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Paper presented at the 45th Annual Conference of the Australian Agricultural and Resource Economics Society, January 23 to 25, 2001, Adelaide, South Australia.

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Factors Influencing a Farmer's Decision to Purchase Seed Potatoes in East Java

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Availability of seed and farm production factors, *i.e.*, land and farm labour, formed a single factor that was found to be the most important factor influencing East-Javanese farmers' decision to purchase seed. While such would suggest that the resulting impact of the factor may influence the amount of seed purchased by farmers, seed is often unavailable when it is required. The lack of availability of good quality seed at planting time often means that farmers will be forced to plant whatever seed is available. Consequently, farmers continue the traditional practice of retaining some proportion of their yield for use as seed. Irrespective, farmers normally attempt to purchase seed when the seed they retained from the previous harvest is no longer profitable. However, farmers are unwilling to purchase seed, unless they believe that the seed will substantially generate profit. Since a large volume is needed, seed is usually the costliest single input in potato production. In addition to being costly, seed potatoes are highly variable in quality. Therefore, whenever they want to renew their seed, farmers are actually taking a great risk. With additional risks arising from seasonal variation and ware potato price fluctuation, farmers usually use some risk reduction strategies including purchasing seed from nearby, reputable suppliers or from a recognised growing area.

(Key words: seed potato, buying decision, East Java, Indonesia)

1. Introduction

Potato has long been considered an important vegetable in Indonesia due to its value, marketability and stability (Hadiwijeno 1993). Potato planted areas expanded from 24,450 hectares in 1980 to 65,050 hectares by 1998. Average yields per unit area have also risen from 9.42 tonnes per hectare in 1980 to 15.4 tonnes per hectare in 1998 (Ministry of Agriculture RI 1999, Statistics Indonesia 1999). However, the main reason for expanded potato cultivation in developing countries today is that, with appropriate technology, the potato crops is highly productive (Horton 1987).

Typically, potatoes can be characterised as a high input and high-risk crop, which in turn generates high return for farmers. The great responsiveness of yield to inputs, such as high quality seed tubers, fertilisers, pesticides, additional labour and other form of energy, basically motivates farmers to use inputs more heavily on potatoes than other crops. Due to the relatively high level of potato yields, the short growing period and the high market value of potato tubers, the potato crops generate a larger return per hectare and per day than most other food and vegetable crops grown in developing countries. Unlike most other food and vegetable crops, however, the usual means of potato propagation is the vegetative seed tubers. Although vegetative propagation has the advantage of trueness to type, a major disadvantage is the possibility of disease transmission. Transmission of tuber borne disease(s) is the main

cause of seed tuber degeneration reflected in gradual reduction in crop yield with the number of crops derived (Allen, O'Brien, Firman 1992). The rate of seed degeneration is generally more rapid in the tropics than it is in the temperate zones, because the pest population is higher, there are more potential sources of infection and seed storage is more difficult (Beukema 1990). These phenomena are serious problems for potato cultivation under tropical conditions and therefore, the prevention of diseases and the use of good quality seed are of utmost importance (Horton 1987, LEHRI 1989).

As the formal seed program in Indonesia remains unable to satisfy the demand for seed potatoes in the country, the only source of high quality seed in Indonesia is imported seed (Siregar 1989, Chilver, Koswara and Rachmanuddin 1994). The price of imported seed, however, is very expensive (Hadiwijeno 1993). Depending on seed rate used by a farmer, the cost of seed for one hectare is between US\$ 1,500 and \$ 2,400. Even before the South East Asia economic crisis, such cost was too expensive for ordinary farmers. Many farmers cannot afford to buy, hence they use their own seed that they selected from the previous harvest and are mostly based on size (30–50 mm). Otherwise, they may buy seed which originated from imports, but have been multiplied a number of times (Hadiwijeno 1993). However, with the absence of certification systems, the quality of this kind of seed is highly variable (Batt 2000).

Notwithstanding, as indicated by Horton (1987), it is not surprising that potato production in the major areas of Indonesia is highly commercialised and based on a high input-output system. Substantial quantities of fertilisers and chicken manure are used and pest control is highly intensive. In addition, potato production generally is labour intensive and absorbs approximately 400 days per hectare per crop (Basuki 1989, Bottema, Hadi and Ferari 1991). Yet, farmers seldom have sufficient capital resources to finance their crops. Often farmers are forced to rely heavily on financial assistance from their seed or input suppliers, financiers and field traders. Moreover, potato farmers also endure some risks due to seasonal variation (Batt 2000). The seasonal variations can considerably influence the yield, market prices and the demand for subsequent inputs, including seed.

2. Methodology

A total of 209 farmers in the highlands of East Java were asked to respond to a prepared questionnaire. Respondents were asked to provide information about themselves, their current farming practises and market intension. Particular emphasis was given on the various factors and constraints that most influenced a farmer's decision to purchase seed, to choose between alternative seed suppliers and the nature, if any, of long-term relationships with seed

supplier(s). Since most Indonesian farmers do not speak English, the survey instrument was written and communicated in '*Bahasa Indonesia*' (Indonesian language). The interviews were conducted at either the farmers' homes or farms by the researchers and an experienced assistant employed by Faculty of Agriculture, Jember University, East Java, Indonesia.

Farmers were selected from three central production areas in East Java Province, namely Pasuruan, Probolinggo, both are situated in the highlands of Bromo Mountains, and Batu Malang. However, in order to approach the farmers, it was necessary to seek permission from the heads of the villages or the heads of farmers' groups who also provided contact persons and addresses of the suitable respondents. Contact names and addresses for additional respondents were sought during the interview process. In the absence of any reliable sample frame or list of potato farmers, such convenience sampling methods and data collection are not uncommon (Della Vedeva and Brieva 1995, Malhotra *et al.* 1996).

Farmers were asked to rate the importance of 34 variables that are believed to influence a farmer's decision to purchase seed potatoes on the scale of 1 (not at all important) to 7 (very important). Questions were based from a questionnaire that used by Batt (2000) which was developed from the previous research reported by Balaoing and Lazo (1967), Monares (1981), Crissman (1989), Beukema (1990), Beukema and van der Zaag (1990), Altoveros (1992), and Della Vedeva and Brieva (1995).

The information and data collected was encoded and encountered for subsequent computer analysis using SPSS package. A one way ANOVA followed by Scheffe's test was performed in order to identify any significant differences in the rank order of importance of those 34 variables believed to most influence a farmer's decision to purchase seed. Factor analysis (with equamax rotation and Kaiser normalisation) was then carried out to identify any significant correlations between individual attributes. The reliability coefficient (Cronbach's alpha) was subsequently identified to indicate more clearly which variables belonged to which construct.

3. Results and Discussion

Mean score results show that availability of seed at planting time, was found to be the most important variable influencing East-Javanese farmers' decisions to purchase seed tubers. Such would suggest that there is some degree of farmers' perceived uncertainty regarding the seed supply, as improved seed is often unavailable when it is needed. However, there was no significant difference between this variable and the next 18 variables (Table 1).

Table 1. Importance of variables influencing East-Javanese potato farmers decision to purchase seed

Variable	Mean
Availability of seed at planting time	6.86 ^a
Availability of farm labour	6.82 ^a
Availability of land	6.74 ^a
Expected yield of ware potatoes	6.72 ^a
Seed rate requirement	6.70 ^a
Freedom from disease	6.70 ^a
Availability of irrigation	6.70 ^a
Availability of other farm inputs	6.68 ^a
Variety of seed	6.60 ^a
Physiological age of seed	6.60 ^a
Seed purity	6.58 ^a
Market price of ware potatoes	6.54 ^a
Quantity required	6.53 ^a
Availability of cash to purchase seed	6.13 ^a
Yield difference	6.08 ^a
Seed size	6.07 ^a
Origin of the seed	6.04 ^a
Anticipated future yield	6.01 ^a
Relative price differences between seed and ware potatoes	6.00 ^a
Farmers attitude to risk	5.94 ^b
Cost of retaining seed	5.93 ^b
Previous purchase	5.84 ^c
Seed is pathogen tested	5.83 ^d
Rate of degeneration	5.82 ^d
Anticipated profitability	5.77 ^e
Price uncertainty in the ware market	5.55 ^f
Proximity to seed supplier	5.50 ^f
Seasonal variation	5.49 ^f
Imported seed	4.87 ^g
Cost of credit	4.49 ^h
Availability of credit	4.40 ^h
High cost of imported/certified seed	4.36 ^h
Guaranteed buy back	3.83 ⁱ
Cost of seed	3.69 ⁱ

where 1.0 is least important and 7.0 is most important those values with the same superscript are not significantly different at $p=0.05$

While many authors acknowledge that the lack of good quality seed at planting time is the major constraint to potato production in Indonesia (Bottema *et al.* 1989, Bottema *et al.* 1991, Hadiwijeno 1993, Gunadi and Basuki 1993, Chilver *et al.* 1994), the productivity of potato crops, is also highly dependent upon the level of intensification employed by farmers. Therefore, the productivity of seed itself is also highly dependent on soil fertility (Horton 1987, Beukema and van der Zaag 1990, Rasco and Aromin 1994), the availability of cheap and productive labour (McConnell and Dillon 1997), the availability and frequency of irrigation (Crissman 1989), the application of fertiliser (Horton 1987, Crissman 1989) and effectiveness of pest and disease management (Horton 1987, Crissman 1989, Beukema and van der Zaag 1990). East Javanese farmers, consequently, placed high rate for availability of farm labour, land, irrigation and other farm inputs in their decision to purchase seed.

Productivity of potato crop per hectare is also subjected to seed rate per hectare. Subsequently, seed rate will be influenced by seed size. Whilst the number of sprouts that develop from a seed tuber is potentially influenced by the size of the seed, the number of stems is not only determined by seed size but also by the physiological age of seed (Horton 1987). Consequently, the required optimum seed rate becomes more difficult to predict. For ware crops, farmers usually plant 35,000 – 45,000 plants per hectare (1.5 – 2.5 tonnes of seed), depending on variety, environment and seed size they expect from the yield (Horton 1987; Beukema and van der Zaag 1990). Since consumers in Indonesia mostly prefer medium-sized ware potatoes (Horton 1987), farmers are generally inclined to plant higher seed rate. Thus, small to medium sized seed will be preferred.

Subject to vegetative reproduction, however, many yield-reducing diseases are transmitted by seed tubers (Horton 1987). Late blight and bacterial wilt are two important diseases easily spread in the tropics. While late blight is easily spread during the growing season, bacterial wilt can remain in the soil for several years. However, the most important diseases transmitted by tubers are viral diseases. Both seed and soil borne diseases, not only reduce the productivity of the crop, but also have significant impact upon the productivity of any other potato crop derived from the seed or grown in the same soil (Beukema and van der Zaag 1990). For this reason, farmers considered seed sanitation (freedom from disease) as one of the important variables influencing their decision to purchase seed.

In most potato cultivation areas of Indonesia, including East Java, Granola is the most popular variety. Approximately 80 per cent of the potato area in Indonesia are planted to Granola (Potts *et al.* 1992). The farmers' preference for Granola is believed to be due to its high rate of productivity per unit area, the high proportion of large to medium tubers harvested, its early maturity and the higher price realised in the market (Horton 1987). However, the main reason for its popularity is its slow rate of degeneration (Rukmana 1997). Given that potato farmers in East Java may retain seed for up to ten generations, resistance to nematodes and viral diseases is especially important.

Meanwhile, East Javanese farmers also considered anticipated future yield as being important in their decision to purchase seed. The future yield of ware potato is basically dependent on the initial quality of seed. Seed that is substantially better in quality is more expensive to produce and therefore more expensive to purchase (Monares 1981). However, the benefits arising from the use of improved seed will generally last longer, as improved seed is more productive.

Kool (1994) indicates that the demand for seed is basically derived from the demand of ware potato in the market. In the regions where the ware potato prices often fluctuate and yields are more unpredictable, the demand of improved seed will be lower than that in a developed market, where market prices of ware potato seldom vary in real terms (Beukema and van der Zaag 1990).

When the lack of high quality seed at a reasonable price is widely perceived as the major constraint in increasing productivity, substantial gain in productivity may be achieved by promoting the production and use of a certified seed system to reduce the risk of distributing tuber borne pathogens (Batt 2000). However, due to a number of technical and institutional reasons, various attempts to establish good certification schemes in Indonesia, have not yet been successful. Even when seed certification programs have been established in most developing countries that have temperate potato production zones, the record of these programs has been mixed. Typically, after an initial period in which basic stocks of clean seed were produced, diseases have appeared in later multiplication generations, and as a result, farmers demand for certified seed has been weak (Horton 1987).

In the absence of certified seed systems, there is no guarantee that the seed tubers purchased are of good quality (Batt and Rexha 1999). While it is acknowledged that the only source of good quality seed in Indonesia is from imports, imported seed is generally too expensive for ordinary farmers (Hadiwijeno 1993). Indeed, some additional problems have been reported with untimely arrival of the seed tubers, the availability of seed for only part of the year, inappropriate varieties, and inappropriate physiological age (Balaoing and Lazo 1967).

Nevertheless, in most potato-producing countries, there are traditional seed sources or seed producing regions, where the rate of seed degeneration is believed to be lower. In the tropics, such as Indonesia, seed tubers move vertically, as a rule, from higher altitude producing regions to lower altitude producing regions (Horton 1987). Intentionally, potato growers seek to obtain planting material that has a low level of disease infection and is in good physiological condition. Hence, they look for seed produced in cool zones, where the population of insects and other sources of infection are low. As a result, intricate informal seed systems have developed that link higher altitude producing areas with lower altitude producing areas. Therefore, it is reasonable for East Javanese potato farmers to place seed origin as one of the important factors influencing their decision to purchase seed.

Since there is no significant difference between so many of the variables farmers indicated as being important, there is possibility of significant interrelationships between several of the variables under evaluation. Factor analysis revealed that there are seven factors that collectively accounted for 63 per cent of variation in the farmers' responses. These factors are presented in Table 2.

Table 2. Factors influencing a farmer's decision to purchase seed

Variable	Factors						
	1	2	3	4	5	6	7
Seasonal variation	0.79						
Price uncertainty in the ware market	0.73						
Farmers attitude to risk	0.68						
Proximity to seed supplier	0.61						
Imported seed		0.83					
Pathogen tested		0.76					
Rate of degeneration		0.69					
Origin of the seed		0.65					
Seed size			0.79				
Variety of seed			0.69				
Previous purchase			0.69				
Availability of farm labour				0.77			
Availability of land				0.73			
Availability of seed at planting time				0.64			
Availability of cash to purchase					0.83		
Cost of retaining seed					0.75		
Anticipated future yield						0.89	
Profitability						0.88	
Cost of seed							0.82
High cost of imported seed							0.75
Factor Mean	5.62	5.65	6.17	6.81	6.03	5.89	4.03
Eigen value	3.94	2.35	1.97	1.94	1.52	1.44	1.35
Cronbach's alpha	0.70	0.77	0.63	0.58	0.63	0.77	0.60
% Variation	17.1	10.2	8.6	8.4	6.6	6.2	5.9
Cumulative %	17.1	27.3	35.9	44.3	50.9	57.1	63.0

Factor 1 (risk factors) consisted of four variables that collectively explained farmers awareness to risks (seasonal variation and uncertainty of price in the ware market), possible mechanism farmers might employ to reduce the risks (proximity to seed supplier), as well as farmer attitude to risks. It is not uncommon that buyers prefer to purchase from local suppliers, since local suppliers are generally less expensive and offer more dependable services than those resided at a distance (Hakansson and Wootz 1975).

Factor 2 (seed origin and seed quality) captured four variables that considered origin of the seed (seed origin and imported seed) having direct impact on the seed quality and performance in the fields (pathogen-tested and rate of degeneration). Farmers believe that

origin of the seed will have direct impact on the seed quality. It is still widely assumed that imported seed is usually more disease free and has higher productivity. Farmers also recognise that seed tubers from certain growing areas are highly degenerated or contaminated by particular diseases.

Factor 3 (offered quality) consisted of farmers' consideration to the service quality (previous purchase) and seed quality (variety, seed size) offered by supplier. Since most farmers are very devoted to certain varieties such as Granola, variety has become one of the indicators of seed quality. Meanwhile, seed size is also an important tangible indicator to the quality of the seed. While small size of seed is often correlated with disease-infected seed, particularly viruses, seed that is too big will require a higher seed rate and produce a higher percentage of small tubers (Rukmana 1997).

Factor 4 (availability of seed and factors of production) captured three variables that considered availability of seed at planting time and at the same time two other production factors (availability of land and availability of farm labour). Such would indicate that availability of seed and farm production factors may influence the amount of seed purchased by the farmers. As potato basically generate higher return per hectare than most other food or vegetable crops grown in the tropics (Horton 1987), when land and farm labour are available or whenever possible, farmers generally prefer to grow potato rather than any other crops. Furthermore, the great responsiveness of yields to inputs, such as good quality seed, often motivates the farmers to use inputs more heavily than other crops. Therefore, the amount of seed purchased by the farmers is anticipated to increase with the availability of land, farm labour and good quality seed. In many cases, however, improved seed is often unavailable when it is required. At planting time, when lands are ready for planting, and farm labourers are around, the lack of availability of good quality seed is often the case. As the literature suggests, the lack of good quality seed tubers at planting time is the major constraints to potato production in most developing countries including Indonesia (*e.g.*, Hadiwijeno 1993, Chilver *et al.* 1994). Dependency on vegetative propagation places considerable importance on the availability of disease-and-pest-free or '*clean*' planting material (Rubatzky and Yamaguchi 1997). When there is no alternative, farmers will plant whatever seed is available (Crissman 1989). Farmers traditionally retain some proportion of their yield, which mainly based on size, for planting their subsequent crops. Potato growers in East Java usually retain 15 – 20 percent, or more from their harvest, for use as seed. Farmers may use the seed they retained from previous harvest for ten or more generations, until the seed highly degenerates (LEHRI 1989). Otherwise, farmers may purchase cheaper local seed from other farmers or their neighbours. When seed is really scarce, occasionally, farmers must source some

proportion of their seed from ware potato market. However, the quality of this kind of seed is, of course, very low. Not unexpectedly, factor 4 was recorded to be the most important construct influencing farmers' decision to purchase seed.

Factor 5 (cash and cost consideration) consisted of two variables (cash availability and cost of retaining seed) that considerably influenced farmers' decisions when they attempted to renew their seed. Most farmers are willing to renew the seed when they perceive that the seed is no longer profitable, in other words, yield expected from crops using the retained seed is less than a certain common seed/yield ratio, such as 1:7 (Wattimena 1977). However, when cash is available, farmers are generally willing to renew their seed earlier, before the seed highly degenerates.

Factor 6 (profitability) captured two variables that considered the profitability and anticipated future yield. Crissman and Hibon (1996) suggest that farmers' decision to purchase improved seed is made knowing that the benefits will be realised over several seasons. In other words, farmers buy seed when they believe that the seed will have a higher yield than their own seed and they can use it for a number of seasons.

Factor 7 (seed cost) was comprised of two variables which considered the costs of buying seed (high cost of imported/certified seed and cost of seed). High cost of imported or certified seed is often recorded as the main reason why farmers retain the seed until the seed highly degenerates. In fact, even if it is not purchased, seed is expensive for farmers, since farmers have the option of selling the tubers or consuming the tubers themselves. Hence, the cost of seed is undoubtedly one of the factors influencing farmers' decisions to purchase seed. However, factor 7 was surprisingly considered as being the least important.

4. Conclusion and Implications

Empirical evidence revealed that the availability of seed at planting time, together with availability of factors of production, *i.e.*, land and farm labour, was found as the most important factor influencing East Javanese farmers' decision to purchase seed. While such would suggest that availability of improved seed and these production factors may influence the amount of seed purchased by the farmers, good quality seed is often unavailable when it is required. At planting time, when lands are prepared for planting, and farm labourers are available, the lack of availability of improved seed is often the case. It is widely recognised that the lack of good quality seed at planting time is the major factor constraining potato production in Indonesia (*e.g.*, Hadiwijeno 1993, Chilver *et al.* 1994). The lack of availability

of good quality seed often means that farmers will grow whatever seed is available (Crissman 1989). Consequently, most farmers traditionally use their own seed that they select from the previous harvest for a number of seasons until the seed degenerates. Potato growers in East Java usually retain 15 – 20 percent, or more from their harvest, for their seed.

Irrespective, farmers normally attempt to purchase improved seed when they perceive that the seed they retained from the previous harvest is no longer profitable. A common criteria used by farmers is to renew their seed when ratio seed/yield less than 1:7. However, when cash available, farmers generally prefer to renew their seed earlier, before the seed highly degenerates.

As the formal seed program in Indonesia remains unable to satisfy the demand for seed potatoes, potato farmers still rely heavily on imported seed to renew their stock (Siregar 1989, Chilver *et al.* 1994). Imported seed, generally too expensive for East Javanese farmers, the cost of imported seed has accounted for more than 50 percent of the total production cost. Only the most wealthy potato farmers will initially use imported seed for growing their ware potato crop. Ordinary farmers usually buy seed from their local supplier which originated from imports but have been multiplied several times. Hakkanson and Wootz (1975) suggest most buyers prefer to purchase from local sources, since they are generally less expensive and offer more dependable service than those located at a distance.

However, East Javanese farmers are unwilling to purchase seed, unless it is profitable to do so. These result concurs with Crissman and Hibon (1996) in that a farmer's decision to purchase improved seed is made knowing that the benefits will be realised over several seasons.

Nonetheless, because a large volume is needed seed is usually still the single costliest input in potato production. In addition to being costly, seed potatoes are highly variable quality (Horton 1987). Therefore, whenever they are willing to renew their seed, farmers actually employ abundant risks. As market price of ware potatoes fluctuates extensively and yields are unpredictable, the demand for improved seed will be low (Beukema and van der Zaag 1990). It confirms the fact that most East Javanese farmers (81 %) retained their own seed to replant for five or seven subsequent crops. Only 1 per cent of the farmers retained their own seed for less than three crops.

In this situation, whenever they want to renew their stocks, farmers usually employ some risk reduction strategies including buying seed from other farmers' known as good seed producers, reputable suppliers, or from a recognised growing area. However, the major reason why farmers are willing to buy from a particular supplier is due to the supplier offering adequate seed quality and satisfying the farmers in their previous purchase. Anderson, Chu and Weitz (1987) suggest that when the decision to purchase entails considerable risk, buyers prefer to purchase from well-known, reputable suppliers or buy only from those suppliers with whom they have purchased on previous occasions. Consequently, farmers are often embedded in a long-term relationship with their most preferred seed supplier, which involve trust, loyalty, commitment and perceived risk of changing supplier.

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**45th Annual Conference of AARES
23-25 January 2001
Adelaide**