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Factors Affecting Farmer's Productivity New Potato Yield Varieties

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ABSTRACT

This study aims to determine the factors that affect the probability of farmers in applying the improved varieties of potato farming. Data used was primary and secondary. Data analysis used logit fungction. The results showed that the variables of age and number of family members significantly affect the chances of farmers applying improved varieties in potato. While farm size, education, and risk behaviors did not significantly affect farmers adoption of improved varieties in potato farming. The policy implication of this research is the productive age structure and labor supply coupled with increased human resource capacity through increased knowledge and insight farmers, increasing the opportunities for applying the improved varieties of potato farming

Key words: factors, logit function, affecting farmers, productivity, new varieties, potato

INTRODUCTION

Potatoes are the world food commodity after rice , wheat and corn. Largest potato producing country in the world is China. Potato production in China reached 85.860.000 tonnes [5]. Potatoes are one of the vegetable crops that have potential and good prospects to support food diversification program in order to achieve sustainable food security.

Phenomenon of increasing price and imported rice indicated that the need of other alternative food sources (food diversification) to support food security. The potato was one of vegetable commodity that belonged to horticulture which has good potential and prospect to support food diversification program in order to realize sustainable food security. The potato was an alternative carbohydrate source. In 100 grams potato contained 19.10 gram carbohydrates, 2 gram protein, 0, 09 milligram vitamin B1, 0, 03 vitamins B3 and 16 milligram vitamin C [7]. Besides potato was a vegetable, in recent years it was also consumed as French fries in fast food restaurants, chips, crispy and potato chips as snack product [6].

Problem in the development of potato farming in Enrekang was a decline in production and productivity of potato. It could be seen from the Central Agency of Statistics (CAS) Enrekang that showed the production of potato since 2006 – 2011 decreased from 1.396.00 tons to 1.312.50 tons and its productivity also decreased from 12.35 tons per hectare to 10.02 tons per hectare [1]. According to Syafa'at [1]6, there was gap of production and productivity related to technology adoption and it was reflected by technical efficiency value and farmer attitude in facing production risk.

To increase the agricultural productivity was needed better or modern technology such as the use of high quality seeds. Kabede [8] explained that the difference of agricultural product productivity was caused by the difference of technology application, production location and efficiency. Besides that, farmers in developing country has considerable difficulty to understand and apply technology because of education and skills limitation, lack of counseling, capital, problems of agricultural loans and inadequate physical infrastructure.

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Diversity or variation of output and reduction of production risk were also the factors that determined farmer decision to adopt technology [13]. Besides that, another factor that determined it was location/distance from the farmer's place, farmer education level, number of family members, and intensity of instructor visits and security of land cultivated by farmers.

Berlo approach directed to the communication element in which the success of technology adoption was determined by Source (instructor characteristics who provided counseling), Message (delivered counseling material), Channel (counseling methods used) and Recipient (farmer characteristics as technology recipient) [12,4] or it was called SMCR. Adoption process depended on the target dynamic nature. Rogers and Shoemaker in Sirajuddin *et al.*, [18] stated that adoption was mental process, decided to accept or reject the new idea and confirmed about the acceptance and rejection of the new ideas. According to Mardikanto [12], adoption in agricultural counseling could be explained as process of behavior change – knowledge, attitude, and skills – of someone after accepting *innovation* which was delivered by an instructor to the target. Acceptance was defined as not only "know" but it was correctly implemented or applied and lived it. The innovation acceptance could be directly or indirectly observed by other people as the reflection of the change of attitude, knowledge and skills.

Recent developments about determining factor of technology adoption could be seen from what Feola and Binder [4] explained about integrated approach. The approach was combination from Gidden's structuralism and behavior interpersonal theory. Gidden's structuralism theory showed that human behavior depended on social structure which was formed around them. Individual action and behavior were determined by the social system in which the individual lived. On the contrary, the behavior interpersonal theory stated that human behavior was fully determined rational action that was born from expected antecedent normative situation, knowledge and attitude and intention to behave. This theory emphasized on human essence as homo economicus [2].

The combination of the structuralism theory and the interpersonal behavior theory resulted integrated approach. This approach assessed that external factor through instructor; built social system and multidisciplinary approach were part of the technology adoption determiner. Provision of proper stimulus to farmer was expected to encourage the growth of farmer rational action that came from the attitude, understood social norm and behavior control [2].

Liu [10] found that farmer who was more sensitive or scared with loss adopted *Bacillus thuringiensis* (BT) cotton later but a farmer who showed the smaller probability adopted BT cotton faster. A farmer who dared to risk adopted the new technology faster while farmer who feared the risk adopted new technology slower. It was because farmer who feared the risk still doubted the effectiveness of BT cotton resistance to pests and diseases so farmer needed a long time to adopt the new technology (BT cotton).

Materials and Methods

This research was conducted in June – July 2011 in Enrekang Regency, South Sulawesi. Samples were taken at random were 117 potato farmers. The data used is primary and secondary data. Primary data were collected from potato growers was farmer profiles, farm size, production data, sales results and data of problems faced by farmers in potato farming. Secondary data was collected from the department of agriculture Enrekang, Central Agency of Statistics Enrekang and other institutions related to the research.

Data analysis used was:

$$Ln\left(\frac{Pi}{1-Pi}\right) = \alpha + \beta_1 X_1 + \beta_2 X_2 + \beta_3 X_3 + \beta_4 X_4 + \beta_5 X_5 \text{ (Pindyck dan Rubinfield , 1998)}$$

Where : Pi = the opportunity of farmers to apply qualified potato, α = intercept, X1 = farm size (hectare), X2 = formal education (years), X3 = age (years), X4 = the number of family members (person), X5 = farmer risk behaviour.

Results and Discussion

Identity of Respondent:

Some characteristics of farmer respondents that would be explained are: (1) age, (2) level of education, (3) farming experience of farmer respondents, (4) number of respondents' family members and (5) area which was cultivated by farmer respondents.

Age:

Age was a factor that influenced work ability and productivity of someone. Someone would have increased work ability with increasing age, but someone would have decreased work ability at certain ages. Age has influence to the maturity of thought and physical ability in managing a business. The distribution of farmer respondents by age was shown in Table 1.

The age of farmer respondents in Enrekang was mostly in the productive age 94.81 percent of farmer respondents who planted graniola potato and 100 percent of them who planted kalosi potato. The average of respondents' age was 42.26 years old of farmer respondents who planted graniola potato and 40 years old of respondents who planted kalosi potato. It showed that farmer respondents who planted graniola or kalosi potato were still in their productive age and possible to work optimally to achieve higher results and profit and were easier to accept the innovation.

Table 1: The distribution of farmer respondents by age in potato farming in Enrekang, South Sulawesi.

Age (years old)	Granola Variety		Kalosi Variety	
	Number	Percentage	Number	Percentage
21 – 25	0	0.00	4	13.33
26 – 30	4	5.19	4	13.33
31 – 35	13	16.88	3	10.00
36 – 40	23	29.87	3	10.00
41 – 45	11	14.29	6	20.00
46 – 50	11	14.29	4	13.33
51 – 55	11	14.29	6	20.00
>56	4	5.19	0	0.00
Total	77	100.00	30	100.00
Average	42.26		40.00	

Level of Education:

Education was an important element that could change behavior or attitude and paradigm. Education would simplify someone to absorb information and new technology innovation so it would influence quality in decision making. Besides that, the level of education was a factor that could decrease the inefficiency level of farming. The higher education a farmer gained the easier farmer to understand and accept new innovations which was delivered to them. Education was also considered as an investment because it could help improving knowledge, skills and expertise of labors so they could work more productive and improve their income in the future.

Direct or indirect formal education strongly influenced the farmer performance related to paradigm and work system. The correlation between education level and farmer ability was significant to develop the business. Likewise, informal education could help the improvement of paradigm and technical skill. The distribution of farmer respondents by the level of education was shown in Table 2.

Table 2: The distribution of farmer respondents by the level of education in potato Farming in Enrekang, South Sulawesi.

Level of Education	Granola Variety		Kalosi Variety	
	Number	Percentage	Number	Percentage
Not Elementary School	14	18.18	1	3.33
Elementary School	33	42.86	16	53.33
Junior High School	14	18.18	8	26.67
Senior High School	14	18.18	5	16.67
Bachelor	2	2.60	0	0.00
Total	77	100.00	30	100.00
Average	7.62		8.00	

According the Table 2, it showed that education level of farmer respondents who planted granola and kalosi potato was low – 49 people of Elementary School consisted of 33 people (42.86%) planted granola and 16 people (53.33%) planted kalosi. Then, for junior high school graduates, 14 people (18.18%) planted granola potato and 8 people (26.67%) planted kalosi potato. The highest education of farmer respondents was a bachelor, there were only 2 people (2.60%) planted granola potato and 14 people (18.87%) who planted kalosi potato were senior high school graduates. Level of education determined someone to accept knowledge and adopt new technology to fix the business.

Potato Farming Experience:

The potato farming experience was how long the farmer respondents have cultivated potato farming. The experience was a determining factor of farming success. There was a tendency that a longer time a farmer managed a farm, so the farmer would know a lot about the farm and adopt technology which was used in the farming. The distribution of farmer respondents by the farming experience was shown in Table 3.

Table 3: Distribution of Farmer Respondents by the Farming Experience in potato farming in Enrekang, South Sulawesi.

Farming Experience (year)	Granola Variety		Kalosi Variety	
	Number	Percentage	Number	Percentage
1 – 5	9	11.69	8	26.67
6 – 10	43	55.84	8	26.67
11- 15	15	19.48	7	23.33
16 – 20	7	9.09	5	16.67
21 – 25	2	2.60	2	6.67
>25	1	1.30	0	0.00
Total	77	100.00	30	100.00
Average	10.58		10.00	

According to Table 3, it explained that farmer respondent experience who has planted granola potato for more than 5 years was 88.31% and 73.34% farmer planted kalosi. The potato farming experience average of the farmer who planted granola was 10.58 years and 10.00 years of which planted kalosi. It showed that farmer respondents have long experience in potato farming. With the experience, it would simplify to accept and to choose innovation or technology to be properly used in the farming.

Number of Family Members:

Number of family members in the house showed the dependency to be borne by the householder but was useful to support the family income by working any job. However, a large number of family members would decrease the welfare level because the family had to spend much money to fulfill daily needs. In other side, the number of family members in a house consisted of father, mother, children and other family members could help production activity in potato farming. The distribution of farmer respondents by the number of family members was shown in Table 4.

Table 4: Distribution of farmer respondents by the number of family members in potato farming in Enrekang, South Sulawesi.

Number of Family Members (people)	Granola Variety		Kalosi Variety	
	Number	Percentage	Number	Percentage
1 – 3	22	28.57	4	13.33
4 – 6	53	68.83	22	73.33
7 – 10	2	2.60	4	13.33
Total	77	100.00	30	100.00
Average	4.00		5.00	

According to Table 4, it explained that farmer respondent who had 4 – 6 family members were 53 people (68.83%) who planted granola potato and 22 people (73.33%) who planted kalosi potato. It showed that farmer respondent did not have problem in labor availability.

Area of Farming Land:

Land was a main production factor to cultivate a farm. Area of farming land was the land that was owned by farmer respondent. The land of farmer respondent was their own land and land lease. Average of land area owned by farmer respondent was 0.62 hectares for farmer respondent who planted granola potato and 0.59 hectares for farmers who planted kalosi potato. The result showed that the farmer's land area was narrow and could be a problem to increase the farming production capacity. The distribution of farmer respondent by the owned land area was shown in Table 5.

The Factors that Influenced Farmer Opportunity in Applying Yielding Variety in Potato Farming:

The analysis result of the factors that influenced farmer opportunity in applying yielding variety in potato farming was shown in Table 6.

Table 5: Distribution of farmer respondent by owned farming land area in potato farming in Enrekang, South Sulawesi.

Owned Land Area (ha)	Granola Variety		Kalosi Variety	
	Number	Percentage	Number	Percentage
0.10 – 0.40	12	15.58	8	26.67
0.41 – 0.80	48	62.34	18	60.00
0.81 – 1.20	16	20.78	3	10.00
≥ 1.21	1	1.30	1	3.03
Total	77	100.00	30	100.00
Average	0.62		0.59	

Table 6: The Factors that influenced farmer opportunity in applying yielding variety in potato farming in Enrekang, South Sulawesi.

Parameter	Estimate	Odds Ratio	Pr > ChiSq
Intercept	-1.3644		0.4225
Farm size (Ha)	-0.3949	0.674	0.6802
Formal Education (Years)	0.0162	1.016	0.8457
Age (Years Old)	-0.0400	0.961	0.1412[d]
The Number of Family Members (Person)	0.4862	1.626	0.0054[a]
Farmer Risk Behavior	0.0030	1.003	0.8970

Explanation: a and d was real on α = 0.01 and 0.15

According to Table 6, it showed that age and the number of family members strongly influenced (α=0.01 and α=0.15%) the farmer opportunity to apply yielding variety while the land area, education, and risky behavior of farmer productivity did not influence the farmer opportunity to apply yielding variety in potato farming in Enrekang Regency.

Age factor influenced negatively and actually to the farmer opportunity to apply yielding variety in potato farming. The odds ratio value variable was 0.961 which showed that if the age increased so the farmer opportunity to apply yielding variety was 0.961 times. The result explained that the older the farmer, the smaller opportunity to apply yielding variety. The younger the farmer made the farmer was more responsive to new innovation and had bigger opportunity to apply yielding variety while the older farmer tended to use traditional way.

Age of farmer condition in the research location was still in productive age around 40 years old so the farmer was expected to be more responsive to the innovation or yielding variety in potato farming. The result was similar with Soekartawi who stated that the younger farmer usually had great curiosity what they had not known so they had to try to adopt innovation faster although they were inexperienced in that thing.

Some results which were similar to the research was Pribadi's research showed that farmer age did influence the farmer opportunity to apply the incense oil technology in tidal land rice farming in South Kalimantan. Another similar research was conducted by Suharyanto *et al*., [17] showed that age influenced negatively and actually the farmer opportunity to apply direct seeding technology in rice farming in Bali.

Number of family members influenced positively and significantly in α= 0.01 percent. The odds ratio value of family members was 1.626 which meant if number of family members increased one unit so the opportunity to apply yielding variety in potato farming was 1.626 times than old technology. It showed that the number of family members made the bigger opportunity to apply yielding variety. Number of family members could become a labor source to help the potato farming management. According to the result, it showed that most farmer respondent had 4 – 6 family members. It showed that there was no problem for farmer respondent in labor availability. The result was similar to Muslimin's research showed that the number of family members influenced significantly the farmer opportunity to choose the new yielding variety in rice farming in South Sulawesi.

Farm size influenced negatively and insignificantly to the farmer opportunity to apply yielding variety in potato farming. Theoretically, farm size had a positive impact to the farmer opportunity to adopt technology because the farmer who owned wide land had a better financial condition. From the result of the research, it showed that the land area factor was not the factor to determine farmer opportunity to apply yielding variety. Odds ratio value of land area was 0.674, meant if the land area increased one unit so the farmer opportunity to apply yielding variety was 0.674 times. Observation result in the research location showed that farmer planted granola and kalosi potato in the area less than 1 hectare. The result was similar to Pribadi's research that showed the land area influenced negatively the farmer opportunity to apply incense oil technology in tidal land rice farming in South Kalimantan. The farmer who owned wider land still used the old technology because there was risk and uncertainty of production that probably happened to yielding variety (new technology). Another research was Suharyanto's *et al*., [17] that showed the land area influenced negatively the farmer opportunity to adopt direct seeding technology in rice farming in Bali.

Formal education factor influenced positively the farmer opportunity to apply yielding variety in potato farming but insignificantly did. It explained that the higher format education of a farmer made the opportunity to apply technology bigger. The odds ratio value of formal education was 1.016, meant if the formal education increased one unit so the farmer opportunity to apply yielding variety was 1.016 times than old variety. The result was similar to Rogers' statement that stated the education level had a positive impact to the technology adoption. It was also similar to Feder who said that the farmer with better education would adopt modern technology faster and used input efficiently during the adoption. The observation result in the location showed that average of education level of farmer respondent was elementary school graduates so it made the farmer adopted or applied the yielding variety in the farming slowly.

Risk behavior of farmer productivity had a positive impact to farmer opportunity to apply yielding variety. It meant if the farmer was more willing to take risk, it would make the farmer had a bigger opportunity to apply yielding variety. However, according to the analysis result of productivity risk behavior showed that farmer respondent avoid taking risk. It meant that farmer avoided or scared of the risk so the opportunity to apply yielding variety became smaller. Farmer changed the behavior slowly to the innovation because the farmer had limited resources especially the capital. Besides that, farmer tended to avoid the risk of adopting new technology or yielding variety after seeing another farmer who had already adopted new technology (yielding variety) succeeded earlier. Liu's research showed that farmer who avoided the risk, would adopt Bt cotton after seeing the result of farmer who had adopted Bt cotton earlier.

Conclusion:

Factors that significantly affect farmers' opportunities to apply new varieties of potato farming is the age and number of family members. Variable farm size, education , distance of land with farm houses and farmers risk behaviors did not significantly affect the opportunities of farmers applying new technologies in farming potato in Enrekang . Therefore, the structure of productive age and the availability of labor in the family coupled with human resource capacity building through knowledge and insight farmers can increase the chances for implementing the improved varieties of potato farming.

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