The monthly income of pineapple farmers was further divided into two categories, below RM 830 and above RM 830. Over 39 respondents or 71 percent had income less than RM 830 and 16 respondents or 29 percent had more than RM 830. A total of 41 respondents or 75 percent indicated that their whole land size were from 0.5 to 5 acres. Nine respondents or 17 percent with whole land size of 6 to 10 acres and for whole land size more than 11 acres represented by five respondents or 10 percent. The mean for whole land size was eight acres. Particularly, total numbers of 49 respondents or 89 percent pineapple farm sizes were from 0.5 to 5 acres. A total number of four of respondents or 8 percent had pineapple farm sizes of 6 to 10 acres and two respondents or 4 percent with more than 11 acres. The pineapple farm size mean was 3 acres.

Table 4 shows the perceptions of pineapple farmers on factors affecting their productivity. There were 21 factors with response choices of strongly disagree, disagree, not sure, agree and strongly agree. Based on the reliability test, the internal consistency of all the factors was good, with a Cronbach alpha of 0.660 that adhere to the ideal Cronbach alpha coefficient which should not be less than 0.7 (Coakes and Ong, 2011).

Factor analysis was chosen to analyse these data in order to reduce the data using smaller set of components through grouping factor based on intercorrelation between factors (Pallant, 2002). The Kaiser-Meyer-Olkin value was .663, exceeding the recommended value of .6 (Kaiser, 1970) and Bartlett's Test of Sphericity (Bartlett, 1954) reached statistical significance (i.e. $p < 0.05$), supporting the factor ability of the correlation matrix. Principle Component Analysis (PCA) revealed that the presence of seven components with eigenvalues exceeding 1, explaining 24.162 percent, 39.135 percent, 47.732 percent, 55.359 percent, 62.472 percent, 68.282 percent and 73.045 percent of variance respectively.

According to Catell (1966), the number of factors that could describe relationship among variables could also be done through Catell's Scree Test by plotting each of eigenvalues of factors and inspect the plot to find a point where the shape of curve changes direction and becomes horizontal. Catell recommended that all the factors above the elbow must be retained because those factors contribute the most to the explanation of variable in data set. Based on the scree plot (Figure 1), only component 1 and 2 were above the elbow and retained.

To aid in the interpretation of the two components, Varimax rotation was performed. The rotated solution revealed the presence of simple structure with two components showing a number of strong loadings and all variables loading substantially on only one component. The total two components solution explained total of 47.732 percent variance with Component 1, 23.342 percent and Component 2, 15.533 percent.

Table 6 shows the strength of the relationship between the two factors or components whereby in this case the value is quite low, at –.301. This information confirms that the two components were not related (the assumption underlying the use of Varimax rotation). Based on the reliability test, the internal consistency of the component considered to be good with a Cronbach's alpha of more than .7 that adhered to the ideal Cronbach's alpha coefficient (Coakes and Ong, 2011). Component 1 and Component 2 had Cronbach's alpha of .867 and .790 respectively which adhered to the Cronbach's alpha coefficient. The items which are related to input and awareness were loaded strongly on component 1, while the items that related to farm background were loaded strongly on component 2 (see Table 5). Therefore, Component 1 was named as input and awareness factor and Component 2 was named as farm background factor.

There are eight items under Component 1 or input and awareness factor that could affect the productivity of pineapple farmers based on the respondents' perception. The items are less capital to buy fertilizer, less capital to buy pesticide, lack of financial capital, lack of awareness on effective disease management, lack of labour, lack of awareness on effective pest management, lack of guidance from government extension agent, and disease infestation.

Three factors or items under Component 1 (i.e. input and awareness factor) are due to lack of capital by the respondents. Credit availability could also cause shift in agricultural productivity (Hussain and Perera, 2004). Lack of subsidies, financial capital and credit may limit the farmers to buy agricultural inputs such as fertilizers, pesticides, tools and suckers for high pineapple production as the inputs may be costly to the farmers particularly among low income farmers. Without any of these inputs, the pineapple farm might not produce much pineapple fruits and affect the productivity of farmers.

On fertilizer usage, Mbam and Edeh (2011) and Adinya *et al.* (2010) indicated that fertilizer application was positively significant to farmer's productivity. The need of fertilizer application in pineapple farming is crucial as a lot of

nutrient required for fruiting process. By applying fertilizer with appropriate amount, pineapple can thrive well and produce high quantity of quality pineapple. Without fertilizer, the pineapple farm may produce low quality and quantity pineapple or none. This will affect the productivity of the farmer. Thus, less capital to buy fertilizer and also less subsidized fertilizer can influence the productivity of pineapple farmers in Samarahan. Adinya *et al.* (2010) also mentioned that the labour availability had positive impact on output of pineapple production. By the presence of labour, either family members or non-family members assisting the farmers in pineapple farm, the productivity of the farmers can be increased. This is due to more farm work can be done in shorter time with the availability of labours.

The finding of this study was similar to that of Epeju (2010) in terms of the perceptions on farmers' extension contact affecting the productivity of farmers. Lack of contact between the farmers and extension agents can cause decrease in productivity. Through extension contact, the farmers gain knowledge and new technology in pineapple farming. Later on, they improvise and improve their farms. This eventually would increase their productivity. Hence, with lack of extension contact, the farmers might not have the latest or updated knowledge and information on pineapple farming making them remain less productive.

On disease, Rochbach and Johnson (2003) stated that pineapple disease directly influenced the proportion of plant population which eventually causing changes in productivity of farmers. Diseases normally caused by environment factors, such as, temperature and climate of the surrounding. Diseases in pineapple, such as, fruitlet core rot and red leaf symptom could cause reduction in pineapple production in a farm. These diseases caused the fruits to be damaged and not marketable. Due to this, the farmers cannot harvest many pineapples, discard the infected fruits and eventually lowered their productivity. Besides that, this disease infestation could be spread to all pineapples in farm leading to more critical loss to the farmers.

Under Component 2 or farm background factor, there are six items that could affect the productivity of pineapple farmers, namely infertile land, pineapple variety used susceptible to disease, pineapple variety not suitable for market demand, difficulty of having quality pineapple suckers, pest infestation and distance from pineapple farm and house far.

Infertile land was perceived as a factor that influenced their productivity in pineapple farming. Hussain and Perera (2004) stated similar encounter where quality of land was one of the determinants of agricultural productivity. Infertile land could slow down or inhibit the growth and development of pineapple fruits as the land inability to supply enough nutrient required by the crop. This could reduce the farmers' productivity as less fruits could be produced.

Pineapple variety could also affect the pineapple farmer's productivity. This was proven by the findings of Mbam and Edeh (2011) where usage of improved variety had positive significance to productivity of smallholder rice farmers. Quality pineapple variety determines the high production of pineapple in a farm. The pineapple usually pest and disease resistant, can grow rapidly and easy to be propagated. Prior to planting, the farmers should ensure the quality of pineapple suckers they obtained in order to grow good and marketable yield of pineapple and increase their productivity. Thus, the difficulty of having quality pineapple sucker and pineapple variety not suitable for market demand factors can affect the productivity of pineapple farmers.

High productivity of pineapple could be achieved if the pest was properly managed (Maleziéux and Bartholomew, 2003). Pest infestation cannot be controlled or prevented as it could be influenced by environment factors, such as, temperature and climate. Pest in pineapple, such as, mealybugs, ants, termites and pineapple scales can be managed

properly and reduced, hence increasing the pineapple farmers' productivity.

Meanwhile, for distance between farm and house far, the farmers agreed that distance could affect their productivity. However, Md Mahmudul et al. (2011) reported that the distance between farmers' house and farm did not influence productivity of farmers. Referring to the pineapple farmers in Samarahan, the farmers travelled to their respective farms with transportations like bicycles, motorcycles, mini vans and cars since the Samarahan roads were in good condition, making the farms reachable regardless of the distance. Nonetheless, if the farm was very far away from his or her house, it would affect the frequency and willingness of the farmers to travel to farm and carry out their farm works as they might need to consider the transportation costs and also time. This would affect the farmers' productivity as they could not manage the farm properly because of fewer visits to farm and carry out farm works.

Table 7 represents the coding of dichotomous and continuous variable. Out of 11 independent variables, there were four variables under dichotomous scale consist of gender, marital status, secondary occupation and land status. The remaining seven variables were continuous scale include age, formal education obtained (year), experience in pineapple farming (year), number of meeting with extension agent last year, distance between farmer's house (km), household size and land size (acre).

Table 8 highlights the logistic regression coefficient, Wald test and odds ratio for each variable. By employing a 0.05 criterion of statistical significance, all of the independent variables consisting of socioeconomic factors had no significant partial effect on monthly income of pineapple farmers except for the LANDSIZE ($B = .492$, $p < .05$). The odds ratio for LANDSIZE shows that when holding all other variables constant, pineapple farmer with bigger land size is 1.6 times more likely to have monthly income more than RM 830 per month.

Land size or specifically, the total area of pineapple farming was the only factor identified having significant and direct effect on the monthly income of pineapple farmers in Samarahan with value of $B=.492$ and $p<.05$ obtained from the logistic regression. Therefore, the area of pineapple farming, the more pineapple can be cultivated and produced from the farm and later higher income would be generated by the farmers. In this study, majority of pineapple farmers, 41 respondents or 89 percent had pineapple farm size ranging from 0.5 to 5 acres with average pineapple farm size of 3 acres. The significant relationship between land size and income of pineapple farmers supported the previous findings which had similar findings. Moloi (2008) demonstrated that farm size had significant effect on farm income of emerging farmers. Hasan et al. (2010) proved that the relationship between pineapple farm size and increased income from pineapple cultivation in Bangladesh was found to be positive and significant. Hence, the pineapple farmers must use their land optimally through good farm management and good agronomic practices to maximize production and gain high income from the pineapple farming.

CONCLUSIONS

The study was undertaken mainly to determine the socio-economic factors affecting the income of pineapple farmers. Besides that, it was set out to identify the perceptions of pineapple farmers on factors affecting their productivity. Based on regression analysis, the land size was the only socio-economic factor which influenced the income of the pineapple farmers in Samarahan, Sarawak, Malaysia. But, the pineapple farmers agreed that they were 14 main factors affected their productivity categorized under two components, namely input and awareness factor and farm background

factor. These findings could be used as a baseline data by the relevant parties or agencies involve in the development of pineapple industry in Sarawak such as Department of Agriculture, Malaysia Pineapple Industry Board, and Integrated Agricultural Development Area in improving the pineapple farmers' productivity and income.

Tables

Table 1: Respondents' Background

Background Information	N	Percentage (%)	Mean
Age Group			
0-20	1	2	48 years old
21-40	17	31	
41-60	30	55	
61-80	7	13	
Total	**55**	**100**	
Gender			
Male	33	60	
Female	22	40	
Total	**55**	**100**	
Marital Status			
Single	5	9	
Married	48	87	
Divorced	2	4	
Total	55	100	
Household Size			
1-5	26	47	2 people
More than 5	29	53	
Total	**55**	**100**	
Formal Education Level			
Primary School	10	18	
Complete Primary School	25	46	
Complete Lower Secondary School	6	11	
Complete Upper Secondary School	4	7	
None	10	18	
Total	**55**	**100**	

Table 2: Pineapple Farming Background

Pineapple Farming Background	N	Percentage (%)	Mean
Pineapple Farming Experience (Year)			
1-5	14	26	2 Years
6-10	25	46	
11-15	5	9	
More than 15	11	20	
Total	**55**	**100**	
Pineapple Farming Status			
Full Time	34	62	
Half Time	21	38	
Total	**55**	**100**	

Table 3: Monthly Income and Land Size

Occupation and Income	N	Percentage (%)	Mean
Monthly Income from Pineapple Farming			
Below RM 830	39	71	
Above RM 830	16	29	
Total	**55**	**100**	
Whole Land Size (Acre)			
0.5 - 5	41	75	8 acres
6 - 10	9	17	
More than 11	5	10	
Total	**55**	**100**	
Pineapple Farm Size (Acre)			
0.5 - 5	49	89	3 acres
6 - 10	4	8	
More than 11	2	4	
Total	**55**	**100**	

Table 4: Perceptions of Pineapple Farmers on Factors Affecting Their Productivity

Factor	Strongly Disagree		Disagree		Not Sure		Agree		Strongly Agree	
	N	%	N	%	N	%	N	%	N	%
Lack of Financial Capital	0	0	0	0	0	0	22	40	33	60
Increasing Age of Pineapple Farmers	0	0	1	2	4	7	23	42	27	49
Decreasing Size of Pineapple Farm because shifting to Oil Palm Planting	17	31	11	20	19	35	6	11	2	4
Less Attention in Pineapple Farming because of Secondary Occupation	11	20	6	11	5	9	15	27	18	33
Infertile Land	10	18	5	9	1	2	24	44	15	27
Lack of Awareness on Effective Disease Management	0	0	0	0	0	0	18	33	37	67
Disease Infestation	0	0	0	0	0	0	7	13	48	87
Pest Infestation	3	6	9	16	1	2	13	24	29	53
Lack of Labour	0	0	1	2	0	0	24	44	30	55
Lack of Male Labour	2	4	3	6	5	9	24	44	21	38
Less Capital to Buy Fertilizer	0	0	0	0	1	2	21	38	22	60
Less Capital to Buy Pesticide	0	0	0	0	1	2	19	35	35	64
Lack of Awareness on Effective Pest Management	0	0	0	0	1	2	16	29	38	69
Pineapple Variety Used Susceptible to Disease	6	11	3	6	4	7	15	27	27	49
Pineapple Variety Not Suitable for Market Demand	6	11	5	9	16	29	12	22	16	29
Difficulty of Having Quality Pineapple Suckers	14	26	8	15	4	7	23	42	6	11
Lack of Guidance from Government Extension Agent	0	0	0	0	0	0	16	29	39	71
Distance from Pineapple Farm and Farmer's House Far	12	22	7	13	1	2	23	42	12	22
Less Household Member to	8	15	10	19	1	2	22	40	14	26

Help in Farm										
Less Subsidised Fertilizer	0	0	2	4	0	0	21	38	32	58
Pineapple as Side Crop	4	7	3	6	2	4	24	44	22	40

Table 5: Varimax Rotation of Three Factor Solution for Factors Affecting the Monthly Income of Pineapple Farmers

Item	Component	
	1	2
Less capital to buy fertilizer	.819	
Less capital to buy pesticide	.804	
Lack of financial capital	.766	
Lack of awareness on effective disease management	.755	
Lack of labour	.707	
Lack of awareness on effective pest management	.656	
Lack of guidance from government extension agent	.591	
Disease infestation	.581	
Infertile land		.762
Pineapple variety used susceptible to disease		.724
Pineapple variety not suitable for market demand		.713
Difficulty of having quality pineapple suckers		.704
Pest infestation		.694
Distance from pineapple farm and house far		.519

Table 6: Component Transformation in Matrix

Component	1	2
1	.954	-.301
2	.301	.954

Extraction Method: Principal Component Analysis.

Rotation Method: Varimax with Kaiser Normalization.

Table 7: Dichotomous and Categorical Variable Coding

Variable	Role	Scale Type	Categorical (Value)	Coding
Monthly Income of Pineapple Farmers (RM/Month)	DV	Dichotomous	<RM 830 per month (0) >RM 830 per month (1)	MONTHLYINCOME
Age	IV	Continuous		AGE
Gender	IV	Dichotomous	Male (1) Female (0)	GENDER (1)
Marital Status	IV	Dichotomous	Married (1) Others (0)	MARITALSTATUS (1)
Formal Education Obtained (Year)	IV	Continuous		FORMALEDUCATION
Experience in Pineapple Farming (Year)	IV	Continuous		EXPERIENCE
Number of Meeting with Extension Agent Last Year	IV	Continuous		EXTENSION
Distance between Farmers' House and Pineapple Farm (km)	IV	Continuous		DISTANCE
Household Size	IV	Continuous		HOUSEHOLDSIZE
Secondary Occupation	IV	Dichotomous	With Secondary Occupation (1) Without Secondary	SECONDARYOCCUPATION(1)

			Occupation (0)	
Land Status	IV	Dichotomous	Self-Owned with Grant (1) Other (0)	LANDSTATUS (1)
Land Size (acre)	IV	Continuous		LANDSIZE

Note: DV = Dependent Variable; IV = Independent Variable

Table 8: Logistic Regression Predicting Monthly Income of the Pineapple Farmers (Rm) From Socio-Economic Factors

Variable	B	S. E.	Wald	DF	Sig.	Exp(B) or Odds Ratio
AGE	.049	.063	.596	1	.440	1.050
GENDER(1)	.546	.927	.347	1	.556	1.726
MARITALSTATUS(1)	-.253	1.515	.028	1	.868	.777
FORMALEDUCATION	.206	.186	1.233	1	.267	1.229
EXPERIENCE	.034	.065	.278	1	.598	1.035
EXTENSION	-.038	.194	.039	1	.844	.962
DISTANCE	-.012	.067	.030	1	.863	.989
HOUSEHOLDSIZE	.066	.206	.104	1	.747	1.068
SECONDARYOCCUPATION (1)	1.141	.975	1.368	1	.242	3.130
LANDSTATUS (1)	-.442	1.086	.166	1	.684	.643
LANDSIZE	.492	.228	4.653	1	.031	1.635

Figures

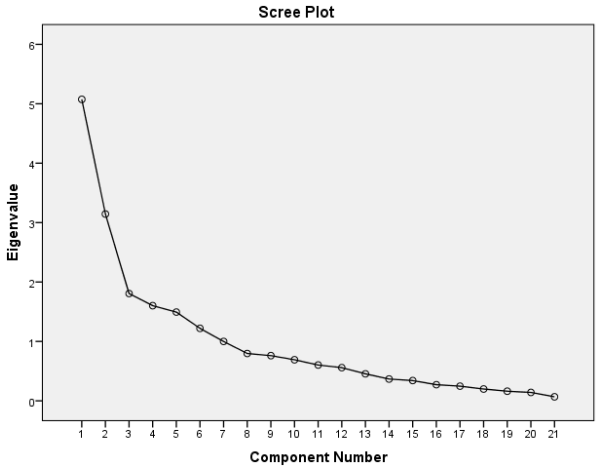

Figure 1: Scree Plot

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