

COMPARATIVE ANALYSIS OF DRY AND WET PROCESSING OF COFFEE WITH RESPECT TO QUALITY AND COST IN KAVRE DISTRICT, NEPAL: A CASE OF PANCHKHAL VILLAGE

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Abstract: A study was conducted at Panchkhal Village Development Committee (VDC) in Kavre district to compare and analyze two processing methods (dry and wet methods) with respect to quality and benefit cost ratio. A total of 30 respondents (farmers, processors, traders and consumers) were selected during survey whereas 7 coffee chain actors (except a local roaster) out of 30 respondents were chosen for in depth case studies. Results showed that there was significant difference in quality of coffee based on cup taste test (at 5% significance level, $p=0.001$). The average moisture content of coffee bean taken from different lots from dry processing method was found to be 12.83% which was higher than the standard commercial moisture range (9-12%) recommended by the International Coffee Organization (ICO). Moisture content (2.66) and flavour (2.3) are the major determinants of coffee quality according to quality attribute importance index. Depulping and fermentation was the most important coffee processing step followed by cherry sorting and grading determining the coffee quality. Knowledge and training was the major influencing factor for quality coffee production followed by supply of quality input. Benefit cost ratio for dry method was found to be higher (1.4) than wet method (1.2). Similarly, 40% respondents considered that inaccessibility to credit is the main reasoning factor behind adoption of two processing methods among farmers. These results could also be helpful in implementing the programs and formulating policies based on farmers need and capacity in order to improve the quality of coffee for export market.

Key words: Benefit cost ratio; Green bean; Cup quality; International Coffee Organization moisture content.

INTRODUCTION

Coffee is one of the high value cash crops grown in Nepal with potential high quality for domestic as well as international niche market (Shrestha et al., 2007, Koirala, 2003). Among the

various cash crops for commercialization, coffee is emerging as a likely agro-enterprise with great potential to provide farm employment and income generation opportunities in the mid hills of Nepal (CoPP, 2007).

Coffee is cultivated in Nepal with no use of synthetic fertilizers and pesticides. This crop has an important occupation in the rural economics with massive participation of marginal, poor and down trodden class of rural communities, and has contributed for the soil conservation, bio-diversity maintenance and watershed balance in the mid-hills of Nepal. Coffee farming in Nepal is proven as promising due to the availability of soil with good structure (physical and chemical) and appropriate micro-climate in the mid hills (Poudel et al., 2009).

Coffee is processed either by wet method to produce parchment coffee or by dry method to obtain cherry coffee (Figure 1). In Nepal, dry processing was predominantly practiced in the past (10 years ago). But nowadays, this method has gradually been replaced by wet processing method. Wet method has also becoming more popular and been introduced for export of green beans (Deoju and Manandhar, 2004). The major problem currently facing Nepali coffee production is the great variation in the quality of dried coffee beans. The problem comes from the fact that the coffee beans are collected from the many small scale farmers and, in the absence of quality standards for coffee, this has led to variation in quality. There are a number of reoccurring processing errors in both dry and wet processing systems. By removing many of these errors, it would be possible to significantly improve the quality of the coffee (ECIBON, 2009).

Quality is defined as product performance that results in customer satisfaction and freedom from deficiencies, in short fitness for use. Therefore, quality is meeting or exceeding customer and consumer expectations (Luning and Marcellis, 2009, Bruhn, 2002). Coffee is a complex product with attributes (flavour, acidity, body, and aroma) that emerge from a combination of these characteristics displaying a rich

variability of that cannot be totally disintegrated (Viani, 2001, Njoroge, 2004 and Laderach, 2007). These natural variations of coffee that complexly produce the final quality relate to different coffee varieties, soil altitude and rainfall conditions and cultivation and processing methods used by producers in different producing regions (Bajracharya and Pathak, 2004, Donnet and Weatherspoon, 2006). Hence, this study aims to highlight the two processing methods of coffee in terms quality and cost and recommends one which is more feasible both economically and technologically.

MATERIALS AND METHODS

Research area

The research was conducted in a Panchkhal VDC of Kavre district. Selection of site is due to the active involvement of most of the farmers, processors and traders in coffee plantation, processing and trading activities and familiarity of the researcher with research site and the people of that site. Kavre is a mid-hill district of central development region of Nepal. It is situated in Mahabharat mountain range covering 140,486 hectares of land with its altitude range 300-3018 meters from the sea level. The average size of household in this district is 5.4. The average land holding is 0.8 ha per family (DADO, 2008).

A total of 120 ha of land is under coffee farming in Kavre district producing 27 metric tons of dry parchment. Almost 22,000 coffee growers are involved in coffee production (MOAC, 2008). Panchkhal is the second largest VDC in the district with almost 150 coffee growers with average number of coffee plants per grower is 80 (DCPA, 2009).

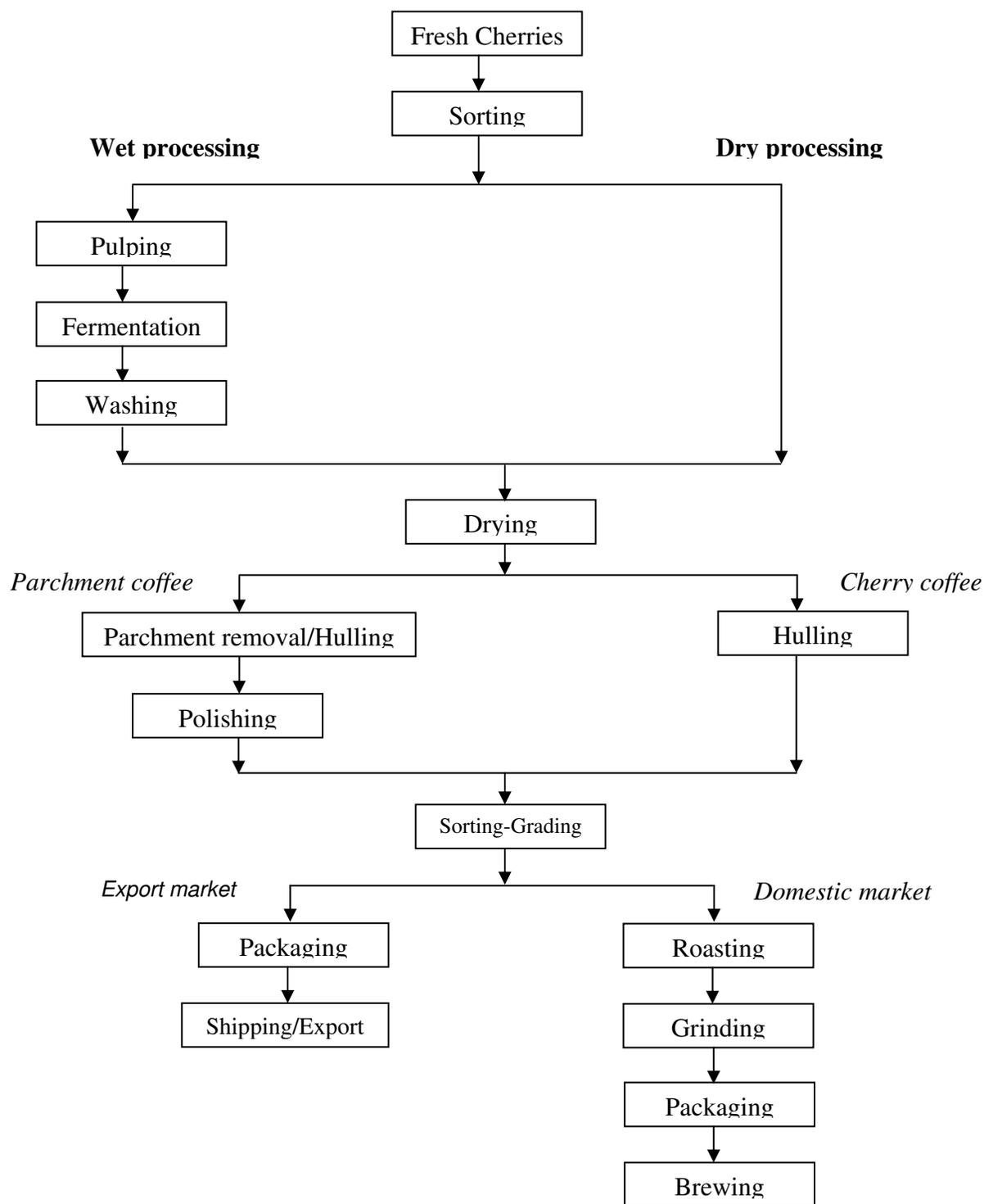


Figure 1: Successions of operations in dry and wet processing of coffee (Source: Coste, 2003)

Research design

The research had more qualitative and few quantitative approaches based on data collection from case studies and survey. All farmers, processors, traders, local roasters and consumers of Panchkhal VDC of Kavre district constituted the sampling frame of this study. Detailed case studies with 7 chain actors including 2 leader farmers, 2 processors (dry and wet methods), 2 traders, and 1 local roaster were done followed by a survey consisting of 30 respondents including 10 farmers, 5 processors, 5 traders, 10 consumers was done with multiple choice questions as checklists for the interview. The six chain actors for case studies except one local roaster were chosen from 30 respondents based on their experiences. Both survey and case studies were carried out in the month of July and August, 2010. The primary data were collected from the pre-tested questionnaires from each respondent during their interview.

Data analysis

Both the primary and secondary data collected from the field survey and case study were coded, tabulated and analyzed according to the objective of research carried out using computer programme Statistical Package for Social Sciences (SPSS) and Micro-Soft Excel. A Chi-square test was applied to find out the significant differences between coffee cup quality processed from dry and wet method based on cup taste test. A standard commercial moisture percentage range of 9-11% was taken as reference value in order to compare with moisture content of coffee green bean processed from two methods. An economic analysis tool, benefit cost ratio was analyzed using total gross return and total cost incurred during production and processing of both methods.

Details for all the variables used in data analysis techniques are as follows:

1. Quantitative analysis:

- a. moisture content of green bean,
- b. Benefit cost ratio: price of coffee at each processing stage, cost of processing, total cost, total gross return

2. Qualitative analysis:

- a. Cup taste test: Chi-square test
- b. Quality attributes: flavour, size of bean, aroma, acidity, colour, presence of extraneous materials (Importance indexing: 1= less important, 2= important, 3= most important)
- c. Evaluation of processing steps (less important, important, most important)
- d. Factors responsibility for Quality (less responsible, responsible, highly responsible)
- e. Reasonability (less reasonable, reasonable, more reasonable)

RESULTS AND DISCUSSION

Comparison of moisture content of green bean

The moisture content of GB taken from different samples obtained from both dry and wet method of processing was recorded by using digital moisture meter which is presented in Table 1. The average moisture percentages obtained were compared with the standard moisture range (9-12%) recommended by International Coffee Organization. It was found that the moisture content of green bean obtained from dry processing was above the standard range, which was due to the reason that farmers had not given attention while drying and storage of coffee cherries after harvest. The moisture content of dry parchment obtained from wet method of processing was found within the standard moisture range.

In general, the quality green bean obtained from wet processing is better fetching higher prices than from dry one as the bean has already received desired level of moisture percentage during drying of parchment in wet method. But further drying of bean is necessary in the dry method as the moisture percentage remains always high due to insufficient drying of cherries. Hence, wet processing is being popular among the coffee growers, processors and exporters in Nepal (Kattel, 2009).

Wickramasinghe (2001) also claimed that wet method produce better quality green bean than dry processing especially in case of Arabica coffee. This is due to the fact that dry cherry contains pulp and mucilage in contact with beans for longer time than dry parchment which means it needs sufficient drying period with more light intensity in order to reduce the moisture level to

12%. In case of dry parchment, the pulp and mucilage is removed within 24 hours and only parchment cover is remained which dries too fast even in low light intensity. The above two

statements claimed by two persons also support the researcher's opinion with regards to moisture content of bean processed by two methods.

Table 1: Moisture percent of green bean processed from dry and wet method

Sample no.	Moisture content of green bean	
	Dry method	Wet method
1	13.2	11.6
2	12.8	12.1
3	12.4	11.8
4	13.0	11.2
5	12.7	12.0
6	12.9	11.5
Total	77.0	70.2
Average	12.83	11.7

Economic analysis of two processing methods

The economic analysis of two coffee processing methods was done by calculating ratio of benefit to cost for each processing method which is presented in Table 2. Dry method of

coffee processing had the higher benefit-cost ratio (1.4) than wet method (1.2). The sales price of raw coffee at each step and production and processing cost was taken during case study of each chain actor and from the National Tea and Coffee Development Board (NTCDB).

Table 2: Benefit-cost ratio analysis of dry and wet method

Description	Dry method	Wet method
	Price or cost/kg (NRs.)*	Price or cost/kg (NRs.)
A. Gross return		
Farmer		
Sales price of fresh cherry	-	27
Dry processor		
Sale of dry cherry	95	-
Pulper (wet)		
Sales of dry parchment	-	140
Huller		
Sale of green beans	220	250
Total Gross return	315	417
B. Costs		
Farmers		
Production cost of fresh cherry	-	17
Dry processors		
Production cost of dry cherry	25	-
Pulper (wet)		
Production cost of dry parchment	-	130
Huller		
Production cost of green bean	198	198
Total costs	223	345
B/C Ratio	1.4	1.2

*Nepalese Rupees

It is obvious that dry method of processing consists of fewer handling steps than wet method. It consists of drying and hulling steps. The cost of drying cherries is low. Hulling cost of dry cherry and parchment is same for both methods. The total gross return in this method is much higher than total costs. Therefore, the B/C ratio is high for dry method. The wet method consists of more handling steps (pulping, drying, hulling). The costs related to these steps are also high. Also the return in this processing is slightly higher. Due to higher handling costs, the B/C ratio is low.

Tiwari (2009) in his report claimed that shifting from dry to wet method of processing has not only improved the quality of coffee but also increased the income of coffee growers. Higher return per unit of the produce (fresh cherry) received by farmers through selling of the fresh cherry at the pulping centres (wet method) has motivated farmers as an incentive to improve

production and processing practices to some extent. The researcher agrees on above statement.

Survey for cup taste test

Based on the organoleptic taste done among 30 respondents for cup quality comparison, the following results were obtained:

Out of 30 respondents who tasted both dry and wet processed coffee, 24 respondents rated “very good” for the taste from wet processed coffee (Figure 2). They were again asked the reason for rating ‘very good’ for the cup from wet processed coffee. They reported that the cup had an excellent aroma (fruity) along with sharp and pleasing taste. Again majority of respondents (19) who rated ‘good’ for the cup given from dry processed coffee claimed that even the cup tasted well but it did not have well aroma i.e. dull and also gave earthy flavour. The Chi Square (χ^2) test revealed that at 5% significance level ($p = 0.001$), there was significant difference in taste of coffee produced from dry and wet method (Table 3).



Figure2: Cup rating by respondents on dry and wet method

Table 3: Comparative analysis of dry and wet processing methods in terms of cup taste test

			Method of processing		Total	Chi-Square Tests
			Dry method	Wet method		
Cup rating	Very good	Count	11	24	35	0.001*
		Expected Count	17.5	17.5	35.0	
	Good	Count	19	6	25	
		Expected Count	12.5	12.5	25.0	
Total	Count	30	30	60		
	Expected Count	30.0	30.0	60.0		

* At 5% significance level.

It has been well accepted that green beans produced from wet method yield roasted beans and coffee beverages, respectively, that are characteristically different from the coffee produced from dry method with respect to flavour and aroma (Knopp et al., 2005). There is no doubt that these differences in flavour in part have to be attributed to differences in thorough processes applied during either method of processing and the fact that only fully ripe cherries are used for wet processing, while fruits of all stages of ripeness are utilized in dry processing.

It is agreed that that wet processed coffee gives much better quality than dry one (Bytof et al., 2000). The decisive quality criterion of coffee as cup or beverage is aroma, which composes of more than 800 compounds. These aromatic compounds are responsible for estimating objectively the aroma differences resulting from different processing techniques. In this condition, the physiological and biochemical changes that occur in the coffee green bean during postharvest treatment and related to quality could be taken into consideration (Bytof et al., 2000). The statements given by above two persons pertaining to difference in taste of coffee made from dry and wet method is in line with the view from respondents taken during the case study.

The processing of same original material (fresh coffee cherries) by both methods (dry and wet) leads to significant differences in the cup quality of the corresponding roasted beans. This difference in quality is mainly based on metabolic changes within the coffee bean that varies depending on the mode of postharvest processing methods. These changes are mainly associated with the mobilization of starch and sugars within the coffee seed generating low-molecular substances. They are free amino acids with potential aroma precursors which ultimately affect the quality of coffee. Normally total content of amino acids is found to be higher in wet processed green beans than dry processed ones (Selmar et al., 2005).

Quality attributes raking

Thirty respondents were given the option to score six important quality attributes of coffee. Each respondent scored in their own order of importance. Based on their own experiences and personal judgment, moisture content was the most important factor and colour least important. Moisture content was followed closely by flavour, aroma, size, and acidity (Table 4).

Table 4: Index of importance for coffee quality attributes

Quality attributes	Respondents (n = 30) Scores			Total	Index	Rank
	1	2	3			
Moisture content	2	6	22	30	2.66	I
Flavour	6	9	15	30	2.3	II
Aroma	9	7	14	30	2.16	III
Size	10	11	9	30	1.96	IV
Acidity	8	17	5	30	1.9	V
Colour	15	8	7	30	1.73	VI

Rating: 1 = least important, 2=important and 3 = most important

The main objective of lowering the moisture in coffee cherries, parchment and beans is to preserve raw coffee safely to storage. This is normally done by sun drying during, which raw coffees are heated by direct exposure to the sun and by radiation from surface heat. If moisture content of coffee bean is not lowered to an acceptable level of 9-12% due to poor drying that develops fungus and off-flavours ultimately affecting the final taste of coffee (Gonzalez-Riosa et al., 2006). This statement supports the perception of majority of respondents who also claimed that moisture content is crucial attribute for coffee bean.

There has been found some contradiction on the optimum moisture range for parchment and green beans. We can find a slight difference in range according to the standards set by various coffee exporting and importing countries. At this condition, one should follow the range recommended by ICO i.e. 9-12 % for export of green beans (FAO, 2008). Size and colour of the bean are also important with regards to sorting and grading of cherries and beans. Grading of green bean according to size leads to obtain

uniform roasting of beans otherwise smaller beans get burnt earlier.

Aroma is the fragrance or odour perceived by nose of freshly roasted bean and ground coffee, Aroma in cup is perceived after four minutes of contact with hot water. Flavour is the combination of aroma and taste of coffee. Flavour of coffee can be described in terms of winey, spicy and fragrant. Acidity in coffee develops sharp taste from sweet to fruity/citrus. This opinion is in accordance with the perception given by Wintgens (2004) in his literature.

Respondents’ opinions and perceptions on evaluation of coffee processing steps

Respondents were asked to prioritise the most important coffee processing steps determining quality. Based on their experiences, the highest number of respondent (10) gave priority for depulping and fermentation as important coffee processing steps followed by coffee cherry sorting and grading. Grinding and packaging and dehusking was given the least priority (2) (Figure 3).

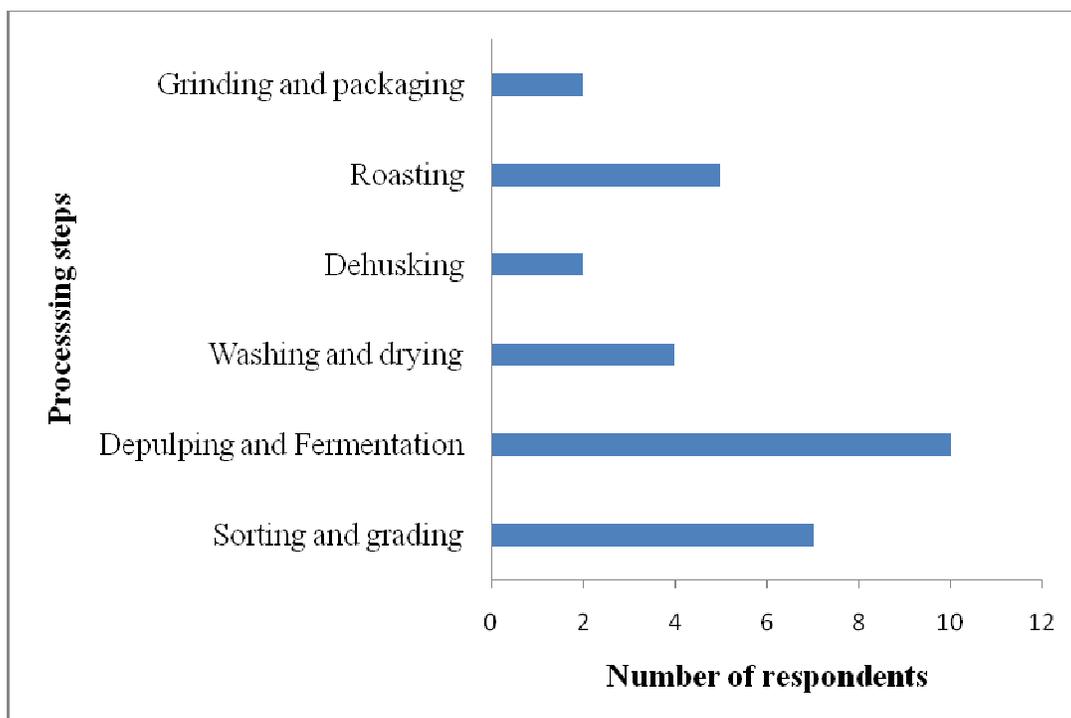


Figure 3: Evaluation of coffee processing steps determining coffee quality (n=30)

The processing method is important for contributing the aroma and flavour in coffee cup quality. Therefore, the quality of coffee is dependent on careful postharvest processing. In primary coffee processing level which starts after harvesting up to drying of parchment, the fermentation of parchment after depulping is the most important stage for maintaining the quality of coffee. If fermentation lasts long, microbial inhibition takes place resulting to pungent flavour and stinker beans and ultimately affects cup quality. The above finding also supports with the findings given by Piechaczek (2009) in his thesis report.

Besides Depulping and fermentation, roasting is another critical stage as this strongly determines the quality attributes in terms of aroma. The release of aroma takes place during coffee roasting that coffee lovers insist on

performing themselves. A good roaster must be a part of artist, and part scientist to maintain the quality and consistence (Hicks, 2002). This finding is also supports with the thinking of majority of respondents who scored roasting as a critical stage with respect to coffee quality.

Factors responsible for quality coffee production

The highest number of respondents (10) gave more emphasis on training of quality management system in coffee production and processing methods. Institutional development and information flow and sharing were emphasized the least in the order of importance. Supply of quality input, policy on coffee production and processing were given mediocre priority (Figure 4).

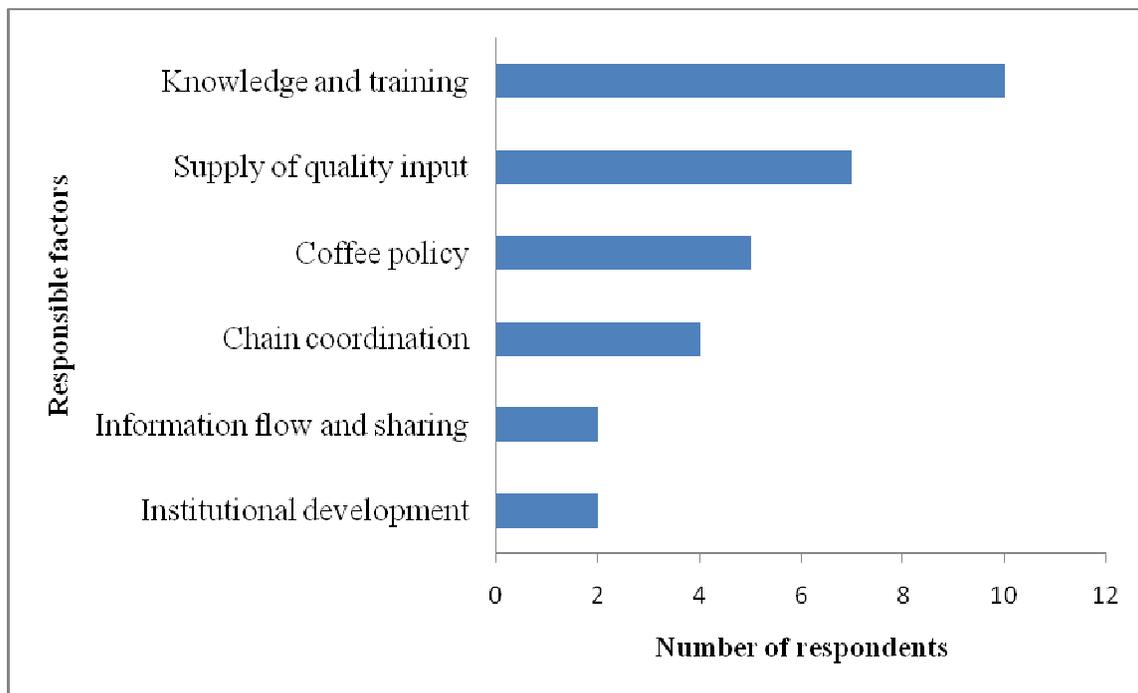


Figure 4: Evaluation of factors responsible for quality coffee production (n=30)

A good knowledge and skill on coffee production, processing and trading supports the chain actors to maintain the coffee quality

throughout the chain allowing consumers to buy coffee without compromising on quality. It also helps to build the capacity of chain actors in their

decision making process. The above statement supports the respondents perception who also claimed that knowledge and training as a crucial factor for quality coffee production (Koirala, 2003). Tiwari (2009) recommended that coordination in the coffee supply chain through better information flow among chain actors would lead to development of common understanding of the term quality as well as appropriate quality management system in coffee. This recommendation also supports the respondents perception on factors for quality coffee production.

Reasons for adopting two methods

Respondents were given chance to choose the options on reasons for practicing two processing methods. Majority of respondents (40%) said that inaccessibility to credit as the main reason followed by proper training, inadequate backstopping with the least to unchanging habits of the coffee processors (Figure 5).

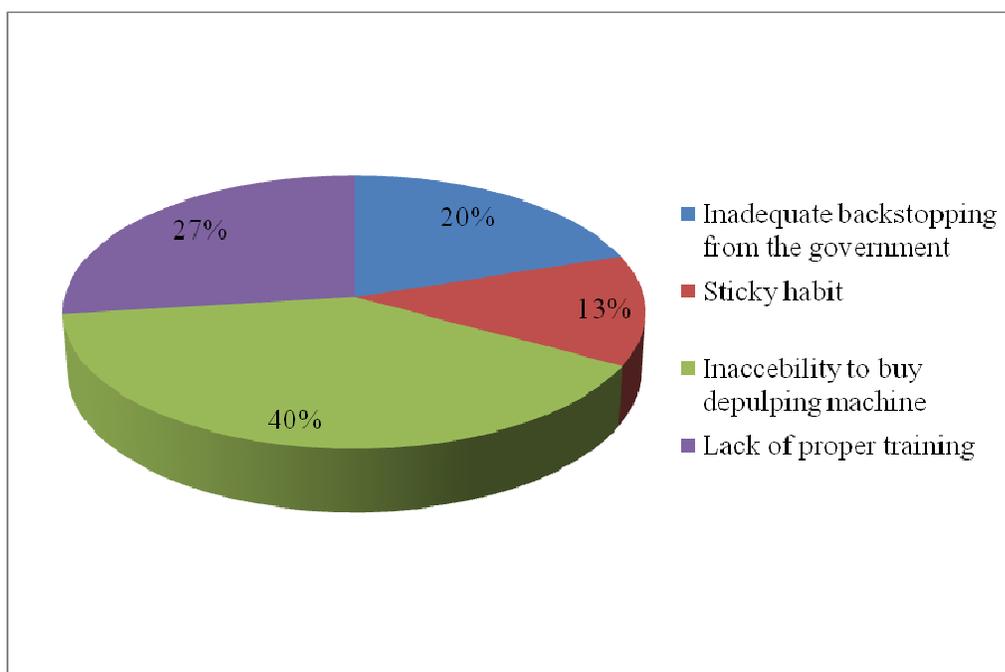


Figure 5: Respondents perception on reasons for adopting two processing methods

Coffee is a secondary crop for the farmers and processors in Panchkhal VDC. They are not paying much attention with regards to quality management. They rather give more time on growing food crops. Farmers do not want to waste their times on selling small volume of fresh cherries frequently after harvesting and dry them to make dry cherry. Only those farmers, who produce bulk volume of fresh cherries, bring to the pulping centres for sale after harvest. This is the reason for processors adopting two methods. Munankami (2004) suggested that coffee processors at farm level needs to increase access to pulping centres. In Nepal, the numbers and capacity of pulping centres established are far

lower as compared to quantity of fresh cherries produced based on the distance and numbers farmers a pulping centre can cater. Due to this reason, farmers and processors in remote areas are still practicing dry method of processing. The researcher is also in accordance with above statement.

CONCLUSION

Based on the findings, the outcome of this research pertaining to quality comparison between dry and wet processing methods of coffee is summarized as under:

- Dry method of coffee processing is simple and low cost with few handling

steps. It produces low quality coffee fetching lower prices where as wet processing methods consists of more handling steps than dry method and 67% of the processors in Kavre district practiced this method.

- Critical limit for moisture content of dry cherries, parchment and green beans practiced by the processors in study area is 11-12%. The standard commercial range of moisture percentage of green bean for export market is 9-12% for both Arabica and Robusta coffees as recommended by International Coffee Organization (ICO). The moisture content of green bean obtained from dry method was beyond the standard commercial range recommended by International Coffee Organization than from dry method. It was due to the fact that drying of cherries took longer time than parchment in order to obtain an acceptable moisture level. Cherries were stored without sufficient drying.
- Based on benefit-ratio calculation, the dry method of processing had the higher B/C ratio than wet method as dry method consisted of few handling steps (harvesting, drying, hulling). The total cost incurred in dry method was lower than the wet method. As quality of coffee processed from wet method is found better than dry one, price structure of coffee should be fixed according to quality standards.
- It was learned from the cup taste that the more aromatic coffee with higher delicacy and fineness could be obtained by the wet process. Coffee processed through wet method becomes mild. It obtained purer flavour but also less body and acidity as compared to coffee prepared from dry method of processing.
- There was no systematic and uniformity in the application of quality controls measures throughout the chain. Most of the actors were unaware of the quality management systems which was being sought by the importing clients.
- The main reasons for adopting two methods among coffee producers in Panchkhal district was the inability of

some processors to buy pulping machine which was caused by poor economic status of the farmers and processor. Additionally, they did not have access to credit for buying pulping machine. This problem needs to be overcome by increased accessibility to credit for the coffee growers and processors.

- To maintain coffee quality through better processing method (wet), Coffee processors at farm level should have increased access to pulping centres. The number and capacity of pulping centres to be established by the farmers groups should not be only on the quantity of fresh cherries produced, but also on the distance and number of farmers pulping centres can cater.
- It is important to standardize (setting standards with respect to quality) the coffee processing method from the beginning and disseminate to the small scale processors and pulping centres to ensure uniformity quality of coffee beans produced.
- There should be increased transparency (in terms of behaviour of chain actors and marketing of product) in the chain during transaction and cooperation among actors. All the actors should have a common understanding of the term quality and its management. Building capacities of coffee farmers, processors and traders through training on coffee processing and quality management system should be done so that they can upgrade their knowledge, skill and attitude on wet processing method with regards to quality.

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