ECONOMIC REQUIREMENTS ANALYSIS FOR TABLE GRAPE CHECK WEIGHING

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ABSTRACT

South Africa's table grape industry exports most of its production to the developed world where customer satisfaction is very important and strictly regulated. Severe penalties are levied for underweight packaged products and contracts could even be lost. This study aims to determine the feasibility of automated check weighing of final product prior to shipping. The frequency of occurrence of underweight packages is investigated by means of structured interviews conducted within the industry. The probable financial impact of underweight packing is estimated and the paper concludes with a presentation of the capital amount producers can spend to eliminate underweight packaging profitably.

1. INTRODUCTION

In recent years an increase in the proportion of table grapes exported in pre-packaged punnets has been observed. Penalties for underweight punnets are severe. Micro-managing punnet packaging is an option but does not suit the industry due to its labour intensiveness. The technology of check weighing punnets in motion is a possible solution but imported systems are rather costly.

The goal of this study is to determine the feasibility of automated check weighing of final product prior to shipping and the capital amount producers in the different enterprise size categories can spend to eliminate underweight packaging profitably.

The study makes use of structured interviews to determine the occurrence of underweight punnets, an analysis thereof and ultimately an estimate of the economic value that a producer will gain from such an investment to avoid such occurrences.

2. BACKGROUND

2.1. Export Trends

South Africa is currently ranked fourth in the world for table grape exports and the second largest in the southern hemisphere. Over the past three years export accounted for some 85% of its total table grape harvest [1]. Of this 58% was exported to the EU market and 22% to the UK market during the 2010/11 season.

The demand for pre-packaged table grapes in the EU and UK has shown steady growth during recent years [2]. Market research by the Centre Technique Interprofessionnel des Fruits et Legumes (CTIFL) determined that pre-packaged products occupied on average 70% of the total fruit and vegetable rack space in France [3]. Table grape producers have however been slow to adapt and the market for 500g punnets was under-supplied during the 2010/11 season [4].

2.2. Packing Technology

The 500g punnet is the most popular size for pre-packaging table grapes in South Africa. On average 10 punnets fit into a carton and 115 cartons make up a pallet, or unit. A punnet contains two or three bunches of grapes. To compensate for weight loss and the limitations of hand packing, 500g punnets are generally packed to between 520g and 570g. Four major methods of packing table grapes into punnets are used [5], [3]. (i) Punnets can be packed by hand using the guess-and-cut method described in Figure 2.1. (ii) It can be packed with the assistance of a horizontal lane sorting combination system as described in Figure 2.2. (iii) A microcontroller based combination rack system such as the one from Ergopak shown in Figure 2.3 can be used and lastly there is the option of (iv) a computerized horizontal conveyor combination system such as Vizier's grape sizing system described in Figure 2.4 [6].

The exact implementation of the different methods may vary somewhat from user to user but the basic principles remain the same.

Final product check weighing systems such as the one from Dantec are available in South Africa at a cost of approximately R90 000.

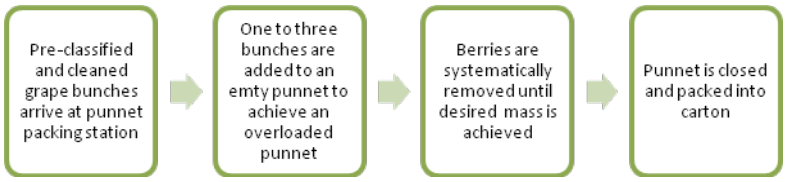

Figure 2.1 Punnet packing by hand

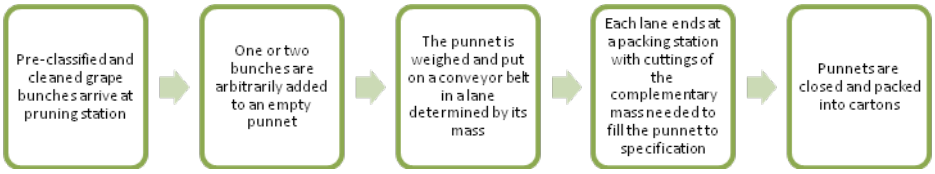

Figure 2.2 Lane sorting assisted method

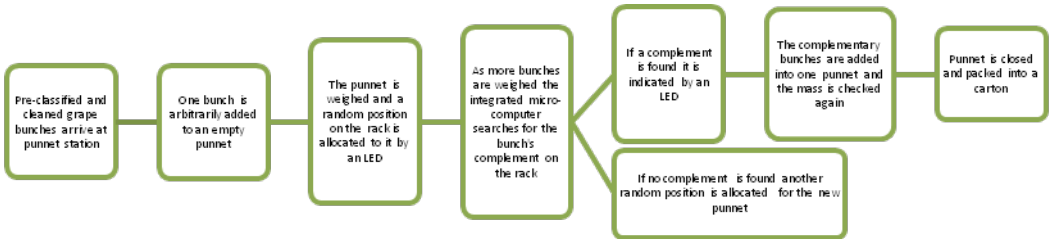

Figure 2.3 Microcontroller based combination method

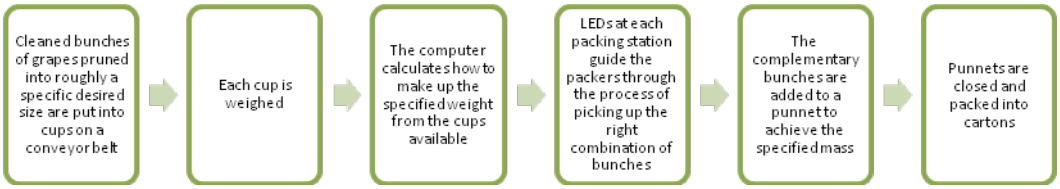

Figure 2.4 Computer based horizontal conveyor combination method

2.3. Quality Control Standards

Different quality control standards apply to farms producing products for export. The combination of standards depends on the client exported to. The standards determine different quality aspects for products including mass specifications. Figure 2.5 depicts the different quality standards and the percentage of interviewed producers they apply to.

Hazard Analysis and Critical Control Point (HACCP) is a food safety management system focused on preventing hazards, [7]. GlobalG.A.P. is a global set of voluntary standards for Good Agricultural Practices [8]. It serves as technical communication platform for continuous improvement and transparency across the entire food chain. The British Retail Consortium's (BRC) Global Standard-Food assists retailers to fulfil their legal obligations and protects the consumer by providing a basis to audit the supplier [9]. Tesco Nature's Choice is a prerequisite for supplying to Tesco, promoting only the best agricultural practices, [10]. The Perishable Products Export Control Board (PPECB) is a statutory organization controlling all perishable exports from South Africa, [11]. PPECB inspectors visit pack houses daily during the packing season to enforce the minimum specifications for

export. All of these standards incorporate the ISO 9001 quality standard in some way. This standard specifies requirements for enhancing customer satisfaction by assuring continual improvement of the product, [12].

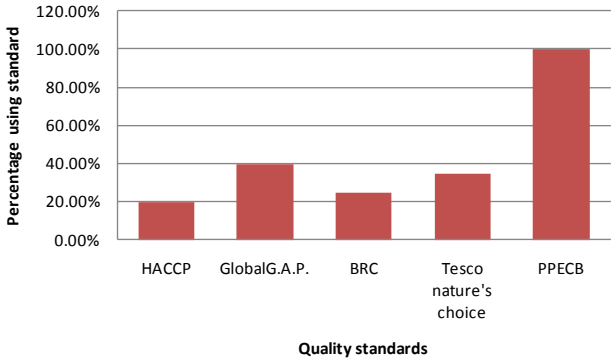

Figure 2.5 Quality standards used by producers

3. RESEARCH METHODOLOGY

This study was conducted among a randomly chosen group of 20 producers producing punnets and 3 export companies by means of structured telephonic interviews in order to investigate the different pack house situations.

4. RESULTS AND DISCUSSION:

4.1. Export trends

The market for punnet packed table grapes is still young and not fully exploited. The packaging methods are still in the early adoption stage of the respective technologies and where they are implemented, the approach is cautious. PPECB stated in an interview that only about 60% of table grape producers produce punnets. The results from the interviews are shown in Figure 4.1. 75% of the interviewed producers are exporting between 20% and 50% of their harvest as punnets. Only 10% export less than 20% and 15% export more than 50%.

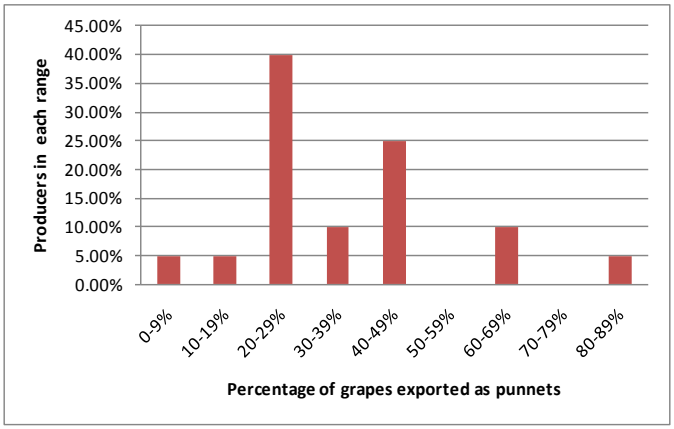

Figure 4.1 Punnet producer export trends

These results support the statement that producers are reluctant to produce punnets, particularly when the result above is compared to the French CTIFL study, reporting 70% prepackaging (Refer par 2.1). Possible reasons include the labour intensity of punnet

packing, the higher cost of packaging material and the complexity of the packing method [5].

4.2. Packing technology and implementation

The different packing technologies used by the interviewed producers are shown in Figure 4.2. The implementations are described in the following paragraphs.

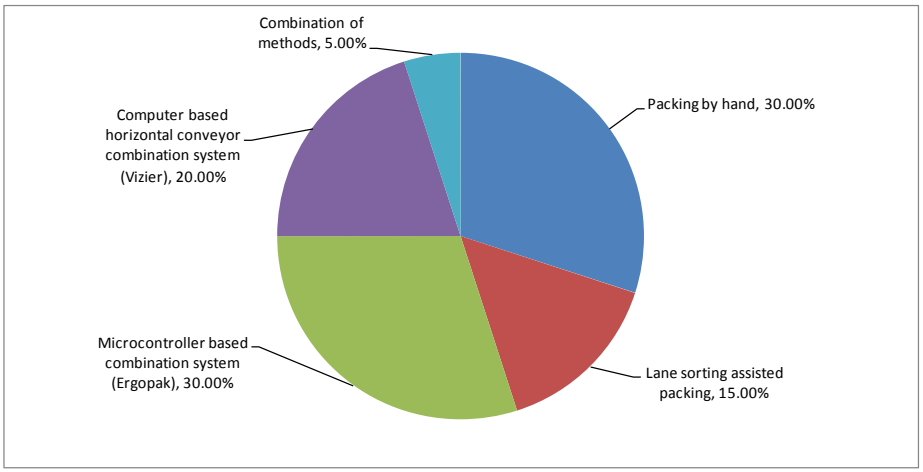

Figure 4.2 Packing technology used

4.2.1. Packing by hand

The method of packing by hand is described in Figure 2.1. It is often referred to as the guess-and-cut method and can be difficult for labourers with a limited formal education to master. According to studies this method is also cognitively exhausting, [3]. Packing by hand is the most labour intensive and requires rather intensive management to be successful. Another factor associated with the method is waste. The removed berries cannot be exported. This proportion of the grapes causes lost sales representing a cost increase factor when the market is under supplied. Figure 4.2 show that 30% of the interviewed producers are still using this method.

Producers using this method report giving a medium to high level of training to the punnet packers. This involves identifying the most able workers and giving them pre-training and job specific training. On some farms the export companies provide the training, but mostly it is provided by the producer's own human resource department. Some producers conclude the training with a formal competence evaluation. Approximately 50% of the workers, predominantly seasonal, return year on year.

Management of the punnet packaging generally consists of a supervisor over each packing line. In some cases each packing station has a leader who coordinates the efforts of the other packers in the team.

4.2.2. Lane sorting assisted packing

The lane sorting assisted packing is described by Figure 2.2. This is the lowest cost machine aided method available and does not solely rely on the abilities of the packers.

Figure 4.2 shows that 15% of the interviewed producers employ this method. All of these producers provide pre training and job training during the season for the most promising workers that are selected for the punnet packaging. Workers are trained to be systematic

in order to reduce errors. This system is generally well managed. Usually each lane system has a supervisor who constantly performs quality and productivity control.

4.2.3. Microcontroller based combination system (Ergopak)

Each punnet station comprises a vertical rack and a microcontroller-based scale on each side. Figure 2.3 describes the operation of the system. The two sides are integrated using common in-process storage. For optimal operation three people are needed on either side.

Research has proven the system to be effective and have a high productivity to capital cost ratio, [3]. According to Figure 4.2 30% of the interviewed producers use this system. It is relatively easy to use but requires training and guidance in the beginning. All producers provide pre–season training, on the job training or both. Many of the workers return each year. In the beginning the stations are managed closely but as the team's experience grows, the need for supervision diminishes. The three workers on each side switch positions throughout the day and cross-check each other's work.

4.2.4. Computer based horizontal conveyor combination system (Vizier)

This is the most capital intensive option for packing punnets and is described in Figure 2.4. Cambray explains that bunches input to the system need to be cut to roughly the desired size to work effectively [6]. Packers also need to be alert not to miss bunches allocated to them because the system runs at high speeds. When used effectively this system delivers a capacity three times higher than packing by hand [5].

Because it is a large and high capital cost system, it is generally more attractive to the larger producers. The survey results in Figure 4.2 show that 20% of the interviewed producers use this system. These are intensively managed by a supervisor for each system. The workers receive pre-season training at the training centre and on the job if any problems arise. Many are recurring workers and also act as mentors for the new ones.

4.3. Quality control

4.3.1. Internal quality control

Quality management in a pack house is done by the Quality Controller (QC). Normally the QC's are trained by the producers, but in some cases the export companies do their own QC training. QC's constantly monitor the quality of the products at different steps of the process. This includes punnet weight. If any problem arises the QC has to document and attempt to correct it. Most pack houses have well developed traceability practices enabling a deviance from the quality standard to be traced back to a person or packing station.

Underweight punnets can occur due to human error, a scale that is not set up correctly or a berry being lost from a bunch when handled. Scales are normally tarred twice a day or more and pack houses are kept at high humidity to prevent loose berries. Since the sources of errors are random, underweight punnets occur stochastically. For calculation purposes it is represented as a percentage of produced punnets.

QC's arbitrarily take cartons from the production lines and check the contents for the correct weight. Between 1% and 10% of cartons are checked. On average between 1% and 3% of the samples are found to be underweight when packing by hand or using the lane sorting system. The problems are traced back and corrective action is taken. A personal interview with a QC revealed the frequency of errors when packed by hand to be about 20%. This was inconsistent with the data given by management. It is the author's opinion

that in general, where management is not working closely with the QC's, they are ill informed because of the "nobody wants to be the bearer of bad news" syndrome or subconsciously they want difficult to manage situations to be less severe. The study indicates that the actual frequency of underweight punnets is higher than originally stated. With the Ergopak and Vizier systems, the occurrence of errors is high in the beginning but as the packers' experience grows it reduces to the order of 1%.

Some other ways to minimize errors are to increase the management and quality control or to increase the mean weight of punnets. One producer effectively managed a mere 15g (about 3 berries) variation in punnets packed by hand and each finished punnet is weighed again to ensure quality. By increasing the punnet weight range by 20g on a lane sorting system another producer nearly eliminated the need for weight quality control.

4.3.2. External quality control

External quality control by the PPECB is mandatory. In some cases inspectors from the exporting companies or the client also do quality control from time to time. PPECB inspectors are required to inspect at least 2% of exported cartons. Cartons are arbitrarily chosen from finished units and all of the contents checked for correct weight. If one defect is detected, more sample cartons are checked. If two or more are found, all the punnets in a unit (pallet) have to be checked and corrected where necessary. If no more are found, only a warning is given. Some clients have a zero tolerance policy and if one defect is found, all punnets have to be checked.

External quality control acts as a good test to the effectiveness of the internal quality control. Producers implementing good internal quality control and stringent management had little to no units rejected by an inspector. Rejection frequencies varied from zero to 8% for all the producers. Quality control checks are also done at the ports prior to shipping and on arrival overseas. The export company Capespan reported less than 1% of exported units rejected overseas.

4.4. Economic penalty

When a unit, typically a pallet of 1150 punnets, is rejected at the pack house all its punnets need to be checked and repacked if defective. This consumes a large amount of time that could have been used to produce more punnets. The defective punnets also require new packaging material when being repacked. Producers estimate the physical cost of repacking to be between R200 and R800 per pallet. When the loss of production of a potential unit is added, the amount can be as high as R10 000 as shown in Figure 4.3. Rejects are therefore rather sent to alternative markets with lower quality standards, than repacked.

Rejected units at a local port are usually sold to the local market with lower specifications instead. When rejected overseas there are a few options. Units can be sent to a different market as lower quality for a much lower price than originally intended. Alternatively units can be repacked at considerable cost or units can be dumped. The revenue loss associated with a different market could typically be up to R4 500. Repacking costs are between 30 and 40 Rand per carton equating to about R4 000 per unit. When dumping a unit, it costs approximately R20 per carton of 10 punnets for the dumping plus approximately R80 income lost per carton. This equates to R11 500 per unit lost. These alternatives are depicted in Figure 4.3. Additionally, the probability of a possible loss of a contract due to frequent defects is high.

The interviews revealed overweight packing as a less obvious, but serious error on the production side, for example by giving away 10% extra grapes per punnet, one carton is

lost for every ten packed. This adds up to more than R1000 per pallet. If a punnet is too full the contents bruise easily during handling and quality problems may arise.

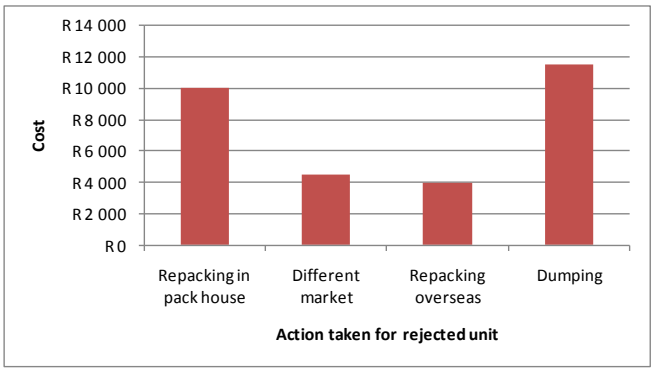

Figure 4.3 Cost of different actions taken for rejected units

5. CONCLUSION

The purpose of this paper is to determine the economic viability of an automated final product check weighing system in the pre-packaged table grape industry. From the interviews it was clear that underweight punnets do occur and often result in units being rejected at pack house level or further down the logistics chain. There was also evidence that a producer effectively eliminated underweight punnets by having a worker weigh every single package.

When asked about the implementation of a check weighing system, many producers stressed the fact that their current layout would have to be changed. This is surely a challenge and would have to be considered during the design. Smaller producers claimed that buying more than one system would also not be economically viable. An adaptation would have to be considered in order to implement one system to more than one packing line.

When calculating the period until a system will generate a profit, the occurrence of underweight punnets was taken as 1% of the total punnets produced. The number of probable rejected units was calculated for each interviewed producer and the cost of repacking a rejected unit was taken as R10 000. The number of systems required for each producer was calculated from data gathered during the interviews.

Figure 5.1 shows the time it will take in years, or packing seasons, before the system currently available at R90 000 generates a profit for each of the interviewed producers. This calculation only takes into account units rejected in the pack house based on prices for the 2010/11 season.

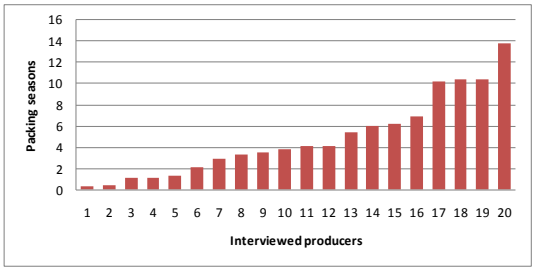

Figure 5.1 Years until system generates profit

On average the system will prove to be profitable within 5 packing seasons. The bigger producers will show profits much faster than the smaller producers. If packing lines could be incorporated as mentioned earlier, the times could almost be halved for some producers.

It is shown that the system will be economically viable if sold for less than R90 000 without considering the potential loss of a contract. Producers will be prepared to pay such an amount if presented with the facts. By adding a log keeping function to the check weighing system, units' mass can be certified and value is added to the product. This can also open doors to new markets. Should a market for punnets packed to an average mass be accessible, the check weighing system could prove invaluable in saving on overweight packages.

6. REFERENCES

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