

School of Management

**Impact Assessment:
Smallholder Coffee Agronomy and
Postharvest Trainings in the Highlands
of Papua New Guinea**

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**This thesis is presented for the Degree of
Master of Philosophy (Rural Management)
of
Curtin University**

April 2015

Dedication

To the Creator and God of Israel – My faith in Him has provided me the spirit of persistence.

To the spirits of my father and mother: the late Andrias Aroga Kepa and Monika Molenu.

To the love of my life: Lyneth Tom Aroga, and dearest children: Kaijah Aroga, Cephas Aroga and Levie Aroga. They were the source of my motivation to achieve this goal.

To the Kepik Karanas tribe of Ialibu, Southern Highlands Province, Papua New Guinea.

Declaration

This thesis contains no material that has been accepted for the award of any other degree or diploma at any university.

To the best of my knowledge and belief this thesis contains no material previously published by any other person except where due acknowledgment has been made.



Signature: _____

Date: 02/11/2015

Abstract

The Coffee Industry Corporation (CIC) Limited of Papua New Guinea (PNG) adopted the Farmer Demand Driven Extension (FDDE) approach in 2003 to address the low production and inconsistent supply of coffee by smallholder farmers. Through a Participatory Rural Appraisal and Planning process, the lack of knowledge and skills in agronomy and postharvest were identified. This study was conducted to evaluate the effectiveness of the agronomy and postharvest training programs in facilitating acquisition of agronomic and postharvest innovations by the farmers. The study had three assessment categories: needs, processes and outcomes. Seven sub-objectives were developed to investigate the appropriateness of: (i) the training needs analysis (TNA) techniques used; (ii) the topics covered during the training programs; (iii) the training methods used during the training programs; (iv) the training aids employed during the training sessions; (v) the evidence that the farmers have learnt during the training programs; (vi) the adoption of acquired innovations; and (vii) impediments to innovation adoption. One hundred smallholders coffee farmers were randomly selected from six groups: three groups who have participated in the agronomy training and three in postharvest. Three of the groups were from the Eastern Highlands Province while three groups were from Chimbu province. Fifty-one farmers were randomly selected from the agronomy groups and 49 farmers from the postharvest groups. The farmers' core motives for attending the training programs were to acquire new information in order to increase production and improve the quality of coffee so that they could realise an improved income. The study found that the agronomy and the postharvest training programs were suitable in facilitating acquisition of required knowledge by the farmers. In addition, the training programs were also beneficial to the farmers in a number of ways: (i) the TNA survey had made them realise their core motives to participate in the training program in addition to consolidating the group members; (ii) the use of the training aids had given the farmers the confidence to actually use them on their farms; and (iii) the farmers were observing positive results: vigorous tree growth, increase in yield and improvements in the colour and weight of the parchment. On the other hand, the study identified some areas in the training program which required improvements: (i) the TNA and follow-up exercises were not necessary as farmers were able to learn without them; (ii) the training providers (TP) lacked in-depth knowledge on pest and disease, pulper repair and maintenance and coffee calendar; (iii) handouts and posters were written in English, making it difficult for illiterate farmers to understand; and (iv) effective application of acquired innovations were impeded by a lack of price incentives for quality and cherry theft. It is recommended that the CIC modifies the training programs by: (i) recalling the TNA and follow-up exercises and save the money. The follow-up activities should be a core function of the contract management unit at the CIC provincial offices; (ii) provide in-service programs

to the TPs on pests and disease, coffee pulper and coffee calendar; (iii) the handouts and posters be translated into Tok Pisin and; (iv) for future use, the agronomy and postharvest curriculum be developed in collaborations with the CIC, the TPs and the farmers. It is also recommended that the CIC facilitates linkages with the farmer groups and existing traders (exporters) with the aim of developing a long-term strategic alliance between the traders and the groups so that the farmers may directly transect their improved quality coffee to the traders for a better price.

Acknowledgments

My deepest gratitude to the following:

Professors Peter Batt and Roy Murray-Prior, for their invaluable support, supervision and mentoring during the course of the thesis. I owe them a lot, for they have made me realise my potential. They were also instrumental in securing for me the prestigious John Allwright Fellowship. Professor Rola- Rubzen for supervising me towards the end of the thesis.

The Australian Centre for International Agricultural Research (ACIAR) for generously offering me the prestigious John Allwright Fellowship.

The Papua New Guinea Coffee Industry Corporation for granting me study leave.

Mr. Potaisa Hombunaka, the former General Manager of the Coffee Research and Grower Services Division of the Coffee Industry Corporation for nominating and encouraging me to take the prestigious John Allwright Fellowship. .

Staff and students at the School of Agriculture & Environment - Muresk Campus Northam, for their generosity towards my family while at Muresk.

Mr. Gordon Wallangas and family for the team spirit while at Muresk.

The Northam Faith Christian Fellowship for their spiritual and financial support to the Arogas while at Muresk.

Messrs. Stanley Mapua, Rati Irikati, Wein Bore, Moses Kepa and Ms Jenifer Bekio for their assistance in the data collection while in PNG.

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Glossary of terms

Definitions of words frequently used in the thesis are provided below:

Agronomy	Field coffee farming and/or management practices.
Blockholders	Advanced smallholder coffee farmers who own more than five and less than 30 hectares of coffee trees.
Cherry	Green, red, and brown fruit of the coffee tree.
Chimbu	One of the Highlands Provinces of PNG where the study was conducted.
Clean water	Water that is free from contaminants that will compromise good quality coffee.
Coffee calendar	The cherry development cycle beginning with coffee flowers to cherry harvesting and the onset of the next flowering session.
Contracts	The legally binding agreement signed between the CIC and the external training providers prior to service delivery.
Demonstration	One of the training methods involving the trainer showing the techniques taught in the classroom and allowing the participants to practice what they have learnt.
Drainage	Removing excess water from the soil and/or controlling run-offs.
Drying materials	Coffee parchment drying materials such as raised table and canvas.
External impediments	Problems that are imposed onto the farmer by outside agents.
Expert input	The use of specialists during the coffee training.
Evaluation	Assessing the worthiness of a program against stated measurable objectives.
Farmer group	A unit of coffee farmers with common interest in the coffee extension program.
Fence	A boundary around the coffee garden to prevent trespassing.
Fertilizer	Inorganic coffee nutrients which can be outsourced from retailers.
Fermentation	Process where the mucilage of the pulped cherries are removed/disintegrated.
Fermentation tests	The grasping handful of fermenting parchment to determine fermentation.
Field trip	An excursion to a farm or processing site for re-enforcement purposes.
Follow-up	An advisory visit made by a trainer after the training has been delivered.
Group discussion	One of the training approaches taken during the coffee training.
Handouts	One of the training aids having printed notes.
Harvesting	The process of picking ripe coffee cherries.

Harvesting and processing	The process of picking, sorting, and pulping ripe cherries, fermenting, washing/soaking, and drying the parchment.
Knapsack sprayer	A small manually operated chemical sprayer which can be easily mounted at the back of a person.
Lecturette	A short form of lecture used to explain a concept during training.
Moisture test	The determination of moisture level in the coffee parchment during drying.
Nutrition	Organic sources of fertilizer such as manure, compost and garden waste.
Parchment	Wet or dried coffee beans which have their sliver skin still on.
Parchment classes	Classification of parchment standards such as class 1, 2, 3 and class 4.
Parchment washing	The removal of fermented mucilage using clean water before drying.
Parchment storage	The approaches taken to store the dried parchment after drying.
Picking test	A mathematical calculation used to find out the percentage of ripe, under-ripe and over-ripe cherries after harvesting.
Poster	Enlarged picture or illustration of Postharvest or Agronomy techniques.
Postharvest	Practices dealing with coffee harvesting, pulping, fermenting, drying, and storing of cherries and/or parchment.
PRAP	One of the components of the FDDE programs.
Price incentive for quality	A monetary reward to farmers with good quality parchment coffee.
Pruning	The act of trimming coffee trees by removing small branches (maintenances pruning) and/or all of the bearing uprights except one (recycle pruning).
Pruning saw	A tool used for pruning coffee.
Pulping test	A technique done on a hand-operated drum pulper to assess cherry pulping.
Quiz	Test given to farmers to assess their agronomy and postharvest knowledge.
Quantity	The amount of coffee yield or harvest.
Quality	The state of how good the coffee is in terms of cup taste.
Question and answer session	One of the training approaches whereby participants can ask questions and the facilitator provides the response.
Rehabilitation	Coffee farming practices which involves techniques such as pruning, weeding, shading, fencing, drainage, nutrition, and pest & diseases control.
Roadside price	Coffee price offered by road-side traders to coffee farmers.
Tok Pisin	PNG national language.
Training aids	All the materials used during the Agronomy and Postharvest training.
Training providers	Service providers contracted by the CIC to deliver the trainings.

- Transect walk** A walk taken through the coffee gardens to make ocular observation of the application of the acquired innovations by farmers.
- Tribal fighting** Tribal conflict between warring clans.
- Secateur** A tools used for pruning coffee, usually the small branches.
- Shade control** Regulating density of sunlight in coffee by managing shade trees.
- Smallholder coffee farmers** Coffee farmers with less than 80,000 coffee trees.
- Social activity calendar** A description of activities which normally occurs in the village.
- Soaking** Emerging of the washed parchment in clean water over-night before drying.
- Washing** A coffee processing techniques where the coffee parchment is washed using clean water after fermentation.
- Y grade coffee** Mild mixed coffee produced by PNG smallholder farmers.

Acronyms

ADB	Asian Development Bank
CCGS	Coffee Credit Grantee Scheme
CIC	Coffee Industry Corporation
CRI	Coffee Research Institute
CTP	Central Training Points
DAL	Department of Agriculture and Livestock
EHP	Eastern Highlands Province
EOs	Extension Officers
FDDE	Farmer Demand Driven Extension
FFTM	Farmer Feed-back Transfer Model
FOB	Free on board
FPA	Farmer Participatory Approach
MFFTTM	Modified Farmer Feedback Technology Transfer Model
ICO	International Coffee Organisations
MC	Moisture content
MEOs	Mobile Extension Officers
PNG	Papua New Guinea
PFTEC	Provincial Farmer Training and Extension Coordinators
PRAP	Participatory Rural Appraisal and Planning
PSC	Premium smallholder coffee
PEC	Project Evaluation committee
RA	Research assistants
SPs	Service Providers
SPSS	Statistical Package for Social Sciences
TPs	Training Providers
TNA	Training Need Assessment
TTM	Technology Transfer Model
T & V	Training and Visit
R&GSD	Research and Growers Services Division
NYC	New York Coffee

Chapter 1. Introduction

1.1 Introduction

Empirical and anecdotal evidence suggests that most smallholder coffee farmers in Papua New Guinea (PNG) have not adopted the innovations that have been delivered to them by the Coffee Industry Corporation (CIC) over the years. This contributes to the major problem currently facing the PNG coffee industry, i.e., inconsistent quality and insufficient supply (Batt et al., 2009). Key impediments to the adoption of technology are well documented in the literature and include poor infrastructure, deteriorating law and order, land disputes, illiteracy, a lack of finance, poor marketing accessibility, poor extension services, and the lack of knowledge and skills (Van den Ban & Mkwawa 1997; CIC 2002; Quirke et al., 2007; Batt & Murray-Prior, 2008).

In an attempt to promote adoption of improved innovations by the farmers, the CIC had adopted Farmer Demand Driven Extension (FDDE) (CIC, 2002). The FDDE promoted the formation of collaborative marketing groups (CMG) and members of the CMG identify relevant innovations which they recognise as important to address their needs. The identified innovation needs are addressed through instituting several training programs which are developed by the members of the CMG, external training providers (TP), and the CIC. However, anecdotal evidence indicates that the training programs themselves are faced with impediments such as a lack of financial support from the CIC, a lack of CIC conducting monitoring and supervision of the adoption of the improved innovations by the CMG, and a lack of CIC linking the CMGs to reputable domestic coffee traders such as processors and exporters. These impediments have reduced the effectiveness of the FDDE training programs which consequently reduced the rate of adoption of innovations.

1.2 Background of the study

Since 1986, the CIC has implemented two paradigms of extension: top-down and bottom-up. The Training and Visit (T&V) (Benor & Harrison, 1977; Van den Ban & Hawkins, 1996) and Central Training Point (CTP) (CIC, 2002) are examples of the top-down paradigms, while the FDDE (CIC 2002) is an example of bottom-up approach. Both the T&V and the CTP are technology driven, except that the latter attempts to deliver technology via farmer groups. The T&V methodology was introduced to the CIC in 1986 by the World Bank and was in operation until 1996. The T&V system was replaced in 1997 by the CTP approach, which was abolished in 2002, paving the way for the FDDE (Yogiyo, 2002).

The FDDE approach was introduced into PNG by the Asian Development Bank (ADB) via the Department of Agriculture and Livestock (DAL) and was piloted in Eastern Highlands

Province (EHP) and Morobe (Lahis, 2005). The CIC adopted the FDDE in 2003 due to stakeholders' demand for change in the extension services delivery in the CIC (CIC, 2002).

The FDDE extension also has the advantage of farmer group mobilization and therefore training is delivered to them by external training providers (TPs) using andragogical principles (Lahis, 2005). Maslow (1970), Van den Ban & Hawkins (1996), Hagmann et al. (1999), Galbraith (2004), Knowles, Holton & Swanson (2005) and IFAD (2007) indicate that adult learning is based on andragogical theory. Empirical studies indicate that adults learn better when they actively participate in training program planning, curriculum preparation, and the delivery of the training, knowing that the training will address their motivations for learning. Consistently, the CIC has recommended that TPs adopt andragogy learning styles in delivering agronomy and postharvest trainings. Under the FDDE, the farmers identify their problems through an interactive process called the Participatory Rural Appraisal and Planning (PRAP).

The PRAP begins with a farmer situation analysis, farmer problem identification, problem prioritising and empowering farmer groups to outsource appropriate interventions to adequately address their problems (CIC, 2005). After the PRAP, training areas identified are contracted to external TPs. To develop a training program, the TPs are encouraged to involve farmers in the training needs analysis (TNA), the development and implementation of the training programs, and an evaluation of the outcomes to facilitate adoption by the farmers. This approach is in line with Crow & Crow (1963), Boyd & Apps (1980) and Knowles, Holton & Swanson (2005) who indicate that unless some behavioural adjustments are observed, little or no learning has taken place. For learning to occur, farmers must be involved in every step of the training program. Therefore, it is important to assess whether the farmers are applying the acquired knowledge and skills, and if not, what are the impediments in the uptake of the new knowledge.

1.3 Problem statement

Coffee levy payers, policy makers, donors and the PNG government often ask the question: are the PNG smallholders learning under the FDDE training programs? This question is constantly raised at various board and stakeholder meetings as coffee production in PNG is stagnant and the majority of smallholder coffee is traded as "Y" grade at a significant discount in the New York Coffee (NYC) market (Batt et al., 2009). There is empirical support from Batt et al. (2009), that the quality/quantity problems can be addressed through instituting proper training and under better marketing arrangements. Therefore, the CIC has adopted the FDDE and through the PRAP, the lack of knowledge and skills in agronomy and postharvest have been identified as the key impediments. Hence trainings in these areas have been conducted. However, the various impediments associated with the delivery of the training

programs, knowledge and skills acquisition, and adoption have never been studied. Therefore, the aim of this study is to evaluate whether the FDDE training is facilitating farmer learning. An in-depth study is necessary because the CIC has committed considerable amounts of money to external TPs to identify farmers' knowledge and skills gaps in agronomy and postharvest and to develop appropriate training programs. Unless these training programs are evaluated, and the issues promoting and/or impeding farmer learning are fully understood, the CIC may lack the insights required to improve the FDDE training. Although most of the TPs are retrenched CIC extension officers (EO) and are competent in delivering coffee innovations to the farmers, they lack adult training skills (L. Matei, 2009 pers. comm., 13th October, 2009). Therefore, it is vital that the TPs' performance on the agronomy and postharvest training is assessed from the farmers' perspective so that the CIC may know whether the current approach to information packing and delivery via the TPs is facilitating acquisition and adoption of innovations by the farmers.

1.4 Study objectives

The main objective of this study is to assess whether smallholder coffee farmers in the highlands of PNG have acquired and are adopting the agronomic and postharvest innovations delivered by TPs under the FDDE training. To realise this objective, seven sub-objective questions were asked:

1. Were the appropriate TNA techniques used to identify farmer motives for learning?
2. Were the essential topics in agronomy and postharvest processing delivered during the training?
3. Were the training methods employed appropriate to facilitate farmer learning?
4. Did the TPs employ appropriate training aids during the agronomic and postharvest training?
5. Did farmers acquire the desired knowledge and skills to improve coffee quality and quantity?
6. If yes, were the farmers applying these innovations?
7. If not, what were impeding the adoption of the acquired information?

1.5 Overview of chapters

The next chapter will provide an overview of the global coffee industry and PNG's position within it. The prevailing agronomic and postharvest practices, coffee quality, coffee production and marketing will be reviewed. Chapter 3 reviews the literature on the principles of agricultural extension and highlights some of the extension models and systems that have been used in PNG within the continuum of top-down and bottom-up extension. The literature also provides insights into the diffusion of innovations, adult learning styles, and adult learning

facilitators. Chapter 4 provides a review of the principles of monitoring and evaluating agricultural extension. Owen's five forms of evaluation and models of evaluation including their approaches are (Dart et al., 1998) are discussed. Chapter 5 reviews the recommended agronomic and postharvest practices in PNG and the current FDDE approach. Chapter 6 provides the study design and methodology, instrumentation, sampling, data collection techniques, data analysis procedures, and the study limitations. Chapter 7 is results and describes the respondents' demographic characteristics, analyses of needs, processes, outcomes and impediments, motivational factors, and current farming practices. Chapter 8 discusses the results under each objective or question while Chapter 9 presents the conclusions and recommendations.

Chapter 2. Global coffee market overview

Coffee is an important commodity in the global economy and its trading value is in billions of US\$. The mainstream coffee trade is vigorous, volatile, and dynamic. To minimise the price volatility and risks involved in the futures market, differentiated markets have been developed. In PNG, mainstream coffee trade is dominant, although access to the differentiated markets is increasing. This chapter briefly reviews from the global perspective the economic importance of coffee, production, consumption, major coffee traders, the types of coffee markets that exist, coffee price movements and coffee quality. The chapter is summarised by reviewing Papua New Guinea's (PNG) position in the global coffee trade in terms of its coffee grade systems, the economic importance of coffee, the production trend by sector and provinces and the types of marketing routes that exist in the country.

2.1 The importance of coffee in the world economy

In 2012, coffee was worth approximately US\$ 16.5 billion with an estimated production of 144 million bags. Ninety eight per cent of this production was from International Coffee Organisation (ICO) member countries and two per cent from non-members. For many countries (Figure 2.1), coffee is vital for the wellbeing of the citizens (ICO, 2012).

Timor – Leste, the youngest nation depends on coffee for 70 per cent of her export earnings, Ethiopia depends on coffee for 34 per cent of her export earnings. Brazil and Vietnam the leaders in coffee production, enjoy only a 3 per cent of their respective export earnings. PNG depends on coffee for 4 per cent of her total export earnings (Fairtrade, 2012; International Trade Centre, 2012). Therefore, coffee is economically vital to many nations.

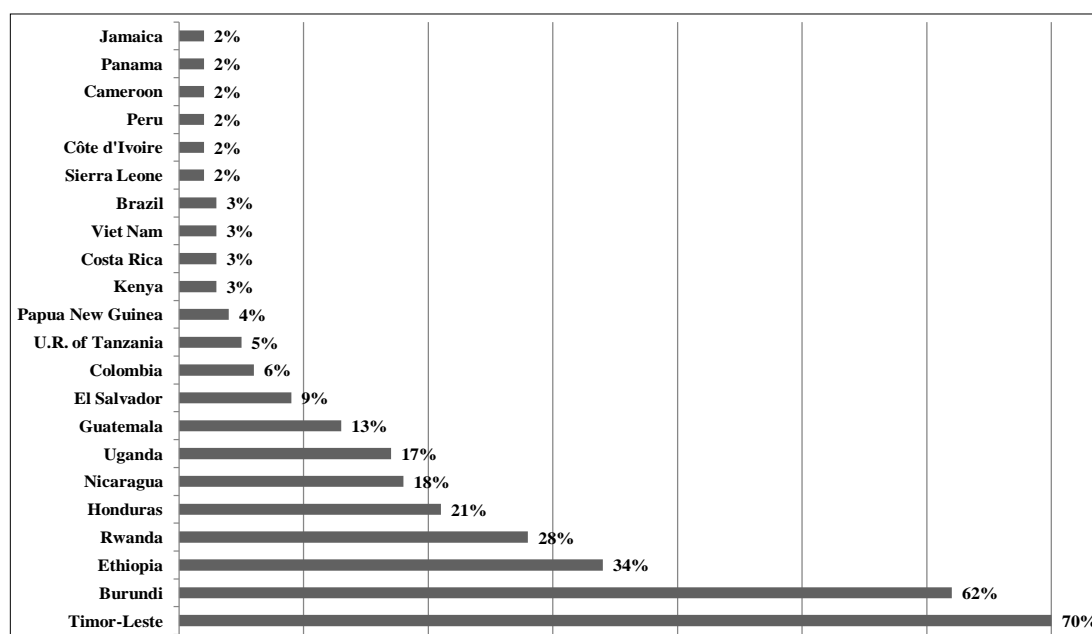


Figure 2.1: Share of coffee in total exports by value, 2005–2010 (Source: ICO, 2012).

2.2 Coffee production

The worldwide annual production is difficult to forecast for production is seen in different forms: (i) production supply - the total production in a crop year plus stock brought over from the previous year(s); (ii) exportable supply - the difference between the amount of coffee consumed domestically and the total volume exported to external markets; and (iii) crop year production - the harvesting and export patterns vary from country to country. In some countries, a whole year can be a cropping year, while in others; there is a definite crop period (International Trade Centre, 2012).

2.2.1 World coffee production trends

The world coffee production has been generally increasing (Figure 2.2). The total global coffee production in 2007 was 116,612,000 bags and reached 144,061,000 bags in 2012. The same trend has been observed in the ICO member and non- member countries. The total production for the ICO member and non-member countries for 2012 was 135,278,000 and 8,783,000 bags respectively (ICO, 2012).

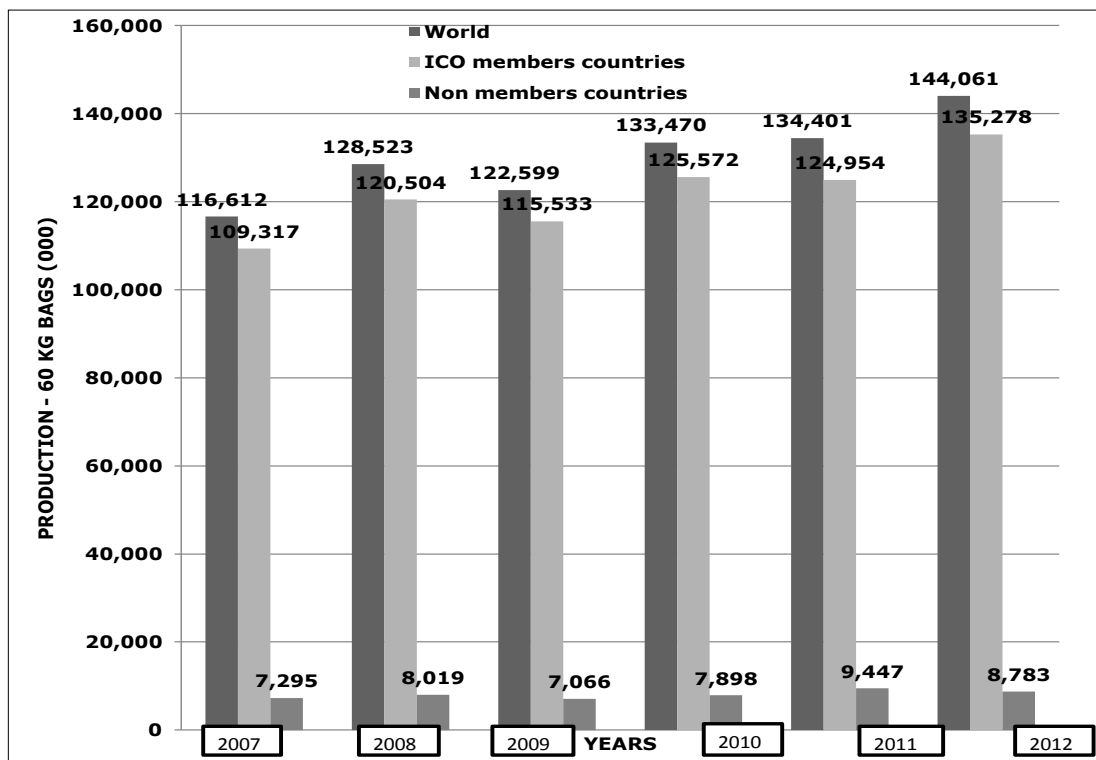


Figure 2.2: World coffee production: 2007 – 2012 (Source: ICO, 2012).

2.2.2 Coffee production by country and by type

In the world of coffee, arabica and robusta are the widely cultivated and traded. In 2012, the production of arabica and robusta was about 64 and 33 million bags respectively. More than 70 countries produce coffee. About 45 countries are significant producers while about 25 countries are categorised as other producers. Coffee producers come under three categories:

arabica, robusta, and arabica/robusta. Twenty-two countries produce coffee arabica, while 12 countries produce both arabica and robusta. About 11 countries produce robusta only. More than half of the world's coffee is produced by three countries: Brazil (33%), Vietnam (13%) and Colombia (8%). Colombia produces arabica while Brazil and Vietnam produce both arabica and robusta. PNG produces both arabica and robusta and is ranked 15th with 1.1 million bags (ICO, 2012). Other leading producers are Indonesia, Ethiopia, India, Mexico, Guatemala, Honduras, Peru, and Uganda. Latin America is the largest regional producer with a 60 per cent share, followed by Asia and Oceania (27%), and Africa (13%) (Fairtrade Foundation, 2012).

2.2.3 Classification of coffee producers

The ICO classifies coffee producing countries into four quality group (Table 2.1): (i) Colombian mild arabicas; (ii) Other mild arabicas; (iii) Brazilian and other natural arabicas; and (iv) Robustas (Internal Trade Centre, 2011).

Table 2.1: Coffee quality group and producers

Quality groups	Producers
Colombian mild arabicas	Colombia, Kenya, United Republic of Tanzania
Other mild arabicas	Burundi, Costa Rica, Cuba, Dominican Republic, Ecuador, El Salvador, Guatemala, Haiti, Honduras, India, Jamaica, Malawi, Mexico, Nicaragua, Panama, Papua New Guinea, Peru, Rwanda, Venezuela (Bolivarian Republic of), Zambia, Zimbabwe
Brazilian/ natural arabicas	Brazil, Ethiopia, Paraguay, Timor-Leste, Yemen
Robustas	Angola, Benin, Cameroon, Central African Republic, Congo, Côte d'Ivoire, Democratic Republic of the Congo, Equatorial Guinea, Gabon, Ghana, Guinea, Indonesia, Liberia, Madagascar, Nigeria, Philippines, Sierra Leone, Sri Lanka, Thailand, Togo, Trinidad and Tobago, Uganda, Viet Nam

Source: ICO, 2012

2.3 Coffee consumption

An accurate record on coffee consumption is impeded by time lags in production, stock movements, emergence of speciality markets, and the coffee forms (green bean, roasted and soluble). Therefore, consumption is categorised by quality: (i) exemplary; (ii) premium; (iii) mainstream; and (iv) low grades. Generally, 80% - 90% of coffee consumed worldwide is mainstream quality. A general consumption trend is based on past records and consumption per capita in major importing, exporting and/or producing countries (International Trade Centre, 2011).

2.3.1 Categories of coffee consumers

Global coffee consumption has been steadily increasing and has reached 131 million bags in 2010 (Fairtrade, 2012). Of this, 69 million bags were consumed in importing ICO member countries, 21 million bags were consumed in non-member countries, and the remaining 41 million bags were consumed in producing countries, led by Brazil (ICO, 2012). Coffee

importing countries are also exporters of processed coffee (Figure 2.3). The USA is the leading importer, although consumption is stagnant. Germany and Japan follow where Japan's consumption has grown by 3.5 per cent a year within the last 10 years. Italy, France and Canada are the next most important consumers, followed by UK and Spain (Fairtrade, 2012; International Trade Centre, 2011).

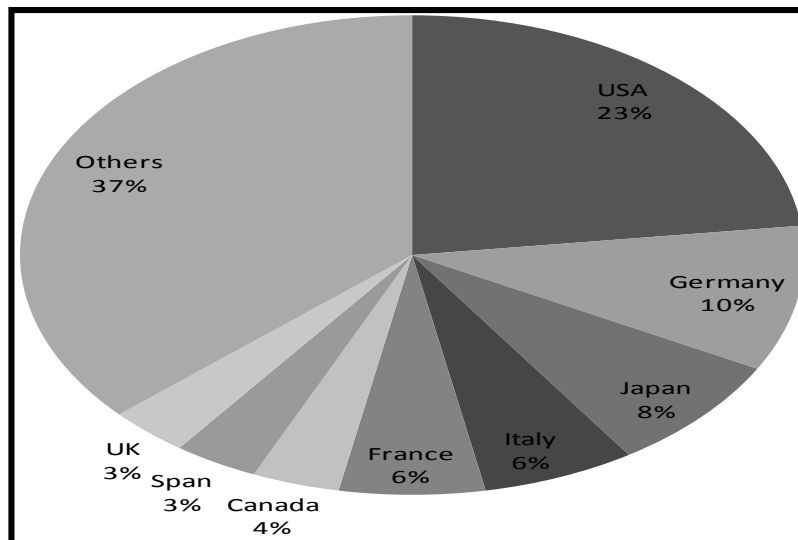


Figure 2.3: Major coffee importing countries (Source: Fairtrade, 2012).

2.3.2 Coffee consumption per capita

The Nordic countries rank highly in consumption per capita: Finland, Denmark, Norway and Sweden (ICO 2012). Although the USA, Germany and Japan are leading importers, their consumption is fairly moderate. Among the producing countries, Brazil is the leader in consumption, while Vietnam and Indonesia remain low. Generally, the ICO estimates about 1.6 billion cups of coffee are drunk worldwide every day (Fairtrade, 2012; International Trade Centre, 2011). Consumption in Third World producing countries such as PNG cannot be established due to lack of data.

2.4 Major coffee traders

The global coffee trade is influenced by nine major traders (Figure 2.4): Neumann, Ecom, Olam, Volcafe, Louis Dreyfus, Noble, Sucafine, Armajaro, and Mercon (International Trade Centre, 2011).

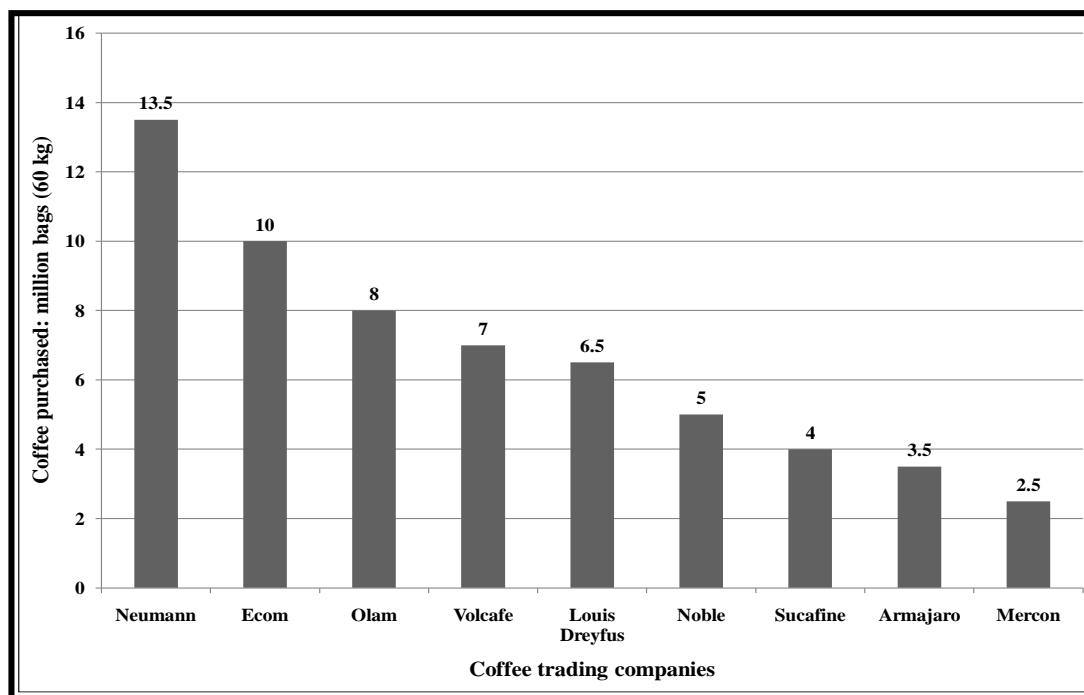


Figure 2.4: Major coffee traders worldwide (Source: ICO, 2012).

Neumann is the leading coffee trader with 13.5 million bags. It has commercial operations in Honduras, Nicaragua, Costa Rica, Peru, Mexico, El Salvador, Brazil, Colombia, Guatemala, Rwanda, Burundi, Kenya, Uganda, Tanzania, Vietnam, Papua New Guinea, and Indonesia (Slob, n.d). Ecom is the second largest with 10 million bags. It operates in 24 countries in five continents (Ecom Trading, n.d, Slob, n.d). Olam is the third with eight million bags. It has offices in most of the large coffee-producing regions including PNG (Olam, n.d). Volcafe is the fourth largest with seven million bags. It has operations in 14 of the top 20 coffee origins worldwide (Volcafe Group, n.d). Louis Dreyfus is fifth with 6.5 million bags and has offices in more than 12 coffee growing countries (Louis Dreyfus, n.d; Slob, n.d).

2.4.1 Coffee roasters and manufacturers

The coffee market is dominated by ten multinational roasters (Figure 2.5). In 2012, Kraft was the leading with 13.5 million bags (mb) followed by Nestle (12.8 mb), Sara Lee (8.5 mb), J.M Smucker (5.5 mb), Elite (3.5 mb), Star bucks (2.7 mb), Lavazza (2.4 mb), Melitta (2mb), Segafredo Zanette (1.9 mb), and Aldi Sud (1.8 mb). Most of the roasters are members of the Community Code for the Coffee Community (4C) and source coffee from Fairtrade Organic, Rain Forest Alliance Certified, and Utz (International Trade Centre, 2011; Cunningham, n.d).

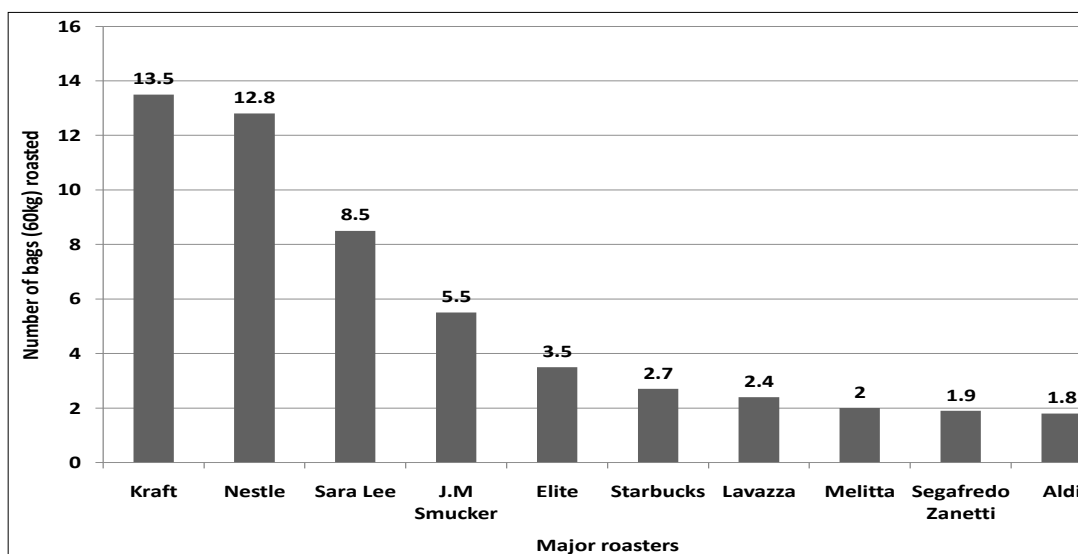


Figure 2.5: Leading coffee roasters worldwide (Source: ICO, 2012).

2.5 Types of coffee markets

The coffee market has three major categories: (i) the conventional and/or futures markets; (ii) differentiated markets; and (iii) sustainable coffee (certifications) (International Trade Centre, 2011).

2.5.1 What is the Futures coffee market?

The Futures market involves legal contracts of delivery on a pre-determined quantity and quality of coffee at an agreeable delivery period and price. It involves buyers and sellers in an open auction and who are willing to trade at a price for a standard quality of coffee to be paid and/or received at a later date. The buyers and sellers are motivated by minimising price fluctuation risks, make investments and ensuring that quality standards are maintained both in the physical coffees and the price paid (International Trade Centre, 2011; Intercontinental Exchange, n.d).

2.5.2 Why a Futures market?

The futures market was originally created to bring order in coffee pricing and to diminish risks associated with the market. Exporters and roasters have created the futures contract market for three reasons: First, the price of coffee at the global market is extremely volatile and risky. Drastic prices changes happen every day due to the imbalance in supply and demand. Therefore, the futures market facilitates coffee price determination. Secondly, price discovery is essential in coffee trade. In the price discovery process, coffee buyers and sellers meet in a competitive marketplace and based on transaction signals, decide on what a given commodity might be worth. Therefore, the futures market monitors and enforces the rules for trading. Thirdly, risk transfer is also an important function of the futures market through

arbitration. There are four futures markets for coffee: New York, London, Singapore, and Vietnam. The New York market mainly deals with arabica coffee while the other three mainly deal with Robusta (International Trade Centre, 2011; Intercontinental Exchange, n.d).

2.5.3 Environment in the coffee futures market

The futures market environment has complex issues including: (i) fixed price- the futures price is an average for individual origin and quality of physical coffee and may be higher or lower. Once a certain quantity and quality of coffee is locked in for a contract, participants cannot abandon the contract; (ii) Liquidity- for survival, the futures market requires an adequate number of participants with competing prices and volume for fluidity and efficiency; (iii) Leverage- in light of price volatility, a coffee buyer does not pay the full market price for each contact, but is paid in small portions to ensure the contract is honoured; and (iv) a significant amount of money and expertise is required. Brokers and banks are a vital part of the business (International Trade Centre, 2011; Intercontinental Exchange, n.d).

2.5.4 Hedging and other operations

Coffee prices are always unstable due to changing weather conditions, unexpected outbreak of pests and diseases, unstable supply and demand, and periodic stock controls. Therefore, all supply chain and/or value chain players such as the producers, exporters, importers and roasters inevitably require risk management strategies to deal with the price volatility. Hedging is one of the strategies that requires experts who can manage risks posed by unforeseen price movements, although hedging does not eliminate risks. Hedging offers a number of advantages: Firstly it allows a producer to lock in a price which according to the producer is profitable. If the market prices fall, the producer is certain of making a profit. However, if the market price rises, the producer will miss out on a larger profit margin. Secondly, it offers a flexible pricing mechanism where in an event of a possible increase in price, an alternative order can be immediately executed at a better price. Thirdly, it involves only small initial amounts of money and is flexible, where if the price of futures goes up, an additional margin can be paid through negotiation and trust/relationship. Fourthly, it provides the necessary confidence for financiers (banks) to finance players in the futures markets; and fifth, it allows commodity banks and brokers to develop risk mitigation which is specific to client requirements (International Trade Centre, 2011; Fairtrade, 2012).

2.6 Differentiated markets

Coffee growers, exporters, roasters, and consumers are developing strategies that are independent of the futures market. These strategies involve differentiating the coffees by origin, variety, flavour, production methods and consumer preferences. Consumer markets for such coffees are small but are growing, thus facilitating the establishment of sustainable and

superior prices that reward coffees produced under sustainable approaches and bring a sense of fairness between the producers, consumers, and the intermediaries. Differentiated coffee markets are rewarding and require understanding on: (i) the market trends; (ii) use of appropriate technology; (iii) distribution and logistical channels; (iv) supply chain management; (v) cohesive cooperatives for competitive advantage; and (vi) relationship management between producers, exporters/importers, roasters, retailers, and consumers. Differentiated coffee can be traded under different names: (i) Geographic indication of origin; (ii) Gourmet and Specialty; (iii) Organic; (iv) Fairtrade; and (v) Eco-friendly or shade grown (Lewin, et al., 2004). Some of these differentiated markets are discussed below.

2.6.1 Geographic Indication of Origin (GIO)

The development of GIO coffee requires a specific farming model such as systematic pruning systems, environment management to preserve the microclimates, and applying specific coffee varietal management practices. Examples of GIO getting premium prices are Jamaican Blue Mountain, Hawaiian Kona, and Guatemala Antigua (Lewin, et al., 2004).

2.6.2 Specialty and Gourmet Coffee

The origin of “speciality coffee” is traced to the US. “Specialty coffee” generally is coffee with great taste and no defects, simply the estate coffees. The term gourmet coffee is interchangeably used with speciality coffee. For gourmet coffee, most of the value adding (branding and packing) is done in the consuming countries although the origin of gourmet coffee is from speciality coffee (Lewin, et al., 2004; International Trade Centre, 2011).

2.6.3 Sustainable Coffees: organic, fair-trade, and rain forest

Sustainable coffees are referred to by labels such as Organic, Fairtrade, and Rainforest Alliance. These coffees are produced by smallholder cooperatives that use farming practices sympathetic to the natural environment. For this, the farmers are rewarded with incentives such as better prices and social development funds (Lewin, et al., 2004). The sustainable coffees are briefly discussed.

Organic

Organic agriculture means holistic farming systems that promote and sustain healthy agro-ecosystem, biodiversity, and nutrient recycling without the use of synthetic chemicals. Organic coffee is supported by both consumers and producers who are concerned about the environment and health. Consumers are willing to pay premiums for organic coffee and producers are motivated by financial incentives associated with the organic products. The real benefit of organic is in the certification programs: before an organic coffee is marketed under the organic certified label, organic farming systems must be practised for at least three years with annual inspections by independent certifiers. The organic certification program is

developed and controlled by the International Federation of Organic Agriculture Movement (IFOAM) (Lewin, et al., 2004; International Trade Centre, 2011).

Fairtrade

Fairtrade is based on dialogue, transparency, respect, and equity to improve conditions of the players involved in the value chain. Fairtrade ensures that coffee is sourced from Fairtrade certified farmers by Fairtrade certified traders. Fairtrade is controlled by an umbrella organization: Fairtrade Labelling Organizations International (FLO). The objectives of the FLO are to: (i) identify and assist eligible smallholder farmers become members of the FLO and obtain FLO certification; (ii) assist small growers to take development into their own hands through employing environmental-friendly farming systems; (iii) ensure small-holders get a premium price and financial incentives for producing organic products, preserving clean water, and promoting good healthcare and education; (iv) developing and promoting Fairtrade labels on retail packaging in consuming countries; and (v) ensure that highest price is paid (Lewin, et al., 2004; International Trade Centre, 2011).

Rainforest Alliance

The Rainforest Alliance exists to conserve trees, wildlife, and the eco-system by promoting sustainable agricultural practices. Rainforest Alliance certification and Seal of approval is based on the Sustainable Agriculture Network (SAN) standards. The conservation of forest and the ecosystem are promoted through three key pillars: (i) environmental protection; (ii) social equity; and (iii) economic viability. Environmentally, coffee farms are required to have at least 70 trees and 12 native species per hectare. Although farmers may use synthetic pesticides and herbicides not prohibited by the US Environmental Protection Agency and the European Union, farmers must maintain buffer zones of natural vegetation between the crop areas and areas used by humans. Socially, child labour is prohibited and fair wages are encouraged per internationally approved standards. Economically, farmers are encouraged to establish a long-term marketing relationship with traders. Rainforest Alliance and SAN provide intensive coaching and training but do not set prices and provide subsidies (Lewin, et al., 2004; International Trade Centre, 2011; Rainforest Alliance, n.d).

Utz coffee

UTZ Certified is an independent organization that promotes sustainable coffee production which sets a 'decency standard' for coffee production and helping growers to achieve it by practising UTZ Certified code of conduct. It has strict criteria for practices that promote protection of the environment and economical farming practices. The implementation of UTZ practices is inspected by independent third-party auditors. UTZ certified believes in: (i) sustainable coffee is achieved by the farmers, thus they should be given the independence; (ii) training of farmers is the key factor for farmer independency in the production of sustainable

coffee; (iii) ensuring accessibility to UTZ certification to any interested players; and (iv) a reliable web-based traceability system along the value chain. UTZ certified is a member of the 4C Association (Lewin, et al., 2004; International Trade Centre, 2011).

2.7 Coffee price movements

Prices of coffee are determined by four key variables: (i) quality - what is the quality of a given coffee or origin; (ii) availability - how much of the particular type of coffee is being offered; (iii) market expectations and speculations; and (iv) currency exchange rates. The futures market monitors prices for four main types of coffee: (i) Colombian mild arabicas; (ii) Other mild arabicas; (iii) Brazilian and other natural arabicas; and (iv) Robustas. The ICO calculates market prices for these four broad groups and monitors price developments for each. The ICO publishes a Daily Composite Indicator Price (DCIP), which is the best price, by combining four of the coffees into a single price representing 'all coffee'. Futures markets are used to offset price risk in the green coffee market where different qualities of coffee are traded. Traders therefore link individual prices with the futures price by establishing a price differential by: (i) the differences between an individual coffee and the standard quality on which the futures market is based; (ii) the physical availability of that coffee; and (iii) the terms and conditions on which it is offered for sale. The free on board (FOB) price is obtained by combining the New York and/or the London Futures price and the differential which enables the market to quote (International Trade Centre, 2012).

2.8 Coffee quality

Quality is a subjective term and means different things to different people. Haarer (1962), Clare (1985), Baker (2001), International Trade Centre (2002) and LMC International (2006) indicate that coffee quality is determined by a number of factors: (i) genetics of the coffee varieties; (ii) geographical locations; (iii) farming practices; (iv) processing techniques; (v) handling and transportation; and (vi) roasting techniques. Quality however, is determined by taste according to consumer preferences. International Trade Centre (2002, p. 245) outlines four quality attributes: (i) suitable for human consumption; (ii) free from extraneous matter; (iii) must conform to descriptions of the selling coffee samples; and (iv) be clean in cup. Clare (1985, p. 355) summarises: 'quality is fitness for purpose'. Batt et al., (2009, p. 5) indicate 'quality is a customer determination based upon the consumer's actual experience with the product measured against the consumer's stated requirement' and has two dimensions: (i) physical description of the product which includes size, shape, colour, pest and disease free, purity, maturity, and freshness; and (ii) functional description which involves the way the product is handled and delivered by the supplier to the consumer.

2.8.1 All coffees sells

Coffee trade consists of different coffee types: speciality coffee, sustainable coffee and mainstream coffee. Even the inferior coffees gets sold. Therefore, the extra effort invested to produce top quality will not necessarily be rewarded with better financial incentives. Big beans with exceptionally good appearances do not always mean they have better cup quality for small bean can also have excellent quality. The essence of quality is understanding what type of coffee consumers want and the ability of the producers and suppliers to make the required quantities available consistently (Batt et al, 2009; International Trade Centre, 2012).

2.8.2 Classification of quality

The ICO segments quality into four categories: (i) Exemplary quality- washed arabicas having high intrinsic value with a unique cup. Their availability is limited and creates a niche market. Examples are Ethiopian Harars, Yemeni Mochas, Indonesian arabicas, and top organic coffee; (ii) High-quality coffees have good cup taste, well presented, but not always perfect. They are retailed as straight origins and as blends. The market for this category is much broader and includes a good percentage of speciality coffee; (iii) Mainstream quality coffee has an average cup quality, but visually not perfect and accounts for 85% - 90% of world coffee consumption; and (iv) Low grade coffees - coffees that do not fit into any of the three categories but have a market (Internal Trade Centre, 2012).

2.8.3 Quality control

Individual coffee producing countries and traders impose independent quality control mechanisms. Green coffees are graded and classified using: (i) altitude and/or region; (ii) botanical variety; (iii) preparation methods; (iv) bean screen size; (v) density of beans; (vi) shape, appearance, and/or colour; (vii) number of defects; and (viii) flavour after roast. Quality standards are implemented using one or combination of the following: (i) government or delegated agencies police the standards through regulations; (ii) in partnership with the local coffee boards, traders police the standards through price offerings; (iii) farmers through cooperatives ensure that the standards are compiled by members; and (iv) consumers ensure that the standards are applied through certification and inspections processes (Internal Trade Centre, 2012).

2.8.4 Quality and hazard analysis critical control points (HACCP)

HACCP is a system of quality traceability along the value chain: the growers, the transporters, and the processors. HACCP is important in coffee due to the presence of kidney damaging mycotoxin, ochratoxin. HACCP involves seven steps: (i) analysis hazards; (ii) identify critical control points; (iii) establish preventative measures; (iv) establish a monitoring and evaluation system; (v) establish a corrective system when a problem is identified; (vi) establish a

verification system to ascertain that a system is working; and (vii) establish an accurate record system of the HACCP system, (Internal Trade Centre, 2012).

2.9 PNG coffee from a market perspective

This section summarises the chapter from the perspective of PNG coffee marketing under four headings: (i) PNG coffee grades; (ii) economic importance; (iii) trade and market routes; and (iv) market chains.

2.9.1 PNG coffee grades

According to CRI (1994), the CIC is responsible for developing independent coffee parchment standards and export grades. The objectives of the parchment standards are to: (i) provide a standard as leverage for the farmers and the buyers to settle for a fair price; and (ii) encourage production of superior quality coffee which should be rewarded with premium price. For this, three standard specifications are used concurrently: (i) parchment foreign matter and defects; (ii) parchment moisture content; and (iii) green bean specifications.

2.9.2 Parchment foreign matter and defects

In this standard, four classes (Table A 1) are used: (i) class 1-premium; (ii) class 2- good; (iii) class 3- FAQ (fairly average quality); and (iv) class 4- rejects. Defects are coffee parchments which are not normal in physical appearance due to damages during processing and handling and/or by pests and diseases. Foreign matter is any substance not derived from coffee cherries (CRI, 1994).

2.9.3 Parchment moisture content

In this standard, four levels (Table 2.2) of moisture content (MC) are used: (i) machine – this parchment should have MC of 9 – 11 percent; (ii) level 1 - should have MC of 11 – 15 percent; (iii) level 2- should have MC of 15- 20 per cent; and (iv) level 3- with MC of 20 – 30 per cent (CRI, 1994).

Table 2.2: Moisture content of parchment

Levels	Moisture (percentage)	Measure
Machine	9- 11	Very hard. No teeth marks
1	11- 15	Hard only with slight marks with teeth
2	15-20	Soft black appearance – Easy mark with teeth
3	20-30	Very soft black. Crushes with teeth

Source: CRI, 1994

2.9.4 Green bean specifications

For export green bean coffee, standards are assessed using grades: AA, A, AB, B, C, PB, X, Y1, Y2, and T (Table A 2). AA – X grades are regarded as plantation coffee while Y1 is defined as having more than 70 defects per kilogram. Y2 is the grade that has maximum of

150 defects per kilogram. Any green bean consignment having more than 150 defects is categorised T grade. Any coffee grades that fall below the T grade specifications are regarded as “rejects”. All the grades are assessed using four criteria: (i) screen bean size; (ii) uniformity of the sizes; (iii) total defects; (iv) raw bean colour; and (v) odour (CRI, 1994).

2.9.5 Enforcement of green bean grades

The CIC employs quality inspectors to view current contract of exporters, issues certificates of verifications on the grades and reclass any coffee that has not followed the rules. Further, the coffee inspectors randomly visit processing sites to ensure that the processors are classifying the coffee correctly. Coffee samples of every shipment is cupped by experienced liquorers and report on any faults associated with that shipment. This report is also used to assess harvesting, fermenting, washing and drying processes (CIC, 1994; Batt, et al., 2009).

2.9.6 Difference between PNG plantation grade and the smallholder coffee

The plantation sector produces the top quality PNG coffee. The plantation grade falls within the green bean categories of A, B, PB, X, and C. This implies that the plantations strictly follow recommended agronomy and postharvest practices. Smallholder coffee however is classified “Y” due to the large variations in the screen sizes; a high number of defects and the cup quality is mild with possible off-flavours (CRI, 1994). Although the smallholders have created another grade Premium Smallholder Coffee, (PSC), which should contain a minimum of 35 defects per kilogram, the green bean sizes may not necessarily have improved. Therefore, there is a significant cost for the processors to sort smallholder coffees. Since the smallholders produce 85 per cent of the PNG coffee, the inherited quality problems contribute to the poor quality, thus the significant (15 – 20 %) discount price for this coffee in the New York market (Batt et al., 2009).

2.9.7 Quality issues of PNG coffee

According to the CIC records over the last six years (2005 – 2011), coffee quality from the smallholder sector is inconsistent. Although cup quality for 2010/2011 crop was comparatively better, it had been inconsistent between the crop periods 2006/2007 and 2008/2009 (CIC, 2012). Further, better coffee prices in 2010/2011, and 2011/2012 did not necessarily facilitate production of better coffee; quality was still poor (J. Edwards, 2013 pers. comm., 25th February, 2013). To address this quality issue, encouraging development of cohesive groups at the village level and developing central wet mills (in remote areas) and linking these groups to the existing traders is recommended (Batt et al., 2009).

2.10 Economic importance and production

The coffee industry in PNG is vital to the rural economy. The coffee market in PNG is highly competitive, with smallholders receiving 70 per cent of the free on board (FOB) price (Batt et al., 2009). In 2011, PNG produce 1.2 million 60 kilogram green bean bags which earned K926.5 (A\$ 500) million and accounted for 31.4 per cent of the total agricultural export earnings. The high production has been attributed to favourable weather conditions and better domestic and global coffee prices. According to the trend of PNG coffee production (Figure 2.6), the 2011 production was 68 per cent higher than 2010, and 54 per cent higher than the average production of 2006 – 2010 (CIC, 2012).

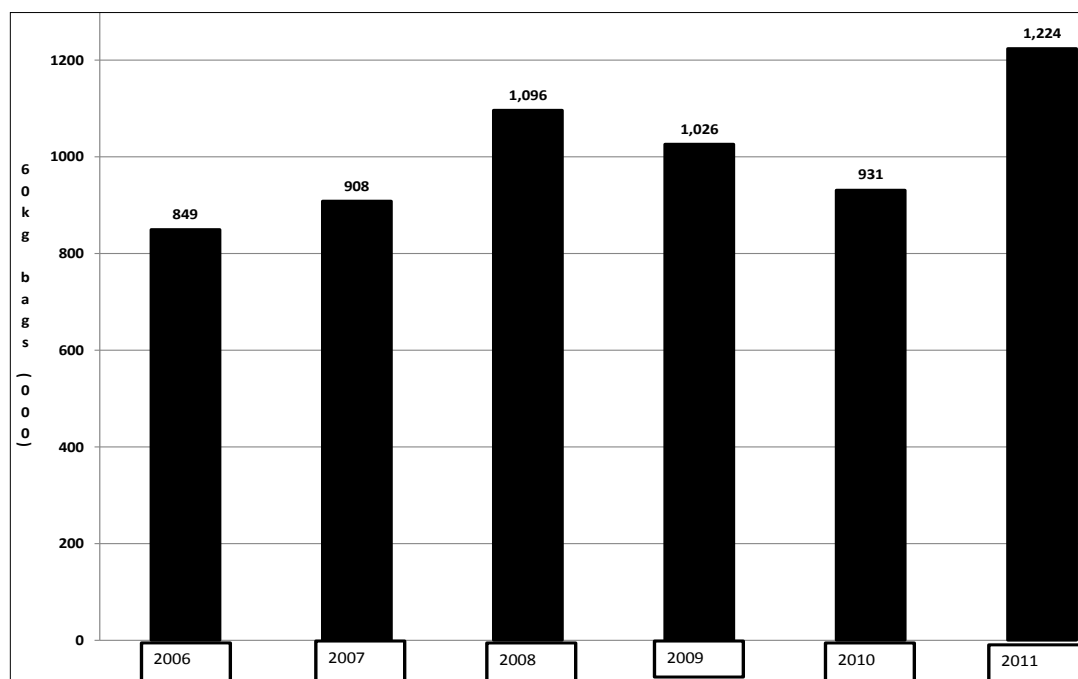


Figure 2.6: PNG coffee production trend from 2006 - 2011. (Source: CIC, 2012).

2.10.1 Production by provinces

Production in the major coffee growing provinces for 2011 was (Figure 2.7): EHP 695,312 bags (46 %); WHP 543, 893 bags (37 %); Morobe 91, 051 bags (6 %); Chimbu – 71, 174 bags (5%); Enga – 62, 928 bags (4%); and others - 24,394 bags.

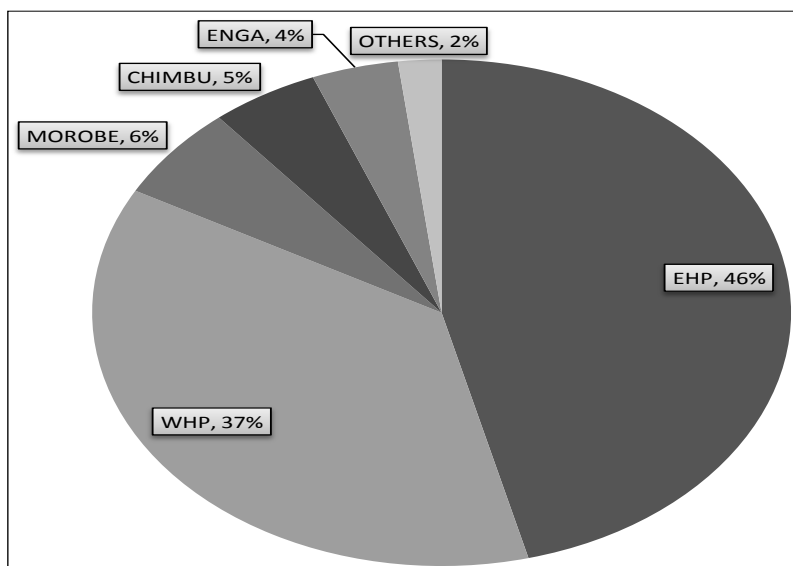


Figure 2.7: Production by provinces in 2011 (Source: CIC 2012).

2.10.2 Production by sector

Comparing sectoral production (Figure 2.8), the smallholder sector produced 82%, followed by blockholders 13% and the plantation sector (5%) (CIC, 2012). Production from the plantation sector continued to decline due to land pressure, law and order and poor roads (Batt et al; 2009).

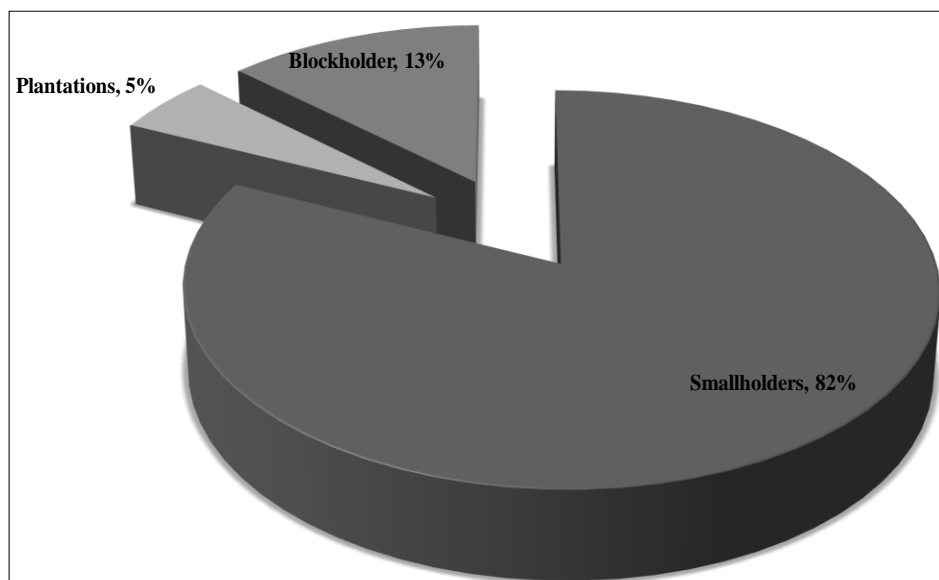


Figure 2.8: Production by sector: 2012 (Source: CIC 2012).

According to the records of the CIC which dates back to 1959, in terms of production the smallholder section has increased its relative share of production since the 1970s when compared to the production of the estate sector (Figure 2.9). Plantations were established prior to introducing coffee to the smallholders. The block-holder sector (advanced smallholder farmers having more than five and less than 30 hectares of coffee) was established in the 1980s

to encourage production of quality coffee by advanced smallholders. Currently both the plantation and the block-holder sectors are struggling to survive due to law and order and land pressure issues (CIC, 2012; Batt et al., 2009).

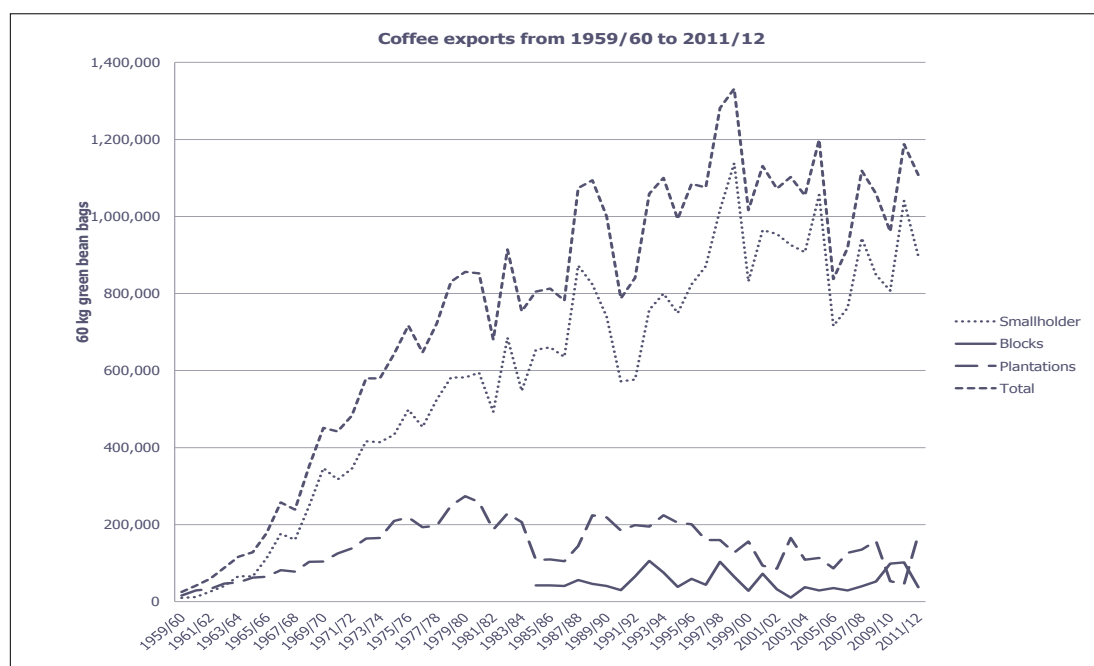


Figure 2.9: PNG coffee export trend by sector – 1960 – 2012 (Source: CIC, 2012).

In the last six years (2006 – 2011), production (Table 2.3) in the Block-holder sector has improved slightly, while there was a steady increase in the smallholder sector. The differences in the production and exportable grade are due to stocks withheld or released (CIC, 2012).

Table 2.3: Coffee production by sector, export volume and income from 2006 -2011

Sectors	2006	2007	2008	2009	2010	2011
Estate sector	128	185	148	151	132	264
Smallholder	675	803	904	927	751	1224
Total production (Green bean: 000 of bags)	803	988	1052	1078	883	1488
Export volume (Green bean: 000 of bags)	849	908	1096	1026	931	1224
Income (Millions in Kina)	491	338	409	509	460	926

Production and export volume in 000 of bags, income in millions of Kina

Source: CIC 2012

2.10.3 Exports by grades

The leading export grade for PNG coffee is Y1 indicating the dominance of smallholder coffee. In 2011 (Figure 2.10), Y1 grade was the leading export grade with 780,443 bags representing 63.7 percent of the total production. There was also an indication of smallholders making improvements: PSC was the second export grade with 150,346 bags, representing 12.3 percent; X-grade was 87,614 bags (7.2 %); and A – grade was 47,551 bags (3.9%). The export of top quality coffee is low, due to the decline in the estate sector. Y3 grade export was 61,816

(5%), implying a significant presence of poor quality coffee. Robusta export was 4,560 bags (0.4%) (CIC, 2012).

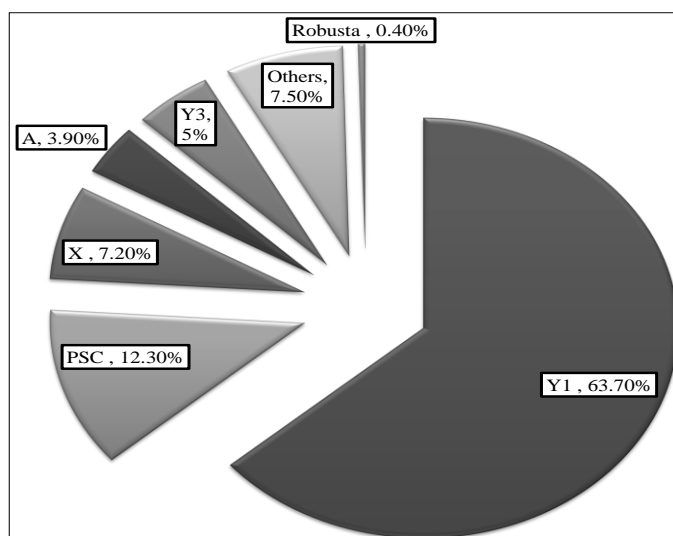


Figure 2.10: Export by grades: Arabica (Source: CIC, 2012).

2.10.4 Exports to destination by grades

For the mainstream market, PNG has four major export destinations: Germany, the United States, Australia, and Japan. For the differentiated markets, nine export destinations exist: Sweden, Belgium, Netherlands, Germany, US, Australia, New Zealand, South Korea, and United Kingdom (UK). However, three countries: Germany, US, and Australia purchase all the grades and types, with Germany imported the highest volume (Table 2.4).

Table 2.4: Green bean export destination of PNG coffees

Destinations	AA/A (%)	AX/X (%)	PSC (%)	Y1 (%)	Y3 (%)	R (%)	Others *(%)	RFA/ Utz Bg	FT Bgs	FTO Bgs	O Bgs
Japan	12.6	2.2	32.0	4.2	-	-	0.6				
Germany	4.4	9.5	10.5	60.6	30.6	13.6	45.1		720	9,280	3,660
United States	41.6	66.9	10.3	19.5	2.0	-	23.8	920	320	2,480	5480
Australia	30.0	14.1	27.9	8.5	42.1	24.1	15.0	2,260	420	6,060	2400
Others	11.4	7.4	19.4	7.2	25.4	62.3	15.4				
Sweden											
Belgium								2,160	1,800		
Netherlands											300
New Zealand								8,600		2,860	95
South Korea										300	320
UK								900		2,415	300

*R= Robusta, * Y2 and T, FRA= Rainforest Alliance, FT= Fairtrade, FTO= Fairtrade Organic, O= Organic,*

Source: CIC, 2012

Exports of the differentiated coffee are on the increase with 54,690 bags, generating K27.85 million (AUS\$ 14 million) in 2011. This represents Rainforest Alliance and Utz Certified (14,840 bags), Fairtrade (3,260 bags), Fairtrade Organic (23,395 bags), and Organic (13,195 bags) (CIC 2012).

2.10.5 Main exporters in PNG

There are 16 major exporters (Figure 2.11). However, 80 per cent of the export market is dominated by only four exporters: (i) New Guinea Highlands Coffee (33%), (ii) PNG Coffee Exports (29%), (iii) Monpi (14%) and (iv) Nuigini Coffee Tea & Spice (6%).

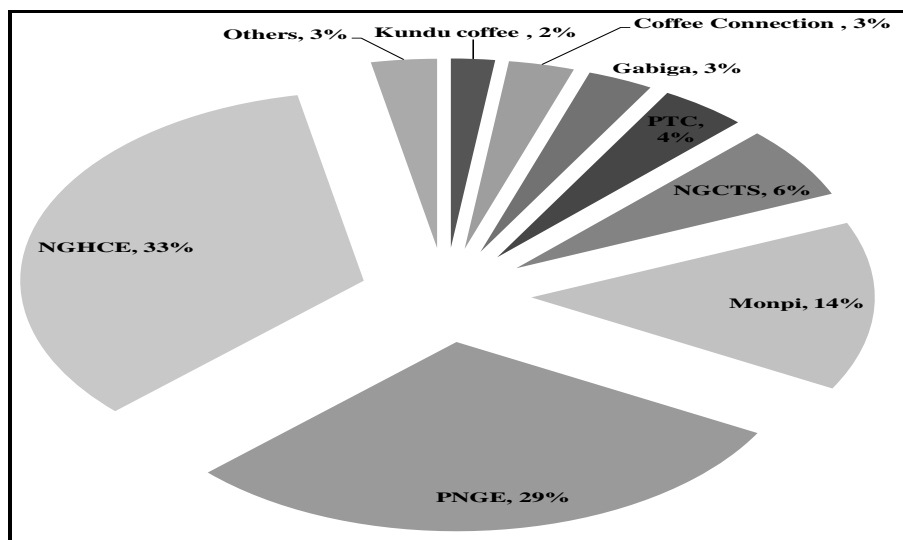


Figure 2.11: PNG coffee export trend by sector – 1960 – 2012 (Source: CIC, 2012).

Most of the exporters are representatives of the multi-national traders with the exception of few a nationally owned firm such as Kongo Kopi. Neumann is represented by New Guinea Highlands Coffee Exports (NHCE) (Neumann Kaffee Gruppe, n.d), Ecom is represented by Monpi Coffee Exports (Ecom Trading, n.d, Slob, n.d), Olam coffee is represented by Yauka Kopi (Olam, n.d), and Volcafe is represented by PNG Coffee Exports (Volcafe Group, n.d). Although Louis Dreyfus is present in EHP (Norikori), there is no export representative (Louis Dreyfus, n.d; Slob, n.d). Noble, Dreyfus, Armajaro, and Mercon are yet to have export representatives in PNG.

2.10.6 Roast and ground coffee

Roasting and grounding of coffee is done by a few companies (Figure 2.12): (i) Goroka Coffee Roasters (GCR) (68%); (ii) Arabicas (25%); and (iii) WR Carpenters (7%). Although Kongo roasts some coffee for domestic use and export, its figures cannot be established. Exports of the roasted coffee had been destined to: (i) Australia (67%); (ii) Canada (14%); Fiji (9%); Hong Kong (9%); Solomon Island (6%); and New Zealand (4%). In 2011, roasted coffee exports generated K0.31 million (CIC, 2012).

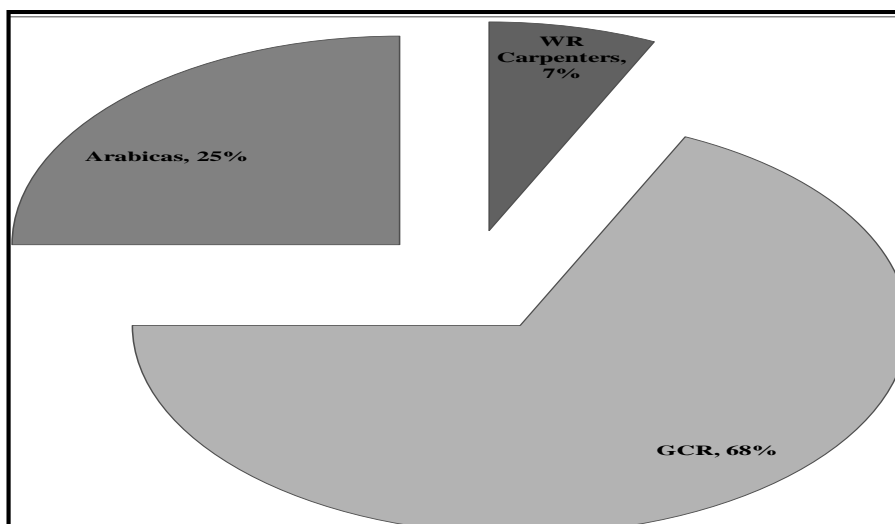


Figure 2.12: Market share of roast and ground coffee (Source: CIC 2012).

2.11 The marketing routes and chains in the coffee trade

The presence of the multi-national coffee traders provides the opportunity for the CIC and the farmers to address the problem: 15-20% discount at the NYC market. For this, the formation of farmer groups and linking them with exporters for cherry and/or parchment trade is encouraged. The traders who have connections to speciality markets such as the Organics, Utz Certified and Fairtrade, transfer premium prices for quality to the farmers through creating market chains. Currently, organic farmers are realising a 32 per cent premium (FOB) over Y grade. The formation of collaborative marketing groups is necessary for the consistent and reliable delivery of good quality parchment. Three types of markets chains are emerging: (i) Speciality cherry chains; (ii) Fair-trade/organic chains; and (iii) smallholder cooperatives producing PSC coffee (Batt et al., 2009).

2.11.1 Speciality cherry chain

The leaders of the speciality cherry chain (Figure 2.13) are subsidiaries of multinationals and some leading PNG companies. These chain leaders own wet and/or dry coffee factories and source cherry from block holders and/or larger smallholder farmers with the objective of systematically converting the cherries into plantation standard coffee for the differentiated market for high prices.

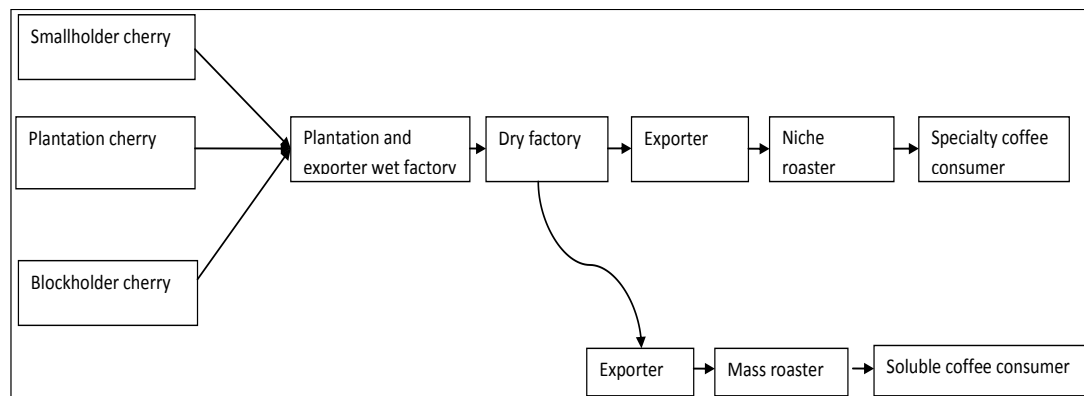


Figure 2.13: Specialised cherry chains (Source: Batt et al. 2009).

Although smallholder cherries are organic, they are poorly processed. Therefore, chain leaders process these cherries according to industry standards to produce top grade green beans. Cherry prices have been better than Y1 parchment prices, with farmers receiving a 34 per cent premium (Batt et al., 2009).

2.11.2 Fair-trade and organic chains

The presence of Fairtrade and organic chains has accounted for a three per cent increase in exports to the speciality market since 2008. The prices receive by the smallholders farmers under the Fairtrade and organic markets are equivalent to plantation grade coffee (CIC, 2008). In 2012, coffee exported to the speciality markets (Fairtrade, Rain Forest Alliance, UTZ, and organic) accounted for 4.5 per cent of the total exports (CIC 2012). Only a few local based companies participate in the Fairtrade and Organic markets. However, those companies (e.g. Coffee Connections, Monpi and PNG coffee exports), who have successfully affiliated with Fairtrade and organic buyers, form linkages with farmer cooperatives at the village level (Figure 2.14). To maximising volume, 3-5 cooperatives are part of the market chain. Each cooperative is made up of several villages that in turn have several family units. Each family unit has a number of households who are made up of individuals. Each individual is registered as a member of the cooperative, thus he or she is a registered member of the Fair-trade and organic market chain. Several central cherry processing factories have been established in the villages to process smallholder cherries. These factories are managed by technical officers employed by the chain leaders. The parchment coffee is then supplied to the chain leaders who further process them for the Fairtrade and organic markets (Batt et al., 2009).

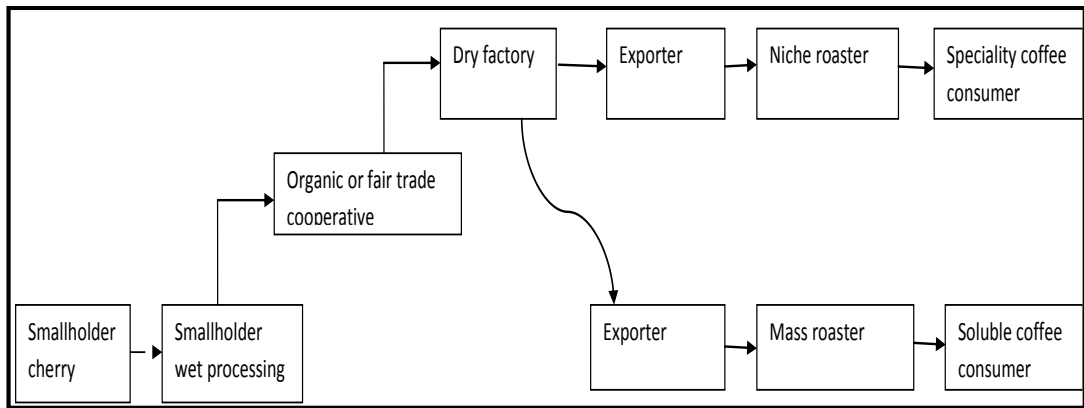


Figure 2.14: Fair-trade and organic chains (Source: Batt et al., 2008, p.30).

2.11.3 Smallholder cooperative groups producing PSC coffee

Farmer groups organised through the Farmer Demand Driven Extension (FDDE) and Coffee Credit Grantee Schemes (CCGS) have formed cooperatives to improve coffee quality and maintain supply so that the group coffee is bulked up and sold through tender to the highest bidder and exported through the existing traders (Figure 2.15). The groups are formally trained by the CIC and farmers apply the knowledge and skills acquired. The coffee parchment obtained from these groups is processed through a processor and/or exporter and the green beans are sold through tender. However, there is no long-term agreement with exporters who can in turn provide the quality assessment of the cooperative coffee. Therefore, inconsistency in both quality and quantity still persists (Batt et al., 2009).

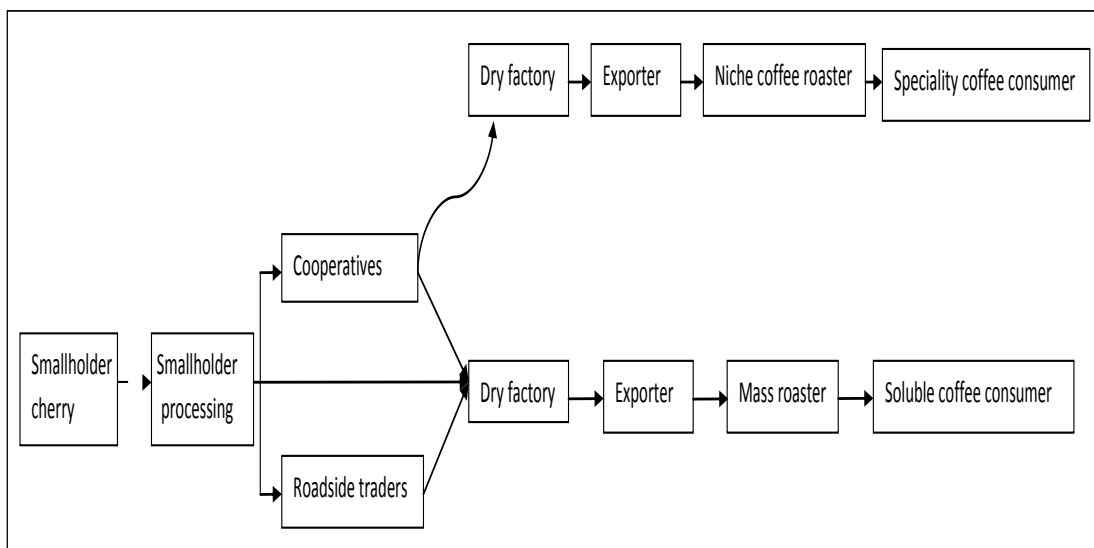


Figure 2.15: Smallholder cooperative chain (Source: Batt et al., 2008, p. 32).

2.12 Summary

The main motivational factors for the PNG smallholder farmers in applying improved postharvest and agronomic innovations are to increase production of better quality coffee in order to realise better prices. From the outset, it is clear that the PNG smallholder coffee is predominantly (80%) Y grade (inferior coffee according to the PNG coffee parchment and green bean standards). Globally, the market share of PNG coffee is small reflecting its low volume and further it is greatly discounted by 15 – 20 percent at the New York coffee market. However, domestically, the world leading coffee exports are well represented by multinational coffee exporting agencies and/or companies. These exporters provide the opportunity for the smallholder coffee farmers to form collaborative marketing groups (CMG) and to form a strategic alliance with reputable exporters of their choice. The farmers' motivational factor for meaningfully applying the improved agronomic and postharvest innovations acquired during the training programs is to realise an incentive price for quality and this objective can be achieved through the formation of strategic alliance with traders. The coffee traders in PNG also provide a number of options which the farmers CMG can realise: (i) the CMGs easily accessible by road to the nearest wet processing factories are able to sell cherries at a better price (36%) than parchment price; (ii) the CMGs who are unable to reach the exporter's wet factories within 48 hours are able to construct for themselves convenient wet factories and collectively process their coffee. Improved parchments can be traded for better prices; and (iii) the CMGs are able to participate in some speciality markets such as Fairtrade through their strategic alliances and premiums can be realised. In this way, the farmers will be continuously motivated to apply the improved innovations acquired. The formation of CMGs is a challenge for many smallholder farmers and it is therefore necessary that the CIC assists the farmers to develop this CMGs. In order to develop sustainable CMGs, it is vital to understand the principles of agricultural extension and the dynamics of how groups operate. The next chapter reviews the literatures on agricultural extension.

Chapter 3. Systems of agricultural extension

This chapter begins by defining extension. Extension models and systems within the continuum of extension are reviewed. The processes of technology diffusion, adoption, and the impacts of farmer group mobilization on innovation adoption are covered. Principles of adult learning are reviewed. The chapter concludes by synthesising the literature in the context of the extension approaches that were used by the Coffee Industry Corporation (CIC) in Papua New Guinea (PNG).

3.1 What is agricultural extension?

The FAO (1984), DAL-PNG and ABD (1991), Mark and G.A.B (1994), and Connelly (2004) have all defined agricultural extension. However, a more practical definition is borrowed from Leagans (1961), by Donald & Joan (1994, p. 1):

The process of extension education is one of working with people, not for them; of helping people become self-reliant, not dependent on others, of making people the central actors in the drama, not stage hands or spectators; in short, helping people by means of education to put to use useful knowledge that works for them.

Van den Ban and Hawkins (1996) describe extension as involving the conscious use of information to help farmers make good decisions. Byrn et al. (1976) indicate that the role of extension is to educate the people to understand that they are an agent of change and are able to influence their communities by addressing their immediate problems through application of acquired technology.

3.2 Models of extension

Within the continuum of extension models, two paradigms of extension approaches have been widely used: top-down and bottom-up. The driver of the top-down approach is technology, while the driver of the bottom-up is farmer motivation.

3.2.1 Top-down extension models

Top-down extension models involve the transfer of technology from a knowledge and technology reservoir to a potential adopter. The technology reservoir may be an information and technology generator such as a research institute, university and/or a government department. Potential information adopters are the farmers. Examples of top-down models are: (i) Technology Transfer; (ii) Farmer Feedback; and (iii) Training and Visit. Each is briefly described below.

i) Technology Transfer Model

In the Technology Transfer Model (TTM), the farmers and information reservoirs/generators are linked via an extension agent (Sermana, 1993) (Figure 3.1). Technology can mean processed information, experiential knowledge and/or wisdom (Evans and Gruba, 2007), and innovation (Van den Ban and Hawkins, 1997; Soanes and Hawker, 2006).



Figure 3.1: Technology Transfer Model (Source: FAO, n.d).

A major weakness of the TTM is that the farmers are not involved in planning and implementing the research at the farmers' level. As farming systems are complex, the technologies are often irrelevant to local conditions (FAO, n.d; Hagmann et al., 1999).

ii) Farmer Feed-back Transfer Model

Farmer Feed-back Transfer Model (FFTM) (Figure 3.2) was developed to address weaknesses in the TTM where Extension Officers (EOs) were allowed to update the information generators about farmers' perceptions and attitudes towards the technologies. However, the information often stopped with the EOs.

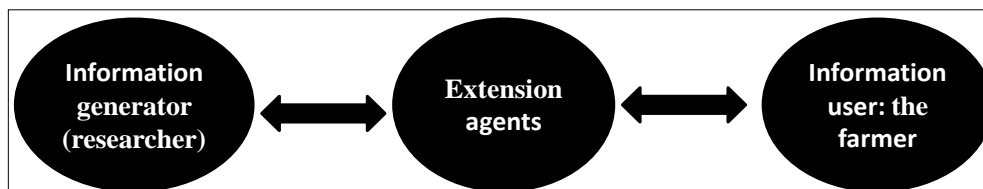


Figure 3.2: Farmer Feed-back Transfer Model (Source: FAO n.d).

iii) Modified Farmer Feedback Technology Transfer Model

The Modified Farmer Feedback Technology Transfer Model (MFFTTM) was developed to address deficiencies in the FFTM by placing a greater emphasis on identifying target farmer groups. It assumes that farming systems, research, extension and evaluation begins and stops with the farmers, while the scientists and extension agents play only a facilitative role (Figure 3.3). The MFFTTM involves problem identification, problem definition, developing possible solutions to potential problems on research sites, and the adaptation of research results to farmers' conditions. This is followed by technology adoption, monitoring, and evaluation (FAO, n.d).

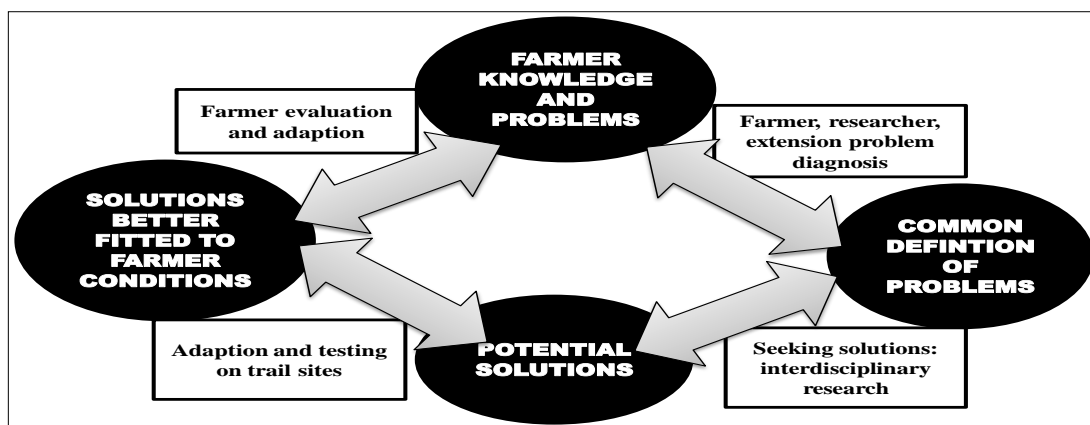


Figure 3.3: Modified Farmer Feedback Technology Transfer Model (Source: FAO, n.d).

(iii) Training and Visit Model

For a more effective diffusion of innovation, the Training and Visit model (T&V) was developed and promoted by the World Bank in the late 1970s with the motto “Grow food, more food, and only food” (Uwe, 1998; Verma, 1998; Scoones & Thompson, 2000; Anderson et al., 2006). T&V was developed based on a Turkish extension experience. It was first trialled in India by the World Bank (Gerster, 2006), and eventually spread throughout the Asia Pacific region (Van den Ban & Hawkins, 1997; Anderson et al., 2006). One of the disadvantages of the T&V extension approach is that it had a high operational cost in terms of the need to fund a well defined and a huge management structure. By design, each layer of the structure (Figure 3.4) required adequate resources and associated funding that went with it. The World Bank was able to fund the T&V systems but when the Bank ceased funding, the continuity of the T&V was left to the implementing countries and agencies. However, most third world countries were unable to secure adequate funding for the operations of the T&V system and as a result the T&V system was not sustainable (Gerster, 2006; Anderson et al., 2006). The operations of the T&V were based on a defined management structure which included a general manager supervising the entire operation assisted by a number of regional managers who in turn supervised a number of provincial coordinators (PCs). The PCs had a number of Extension Officers (EOs) placed at the districts to manage a number of coffee management divisions. The link between information generators and the extension agents was provided by a number of subject matter specialists who specialised in information packaging and training the EOs. The EOs were responsible for on-train the farmer trainers, who would then on-train the farmers. At these levels, adequate resources such as vehicle, fuel, camping gears and rations, accommodation costs, service provider fees etc were required.

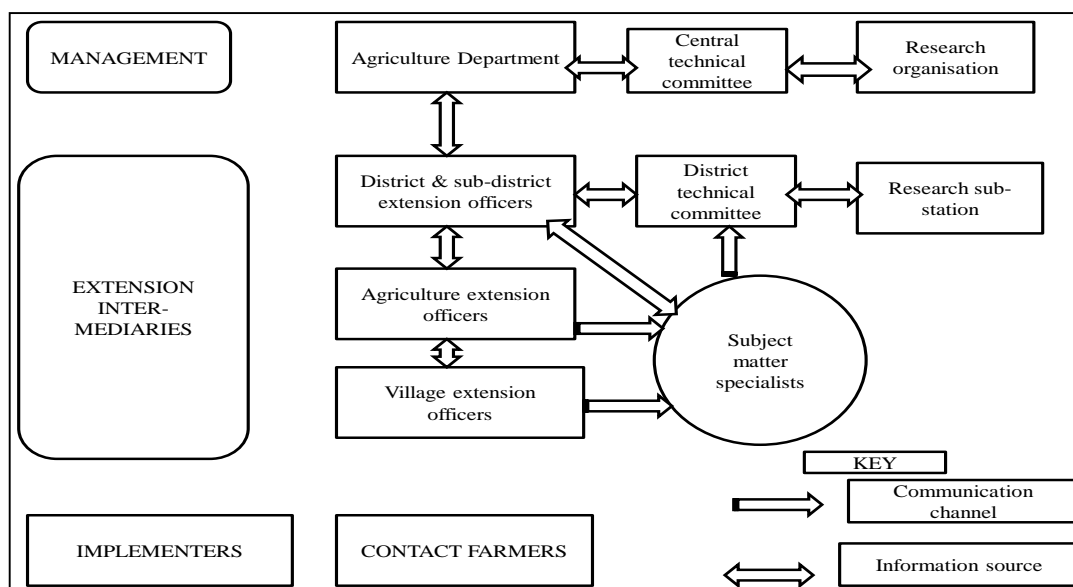


Figure 3.4: Linkage between T&V extension, research and farmers (Source: Adapted from Feder & Slade, 1986).

3.2.2 Bottom-up extension models

The bottom-up models are based on the idea that people are the source of knowledge. It assumes that people know their problems and the solutions that will work well. Therefore, technologies offered by extension workers should be tailored to meet the needs and aspirations of the farmers.

(i) Farmer Participatory Approach

The Farmer Participatory Approach (FPA) relies on the involvement of researchers, extension agents, and farmers. While there are many definitions for participation, Van den Ban and Hawkins (1996, p. 218) define participation as:

‘Farmers or their representatives participating in the organization of the extension services, in making decisions, in setting goals for target groups, and in evaluating extension activities’.

A distinctive feature of the FPA is that the farmers are in groups (Van den Ban and Hawkins, 1996). The FPA involves a cost sharing strategy where the farmers contribute in cash and/or in kind towards funding the extension services, while the extension organisation contributes by getting the program going (Jules and Simplice, 1998; CIC, 2006). The key characteristics of the FPA are: (i) community mobilization, (ii) equal partnership; (iii) group empowerment; (iv) participatory learning; (v) equality and self-reliance; and (vi) the group as an agent of change (Hagmann et al., 1999). In addition, Jules and Simplice (1998) indicate that the FPA approach has the following features: (i) a defined methodology of problem identification and a systemic learning process; (ii) farmer problems are screened from a number of perspectives; (iii) the technologies delivered to the farmers are context specific; (iv) farmer problems are addressed by expert facilitators and through stakeholder involvement; and (v) farmers own the

extension problem which leads to sustained action(s). FPA views research, development and the extension process as both cyclic and interactive, involving cooperation from a wide range of key stakeholders such as farmer groups, extension agents, researchers and government and non-government organisations.

(ii) Participatory Rural Appraisal and Planning

Participatory Rural Appraisal and Planning (PRAP) is now widely used in many developing countries (Jules and Simplicie, 1998; Selener, Endara, and Carvajal, 1999). The PRAP approach identifies problems within the communities. Farmers are encouraged to be in groups and are guided by external facilitators to describe and analyse group problems, identify solutions to problems, design programs and develop implementation schedules (Jules and Simplicie, 1998).

(iii) Farmer Demand Driven Extension

Farmer Demand Driven Extension (FDDE) is gaining momentum as an alternative extension program in Africa and the Asia Pacific regions (Qamar, 2004). Qamar indicated that extension activities and preparation for demand-for-service is done by rural farmer groups with the EOs facilitating the planning process. The extension planning takes place at the farmer sites, involving farmers, extension agents, scientists and financiers. Chris (2004) observed that the FDDE approach is based on a strong partnership between the farmers, the government and the private sector. Farmers require initial government assistance to pay for the needed extension services and over time, the farmer groups may have the capacity to pay for such services themselves. The strength of the FDDE is with the farmers groups, as these groups are more manageable in terms of resource mobilisation and problem solving. Planning and execution of the FDDE is lengthy and bureaucratic, but is necessary for the purposes of accountability and planning (CIC, 2004). However, based on experiences on the FDDE in Africa, Chris (2004) highlighted six threats that may hinder the success of FDDE: (i) weak commitment by government agencies to the farmer groups and long-term follow-up; (ii) the diverse interests by farmers and inadequate resources to meet these demands; (iii) a lack of confidence and incompetency among service providers; (iv) conflict of interest with regards to the responsibilities of government and public service agencies; (v) misappropriation of project funds; (vi) uneven distribution of services to farmers; and (vii) budgetary support is necessary for capacity building and for the success of FDDE.

3.3 Extension systems

Four extension systems are reviewed: (i) public; (ii) commodity-based; (iii) commercial/private; and (iv) partnership extension.

3.3.1 Public extension

Public extension systems are ministry-based, facilitating technology transfer to farmers by government extension agents (Uwe, 1998; Donald and Joan, 1994). The main problem with public extension systems as noted by Donald and Joan (1994) is that of not doing enough, not doing it well, and not being relevant. This problem arose because agricultural extension organisations focused on supporting the production of marketable and/or export crops (Axin and Thorat, 1972). Donald and Joan (1994) and Uwe (1998) further indicated that public extension has not reached the vast majority of the rural population, due to financial constraints and because EOs, often with minimal qualifications, were given multiple responsibilities. Effective extension was also impeded by high levels of illiteracy and the remoteness of target communities.

3.3.2 Commodity-based extension

Commodity-based extension aims to facilitate an increase in volume and/or to improve the quality of agricultural products such as cash crops and livestock (Uwe, 1998). Donald and Joan (1994) indicated that the costs involved with commodity-based extension are paid for by the private sector or through public-private-partnership (PPP) extension where specific commodity-based technology is delivered to the farmers, but operations are funded by the public and donors (DAL-PNG and ADB, 1991).

3.3.3 Commercial and/or privatized extension

Commercial extension is common among the private sector and is driven by the motive of making profit, (Qamar, 2005). Commercial extension is a marketing strategy developed by agricultural organisations and individuals to sell agricultural inputs or provide consultancy services to farming communities. Commodity traders develop private extension with the aim of procuring better quality farm produce from the farmers in order to meet specific market requirements (Uwe, 1998).

3.3.4 Partnership extension systems

A further modification to the commercial extension approach is the partnership extension system, which involves building a cordial extension relationship between the farmers and technology and/or financial companies. Both the technology developer and the farmers are important partners in the sustainability of the extension relationship. Partnership extension, also known as an out-grower scheme, involves commercial arrangements between an agricultural company and the farmers. The farmers supply a certain quantity and quality of crops or animals to the company that they are affiliated with. In return, the company provides the farmers with farm inputs, finance, training and market accessibility (Felgenhauer and Wolter, n.d). Agricultural companies who participate in out-grower extension schemes are

often multinationals or government funded organisations and have well established marketing networks.

3.4 Technology diffusion and adoption

This section discusses: (i) innovation; (ii) diffusion; (iii) the innovation adoption process; (iv) innovation adopter categories; (v) group mobilization and innovation adoption; (vi) infrastructure; and (vii) literacy.

3.4.1 What is innovation?

‘Innovation is an idea, a method or an object which is regarded as new’ (Van den Ban and Hawkins, 1996, p. 96). Innovation is the production of technology and knowledge, which is essential to: (i) assist agricultural managers to make decisions; (ii) improve farmers’ well-being through training; (iii) assist in the development of new farming systems and practices; and (iv) help improve farmer cooperatives (Van den Ban and Hawkins, 1996). Rogers and Shoemaker (1971) outline the characteristics of an innovation that facilitate its adoption: (i) relative advantage - can the farmer achieve better results using the innovation as compared to previous practices; (ii) compatibility - will the innovation be tolerated and accepted socially and culturally; (iii) complexity - can the innovation be easily applied by the farmers; (iv) trialability - can the innovation be trialled on a small scale before up scaling; and (v) observability - will the impact of the technology be physically seen by the farmers?

3.4.2 What is diffusion?

Diffusion is the process by which innovations spread from the origin through various communication channels to the end user (Rogers and Shoemaker, 1971). Communication is not diffusion: communication is about the types of messages and speeches, while diffusion refers to the spread of new technical information to the society (Wayne and Don, 1994). Diffusion of innovations among farmers will take place naturally as farmers learn from each other. According to Van den Ban and Hawkins, (1996, p. 96), ‘progressive farmers who are able to learn and adopt new innovations faster than others become ‘opinion leaders’ and it is through them that other farmers are able to learn and adopt new technologies’. Opinion leaders are characterised by their level of education, financial ability to try out new ideas, external connections with development agencies, or their interest in the subject area. However, opinion leaders are not necessarily early adopters.

3.4.3 The technology adoption process

Time will elapse from the moment an innovation is developed until the time it is adopted by farmers (Van den Ban and Hawkins, 1996). The lapse is due to the time taken by the farmers in making decisions to adopt technology. The technology adoption process (Figure 3.5)

involves the following processes: (i) awareness - farmers first hear about the innovation from other farmers, scientists, and/or Eos; (ii) interest - farmers seek more information about the new technology; (iii) evaluation - farmers further assess the advantages of the technology; (iv) trial - farmers try out innovations on a small scale to see the results; and (v) adoption - when farmers see that the new innovation is producing better results, the new innovation is up scaled (Van den Ban and Hawkins, 1996).

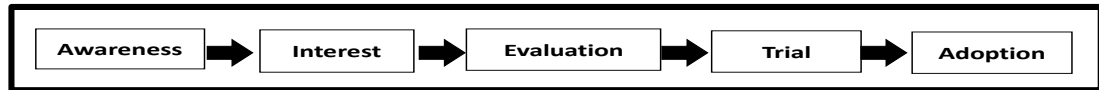


Figure 3.5: The Technology adoption process (Source: Adapted from Van den Ban and Hawkins 1996).

3.4.4 Second view on the technology adoption process

Van den and Hawkins, (1996) and Devenish (2006) have a second view on the technology adoption process (Figure 3.6) and indicated that the process starts with knowledge, persuasion (which involves forming and changing attitudes), decision making (adoption/rejection), implementation and confirmation. Devenish (2006) identified barriers which affect the farmer's ability and capacity to adopt innovations efficiently. These barriers include farmers' lack of: (i) recognition of the immediate and long-term benefits of the innovation; (ii) experience and self confidence to make a change; (iii) resources in funding the adoption of the innovation; (iv) proper steps and procedures in adopting the innovation in the absence of adequate supervision and monitoring; and (v) opportunities to talk with other farmers. Extension agent's main task is to remove these barriers by: (i) knowing the farmers' problem; (ii) working closely with the farmers to identify and overcome the barriers; (iii) involving specialists who could remove the barriers; (iv) raising awareness of success; and (v) sourcing credit and/or providing financial incentives to address the problems.

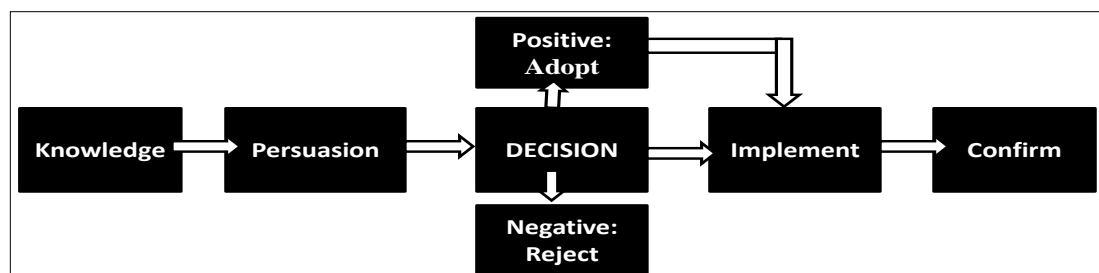


Figure 3.6: Second view of technology adoption process (Source: Adapted from Van den Ban and Hawkins, 1996).

3.4.5 Innovation adoption categories

Using an innovation adoption index, some researchers (e.g. Wayne and Don, 1994, p. 46) and Van den Ben & Hawkins, 1996, p. 100) divide a farming community into five categories of adopters, based on the time taken to adopt an innovation (Figure 3.7). The farmer groups are:

(i) innovators- the first 2.5 per cent of the farming community who respond to new innovation when it is available; (ii) early adopter - upon seeing the results of the innovation applied by innovative farmers, the next 13.5 per cent of the farming population start to adopt it; (iii) early majority- this group (34 per cent) are convinced that the innovation is workable after seeing results and they too start adopting; (iv) late majority- this group (34 per cent) take a bit more time to see how the early majority adopt the innovation and after being convinced that the technology really works, they also adopt it and; (v) laggards- this group (16 per cent) will have nothing to do with the technology and will not adopt it for they are satisfied with their current farming practices.

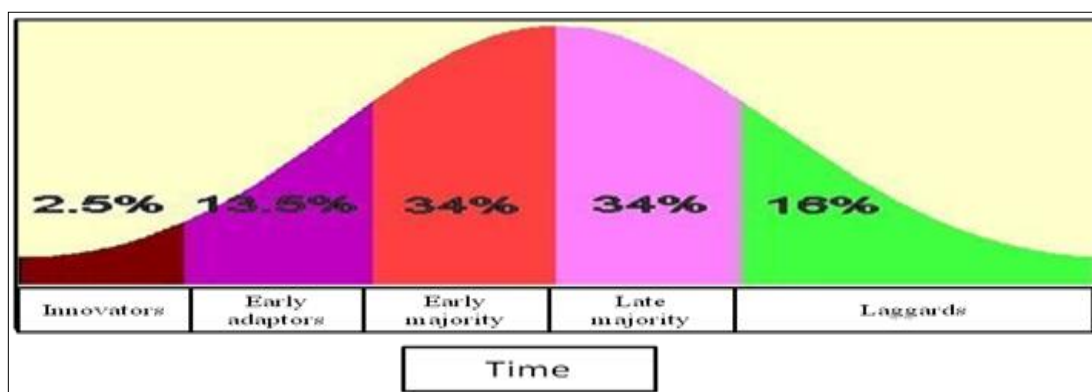


Figure 3.7: Innovation adoption curve (Source: Van den Ban & Hawkins, 1996).

3.4.6 Impact of farmer group mobilization on technology adoption

One of the factors that encourage farmers to work in collaborative marketing groups (CMG) is the sense of security by members of the CGM in adopting new innovations. Individual farmers do not feel isolated in taking the risks associated with adopting new technologies, as the effect of adopting a particular innovation is felt by everyone in the group (Place et al., 2004). Matuchke (2008) indicated that empowering farmers entrepreneurially ensures that the technology is market driven. CMG can facilitate the delivery of innovations via training so that improvements in yield and quality are realised through the adoption of acquired innovations. CMGs are able to realise meaningful adoption of innovation through the formation of strategic alliances with local traders with the aim of producing better farm products (Loveridge et al., 2003).

3.4.7 Impact of infrastructure on technology adoption

Infrastructure plays a significant role in facilitating the adoption of technology by farmers. There are two main forms of infrastructure: hard and soft. Hard infrastructure includes roads, bridges, airstrips/airports and wharves. Soft infrastructures include banking, agricultural suppliers, research and extension, transport systems, and marketing outlets (Wanmali and Islam, 1997). Minten (1999) indicated how the presence of a good road system often determines the prices that farmers receive. Communities that lack good roads are likely to get

lower returns for their agricultural products. Poor roads also affect farmer accessibility to new innovations. Good infrastructure creates conducive environments for farmers to receive new innovations (Palmer, 2004).

3.4.8 Impact of literacy on technology adoption

Weir and Knight (2000) indicated that educated farmers appear to be early adopters of technology and illiterate farmers tend to adopt innovations after observing from educated farmers. Generally, farmer training plays a role in increasing farm output and shifting the production frontier outwards. Hojo (n.d) indicated that educated farmers have increased their ability to understand and evaluate the information on new products and processes and therefore are quicker to adopt innovations if they know that the innovations are profitable in the long run. In addition Bandiera and Rasut (2001) indicated that farmers in the developing countries adopt innovation by sharing and learning from each other and educated farmers becoming the catalyst for innovation diffusion among the illiterate farmers. Therefore, literacy plays a role in the acquisition, diffusion and application of innovation.

3.5 Principles of adult learning

This section reviews: (i) the definition of learning; (ii) andragogy; (iii) learning motivations; (iv) adult learning styles; and (vii) characteristics of a good adult learning facilitator.

3.5.1 What is learning?

Hilgard and Bower (1966), Williams (1994), and Knowles et al. (2005) admit that defining adult learning is difficult. However, a definition of learning relevant to agricultural extension is provided by Crows and Crows (1963, p. 1):

Learning involves change. It is concerned with acquisition of habits, knowledge, and attitudes. It enables an individual to make both personal and social adjustments. Since the concept of change is inherent in the concept of learning, any change in behaviour implies learning is taking place.

Therefore, learning involves acquisition of technology, which will bring about change in one's perception, attitude, and behaviour as a result of applying what has been acquired. Hilgard and Bower (1966) and Conner (2004) indicated that adult learning is a process which involves making new arrangements and developing new concepts, then forming new sequences, because adult learners have age and experience advantages. To distinguish adult and child learning, Knowles et al. (2005) outlined two types of learning: andragogy and pedagogy. Pedagogy means the art and science of educating children by using a teacher centred approach, while andragogy is the art and science of facilitating adult learning.

3.5.2 Andragogy in agricultural extension

Adults are superior learners for their learning involves dealing with real problems. In adult learning, the emphasis is on life situations and not on abstract concepts (Galbraith, 2004; Knowles, 2005). Conner (2004) identified five issues which andragogy theory addresses: (i) awareness of the learning topics; (ii) directing learners via information; (iii) relating learning topics to learner's experience; (iv) people learn with motivation; and (v) people require help to overcome learning impediments. Adults are capable of learning if their learning motives are identified and the innovation directly addresses these motives. Williams (1994) suggested that learning facilitators should transfer innovations by using practical student-centred learning approaches.

3.5.3 Motivation as a driver for adult learning

Motivation is the driver of adult learning (Williams, 1994). Adults want to make sense of their environment and effectively find meaning to what they do. Adult learners are characterised by: (i) they are independent and learn at their own phase; (ii) have experience and expect respect from learning facilitators; (iii) are motivated to learn if the trainings are relevant and in line with their core motives; and (iv) adults learn by doing (Table 3.1) (Raymond, 2004).

Table 3.1: Characteristics of adult learners

Characteristics	Additional comments
Autonomous & self directed	Adults are practical orientated and objective learners. Learning facilitators should build on from what the learners already know. A guided discovery method is required.
Have wealth of life experience	Adult learners value their experiences. For effective adult learning, relate theory and concepts to the participants' experiences.
Goal oriented	Adults learners often ask: 'what's in for me?' They are goal oriented and want to know the objectives of the training prior to attending.
Relevancy orientated	Adults seek the relevance of the knowledge/skills to their practical situations. If the innovation is relevant, learners are motivated to learn.
Practical oriented	Adults are out-door students. Too much of theoretical insights do not mean much unless they have hands-on practical experience.
Seek respect	Adults regard themselves as experienced and knowledgeable in their fields. Therefore, adults anticipate respect from learning facilitators.

Source: Adapted from Lieb (1991)

3.5.4 Sources of motivation

Motivations are generated by the culture and the environment of the learner. Learning facilitators need to understand the cultural contexts of the farmer so that innovation is meaningful. Lieb (1991) identifies six factors (Table 3.2) that motivate farmers to learn: social relationships, external expectations, social welfare, personal advancement, escape stimulation and cognitive interest.

Table 3.2: Factors of motivation to learning

Factors	Additional comments
Social relationships	Have desire to make new friends and associations
External expectations	To fulfil the expectations of someone with formal authority
Social welfare	To improve one’s ability to serve the community.
Personal advancement	To achieve higher status in a job and professional advancement.
Escape stimulation	To relieve boredom and get a feel of something different
Cognitive interest	To learn, fulfil, and satisfy an inquiring mind.

Source: Adapted from Lieb (1991)

3.5.5 The adult learning cycle

Kolb’s Learning Curve (Figure 3.8) is widely accepted as an adult learning cycle which involves: (i) experience; (ii) observation and reflection; (iii) conceptualisation; and (iv) planning (Williams, 1994).



Figure 3.8: Cycle of adult learning (Source: Adopted from Williams, 1994).

3.5.6 Adult learning styles

According to Williams (1994), the learner firstly engages in doing something from which a concrete learning experience is gained. The results of the desired innovation are observed which provide the basis to form concepts. These concepts are tested in new situations. According to Derby and Frazer (2007, p. 6), ‘a learning style is the way a person takes-in, processes and organises information’. Galbraith (2004) indicated that there is no definite model of a learning style. However, to appreciate how adult learning occurs, it is necessary to understand the function of the human brain in the three domains: (i) cognitive, (ii) affective, and (iii) physiology. Cognitive learning style relates to the learner’s ability to perceive, think, solve problems and remember. Affective learning styles involve personal traits including motivation, emotion, and values. An affective learning style impacts on the motivation to learn, which leads to sustained behaviour. Physiological learning styles relate to how a learner relates to his environment in relation to the application of senses and feelings. Galbraith (2004) and Derby and Frazer (2007) concluded that the key to understanding learning styles lies in the integration of the three dimensions of learning.

3.5.7 The adult learning facilitator

Technical proficiency in the subject matter to be delivered should be the first characteristic of any adult learning facilitator (Galbraith, 2004). Stewart (1998) and Galbraith indicated that adult-centred learning should begin with the learning facilitator knowing: (i) the content of the subject; (ii) problems of the participants; and (iii) aspirations of the learners. Galbraith continued by stating that learning facilitators should possess the desirable interpersonal skills, positive approaches, self-confidence, enthusiasm, responsiveness and creativity.

3.5.8 Teaching styles of an adult learning facilitator

Teaching style is defined as ‘a mode of expression which includes overall educator personalities, attributes, traits and qualities that a teacher should display during adult instruction’ (Galbraith, 2004, p. 7). Galbraith provided seven attributes of a good teaching style: (i) psychological environment- establish a physical environment conducive for learning; (ii) learner centred- involve participants in planning the methods and learning activities; (iii) problem identification- involve participants in identifying their learning needs; (iv) resource allocation- involve learners to identify resources and how to use them; (v) implementation of learning plan- encourage participants to carry out their learning plans;(vi) provide assistance- help learners to carry out learning plans; and (vii) evaluation- involve learners to evaluate their learning experience.

3.6 CIC extension perspectives

The CIC has adopted both the top-down and bottom-up extension approaches. Following the top-down paradigm, the T&V was the first model to be adopted in 1998, followed by the CTP. The FDDE model, an example of a bottom-up extension approach, is currently implemented by the CIC. This section reviews the experiences generated from these extension approaches and examines in more detail the following: the T&V system, the CTP model, the FDDE approach, and the impediments to technology adoption under these extension approaches.

3.6.1 The T&V model

According to Yogiyo (2002), the T&V model was the first extension model to be used in the CIC in 1986/87 until 1999. During this period some strengths and weaknesses were observed. The strengths were: (i) the model functioned well under a well defined organisational structure; (ii) had a very strong planning approach based on management by objectives (MBO); (iii) training of EOs had been a priority; (iv) coffee innovations were obtained from the Coffee Research Institute and the farmers were trained; and (v) these efforts have resulted with increase in coffee production from 28,000 tonnes to 43,000 tonnes (DAL-PNG & ADB, 1991). The weaknesses of the T&V were: (i) the ratio of farmers to EOs was too large, resulting in inadequate coverage; (ii) there had been a lot of management layers in the T&V system

which required adequate resources to operate well. The lack of it resulted with very slow flow of information to the farmers and little or lack of field visits to the farmers; (iii) high administrative costs had been experienced; (iv) high turn-over of staff due to the systems inability to keep the staff functioning; and (v) a lack of accountability. The greatest impediment to the success of the T&V system was the lack of government funding into the CIC. According to DAL-PNG and ADB (1991), the sustainability of the T&V system depended on: (i) availability of committed funds from financiers; (ii) increased staff; (iii) adequate logistics support; and (iv) linking farmers to the market especially for coffee farmers.

3.6.2 Central Training Points (CTP)

Due to shortage of funding, in 1999, the CIC adopted the CTP model. Under the CTP, the farmers were clustered into collaborative marketing groups (CMG) with EOs overseeing council-wards. The CIC established training-houses which were fully kitted with generators, video screens and decks, and transmitter radios. Coffee innovations were delivered by the EOs using the training houses while important extension announcements were aired through the local radio stations. The farmers were encouraged to watch innovations via video tapes. Coffee field laboratories were established to demonstrate the agronomy and postharvest practices to the farmers. However, there were a number of factors which caused the CTP system to be unsustainable and they included inaccessibility in and out of the farming communities due to poor road conditions or the sites were too remote to be accessed. High costs involved with paying for air-time on the local radio station and the lack of continuous funding of the operational costs associated with implementing the CTP program also limited the impact of CTP on the farmers (Yogiyo, 2002).

3.6.3 The Farmer Demand Driven Extension (FDDE)

The FDDE model was adopted by the CIC after a stakeholder consultation in 2002 because the T&V and CTP approaches were too costly and inadequate to address the coffee quality issues (CIC, 2002; Yogiyo, 2002). The FDDE was adopted by the National Agricultural Extension Services (NAES) and was piloted in Morobe and Eastern Highlands under the Smallholders Support Services Pilot Program (SSSPP). The SSSPP was funded by the Asian Development Bank (Murray-Prior et al., 2008).

According to Matei (L. Matei, 2009 pers. comm., 13th October 2009), the FDDE concept encouraged the formation of CMGs by the farmers. Prior to participating in the FDDE, a CMG must: (i) have more than 20 households (40 mature members of which 30% must be females); (ii) each member should have 700⁺ coffee trees; (iii) be willing to contribute cash and/or kind towards the extension program; and (iv) be willing to further progress their CMG. Problems of the CMG were identified through a process call Participatory Rural Appraisal and Planning

(PRAP). Problems such as a lack of knowledge and skills in agronomy, postharvest, pest and disease, marketing, and financial management were to be addressed by the CIC through engaging external training providers (TP), while the CIC EOs based at the provincial centres were contract managers.

3.6.4 Components of the FDDE

A lot of procedures and methods were involved in the FDDE model that was applied by the CIC. However, the CIC does not have a reliable documentation on the FDDE approaches it uses. The following description of the FDDE approaches that was applied by the CIC is based on the experiences of the author. Details of these procedures are given in Appendix 2. Figure 3.9 summaries the procedures.

The FDE had five major phases and were closely associated with a normal program planning cycle (Dart, 2000; IFRCRCS, 2010): The five phases were: farmer awareness, situational assessment, situational analysis, project implementation, and monitoring and evaluation. Farmer awareness on the FDDE was done using five main steps: (a) awareness via media; (b) issuing and processing application forms; (c) preliminary farmer site visit and bio-data collection; (d) processing and submission of farmer profiling to project screening committee (PSC); and (e) preparation for a PRAP survey. Situational assessment- this part of the PRAP process involved the farmer groups and the extension and research staff where the farmers' situations and problems in their communities were assessed using five methods: (a) transect walk; (b) historical profiling; (c) village mapping; (d) Venn diagram; and (e) seasonal activity calendar. Situational analysis - this was the later part of the PRAP process where the actual problems of the farmer groups were isolated and prioritised. This was done using five steps: (a) problem identification through SWOT analysis; (b) problem prioritisation through problem tree analysis and ranking; (c) responsibility demarcation where the external problems were left to the CIC to address while the internal problems were left to the farmer groups to address; (d) terms of reference development through logistical frame; and (e) PRAP final report – this report was developed by the PRAP team (usually the CIC extension staff) and was submitted to the PSC for screening and funding. Project implementation – this phase involved converting the farmer problems into projects. Prior to implementing the project(s), the TPs and the EOs developed milestones for the project so that upon satisfactory delivery of a milestone, the TP was paid. The project milestones involved in coffee training were: (a) training need analysis (TNA); (b) developing a training program; (c) training delivery; (d) follow-up visits; and (e) final report. Monitoring and evaluation – the extension team at the provincial level were the project management unit (PMU) and their job was to actually monitor and evaluate the progress of the FDDE. The PMU was tasked to oversee the performances of the TPs and submit monthly reports to the PSC. Independent reports per milestone were also submitted by

the group leaders and the TPs. The PCS screened all the reports and if the reports were satisfactory, payments were made to the TPs. A project was concluded with a formal graduation.

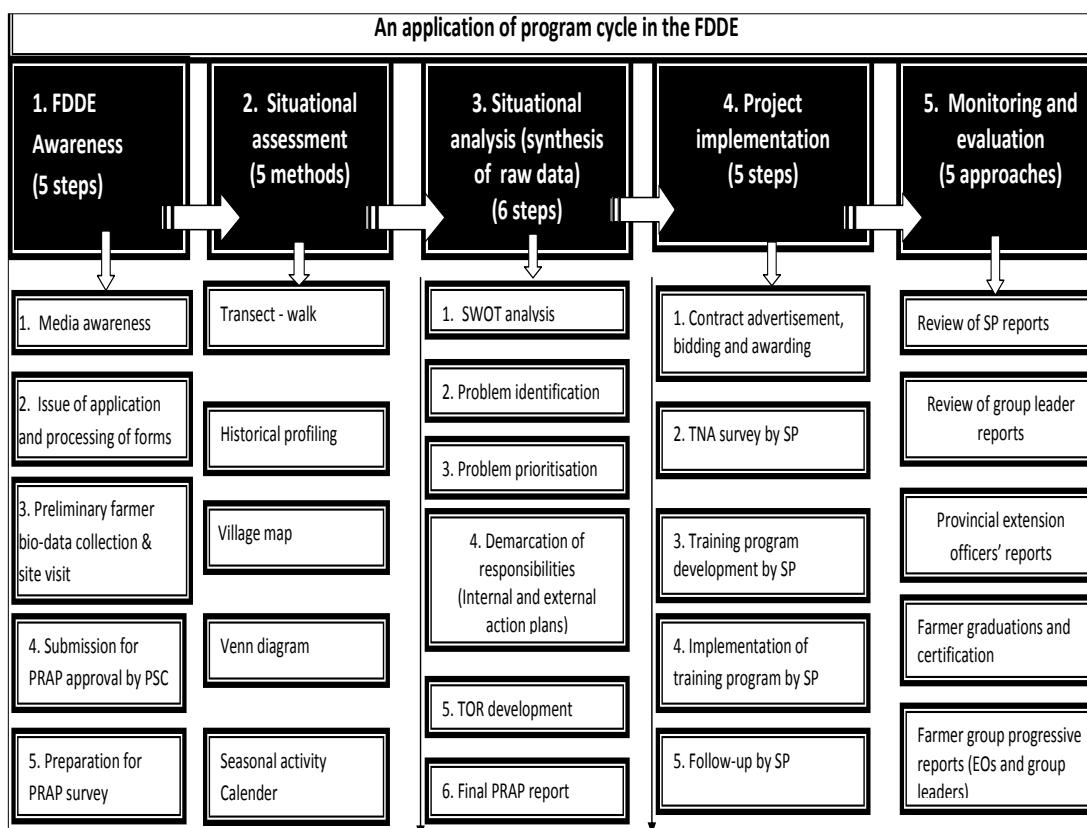


Figure 3.9: The FDDE planning process (Source: Author's experience).

3.6.5 Advantages and disadvantages of the FDDE

According to Matei (L. Matei, 2013 pers. comm., 4th April 2013), the CMGs formed through the FDDE had the potential to address the coffee industry's problem of poor quality and inconsistent supply of coffee by linking the CMGs to reputable domestic coffee traders. Innovations were delivered using former CIC EOs as TPs. However, according to Matei, lack of government funding for extension is the greatest obstacle to meaningfully progress the FDDE extension and the formation of CMGs. Therefore, theCIC was unable to sustainably support the FDDE especially hiring external training providers, although the FDDE is a better extension model compared to other models used in the CIC. Table 3.3 gives the advantages and disadvantages of the FDDE.

Table 3.3: Advantages and disadvantages of FDDE PRAP process

Advantages	Disadvantages
1. Community mobilization and resources sharing were encouraged.	1. False expectations could be raised during the PRAP sessions which the CIC can not fund or meet
2. Problems were identified by the farmers themselves through active participation.	2. Facilitator biases could be introduced in the PRAP documentation.
3. Visual aids (tables, Venn diagrams, maps,) were used to facilitate farmer understanding.	3. Problems were group representative, thus individual problems were omitted.
4. Farmers were involved in addressing identified problems.	4. In diverse communities, communication could be a problem.
5. External partners (TPs) became part of the development process.	5. Community information could be used by other people without consent.
6. Community problems were formally documented.	6. Delays in addressing complex problems by partners could frustrate the groups.
7. Identified problems were marketable to donor agencies.	7. Illiterate farmer groups may not market the PRAP document for external funding.
8. Gender participation was encouraged.	8. Farmer did not ask for what they did not know

Source: Author's experience

3.6.6 Traders' response to the FDDE

According to John (E. John, 2013 pers. Comm., 25 February 2013), traders were not aware that the CIC was implementing the FDDE model. Although this claim can not be substantiated, the lack of FDDE awareness by the traders could be due to a lack of appropriate forums where the CIC could give the opportunity for stakeholders in the coffee industry to share appropriate information on the FDDE. Further, the CIC extension team could be operating in isolation from the traders due to reasons only known to them. However, some traders such as PNG Coffee Exports and Monpi were forming strategic alliances with some CMGs that had been formed by the traders themselves or with those formed by the CIC through the Coffee Credit Grantee Schemes (CCGS).

3.6.7 Impediments to technology adoption

Batt et al., (2009) identify five common impediments to technology adoption under PNG conditions: (i) poor roads (ii) lack of market accessibility; (iii) low literacy; (iv) lack of knowledge and skills; and (v) lack of finance.

Poor roads

Mountainous terrains, fast flowing rivers, and wide swamps occupy 50 per cent of PNG's land mass, making road construction difficult and expensive. Road construction in PNG is further impeded by excessive land compensation demands by the traditional land owners (World Health Organisation, 2010). Farmers' accessibility will continue to be disadvantaged by a lack of better roads (PNG, 2003; Batt & Murray-Prior, 2006; Batt et al., 2009).

Lack of market accessibility

For many areas, coffee is a priority cash crop. However, a lack of information on better market accessibility and lack of cheap transport were impediments (Batt et al., 2009).

Low literacy levels

About 2.4 million of the six million people in PNG were illiterate (World Health Organisation, 2010), while UNESCO (2012) indicated that more than 1 million adults in PNG were illiterate and half of these were women. This implies that the vast majority of the smallholder farmers were illiterates, making synthesising of coffee innovations difficult. This greatly impedes the consistent production of top quality coffee.

Lack of coffee knowledge and skills

A lack of knowledge and skills in coffee farming is a major impediment to quality improvement (Batt et al., 2009). Therefore, under the FDDE, coffee training was a priority, which aims at transferring the innovations to the rural farmers. Batt and Murray-Prior (2006) observed that some farmers who have participated in the FDDE training have adopted some innovations. Batt et al. (2008) further noted that the promotion of strategic alliances between farmers, traders, and the CIC is required for technology adoption so that consistent production of good quality coffee is achieved.

Lack of finance

Smallholder coffee farmers were subsistence farmers. Their income levels were low and therefore, most farmers were unable to finance the application of innovations in their coffee plots (Batt et al., 2008; World Health Organisation, 2010).

3.7 Summary

In an effort to address production of inferior coffee and stagnant production, the CIC has adopted both paradigms of extension. Having realised that individual farmers were unable to effectively and independently adopt the agronomic and postharvest innovations that were delivered through the top-down extension, the bottom-up extension (FDDE) was adopted. The training programs were contracted to training providers (TPs) who were tasked to train the farmers in groups. The TPs have adopted the adult learning theories where the agronomic and postharvest curriculums were developed together with the farmers using the training needs analysis (TNA) approach. However, innovation diffusion among farmers takes time and timely applications of innovations are impeded by poor roads, deteriorating law and order problems and a lack of finance. Regardless of these constraints, anecdotal indications are that farmers have learnt under the FDDE. To ascertain whether learning was taking place, an evaluation was necessary. The next chapter provides the literature review that was done on the principles of monitoring and evaluation before conducting the study.

Chapter 4. Principles of monitoring and evaluation in agricultural extension

An agricultural extension program has four major stages: (i) situational assessment; (ii) program planning; (iii) program implementation; and (iv) impact assessment (IFRCRCS, 2010). Along the stages of the program cycle, Owen's five forms of evaluation (Dart, Petheram and Straw, 1998; Dart, 2000) were employed to assess the worth of a program. For this thesis, there were three categories of assessment: needs, process, and outcome that were associated with the delivery of training under the Farmer Demand Driven Extension (FDDE) model adopted by the Coffee Industry Corporation (CIC) of Papua New Guinea (PNG). To appreciate and to select appropriate evaluation approaches for the thesis, an intensive literature review was done. Consistently, this chapter covers five main topics: (i) what is evaluation; (ii) Owen's five forms of evaluation in the program cycle; (iii) models of evaluation; and (iv) data collection methods in monitoring and evaluation. A summary of the chapter is provided outlining the reasons for selecting the monitoring and evaluation approaches selected for data collection for the thesis.

4.1 What is evaluation?

The meaning of evaluation is constantly changing reflecting evolving trends in extension and its application as various people seek to better understand the processes (Kumar, 2005). Suvedi, Heinze and Ruonavaara (1999) indicated that in agricultural extension, evaluation is a systematic process which seeks to judge the merit of a program. Evaluation provides the basis upon which an educated decision on the future of the program can be made. In practical terms, Mortiss (1988, p.117) defines evaluation as 'the process of determining how well you are doing and what you are trying to do'. He endeavours to simplify the process of evaluating agricultural extension programs by suggesting that it assesses the value and the purpose of extension programs and activities progressively against stated objectives. According to Dart, Petheram and Straw (1988), monitoring and evaluation are inter-related. While an 'evaluation is establishing the value of an extension project, monitoring is a management function which involves collecting information systematically for decision making. Furthermore, evaluation may be seen as a management approach which can be used, through a defined process, to collect and analyse data which can provide the information necessary to improve present and future decision making, extension program planning and executing related activities in a manner that uses resources effectively' (Van den Ban and Hawkins 1996, p. 202). Evaluating agricultural extension programs therefore is the execution of a mode of enquiry governed by a set of objectives or assessment criteria necessary to adequately collect data, which can be

analysed and the findings reported to stakeholders to demonstrate the success of an extension program.

4.1.1 Purposes of evaluation

Douglah (1998) gives two reasons for evaluation: to improve and prove the program. Improving the program is referred to as a formative evaluation while proving the program is referred to as a summative evaluation. Dart, Petheram and Straw (1988) elaborate by stating that a formative evaluation is done for program staff so that judgments on the program can be made for the purposes of accountability and improvements. Douglah (1998) reveals that a formative evaluation is useful to examine the content, the adequacy of resources and the implementation of the program. On the other hand, a summative evaluation is generally conducted after the program has been completed and for the benefit of external decision makers. Formative evaluation is often called process evaluation because it focuses on the process of a program instead of the outcome of the program.

Evaluation provides insights for extension administrators, managers, and implementers to make comparisons and explore alternative methods of implementing extension programs or to modify current approaches so that the programs are more cost effective, efficient, and sustainable (Dart, Petheram and Straw, 1988). Lees (1990, p.14) summarises the purposes of evaluation as: (i) assessing the appropriateness of an extension program in light of government and organisational policy shifts; (ii) testing the relevance of the extension program objectives in relation to society's needs; (iii) assessing whether the outcomes of an extension program are in line with desired outcomes, (iv) determining whether the programs were cost effective and economical; (v) seeking alternatives ways to achieve optimum results; and (iv) justifying the continuity, alteration or discontinuity of an extension program.

4.2 Owen's five forms of evaluation and program planning

One of the most widely used evaluation models is Owen's meta-model (Dart et al., 1998). Owen's Five Forms of Evaluation including: (i) Form 5: Evaluation for program development, (ii) Form 4: Evaluation for program design clarification, (iii) Form 3: Process evaluation, (iv) Form 2: Monitoring and evaluation for program management and (v) Form 1: Evaluation for impact assessment. The five forms of evaluation are associated with program planning and implementation (Figure 4.1)

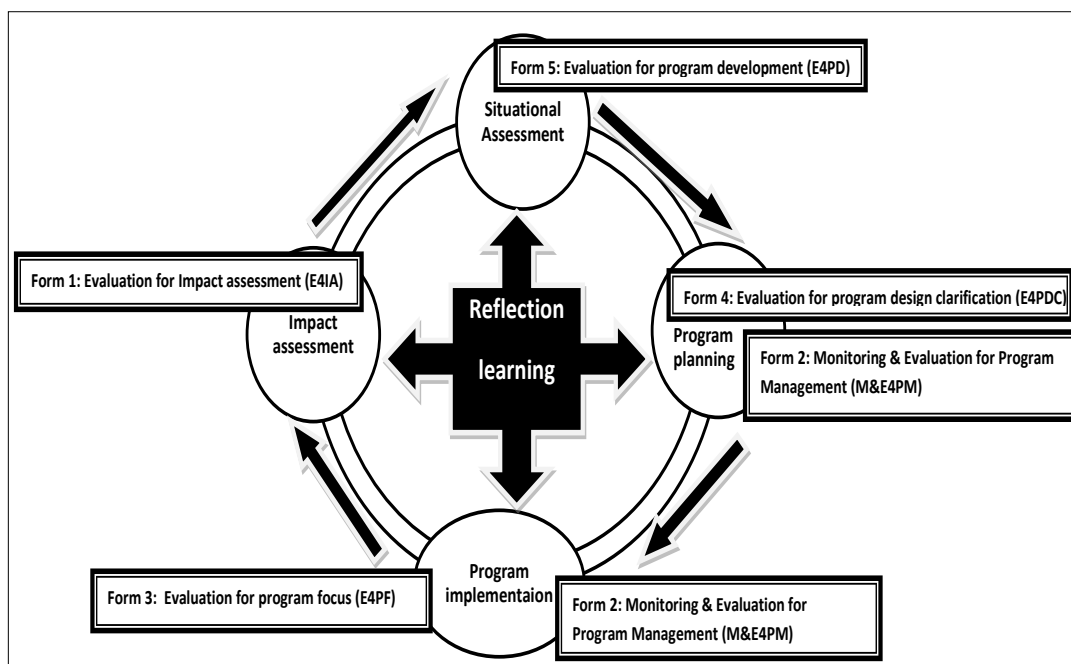


Figure 4.1: The program cycle and Owen's forms of evaluation (Source: Adopted from Dart, 2000; IFRCRCS, 2010)

4.3 Form 5: Evaluation: Situational needs analysis

Form 5 evaluation is a composite of different program planning approaches: needs analysis, participatory rural appraisals and rapid rural appraisal (Dart, 2000; IFRCRCS, 2010).

4.3.1 What is a situational analysis?

Laverne and Harold (1994) indicate that situation is the interaction of circumstances, issues, problems and cultures in a society. A situation is a sum of the social components in which a farmer operates. Knowing one component of the social dynamics, leads to the need to know other issues to make sense of the whole situation. An assessment is the act of calculating, investigating the importance and the quality of something (Soanes and Hawker, 2006). Therefore, a situation assessment is system or an approach of focussing into an environment of a particular circumstance by involving research and analysis of data to generate insights regarding components of the situation (Laverne and Harold, 1994; Gibson, 2001).

4.3.2 Training Needs Analysis: a form of a situational assessment

Synonymous with situation analysis is Training Needs Analysis (TNA). A TNA is a methodology used in the Form 5 evaluation (Dart, 2000). A TNA is used to identify the current competency level of a person performing a task and impediments to perform at an expected level. Some indicators that warrant a TNA are: (i) complaints- users of services and consumers of products may complain about the quality of the services and products delivered, (ii) poor performance - poor quality of work, output of staff members are below expected levels and staff turn-over is high in an organisation; and (iii) introduction of a new innovation to an

organisation. Information for a TNA is obtained from reports, interviews, and observations (Kroehnert, 2000).

4.4 Form 4 Evaluation: Program planning

Form 4 evaluation is the most suitable evaluation approach used at the program planning stage. A logical framework is the most common evaluation tool used during program planning (Dart, 2000).

4.4.1 What is program planning?

Program planning is synonymous with process analysis. A working definition of program planning is provided by Laverne and Harold (1994, p. 86):

A program is a set of purposeful, planned and interrelated experiences to reach our educational objectives and to solve problems. Planning is the dynamic act of reflecting about, thinking about and choosing among various options regarding the destination (goals and objectives) and the route or journey (education experience) we should follow to reach those destinations.

Program planning is an intensive task involving identification of relevant approaches that will be used to address the problems identified during the situational assessment. A program normally has levels of objectives in a cascading logic (IFRCRCS, 2010).

4.4.2 Program planning, problem identification and objective setting

Situational analysis involves identifying and defining problems. According to (IFRCRCS, 2010), four major tasks are undertaken: (i) problem analysis; (ii) objective development; (iii) objective selection; and (iv) objective definition.

Problem analysis

Problem analysis helps one to understand the problem in detail. It uses tools such as stakeholder analysis, SWOT and problem trees. Stakeholder analysis involves the stakeholders in making suggestions to the program (IFRCRCS, 2010). SWOT analysis involves identifying the strengths, weaknesses, opportunities, and threats. Strengths and weakness are internal factors, while opportunities and threats are external factors (Coulthard, Howell and Clarke, 1996). Problem tree analysis is a method used by program planners to understand the core problem(s) and their causes. The analogy of a tree is used to analyse the seriousness of the problems (Figure 4.2): the main problem as the trunk, the cause of the problem as the roots, and the effects of the problem as the branches and the leaves (Canadian Food Grain Bank (n.d)).

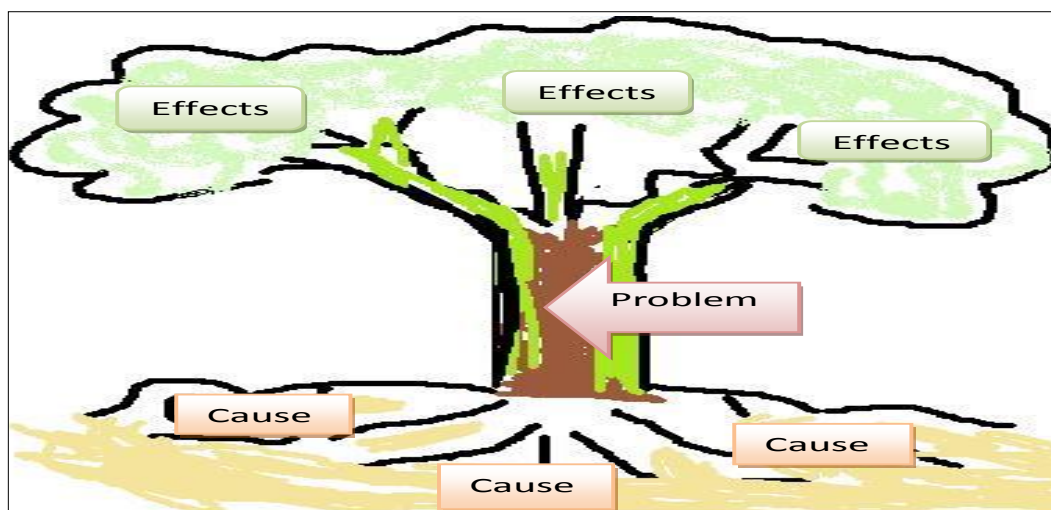


Figure 4.2: An illustration of a problem tree (Source: Adopted from Canadian Food Grain Bank, n.d)

Objective development

Without objectives guiding a program, an evaluation of agricultural extension programs has no meaning, because an evaluation seeks to determine whether a program has achieved its stated objectives (Van den Ban and Hawkins, 1996). Program objectives determine the course and the end results of a program. Therefore, objectives must be qualitative, quantitative, time-bond, flexible and adjustable (Artur, Timothy and Jose, 1998).

Objectives should be stated at various levels (Figure 4.3): (i) the impact (societal), (ii) the outcome (organisational), (iii) outputs (program), (iv) activities (project) and (v) inputs (resources). In agricultural extension, which involves the diffusion and adoption of innovations, objective definition should be done with an appreciation that some form of change will take place in the community (Sheila, 1994; IFRCRCS, 2010).

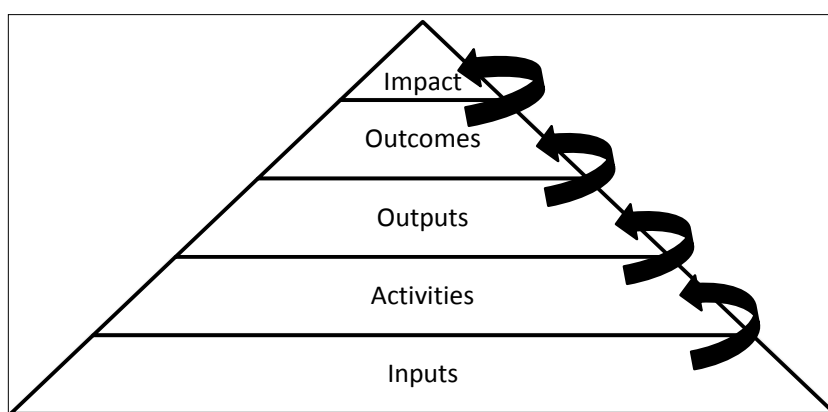


Figure 4.3: The pyramid of objective hierarchy (Source: IFRCRCS, 2010)

4.4.3 Program implementation

Program implementation involves developing and implementing a work plan. A program may have several projects and activities in order to achieve the output(s). A work plan is actually an activity schedule that prioritises what has to happen first, when the activity will be executed and for how long this will last. Having done the situational assessment, motivational factor identification, program prioritisation and establishing a logical framework done, program implementation is the next phase in the program cycle. By necessity, program implementation involves reflecting, reviewing and adjusting and keeping the plan flexible and open to accommodate desired changes as the program progresses (Rabey, 1985; Laverne and Harold, 1994). Human talents are an invaluable asset and are essential to implement a program. In a work plan, the person who will perform the job must be identified and meaningfully engaged (IFRCRCS, 2010). Program implementation also means knowing resource requirements, where to obtain the resources and how to utilise the resources (Rabey, 1985; Nall, et al, n.d). One of the most important elements of resource planning is developing a program budget which considers the activity schedule and resource requirements in parallel. The budget is a plan that illustrates the resource requirements in monetary terms (Rabey, 1985; IFRCRCS, 2010). Program budgeting is essential for it generates an estimated monetary value of the program to financiers (IFRCRCS, 2010).

4.4.4 Relevance of marketing mix in program implementation

To be effective, extension must be marketed to the farmers. Marketing is defined as ‘a social and managerial process by which individuals and groups obtain what they need and want through creating and exchanging products and value with others’ (Kolter et al; 2006, p.7). In agricultural extension, marketing involves pro-active thinking, keeping in mind that the clients are the users of the programs they have partly designed. Exchange of extension products between an extension agent and the farmers takes place when the farmers pay some sort of a price in exchange for extension product offerings that they perceive are beneficial. Therefore extension products should be systematically planned and implemented with the target audience in mind (Sheila, 1994; Ledoux and Melesse, 1995).

Marketing also recognises that different consumers have different needs. Segmentation involves identifying farmers with like interests in terms of demography, geography, or social affiliations such as religion, sports and educational systems. The one-size-fits-all extension system (T&V) has experienced problems, while highly specific and targeted extension programs have been more successful (Sheila, 1994; Ledoux and Melesse, 1995).

‘A product is anything that can be offered to a market for attention, acquisition, use, or consumption that might satisfy a want and/or a need...’ (Kolter et al, 2006, p. 253). Farmer satisfaction is the key to extension program selling and therefore core extension products must

be presented attractively to the farmers so that they can own the program in terms of their willingness to commit resources (Sheila, 1994).

Price is defined as ‘the amount of money charged for a product or service, or the sum of the values consumers exchange for the benefit of having or using the product or service’ (Kolter et al, 2006, p. 332). In extension, the farmers should pay for the program. This can be through spending time to participate in seminars, workshops, and demonstration and contributing cash. If the farmer is not willing to pay these prices, the program will not be successful (Sheila, 1994).

‘Promotion is the means by which the product and the benefits of the product are communicated to the buyer’ (Coulthard, Howell and Clarke, 1996, p. 85). Promotion means making the target audience aware of the extension program. Promotion is advertising a product in order that people accept and participate meaningfully in the extension program (Ehmke, Fulton and Lusk n.d). According to Sheila (1994), the purposes of promoting an extension program are to: (i) clarify what the product offer is, what are the benefits and who will benefit; (ii) encourage farmers to participate in the program; (iii) build confidence and profile the organisation through personnel selling; (iv) introduce opinion leaders/early adopters of the program to other farmers; and (v) display new technologies which will be extensively used during the program.

‘Place refers to the distribution channel used to transfer the products to the customers or the farmers’ (Sheila, 1994; Ehmke, Fulton and Lusk, n.d). Kolter et al., (2006) indicated that terms like logistics, supply chain management, material management, and physical distribution are interchangeably used to describe the place. In agricultural extension, place is about identifying the best channels of distribution to effectively and efficiently transfer the product offer to the farmers, and who will be responsible to ensure that such products reach the farmers (Sheila, 1994). One way of transferring an extension product to the farmers is through collaborations with partners.

4.5 Forms 2 & 3 Evaluation: Program monitoring

Monitoring forms a major component of the program implementation phase (IFRCRS, 2010). Form 2 evaluation is used for program management and is routinely done to collect information for the benefit of the management information systems (MIS). Form 3 evaluation is conducted to improve the program and is done at an advanced stage of the program implementation phase (Dart, 2000).

4.5.1 Bennett's hierarchy of evaluation

Form 3 evaluation is closely associated with the lower levels (1-3) of the Bennett's hierarchy of evaluation (Dart, 2000) (Table 4.1).

Table 4.1: Bennett's hierarchy of evaluation

Level	Bennett's description	Types of evaluation	
7	Consequences for the target group	Evaluation and monitoring relating to social and economical impact	
6	Behavioural changes in the target group (practice and quality of product)	Evaluation and monitoring relating to behavioural change	Summative Evaluation
5	Change in knowledge, attitudes, skills, motivation, and group norms	Evaluation and monitoring relating to intermediate indications and behavioural change	
4	The farmer opinion about extension activities	Evaluation and monitoring relating to farmers' opinion	
3	Farmer participation in extension activity (participation monitoring)	Monitoring degree of participation	
2	Implementation of the program by extension agents (activities monitoring)	Activity monitoring	Formative evaluation
1	Programming of the extension activities (input monitoring)	Input monitoring	

Source: Dart (2000) as modified from Bennett (1977)

Level 1 evaluation involves monitoring the use of inputs in the program. Level 2 is about monitoring the progress of activities and Level 3 involves monitoring farmer participation at the activity level. Farmer participation at the lower level of the Bennett's hierarchy is vital because their involvement provides the basis for the summative evaluation at levels 4-7 where farmers' knowledge, attitude, skills and aspirations (KASA) are assessed (Dart 2000; IFRCRCS, 2010).

4.5.2 What is monitoring?

Monitoring is a management function that involves the continuous collection of information for a program in order to track and check quality compliance. Monitoring provides updates for decision making and for future reference and focuses on the implementation of the program (IFRCRS, 2010; Wall, n.d). The question often asked in monitoring is: "is the project doing things right?" Monitoring involves collecting and managing six types of information: (i) diagnostic; (ii) implementation; (iii) utilization; (iv) impact; (v) situational; and (vi) review (Dart, Petheram and Straw, 1988; Misra, 1994; ARDSF, n.d, FAO (n.d)).

4.5.3 Principles of monitoring in agricultural extension

According to Misra (1994), monitoring is important for the benefit of: (i) the lead organisation such as the commodity bodies, the government, traders and NGOs who implement the program; (ii) the financier of the program; (iii) the beneficiaries; usually the farmers who want their lives to be improved; and (iv) the general public including learning institutions, other government organisations and the private sector.

Muraskin (1993) indicated that extension organisations are conscious of how programs are being implemented and look for information that will contribute to their MIS. In the event that the program is not on track, timely decisions can be made to adjust the program to achieve the program goals. Progress reports to financiers are necessary to identify weaknesses and strengths in the program so that resources can be justifiably utilised.

Misra (1994) identified ten guiding principles for program monitoring: (i) simplicity- the monitoring system should be able to simplify the complex field situations into easy-to-understand forms by capturing the important messages that need to be incorporated into the program in order to achieve the desired impact; (ii) timely- monitoring is assessing the progress of the program when it occurs and therefore as soon as the activities are happening, monitoring must be conducted. Inputs in certain agricultural systems (e.g. coffee) are dictated by the crop cycles and if monitoring is not done at the critical crop cycle, vital information may not be collected. Therefore performance of the crops in response to the inputs can be accurately assessed if the monitoring is done in a timely manner; (iii) relevance- monitoring should be guided by the hierarchy of objectives of the program as indicated in the log-frame. Monitoring done outside the program objectives may be misleading, (iv) dependable- managers of the organisations involved in the extension program will be able to depend on the information generated from monitoring; (v) participatory- monitoring must involve all the parties affected by the program; (vi) flexibility- although timely monitoring is vital, there should be room for flexibility, taking into account resources and accessibility constraints; (vii) action- findings of monitoring should be implemented, for without it, monitoring has no value; (viii) cost effective- use monitoring approaches that are cost effective and efficient without compromising the meaning of monitoring; (vix) management orientated- the findings from the monitoring should guide the management of the organisation to take appropriate actions; and (x) client oriented - the monitoring findings should diagnose problems and provide insights to problems for the management and/or the farmers to act.

4.5.4 Types of monitoring in agricultural extension

Two types of monitoring exist: implementation-focus and result-based. Each method has distinctive features.

Implementation-focus

Also referred to as objective monitoring, this is done so that changes experienced by the farmers in terms of KASA can be assessed. It paves the way for a detail program impact evaluation and has the following features: (i) before intervention, the farmer situation or problems are described; (ii) benchmarks or activities of the program and desired outputs are identified; (iii) data is collected on the inputs made, activities conducted, and outputs achieved; (iv) reports are done discretely on both the inputs and outputs achieved; and (v) information

is compiled on administration, implementation, and management issues (Rajalahti, Woelcke and Pehu, 2005).

Results-based

This involves assessing the effects of the program on society so that farmer perceptions regarding the program are assessed and the program managers are informed. Features of results-based monitoring are: (i) baseline data to describe farmers' problems or situation is done prior to conducting the monitoring; (ii) the general outcomes of the program are identified and data is collected to verify achievement of the anticipated outcomes; (iii) monitoring is time bound and specific; (iv) monitoring is based on assessing the occurrence of change among the farmers as a result of the program intervention; (v) the nature of reporting is both qualitative and quantitative; (vi) monitoring is done in consultation with collaborative partners; and (vii) the success of the program depends on the collaborative efforts of the partners (Rajalahti, Woelcke and Pehu, 2005).

4.6 Form 1 Evaluation: Impact assessment

Impact assessment is the final phase in the program cycle. This is a summative or impact evaluation and is conducted after completion of a program and is guided by the higher goals of the program (Dart, 2000; IFRCRS, 2010; Wall (n.d)).

4.6.1 Purpose of impact evaluation

Dart, Pethram and Straw (1998) and Dart (2000) outlined three reasons for conducting an impact evaluation: (i) understand the outcome of the program; (ii) justify program spending; and (iii) provide program guidance. Impact evaluations are conducted for the long-term program accountability and for the benefit of stakeholders (David, 1998).

Evaluation outputs can have negative and/or positive impacts on the stakeholders who have an interest in the program. It is vital therefore to identify the stakeholders and appreciate their values, expectations and interests in the program. Knowing the stakeholders prior to evaluation also helps in terms of minimising problems or the rejection of the results because stakeholders may form an opinion that the evaluation has been biased and/or irrelevant (David, 1998).

According to Laverne et al. (1994), evaluation is the outcome of two important elements (Figure 4.4): measurement and description, and comparison and judgment. Measurement and description involves exposing the situation or problem the extension program was designed to address. The description must be quantified so that the description of the evaluation is accurate, concrete and useful (Laverne et al., 1994). Soanes and Hawkers (2006, p. 196) define comparison as an act of describing the 'resemblance of something with something else'. This implies that in order to make a comparison, something (conditions, issues, and problems,

norms) had to pre-exist. The difference between the situation that pre-existed and after the program intervention is the basis for comparison (Laverne et al., 1994). Judgement is ‘the ability to make considered decisions’ (Soanes and Hawkers, 2006, p. 549). This leads to the reasoning that based on the comparisons being made, decisions are made in relation to the difference between the before and the after program intervention, and whether the outcomes met social norms and expectations. Therefore, judgement determines worth and value of the program (Laverne et al., 1994).

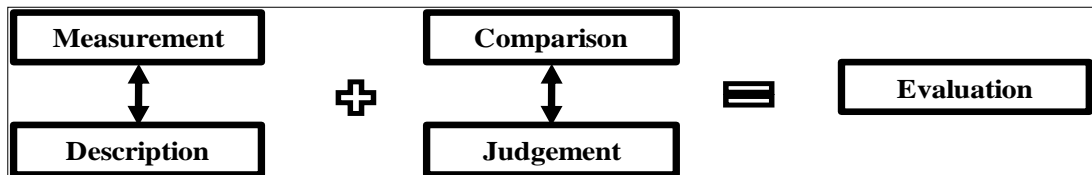


Figure 4.4: The process of evaluation (Source: Laverne et al., 1994)

4.7 Models of evaluation

Ten major models of evaluation exist which are interchangeably used along the program cycle (Lees, 1990; David, 1997; Dart, 2000). The models are: (i) Expert; (ii) Attainment of objectives; (iii) Goal-free; (iv) Management decision; (v) Naturalistic; (vi) Experimental; (vii) Adversary; (viii) Participatory; (viii) Comparative economic impact; and (x) Financial analysis. However, only four are reviewed for they are related to the program cycle in the Farmer Demand Driven Extension adopted by the CIC and the objectives of this thesis.

4.7.1 Attainment of objective model

The attainment of objective model is sometimes called testing-objective approach. It measures the outcomes of a program against its stated objectives and is the most common evaluation model used in assessing extension programs (Laverne et al., 1994; Petheram, 1998). Measurable objectives form the basis to assess the success of the program. Data about the program are collected and analysed. Evidence is used to validate the achievement of the objectives. Prior to assessing the outcomes, the program objectives are evaluated to ascertain that the objectives were relevant and represent farmer problems and issues (Laverne et al., 1994; David, 1997; Petheram, 1998; Dart, Petheram, and Straw, 1998; David, 1998; Dart, 2000). Owen (1993) indicated that the main aim in planning a goal-based evaluation is to determine the real goals of the program and decide whether the program has attained the goals. This means that a program, prior to its implementation, must have measurable objectives. Data to validate the success of the program is based on these objectives.

4.7.2 Steps involved in goal-based impact evaluation

Attainment of objective or goal-based impact evaluation model has six main steps (Laverne et al., 1994) (Figure 4.5): (i) objective identification; (ii) specify criteria and standards; (iii) identify and collect evidence; (iv) analyse data; (v) compare results with standards; and (vi) make judgments. Petheram (1998) identified that there are three basic elements that govern the objective-based evaluation model: (i) identifying or knowing the objectives of the program; (ii) deciding how to assess the objectives; and (iii) determining whether the objectives of the program have been achieved.

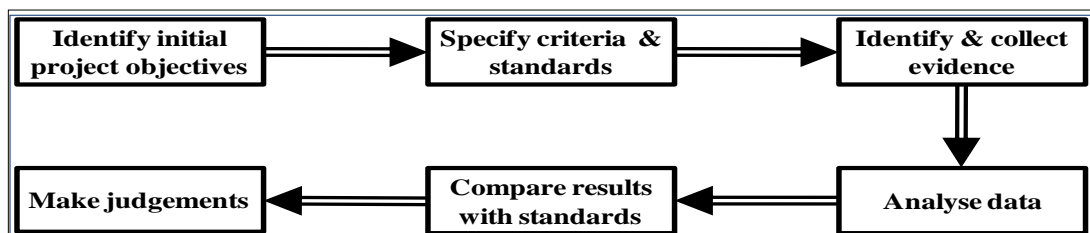


Figure 4.5: Steps in an objective-based evaluation (Source: Laverne et al., 1994)

Objectives can be long-term, short-term, broad-term, or specific. However, especially in agricultural and educational programs, farmers, whether in groups or individuals, respond better to specific and achievable objectives that are relevant to their needs. Therefore, understanding extension objectives at the society, group, extension agent, and clientele levels is crucial. All of these objectives have two uses in common: facilitate learning experience and provide directions for evaluation (Byrn et al., 1967).

4.7.3 Goal-free model

The Goal-free model is also known as the needs based or judgement approach, the primary task of the evaluators is to tell the farmers the results in their communities due to the program intervention. The evaluators identify the pre-existing needs and conditions of the farming communities and then the farmers are asked to identify the changes that have taken place as a result of the program intervention. The identified changes, or lack of them become the starting point to modify the program (David, 1998). Swanson et al. (1997) and Patton (1997) argued that a goal-based evaluation has a disadvantage: it does not evaluate the worth of the extension program for the society in which the extension program is implemented.

4.7.4 Management decision model

The management decision model (MDM) requires all stakeholders to be involved in the evaluation process. The results are then used by management to decide on the current and future operations of the program. However, the disadvantage of this model is that the views of major stakeholders in the program may be seen as being more important than the views of minorities such as women and children (Swanson et al. 1997; David, 1998; Dart, 2000).

4.7.5 Types of decisions influenced by the MDM

According to Laverne et al. (1994), the decisions that can be influenced by the MDM include: (i) *Planning decisions* - this involves assessing priority needs, project objectives and intended results. The results of the evaluation are used for planning the next course of action; (ii) *Structural decisions* - this decision affects the way quarterly or annual work programs are planned, resources used, and staff deployed, or how the budget is framed and the type of education or training approaches taken. Swanson et al. (1997) clarify that MDM is geared towards directing the extension program during the initiation and operational stages so that results are relevant at particular stages of the program; (iii) *Implementation decisions* - this affects the day-to-day decision making on the implementation of activities, the performance of staff in relation to executing the activities and the general public reactions to the program; (iv) *Recycle decisions* - this decision concerns the future of the program in terms of terminating it if the program is not producing anticipated results as per the stated objectives, modifying it if there is a possible chance of improvement, or continuing the program in its current form if it is meeting the objectives satisfactorily.

4.7.6 Participatory model

The participatory model (PM) is also known as pluralist-intuitionist model. It involves the collective efforts of the farmers and extension workers adopting the concepts of participatory action research (Dart, 2000). Critical problems in the groups are identified. Interventional programs are developed and the critical problems are assessed whether the program intervention has addressed the critical problem areas. The farmers involved in the program are regarded as the best judges to assess the program impacts and therefore are able to provide accurate judgements on the program. Both the farmers and evaluators are given the freedom to assess the program so that maximum participation takes place in identifying issues affecting the farmers. Participatory evaluation promotes sustainable agriculture because involving farmers in evaluating the programs gives a sense of responsibility, ownership and self-education, which can result in a concrete learning experience (David, 1998; Swanson et al., (1997). Dart et al., (1998) indicated that participatory evaluation aims to assess both the intended and unintended outcomes of an extension program through case studies. Swanson et al., (1997) borrowed ideas from Arnstein, (1969) to illustrate five different levels of farmer participation in evaluation (Figure 4.6). The disadvantage of this form of evaluation is that it is very lengthy.

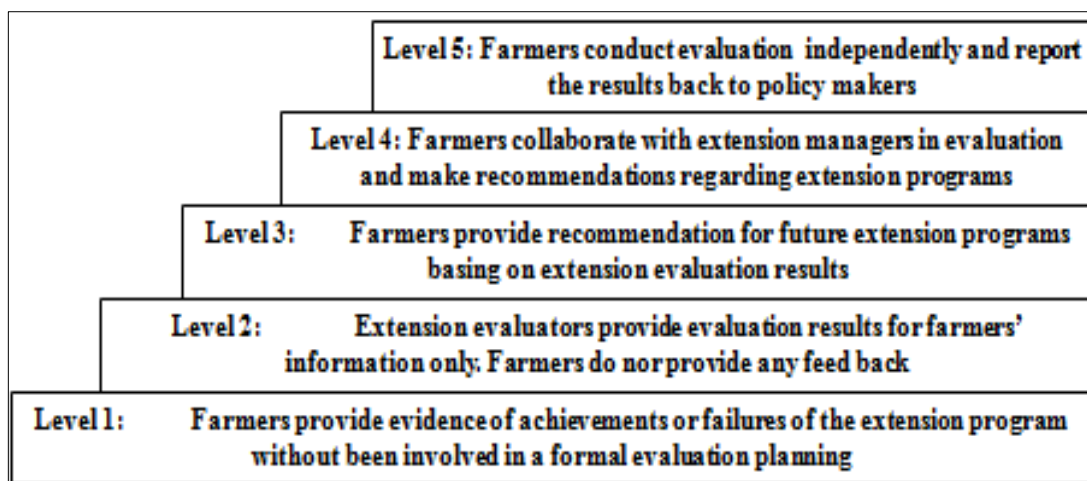


Figure 4.6: Level of farmer participation in extension evaluation (Source: Adapted by Swanson et al., 1997; David, 1998 from Arnstein, 1969)

4.8 Data collection methods in monitoring and evaluation

As there are numerous methods of data collection in monitoring and evaluation, they are interchangeably used. McCaslin and Jovan (1998) classified the different data collection methods into five categories: (i) individual; (ii) group; (iii) rapid rural appraisal; (iv) document analysis; and (iv) observations. Each of these is briefly described below.

4.8.1 Individual techniques

Individual techniques involve data collection methods from individual farmers. For this, several methods are used: (i) face-to-face interviews; (ii) key informant interviews; (iii) field worker reports; (iv) dart board/ranking; (v) critical event/incident analysis; and (vi) self drawing.

(i) Face-to-face interviews

Surveying is the use of written questionnaires and is the common form of face-to-face interviews (Mark and G.A.B, 1994). Surveys are conducted through face-to-face interviews, or self-administered by respondents through mailing (electronic and hard-copy) and through telephones. The participants in a survey should be from a sample population randomly selected (David, 1998). A rule of thumb for quality information collection: the questions must be well thought to minimise respondent boredom (Mark and G.A.B, 1994). For this, Mark and G.A.B identified the characteristics of an ideal questionnaire which should be appealing to the respondents: (i) the appearance of the questionnaire must be attractive and easy to fill; (ii) the headings and the instructions on the questionnaire must be printed clearly and easy to follow; (iii) coding – the questionnaire should be pre-coded with numbers or reference, especially if details of the respondents are known. Coding is useful for questionnaire collections and data processing; (iv) numbering of the questions and leading questions should be accurate. Page numbers of the questionnaires should be printed clearly for easy referencing; (v) the questions

are developed in a cascading logic; (vi) Personal information of the respondents should be on the last part of the questionnaire; and (vi) enough writing space should be provided.

The purpose of an interview is to assess the achievements of the program indicators. Both qualitative and quantitative data can be collected. For illiterate farmers, a face-to-face questioning through an interpreter is recommended. For literate farmers, the questionnaire can be self-administered (Brace, 2008; Hall et al., 2008).

(ii) Key informant interviews

Key informant interviews involve targeting individuals: opinion leaders, innovative farmers, group leaders and community workers such as councillors, teachers and church workers who are knowledgeable on the program under review. Broader insights about the progress of the program are collected. However, information collected must be verified through other sources (Hall et al., 2008).

(iii) Field worker report

This approach involves sharing some of the evaluator's responsibilities with the fieldworker such as an extension officer. The evaluator develops specific forms containing instructions on how the fieldworker should assess the program indicators during the normal field visits. Special attention should be made towards assessing the program indicators. Photographs, maps, Venn diagrams and SWOT analysis should form part of the fieldworker's report. The report is an account of how the extension worker perceives the planning, implementation and outcomes of the program (Hall et al., 2008).

(vi) Dart board/Ranking

This approach allows farmers to rank the program products according to their usefulness. A dart board with different circles can be used to allow the farmers to indicate the usefulness of the program indicators: the closer the placement of the indicators near the bull's eye, the better ranked the indicators; the further the arrow from the bull's eye, the worse the indicators. The evaluator probes the farmer to explain the position of the arrows on the dart board. Farmer responses are recorded and analysed. Rating scales are also associated with dart boards especially when the farmers are illiterates. This approach involves assessing farmer's thoughts in assessing program indicators.

In ranking, a precise statement regarding a variable is written and explained to the farmers. The farmers are then asked to rate the statement according to strongly agree to strongly disagree, or very useful to not useful. Rating scales can be symbolised by colours, pictures, circles sizes, and dartboards. The rating scales or symbols are properly explained to the farmers before the farmers are asked to rate the variables. The farmers then rate the variable by circling

the numbers, choosing the colours, or placing the arrows on the dartboard. Rating scales are a useful tool to measure farmers' attitude, opinions, and beliefs (Hall et al., 2008; Brace, 2008).

(v) Critical event/incident analysis

This approach can be either used at group or individual levels. Information is collected from the farmer(s) after a particular incident. For instance, if something unexpected has happened in the program which is of interest to the farmer and the evaluators, the farmer is interviewed concerning this (Hall et al., 2008).

(vi) Self drawing

This is common with young literate farmers who are able to communicate the program effects through illustrations, artistic work or pictures. Although drawings can generate rich insights, empirical analysis cannot be made (Hall et al., 2008).

4.8.2 Group techniques

Group techniques involve collection of data from more than one person. Several methods are used: (i) Delphi approach; (ii) Focus group interviews; (iii) Nominal group interviews; (iv) Informal group interviews; (v) Community meeting; (vi) Role plays; (vii) Field tours; and (viii) Case studies (Hall et al., 2008, Gibson, 2001).

(i) Delphi approach

According to (McCaslin and Jovan, 1998), the Delphi approach involves groups of people with a wealth of experience and knowledge on a subject area under assessment. Three rounds of data collection and analysis are done (Figure 4.7).

Firstly, open-ended questions on the subject under assessment are designed and sent to farmers who are participating in the survey and the responses are collected. The responses are analysed and summarised. This leads to the development of a second round of questionnaires. The second lot of questionnaires are designed to ask the respondents to make their positions clear on the opinions raised in the first lot of questionnaires. Farmers are asked to state whether they agree on certain issues and provide reasons for their responses. Farmer responses are collected and analysed, leading to the development of a third and final questionnaires. In the third round, the farmers are asked to make comments on issues that are not too clear in the second round of questionnaires which have been analysed. The farmers are allowed to make additional comments regarding their ranking and preferences. The final data is analysed and a report produced.

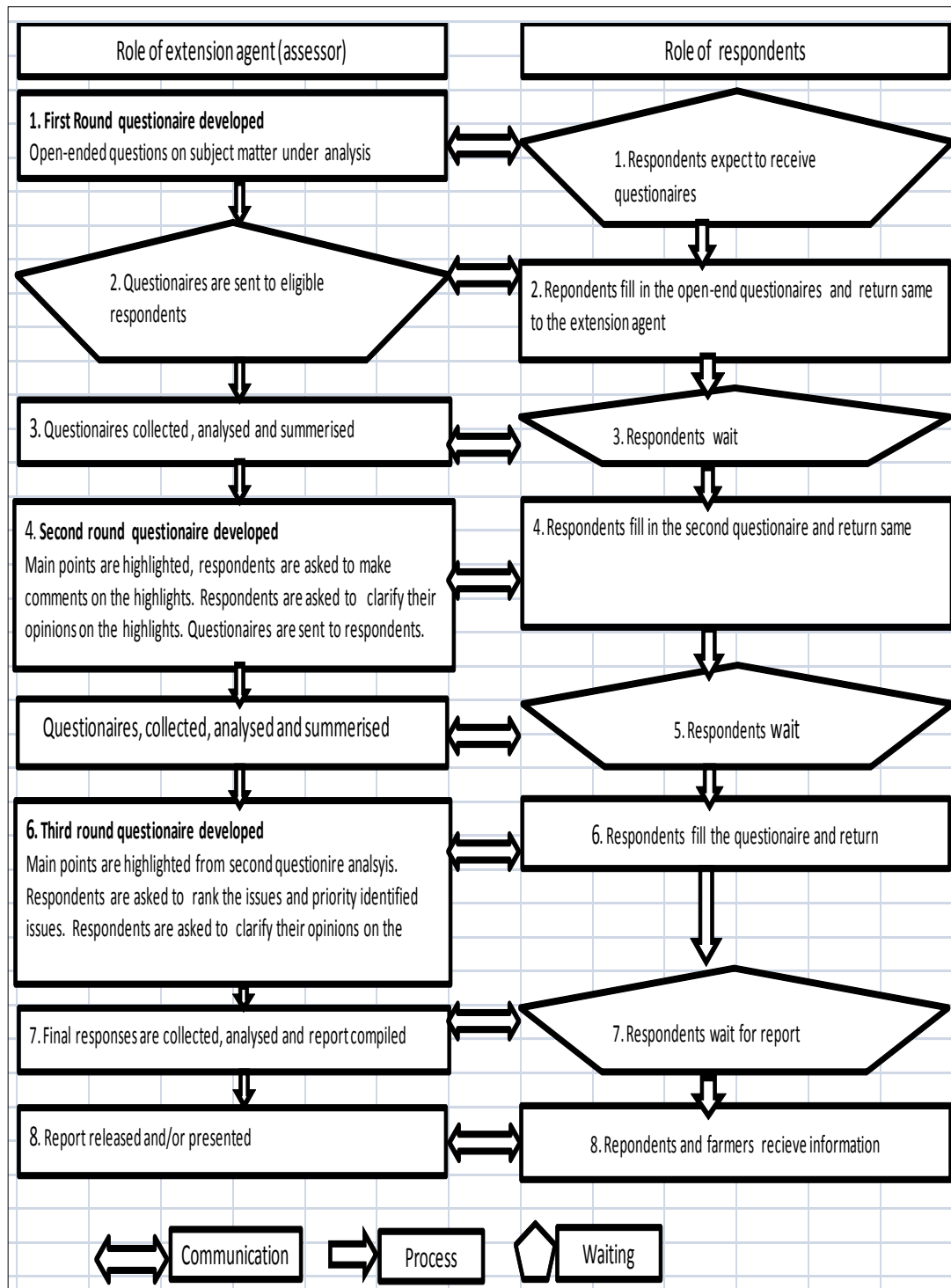


Figure 4.7: The Delphi approach (Source: Adopted from McCaslin and Jovan, 1998)

The Delphi approach has two advantages: (i) it involves respondents who are well versed with the industry and they are better placed to provide insights which may help shape the industry. For this, the respondents are given the freedom to express their opinion in a guided survey without the pressure from the majority of the respondents; and (ii) cost of bringing respondents to a central location is avoided.

Disadvantages of the approach are: (i) identifying knowledgeable and experienced respondents on the subject matter could be difficult; (ii) requires a longer period of time, thus in the process, some respondents may quit and/or will not be available for the entire process; (iii) requires an effective questionnaire delivery system, hence in places where postal services, telephone, transportation and internet services are poor, the approach may be difficult; and (iv) respondents must be literate and must be highly motivated.

(ii) Focus group discussions

This approach involves groups of people (6-20 individuals) who are experts in the subject matter under assessment. Questions or topics on the subject matter are prepared in advance and the respondents are asked to discuss and provide their opinions, experiences and knowledge under the guidance of a moderator or researcher. For intensive and informative discussions, the moderator ensures that everyone in the group contributes and shares information in a friendly and learning atmosphere. Information provided can be collected through using recording devices such as a video recorder, a tape recorder, written notes, and recording sheets (McCaslin and Jovan, 1998; Kumar, 2005; Hall et al., 2008).

McCaslin and Jovan (1998) identified five steps involved in conducting a group interview:

(a) Developing key questions. This involves identifying or developing key questions that should guide the path of discussion. The key questions on the discussion topics should reflect the objectives of the situational assessment or research;

(b) Identifying and recruiting the respondents through judgemental or purposive sampling. This approach involves the researcher selecting respondents who are capable of providing accurate information concerning the topic under research. Purposive sampling is suitable for historical recall or working on a subject that is less known by the general public (Kumar, 2005).

(c) Resource planning involves developing the program including indentifying the resources needed for the situational assessment and itinerary for the activities.

(d) Facilitating the discussions/interviews involves coordinating the discussions or the interview process and data collection.

(e) Data analysis and reporting involves making sense of the data collected and writing it in a way that the stakeholders are adequately and reliability informed of the situation.

(iii) Nominal group interviews

This approach involves literate representatives of a group or a community. The respondents discuss the subject matter under assessment and proceedings of the discussions are recorded by themselves. For the session to proceed, the topics or issues of discussion are spelled out

clearly. The participants are given the opportunity to brainstorm on a piece of paper their thoughts on the topics. Individual participants write their ideas and are allowed to present their ideas in a round-robin fashion while an external evaluator writes the thoughts on a big sheet of paper, or on a chalk board. The ideas should be clearly read by everybody in the room. The participants are allowed to seek clarification, express disagreements or provide complimentary comments on the ideas raised. The ideas are then categorised into similar variables and are clearly displayed on a chart or board. The respondents are then asked to rank the ideas in order of their preference through voting. The evaluator tallies the votes. In front of the respondents, the problems are prioritised according to the number of votes. The results are then discussed by the farmers and disagreements are ironed out before any conclusions are reached (McCaslin and Jovan, 1998; Gibson, 2001).

(iv) Informal group interviews

Issues or problems affecting the community or a group are usually voluntarily expressed during informal gatherings such as after a church service, at a local market, at a political rally, field days and/or other public gatherings. Researchers make themselves available at these gatherings and valuable insights are collected. Individuals who have actively expressed their concerns or ideas openly and clearly are identified as opinion leaders and they are further interviewed to get more insights and assessments (McCaslin and Jovan, 1998).

Informal interviews involve informants, oral histories and story-telling. Informants, whether opinion leaders and innovative farmers should provide in-depth situational information on the program. The information collected can be entered into frequency tables or interpreted through pattern-matching. Informal interviews can be done through focus group or sub-focus group discussions (David, 1998).

(v) Community meetings

Community meetings involve an open discussion with the community who are beneficiaries of the program. Issues regarding problem identification, program planning, and implementation are collected from the people. The interviewer or the project implementer occasionally asks probing questions to get further insights on the topics under discussion. To get maximum feedback from a community meeting, the farmers should be encouraged to be in smaller groups to discuss the issues. Representatives from the groups are allowed to present the collective views of their group members in the presence of the community members (David, 1998).

(vi) Role plays: visual/audio stimuli

Role plays allow farmers to role-play the meaning of the program from the farmers' perspective. The program implementer and/or the evaluator only guide but do not manipulate the scripts. The program beneficiaries can also tell a story about where they were, where they

are and where they anticipate to be in the future as a result of the program intervention. For instance, the lifestyle of rural villagers without a proper water supply and the lifestyle after constructing a water supply can be displayed through a drama or a role play by villagers who are involved in the said water project. This approach is useful with farmers who are illiterate. Program evaluators could relate the past and the present experiences (David, 1998).

(vii) Field tours

Field tours provide an avenue for collaborative efforts by stakeholders to evaluate the program. Extension workers, farmers, scientists, financiers, policy makers, and evaluators share ideas and experience while taking a tour around the project areas. A pool of specialists is created where specific aspects of the program are assessed competently. Insights are generated from different perspectives, and a holistic and a balanced evaluation is facilitated (David, 1998).

(viii) Case studies

Case studies can provide useful information to determine why a program succeeded in place *X* and not in *Y*. Vital variables that constitute case study evaluation are geographical locations, soil types, culture, age, gender, disposal income, illiteracy, accessibility to government service, communication, and accessibility to infrastructure. Repeated interviews and interactions with the farmers are required for a good evaluation (David, 1998).

4.8.3 Rapid Rural Appraisal

Rapid Rural Appraisal involves comprehensive techniques such as transect walks, mapping, SWOT analysis, historical profiling, Venn diagrams, Seasonal activity calendars, and Problem tree analysis. These methods of evaluation are comprehensive and involve full participation of the farmers so that relevant information about the program is provided (McCaslin and Jovan; 1998; Dart, 2000).

4.8.4 Document analysis

Secondary data is information gathered not under the current area of study but which have been gathered under other studies or purposes (Hair, Bush, and Ortinau, 2003). Sources of secondary data are government and corporate publications and reports, past research documents, personal records, and mass media (Kumar, 2005). In-depth information can be retrieved, as most of the information is historical, hence rural development or marketing trends can be easily seen (Hair, Bush, and Ortinau, 2003). For the purposes of evaluation, themes or criteria may be developed and information searched accordingly (David, 1998).

Mark and G.A.B, (1994) provided advantages of evaluation through documentation: (i) It is cheap as someone has already laboured and collected the information; (ii) it is accurate as almost all written documents represent the actual situation. Therefore, unless intended otherwise, the content of reports should be reliable; and (iii) provides extra information which

may be useful for the evaluation. However, Kumar (2005) revealed limitations of secondary data because variations in validity and reliability are common. He suggests most secondary data is not derived from objective data collection and generation and therefore personal biases can be introduced. This can mislead the situational assessment. Also the information presented may not be in the form that is required.

4.8.5 Observations

Observations are used to validate information collected using other methods such as key informant interviews, community meetings, focus group meetings and visual/audio stimuli. Two types of observations are done: informal and formal. Informal observations involve the evaluator making ocular observation and noting what the farmer(s) are saying about a particular situation. Formal observation involves the evaluator pre-determining variables for observation. For this, observation sheets and rating scales are defined and assigned to the variables to be observed. The data collected can be analysed descriptively and statistically. A considerable amount of time is required to actually involve the farmers in the program and make meaningful observations. Areas of observation are also dictated by the program indicators and observations can be made before, during, and after the program (David, 1998; Yin, 1994).

Techniques used in observation may include ocular observation during field days or shows, audio visual recordings, visual images, tape recordings, aerial views, computer log-in and frequency of visits to sites. External and/or project participants/beneficiaries can be involved in the assessment of the project. Prior to the evaluation, the evaluators should have a list of variables which should be observed. Both qualitative and quantities data are collect and analysed. Findings of the observation are reported back to the stakeholders highlighting the strengths, weakness, threats and opportunities. The reports can be used to improve the project performances (David, 1998, Mark and G.A.B, 1994).

4.9 Chapter summary

Theoretically, the FDDE model adopted by the CIC is consistent with the steps involved in the program cycle, Owen's five forms of evaluation, and Bennett's hierarchy of evaluation. The monitoring and evaluation approaches that are suitable in the FDDE are also highlighted. The literature gathered under this chapter is summarised in the FDDE content with the help of Figure 4.8. The first column highlights the stages in the program cycle. The second column positions the evaluation approaches that are employed at different program cycle of the FDDE (details of the FDDE approaches are given in appendix 2). Column three appropriates the involment of the Owen's forms evaluations program cycle, hence the FDDE program. Column four indicates the evaluation models that should be approparaitely employed in the program

cycle and the last column approparites the different levels of Bennett’s hieracy. From the outset however, it should be noted that the different monitoring and evaluation models and apparoches covered in this chapter is interchangeably used and is not restricted to a specify area in the program or the FDDE cycle.

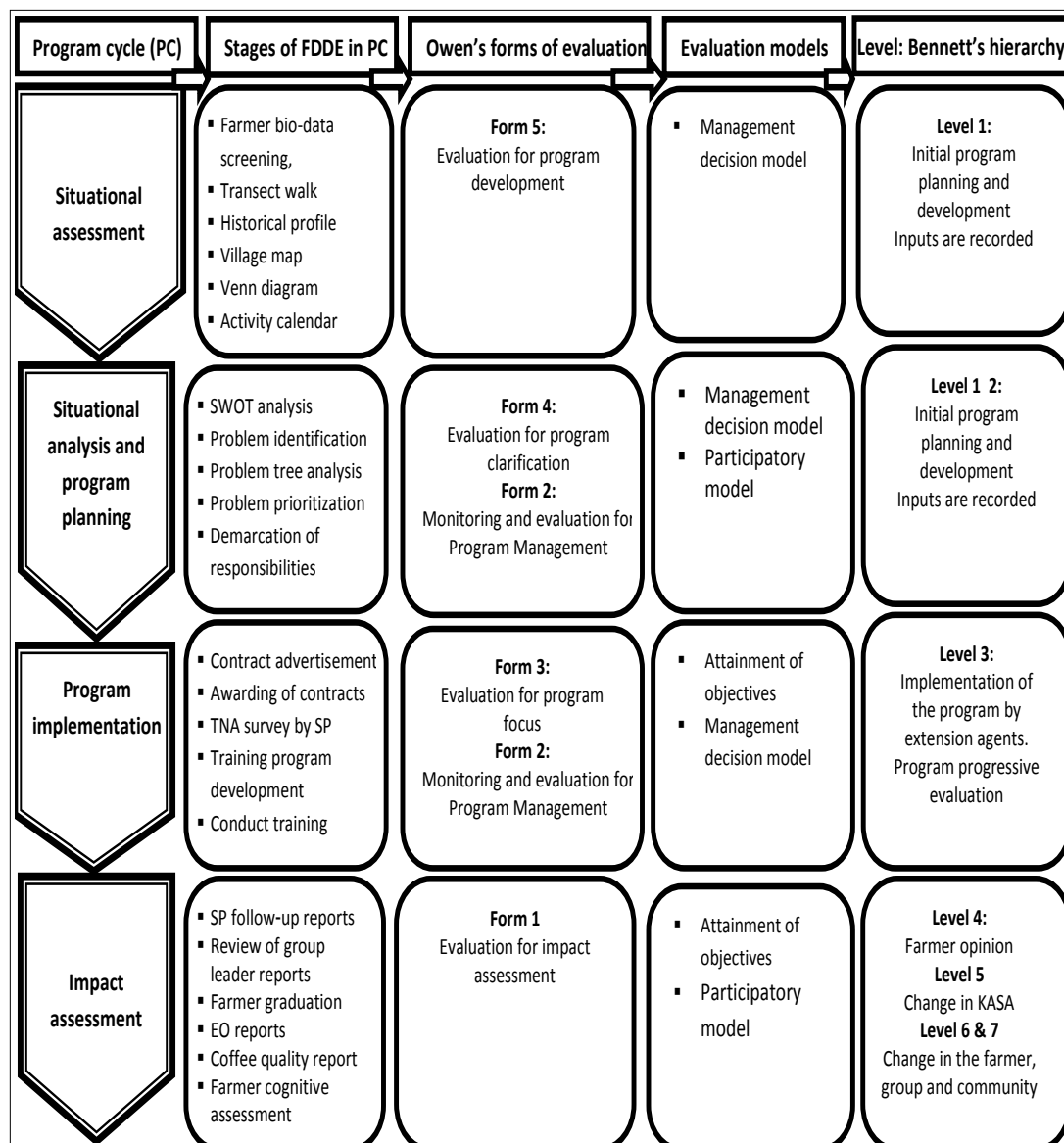


Figure 4.8: FDDE evaluation, program cycle and Owen’s forms of evaluation (Source: Author’s perspective)

The first step in the situational assessment of a potential farmer group under the FDDE is farmer bio-data screening after the awareness. If the farmer group has met most of the requirements to participate in the FDDE, the group proceeds with the other five methods of situational assessment: transect walk, historical profile, village map, Venn diagram and activity calendar. The data generated from these methods are further used for confirming the existence of the problems. Form 5: evaluation for program development and decision making model of evaluation is most relevant here. Situational assessment in the FDDE is the most

important step because it provides a concrete path way for the program planning. Therefore Bennett's level 1 evaluation is applicable for it assesses only the resources input.

Situational analysis is a continuation of the situational assessment which leads to the actual program planning in the FDDE. Strengths, weaknesses, opportunities and threats (SWOT), problem identification, problem tree analysis, problem prioritization and demarcation of responsibilities between the farmers and the CIC are done. Evaluation Forms 2 and 4 are interchangeably relevant and the evaluation models used are management decision and participatory. There is no impact assessment at this stage. However the resources used during program planning processes are recorded. The Participatory Rural Appraisal and Planning (PRAP) report compiled by the CIC extension officers is the ultimate output at this stage.

At the program implementation stage of the FDDE, a number of activities take place: contract advertisement, bids screening and awarding of contracts to training providers (TPs), conducting of TNA by TPs, training program development and implementation of the training program. A progressive evaluation takes place here by employing evaluation Forms 2 and 3 and using attainment of goals and management decision evaluation models.

Time lapses (5 – 10 years) before an impact assessment on the FDDE program are done. However, progressive reviews are done on: TP's follow-up reports, group leader reports, extension officer assessment, farmers' testimony through word of mouth and finally the graduation which concludes the FDDE program for a farmer group concerned. At an impact level, and through the application of the FDDE model, one of the evidence that could be demonstrated by the farmer group who have participated in the FDDE is their ability to produce superior quality coffee consistently. Regarding this, Romalus (2012) indicates that after some years of implementing the innovation acquired, there is marked improvement in the cup quality on coffees from some farmer groups who have participated in the FDDE training.

This study was assessing the processes, outcomes and impacts of the FDDE at the program implementation level (Bennett's hierarchy levels 1 -6). The critical stage of process analysis was the development of the agronomic and postharvest curriculum through the TNA survey. At the outcome stage was the assessment of cognitive acquisition and application of the acquired innovations by the farmers. At the impact level was the assessment of the outcomes of applied innovations by employing attainment of objectives and management decision models of evaluation. It is appreciated that the different monitoring and evaluation (M & E) approaches that were mentioned in literature are likely to be interchanagable used at different components of the FDDE. For this study, interchangeably used were the monitoring and evaluation approaches. For instance, individual techniques such as informant interviews were

used with key extension staff of the CIC to gather broader insights regarding the FDDE. Field reports such as PRAP and quarterly reports from the extension officers and group leaders were reviewed. Informal group discussions were held with other members of the groups who did not participate in the face to face interviews. Field tours in the form of transect walks were held before and/or after surveys. Information gathered for these approaches were used to support the results. However, face to face interview was the main source of data collection approach employed for this study given the following benefits: (i) easy to develop the instrument within a reason short period of time; (ii) reliable in terms of pre-testing the instruments; (iii) easy to clean the data and coding it; and (iv) easier to analyse the data statistically. Dart board and ranking was considered but its use was impeded by the need to prepare the instruments well in advance (no time) and sourcing suitable instruments was problematic given the financial constraints. However, for future studies, it would be better to use other M&E approaches such as case studies and comparative analysis to appreciate the changes taking place (if any) in groups who have fully participated in the FDDE and those that have not. Roles plays and self drawing would be better M&E approaches so that the beneficiaries of the FDDE would tell a story and/or display an artist work of the project impacts taking place in their communities and lives.

It was critical to understand that since the outcome of the agronomy and postharvest training was the production of superior coffee through the application of the acquired innovations, it was necessary to understand the appropriate topics that could have been delivered by TPs in both the agronomic and postharvest training programs. Therefore, a literature review on coffee agronomy and postharvest was vital. The next chapter provides this review.

Chapter 5. Agronomy and postharvest practices

Two of the most important innovations that were delivered to the farmers groups through the Farmer Demand Driven Extension (FDDE) approach by the training providers (TP) were knowledge and skills on coffee agronomy and postharvest practices. This chapter reviews the knowledge and skills concerning agronomy and postharvest in order to ascertain that the delivery of the agronomy and postharvest innovations to the farmers was consistent with the existing knowledge and practice. The chapter starts with an overview of the botany and history of *coffea canephora* and *coffea arabica*. The Agronomic practices reviewed include planting materials, land preparation, and field management are reviewed. Reviews under postharvest cover dry and wet processing methods, with more emphasis on the latter as it relates to the practices widely used in Papua New Guinea (PNG). The chapter concludes by making inferences of the review to the PNG coffee agronomy and postharvest practices.

5.1 Botany and history: *coffea canephora* and *coffea arabica*

Coffee belongs to the family of Rubiaceae of which there are four species that have economic importance: (i) arabica, (ii) canephora (robusta), (iii) liberica and (iv) excelsa (Ukers, 1922; Haarer, 1962; Cartledge, 1976; Coste, 1992; CRI, 1994, Sinclair, 1995). Morphologically, arabica and robusta have several common features, but there are also some differences. Arabica is self-pollinated resulting in uniform characteristics and propagation is mainly through seeds. On the other hand, Robusta is cross-pollinated and must therefore be vegetatively propagated (Coste, 1992; CRI, 1994; Kukhang, 1996; Nake et al., 2005). Both species have green leaves and the flowers are white. In the natural form, robusta is taller and bushier than arabica. Both species have well developed tap root systems. Cherries of both species are generally green when unripe and red when ripe. The cherries are oval, although arabica cherries are much bigger than robusta (Coste, 1992; CRI, 1994).

5.1.1 *Coffea arabica*

Ukers (1922), Haarer (1962), Cartledge (1976), CRI (1994), Anthony et al. (2002) and International Trade Centre (2002), identify Ethiopia as the place of origin of arabica coffee. These sources indicated that arabica coffee spread from Ethiopia to Egypt, into Yemen and to the Middle East: Persia, Turkey, and North Africa. Coffee then spread to Europe. *Coffea arabica* is now widely cultivated and accounts for over 61 per cent of the world production (International Trade Centre, 2002; Kimani et al., 2002). There are a number of arabica varieties but the most common varieties include: Amarelle, Arusha, Maragogype, Bourbon, Mundo Novo, Laurine, Mokka, Caturra, Catuai, and Catimor (Coste, 1992). Arabica is a high altitude

crop, which requires an optimum temperature range of 15-24°C with an ideal rainfall of 1,500mm-2,500mm (Coste, 1992; CRI, 1994; Nage et al., 2005).

5.1.2 *Coffea canephora*

Robusta coffee is believed to have originated from the Atlantic coast and Angola (Haarer, 1962; International Coffee Trade, 2002; Kimani et al., 2002). Robusta is commercially grown throughout the world and accounts for over 38 per cent of the world coffee production (International Trade Centre, 2002). Robusta thrives well at an elevation of 200-800 metres above sea level. Favourable temperatures are between 18-32°C. Rainfall requirements for robusta range from 1,500 - 2,000mm (Coste, 1992; Nake et al., 2005).

5.2 Agronomy practices

Generally, both arabica and robusta follow the same agronomic practices: planting materials and land preparations, field planting and management and pest and disease control. Coffee has a defined production cycle. In order to maximise yield potential of coffee, timely manipulation of the physiological features of the coffee tree through agronomic practices are necessary (CRI, 1994).

Land preparation is critical for coffee establishment. The first step involves clearing trees and/or slashing shrubs followed by burning. This is followed by marking the land and digging planting holes according to desirable design and density specifications. For arabica, there is a relationship between yield and the size of planting holes: the bigger (0.9m x 0.9m x 0.9m) the hole, the higher the yield (Coste, 1992; CRI, 1994). Planting materials of coffee are propagated using various methods: seeds, cuttings, budding, grafting, layering and somatic embryo (Haarer, 1962; Coste, 1992).

Field management practices include pruning, shading, fertilizer application, weed control, pest and disease management and drainage. Coffee is a perennial crop and has a production cycle. Therefore, coffee management should be dictated by the coffee calendar (CRI, 1994).

5.2.1 Pruning

Pruning is removing vegetative parts of the coffee tree in order to concentrate vigour into certain parts of the tree. Coffee bears well on a one-year old wood; therefore the coffee trees should be pruned routinely for maximum yield. The benefits of pruning include: (i) promotes production of healthy bearing laterals and/or uprights by removing unproductive parts of the tree; (ii) maximises production; (iii) reduces pests and diseases infestations; (iv) promotes easy harvesting by reducing the height; and (v) facilitates easy application of other management practices such as spraying. There are three main pruning systems: (i) single stem; (ii) single stem free growth; and (iii) multiple stem pruning. The terms single and multiple stem do not

refer to the number of bearing uprights. However, the main difference between single stem and multiple stem is that single stem system has restricted height and a permanent framework while a multiple stem system has trees with no restricted height and permanent framework. Although a single stem pruning system can have two bearing uprights, all forms of single stem pruning have restricted heights through capping to form an umbrella shape and the cherries are encouraged on the primary, secondary, and the tertiary branches, while in a multiple stem pruning system, cherries are borne mainly on primary branches (Haarer, 1962; Coste 1992; CRI, 1994; Tolopa, 1998).

5.2.2 Fertilizer application

In both the smallholder and estate sector, depletion of nutrients in coffee soil is high during harvest and recycle pruning where the beans and the wood respectively are taken out of the farm. An estimated 35 kg of Nitrogen, 7 kg of P₂O₅ and 50 kg of K₂O is removed from the soil when 1 tonne of green bean coffee is harvested. In addition, Nitrogen is lost during leaching and phosphate is lost through fixation. Therefore, unless these nutrients are replaced, the quality of the coffee beans will be affected (Coste, 1992). Uker (1922) recommended that the application of organic materials such as stable manure, leguminous plants, leaves, mulch, garden residues, ash and coffee pulp should be applied to the coffee trees for they contain minerals that could replace the nutrients that are lost during picking and pruning.

5.2.3 Weed control

Weed control is important in coffee to avoid competition for moisture, nutrients, space, sunlight, and to minimise the spread of pest and disease. If weeding is neglected, coffee yields will be depressed and poor quality will result (CRI, 1994; Manzan, 2000). Integrated weed management (clean weeding, slashing, chemical, biological, shading, cover cropping and mulching) is vital, for using only one method has more disadvantages (Coste, 1992; CRI, 1994). For instance, weeding with spades has proven to be uneconomical due to high labour costs, although weed germination can be delayed for a while (Coste, 1992). In high rainfall areas, coffee with heavy mulch cover has resulted in depressed yields and sticky soil structure. Intercropping coffee with food crops has benefits for smallholders (Haarer, 1962; CRI, 1994). In addition, George (C. George, 2015 pers. Comm., 20 August 2015) indicated that an Australian Centre for International Agricultural Research (ACIAR) livelihood project conducted in Baira (EHP) showed encouraging results in coffee which were inter-cropped with food crops. Some coffee farmers were able to intercrop coffee with crops such as bananas and this had provided benefits to the coffee tree in terms of the banana leaves providing shade at the same time suppressing weeds. Further, the farmers were able to weed their food crops together with their coffee trees. In this way the coffee trees were vigorously growing which eventually gave increased yield. Although fast and economical, herbicides are expensive and

can promote development of weed species that are resistant to some herbicides. Herbicides are harmful to humans when used without proper protective gear (Coste, 1992; CRI, 1994).

5.2.4 Shade trees

The option of growing coffee under shade is determined by coffee variety, climate, management style and locality (Ukers 1922; Haarer, 1962; Coste, 1992). CRI (1994) highlighted the advantages and disadvantages of having coffee under shade. Advantages of shade include: (i) maintains a constant temperature, thus controls rate of photosynthesis, which leads to control in flowering and fruiting, leading to minimising overbearing dieback; (ii) controls erosion and minimises leaching through leaf litter and deep root systems; (iii) reduces weed density through leaf litter, reducing labour cost associated with weed control; (iv) intercepts leached nutrients by the deep root systems which are eventually added to the top soil through decaying leaf litter; (v) breaks the hard pans by the root systems of the leguminous trees, hence improve drainage of the soil; and (vi) provides firewood, timber, and cash through selling wood and timber. The disadvantages are: (i) compete with coffee for moisture, nutrients, space, and light; (ii) requires hired labour for pruning; (iii) damages coffee trees during pruning, thinning, and felling; (iv) dense shade trees promote etiolated and weak branches of the coffee trees which result in few cherries; and (v) reduced yield due to reduced flowering, fruit setting and response to nitrogen is limited.

5.2.5 Pest and disease control

Pests of coffee include insects, mites, nematodes, molluscs, birds, mammals and some weed species. Pests of economic importance to coffee are mainly insects (Haarer 1962). Coste identified scales as the most important economic pest of coffee. Diseases of coffee are caused by fungi, bacteria and viruses (Haarer, 1962; Waller, 1985). Coste (1992) indicated that fungi are responsible for many diseases of coffee and are classified under four areas: (i) rots (e.g. roots and collar), (ii) rusts (e.g. *Hemileia vastrix*, *Hemileia coffeicola* and *Cercospora coffeicola*), (iii) wilt (e.g. *Carbunculariosis*) and (iv) berry related diseases (e.g. *Colletotrichu coffeanum*). Haarer (1962) identified two diseases caused by viruses: Blister Spot and Ring Spot. Galls on coffee roots are associated with bacteria. (Haarer (1962), Waller (1985), Coste (1992) CRI (1994) Sinclair (1995) and Apety (1998) identified three main control methods of pests and diseases: (i) chemical; (ii) biological; and (iii) cultural. Cultural and agronomic practices have been the best approaches to deter development and/or spread of pests and diseases. Timely application of pruning systems, weeding, shade control, drainage and removing diseased trees and burning them on site and/or burying have been the important management practices.

5.2.6 Coffee Calendar

The coffee calendar is a management matrix which schedules the timely application of agronomy practices in accordance to the coffee physiological changes. Untimely application of farm inputs can result in expensive wastage. Therefore, understanding of the coffee production/development cycle is essential (Cannel, 1985, CRI 1994, Yogiyo et al., 1996).

5.3 Postharvest practices

Processing starts with ripe cherry picking through to the production of the green bean (Clarke, 1995; CRI, 1994). Mucilage, which is composed of sugar, fibre, and ash, is formed only on ripe coffee cherries (FOA, n.d). When the beans reach full size, the cherries take approximately 10 days to ripen and if not harvested immediately, they turn brown and/or black (over-ripe), resulting in quality deterioration (Haarer, 1962). Coste (1992) and Clarke (1995) identify two methods of processing: wet and dry. Clarke noted that dry processing involves three stages: (i) harvesting of ripe cherries; (ii) drying of the cherries; and (iii) hulling of the dried cherries to produce green bean. Dry processing is commonly associated with robusta; however, Clarke (1995) indicates that Brazil processes 95 per cent of its arabica coffee using the dry process. According to (Coste 1992), wet processing involves three stages: (i) removal of pulp and the mucilage; (ii) drying of the parchment; and (iii) hulling. The wet processing method is the focus of this section.

5.3.1 Wet processing

Wet processing is necessary for the production of good quality arabica coffee. It uses a lot of water, time and labour in: (i) picking; (ii) sorting; (iii) pulping; (iv) fermentation; (v) washing and/or soaking; (vi) drying; (vii) hulling; (viii) polishing; (viii) storage; and (x) marketing (Haarer, 1962; Clarke, 1985; Coste, 1992; CRI, 1994).

5.3.2 Cherry picking

Haarer (1962, p. 256) indicates that a simple test to see if a cherry is ripe is through squeezing a ripe cherry at one end with the fingers and when the pressure bursts opens the cherry at one end and the beans fly out, that shows that a cheery is ripe'. CRI, (1994) noted that the quality of the beans cannot be improved once the cherry has been harvested. Therefore, quality will be compromised if picking is poor. Haarer (1962), Clarke (1985) and CRI (1994) indicated that picking should start as soon as the cherries are red-ripe because under-ripe and/or over-ripe cherries get nipped when pulped. These have adverse effects on quality (bad flavours, taints and inferior grades) and damage pulpers. CRI (1994) recommended that, especially in large farms, pickers should be supervised and picking tests taken randomly while picking is in progress. Through picking tests, problems associated with poor picking and farm management are identified. Picking tests uses two approaches: (i) sorting after harvesting and identification

of foreign matters such as leaves, soil, stones, un-ripe, half-ripe and dried (black) cherries; and (ii) through floater assessment whereby a handful of ripe cherries are immersed in a bucket of clean water and the numbers of floaters that surface to the top of the bucket are counted. Generally, a count of 2-4 per cent under-ripe and over-ripe cherry is accepted. A high percentage of under-ripe and over-ripe will cause the following problems: pulper damage, uneven fermentation, weight losses, and poor cup quality. A high number of floaters in the test imply that agronomy practices at the field are not properly applied.

5.3.3 Pulping

Pulping is the mechanical removal of the outer skin from the ripe cherry to produce parchment (Haarer, 1962). Pulping of the cherries should be done within eight hours of harvest so that delay in pulping does not compromise quality. If a delay in pulping is inevitable, the cherries should be soaked under clean water so that pulping is done as soon as possible. Failing that, the cherries will immediately go bad resulting in the production of 'off-flavours' and discoloured parchment (Coste, 1992; CRI, 1994; Clarke, 1995). Coste (1992) identifies two types of pulpers: drum pulper and multi-disk pulper. The former is widely used by smallholders.

Use of a poorly adjusted pulper leads to bean nipping and un-pulped cherries. This leads to irreversible quality problems: tait flavours and inferior taste. A well-adjusted pulper should nip only 2-3 per cent of the output. After pulping, pre-grading of the parchment is done for three reasons: To separate (i) the un-pulped from the pulped cherries; (ii) skin from the parchment; and (iii) floaters from the heavy parchment (CRI, 1994).

5.3.4 Fermentation

Fermentation is the de-grading of mucilage in the fresh parchment (Clarke, 1985). Coste (1992) identified four methods of fermentation: (i) biological; (ii) chemical; (iii) mechanical; and (iv) mechano-chemical combination. Haarer (1962), Coste (1992) and CRI (1994) indicated that the biological method is widely used and uses two approaches: (i) conventional method using free draining tanks made of cement boxes and perforated containers. CRI indicated that fermentation using the conventional methods takes 36 hours and; (ii) use of enzymes such as Ultrazym and Pectozyme. Enzymes are used in factories that handle huge volumes of coffee to reduce fermentation time.

The optimum temperature for fermentation is between 30 °C - 35 °C. Fermentation is slow at a lower temperature. The optimum pH ranges from 5.5 to 6.0 and in acidic conditions fermentation is slow. Four ways to hasten fermentation are: (i) use of recycled water (water used for pulping and washing); (ii) dry fermentation; (iii) intermediate washing; and (iv) use

of commercial pectic enzymes. Fermentation tanks should be painted with heat absorbent and acid resistant materials (Mburu, 1995).

The fermentation test is grasping and squeezing fermenting parchment in the hands to feel the grittiness of the beans. If the parchment is sand-rough, fermentation is completed. If the parchment still feels sticky, fermentation is incomplete, thus more time should be allowed. The fermentation test is critical because if fermentation is not monitored properly, serious quality issues such as onion or fruity flavour and discolouring of parchment can result (Haarer, 1962; Clarke, 1985; CRI, 1994; Mburu, 1995).

Soaking, or under water fermentation, is immersing of the fermented parchment in clean water. Soaking is done to remove remaining mucilage and acids between the grooves of the beans to produce a clean and good quality parchment (CRI, 1994; Mburu 1985).

5.3.5 Parchment drying

‘Drying involves reducing the moisture content (MC) of the parchment in order to further process it or store it for a longer period of time without deteriorating the quality’ (Mburu, 1995, p. 2143). The MC of a washed parchment is about 55 per cent, which must be reduced to 10.5 per cent. There are two methods of drying: sun and hot air. Sun drying is cheaper and is done on raised beds made of timber with wire mesh surfaces and/or using canvas. Hot air drying is expensive and involves using rotary driers driven by motors which fan hot air coming from sources such as firewood lit in drum ovens (Haarer, 1962; Mburu, 1995). Coste (1992) indicated that the simplest method of drying for smallholder farmers is the use of fixed or mobile raised screen made from locally available materials. A drying screen, usually 2 m x 1 m, with a floor surface of woven fibre, is fixed above the ground so that free circulating air and sunlight can dry the parchment.

CRI and Mburu identified four main stages of sun drying: (i) skin drying involves reducing the MC from 55 per cent to 42 per cent through direct sunlight drying on raised beds so that no water is present in between the bean and the parchment. The parchment is thinly spread and constantly turned to avoid moulds and rotting; (ii) white or opaque stage drying is an important stage because according to Mburu (1995, p. 2134) ‘fatty acids, cafestol, and Kahweol are formed in the beans which play an important role in the formation of bluish and greyish colour of the raw coffee which is good for quality’. The MC is reduced from 40 per cent to 30 per cent through a slow drying process, giving a soft white parchment with opaque beans. Shade must be provided during the hottest hours (10:30 am – 2:30 pm) of day so that cracking in the parchment is avoided; (iii) Black stage - the MC is reduced from 30 per cent to 11 percent. The colour of the bean turns black and hard. Quality problems at this stage are minimal, however, the parchment should not come in contact with water; and (iv) conditioning

is the last stage of drying where the MC is maintained at 10.5 percent. For this the parchment is stored in bins and well-ventilated rooms. The colour of the bean should be translucent jade green and biting can barely leave a teeth mark. This indicates that the parchment is fully dried. For smallholders, well dried parchments should be kept in cool smoke free houses.

5.4 PNG coffee agronomy and postharvest practices

This section combines the literature reviewed in this chapter and gives a brief insight into the PNG coffee industry. This section is organised per: (i) introduction of coffee into PNG; (ii) the types and varieties of coffee grown; and (iii) the current agronomy and postharvest practices.

5.4.1 Introduction of coffee into PNG

PNG was colonised by two different countries: Britain and Germany and the country was often referred to as British New Guinea (BNG) and German New Guinea (GNG). Both colonisers were responsible for introducing coffee into their respective territories. The first official introduction of coffee into BNG was facilitated by Sir William MacGregor. A few coffee seeds were brought in from Jamaica and were germinated by Charles Kowald on an area of six acres, which showed excellent results (Sinclair, 1995).

The British administrators are believed to be responsible for introducing coffee on the Papuan side. Coffee was found growing in botanical gardens, outside the British administrative building in Port Moresby between 1885 and 1890. In 1896, 20,000 arabica coffee plants were surviving in the Variarta plantation on the Sogeri plateau a few kilometres outside the city of Port Moresby. The New Guinea Department of Agriculture first established a commercial planting near Wau (Morobe) in 1928/1929. Coffee seeds were first introduced into the Highlands (Asaro-EHP and Ogelbeng-WHP), by the early Lutheran Christian Missionaries in the pre-war years. The first plantation in the Highlands was established near Goroka in 1947 by James Leahy while coffee was planted in Aiyura Experimental station in 1937, of which the stocks of first plantings still remain today (CRI, 1994).

5.4.2 Commercial coffee varieties

The early expatriates have introduced different varieties of coffee into PNG. Now there are more than 200 coffee varieties in the CIC Germplasm. However, there are only eight commercial varieties: six arabica and two robusta (CRI, 1994). Both arabica and robusta are grown but *coffea arabica* is the most dominant (Cartledge, 1976; CRI, 1994; Sinclair, 1995).

Arabica varieties

Of the six commercial arabica varieties, four are tall and two are dwarf: (i) Typica (Blue Mountain) was the first tall variety to be introduced into Wau from Jamaica. This variety is

characterised by brown growing tips on young leaves, narrow leaves, horizontal branching, small growing habit and small cherry size. The variety is hardy and is able to withstand drought. Typica is the recommended variety for smallholders; (ii) Bourbon was introduced in the 1930s by the Lutheran Missionaries. This tall variety was developed in the Highlands. Bourbon is characterised by large leaves with green growing tips on young leaves. It has erect branches with a vigorous growing habit and has good cup quality. It has a large stem diameter and produces fairly large cherries; (iii) Arusha was introduced from Kenya in 1950 and was screened intensively by the PNG Coffee Research Institute (CRI) in the 1980s before being released to farmers. Arusha is characterised by its tall height, vigorous growth habit and high yield. It has large cherries with big stem diameter. It requires high input output management practices and therefore Arusha is recommended to farmers who are able to provide the intensive management practices required; (iv) Mundo Novo was introduced from the USA in 1962. This tall variety is characterised by green growing tips on young leaves and erect branches. It gives high yields under good management practices but the bean sizes are uneven; (v) Caturra is a dwarf variety and was introduced in 1957 from Jamaica. It is identified by its green growing tips and compact branches. It is high yielding under good management and gives good cup quality; and (vi) Catimor is a dwarf variety and was introduced in 1985 from Portugal and Australia. It is the only variety that is tolerant to Coffee Leaf Rust, and grows between the altitudes of 400-1800 m. It is high yielding under good management practices and gives a very good cup quality.

Robusta varieties

According to CRI (1994), there are only two known commercial robusta varieties: Besuki and Omuru 1. (i) Besuki was introduced from Java by the Department of Agriculture, Livestock & Fisheries in 1954. The beans are small and yields are low when compared to the Arabica varieties; and (ii) Omuru 1 was developed by the CIC through the CRI and was first planted at Madang in 1993. Omuru 1 is high yielding and has good cup quality. It is propagated vegetatively and is tolerant to CLR. Under good management practices, Omuru 1 performs well.

5.4.3 Agronomy

The agronomy practices employed in PNG are no different to practices employed in other coffee growing countries. However, unlike other countries, PNG receives more rain than is required and therefore, the agronomic practices are dictated by the prevailing weather patterns (CRI, 1994). Therefore, the agronomic practices that are applied on the field in both the smallholder and the estate sectors are guided by a coffee calendar (Figure 5.1) (1994).

Month	Activity			Fertilizer program
	Weather	Management practices	Changes on the coffee tree	Nutrients
October	Beginning of wet season	<ul style="list-style-type: none"> ▪ Weed control 	Main flowering	Nitrogen (N)
November	Heavy rain	<ul style="list-style-type: none"> ▪ Desuckering 	Growth of suckers	Potassium (K)
December		<ul style="list-style-type: none"> ▪ Drainage 	Fruit setting	N
January		<ul style="list-style-type: none"> ▪ General Pest & disease control 	Fruit growth and development	Phosphorus (P)
February		<ul style="list-style-type: none"> ▪ Coffee leaf rust spray 		K
March		<ul style="list-style-type: none"> ▪ Weed control 		NPK
April	Dry period	<ul style="list-style-type: none"> ▪ Desuckering 	Fruit fully develops and ripening begins	N
May		<ul style="list-style-type: none"> ▪ Main harvesting and coffee processing periods 		Fruit fully ripe for picking
June			Picking begins	
July			<ul style="list-style-type: none"> ▪ Main pruning 	Growth of new leaves and stems
August		<ul style="list-style-type: none"> ▪ Weed control ▪ Drainage 		
September	Beginning of wet season			

Figure 5.1: A general PNG coffee calendar (Source: Yogiyo et al., (1996)

Rehabilitation is synonymous with field management or agronomy practices and involves seven main practices: fencing, shading, drainage, weeding, pruning, pest and disease control and nutrition application.

Fencing is necessary because, in the villages, pigs and goats are raised on free-range system and can easily damage the coffee trees. Therefore, the coffee trees should be fenced using wires and/or wood.

The use of shade is very important in PNG coffee. Varieties of shades trees (Casuarina, Albizzia, Leucaena, Wattle, Gliricidea, Erythibna, and Grevillea) are often used in the smallholder gardens because they: suppress weeds, reduce sunlight intensity, preserve moisture, minimise pests and diseases, provide nutrients through leaf litter and provide timber for sale, firewood and for fencing (CRI, 1994; Aroga, 2008a).

Weeding is often a problem and accounts for 30-80 per cent of yield loss and also affects coffee quality (CRI, 1994; Manzan, 2000). Therefore farmers are encouraged to use intergrated weed control methods.

Pruning is an important aspect of coffee management as this improves the response of the coffee trees to other management practices. The two major types of pruning practices are single stem and multiple stems. The type of pruning systems applied by smallholder farmers is determined by the farmer's confidence based on their knowledge, skills, financial capabilities, tree density, shade cover and altitude (Tolopa, 1998). Single stem pruning system has more than one bearing uprights with restricted height and definite framework. Crop is carried on secondary and tertiary laterals. Although single stem pruning system is expensive

as skilled pruners are required to shape the trees to a desirable height and framework, it is more suitable at the lower altitude where the trees grow faster. Multiple stem pruning has unrestricted height and lateral frame. The crop is on the primary branches and the coffee trees are easier to control by replacing the bearing heads by instituting a recycle pruning. At the lower altitudes, this pruning system is not recommended because the trees grow too fast and tall making picking and spraying difficult. Multiple stem pruning is the recommended pruning practice for farmers at the higher altitudes because the tree grows at a slower rate and picking is a lot easier, although after more than seven years, the trees are normally too tall to be managed and picking is problematic. Therefore, recycle pruning is commenced at this stage (CRI, 1994).

5.4.4 Pests and diseases

The main pests of coffee listed in order of their economic importance are: green scales, coffee ring borer (*Meroleptus cinctor* Marshall), leaf hoppers (Hemiptera: Cicadellidae), coffee centre borer (*Zeuzera coffeae*), coffee leaf roller (*Hamona coffearia* Nietn), Cicadas (Homoptera: Cicadidae) and Army worm (*Spodoptera exempta*) (CRI, 1994). Apety, (1998) has found in Aiyura that heavy infestations of green scales can cause a 50 per cent reduction in cherry yields. Coffee berry borer is not yet in PNG.

Most of the diseases in coffee are fungal and they include: coffee leaf rust (*Hemileia vastatrix* Berk. and Brook), leaf and berry spot (*Cercospora coffeicola*, Berk and Cooke), Pink disease (*Phanerocchaete salmonicolor* Berk. and Broome), Black Rot (*Kaleroga noxia* Donk) and White Threat Blight (*Marasmius* and *Corticium*) (CRI, 1994). Coffee leaf rust is the most serious disease of coffee (CRI, 1994; Sinclair, 1995). Most smallholders use a combination of cultural and biological control methods to manage the pests and diseases. Cultural practices are the timely application of the field management practices, while biological controls include use of predators such as wasps (*Metaphycus baruensis*) and lady bird beetles for green scales (Apetty, 1998) and *Verticillium lecanii* for coffee leaf rust (CRI, 1994). The Catimor variety is tolerant to CLR (CRI, 1994). Most smallholder farmers grow coffee in sympathy with the environment and therefore there is hardly any use of synthetic chemicals such as inorganic fertilizers and pesticides. Use of garden residues, mulch, leaf litter from shade trees, and legumes inter-cropped with coffee are common.

5.4.5 Postharvest practices

PNG uses wet coffee processing techniques. Generally, the main coffee season starts in May/June. The smallholders are encouraged to pick only red ripe cherries, but this is not always practised. Therefore cherry sorting is encouraged to remove foreign materials and to separate ripe, over-ripe, under-ripe, black cherries and floaters.

Most smallholder farmers are encouraged to use drum-pulpers which are motorised or hand-operated. Hand pulpers have the capacity to pulp 180 kilograms -200 kilo grams of cherries per hour, while motorised pulpers can pulp 600 kilograms per hour. The pulpers must be adjusted before and during the pulping process (CRI, 1994). Anecdotal evidence indicates that some smallholders still use heavy stones, feet, teeth, and hands to pulp the cherries.

Smallholder farmers are encouraged to use recommended fermenting vents such as polythene tanks, concrete and wooden boxes. However, due to the high costs of acquiring these materials, the farmers are encouraged to use clean empty stock-feed bags (CRI, 1994). Before re-use, the bags should be washed thoroughly to avoid contamination. Smallholders using bags for fermentation are encouraged to wash off the mucilage every day with clean water and the water drained off. If mucilage is still attached to the parchment, fermentation should be allowed to continue in a different clean bag. However, experiences are that: (i) parchment washed in bags is not thoroughly done; (ii) a lot of clean water is required; (iii) lights and/or floaters cannot be easily removed; and (iv) it is laborious (CRI, 1994; Aroga, 2008^b). While smallholder farmers are encouraged to soak the parchment in clean water for 12-24 hours following fermentation, anecdotal evidence indicates that this is not necessarily the practice with many smallholder farmers.

Approaches taken by smallholders to dry their parchment vary with many drying their coffee either on the ground using simple materials and bags. The CIC recommends that drying is done on raised beds made of timber and woven wire mesh. The initial drying (skin drying) reduces the MC to 42 percent, which is eventually reduced to 20-25 percent. During the main drying, the MC is reduced to 10.5 percent. Sun-drying is the normal practice in PNG for the following benefits: (i) the quality is improved by bleaching effects of ultra-violet light; (ii) brown discoloration and chlorophyll from some unripe cherries is bleached; and (iii) easy to control. The dried parchment is processed into green bean. The recovery ratio for this process is the difference between the weight of the parchment and the weight of dry, sound and clean green bean. A well-dried parchment with a MC of 12-10 per cent has a high recovery ratio of 80 percent. However, smallholder parchment is known for its inconsistency in the MC levels and foreign matters such as stones, sticks and dirt are likely to be present, hence reducing the recovery ratio. To determine a fixed recovery ratio for the smallholder coffee, parchment standard has been developed. The parchment standard is based on: (i) MC level in the parchment; (ii) colour and appearance of parchment, silver skin and green bean; and (iii) defects (CRI, 1994). The details of the parchments standards are given in Table 5.1

Table 5.1: Parchment standards of PNG coffee

Parchment classes	Description	Moisture content (%)	Colour and appearance	Silver skin green bean	Defects/100 grams
Class 1	Machine coffee – premium	9-10: very hard. No teeth mark	A very pale and even colour. Substantially free from defects	Clean translucent silver skin. Clear green bean : jade to olive coloured	>12 defects. NO FOREIGN MATTER
Class 2	Good coffee	11-15: hard, slight mark with teeth	An even colour. Few defects	Clean translucent silver skin. green bean : clear jade to olive colour	Up to 70 defects. No foreign matters
Class 3	FAO	15-20: black appearance. Easy teeth mark	An uneven and mixed colour and some defects	A dirty silver skin. Hard to remove. green bean : Yellow green to brownish	Up to 35 defects. Free from foreign matters
Class 4	Rejects	20-30: very soft. Crush with teeth	Discolour and dirty.	Very dirty. green bean: very uneven	More than 70 defects. Some foreign matter

Note: *Defects* – Coffee parchment beans which are not normal in physical appearance. Beans damaged by nature or insects or during processing.
Foreign matter: Any substance not derived from the coffee cherry

Source: CRI 1994

Smallholders are discouraged from storing their dried parchment in dwelling houses where smoke from fire is common. Instead, the smallholder parchment should be stored in dry and smoke free houses, although this recommendations are not necessarily followed (CRI, 1994). The recommended postharvest best practices for smallholders are summarised in Figure 5.2.

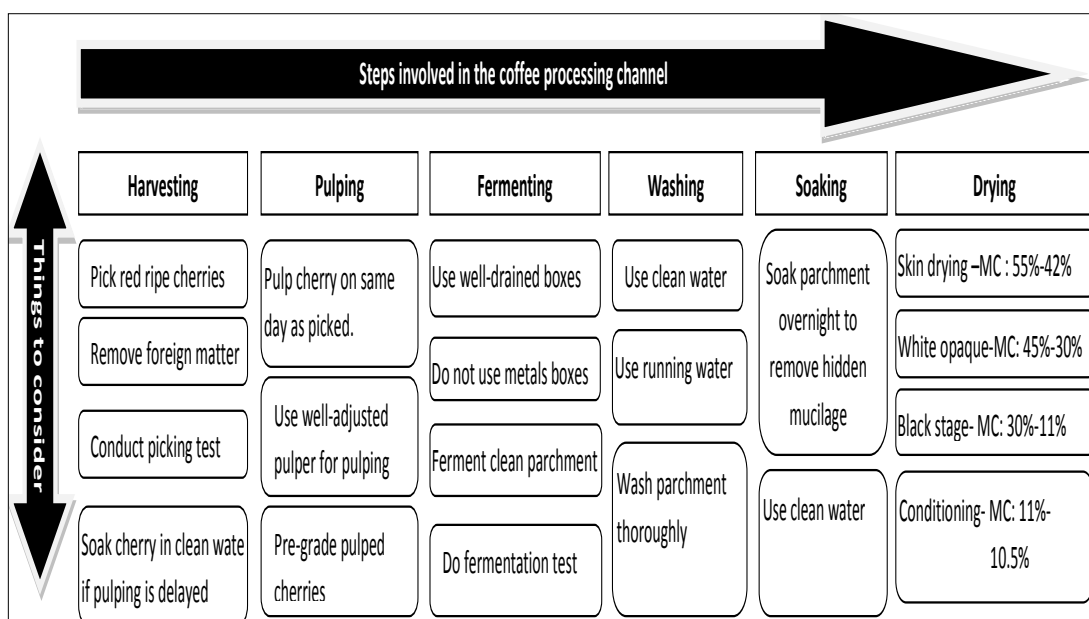


Figure 5.2: The CIC recommended coffee processing steps (Source: Adopted from CRI, 1995)

The agronomy and postharvest practices recommended by the CIC for the farmers have empirical bases and are consistent with the acceptable global practices. Therefore, CIC believes that if 80 per cent of the agronomy and postharvest techniques were applied by the farmers, there is a possibility that the poor quality coffee produced at the smallholder levels could be minimised. To achieve this, the CIC under the FDDE approach has engaged TPs to transfer the appropriate agronomy and postharvest innovations to the smallholder farmers through implementation training programs.

It was appreciated that the timely application of the correct agronomic innovation is necessary to realise an increased production of better quality cherries in terms of bean size, cup quality and minimised defects due to pest and disease attacks. In order to produce better cherries, it was important for the smallholder farmers to fully understand all the essential aspects of coffee agronomy. During the agronomic training program, the training TPs should have covered in detail the following topics: pruning systems, shade management, weed control, pest and diseases and their control methods, the importance of nutrients and their application methods, importance of drainage and drainage systems, functions of fencing and fencing materials and a typical coffee calendar. It was clear also that postharvest techniques are vital in maintaining the quality of the coffee coming from the field. Coffee quality cannot be improved in any way through the postharvest practices. The function of a good processing practice is to preserve the good qualities of the coffee cherries harvested from the field. If however, the farmers are not careful on how they process the cherries using best practices along the processing chain, the quality of the coffee could be compromised. To ensure that quality coffee is preserved along the processing chain, the smallholder farmers need to know the correct techniques. The TPs should have covered in detail the following essential topics: coffee cherry harvesting methods, pulpers and pulping techniques, fermentation and fermenting equipment, washing and soaking procedures, parchment drying stages and drying techniques, parchment classes and moisture contents and storage. The next chapter examines the methodology of the study which was used to assess whether the farmers had acquired the agronomy and postharvest innovations transferred to them during the training programs.

Chapter 6. Study design

The vast majority of the Participatory Rural Appraisal and Planning (PRAP) reports compiled under the Farmer Demand Driven Extension (FDDE) program identified the need for more training to be delivered to the smallholder farmers on coffee agronomy and postharvest practices. To address these problems, external training providers (TPs) were contracted by the Coffee Industry Corporation (CIC) to transfer appropriate agronomic and postharvest knowledge and skills to the farmers. However, no studies have been conducted to evaluate the impact of these training programs. This chapter describes in detail the methodologies employed to conduct such as evaluation in the Highlands of Papua New Guinea (PNG). This chapter is organised under six main headings: (i) study approaches; (ii) instrumentation; (iii) study population; (iv) data collection methods (v) data analysis; and (vi) study limitations.

6.1 The study approaches

6.1.1 The study structure

The three keys areas of analysis for the study were: (i) process; (ii) outcomes; and (iii) the impact of the agronomy and postharvest trainings (Table 6.1). The process analysis sought to assess whether a Training Needs Analysis (TNA) had been conducted by the TPs. The outcome analysis was to assess the content and delivery of the actual training. The impact analysis assessed the extent to which the farmers had acquired and implemented new agronomic and postharvest knowledge and skills.

Table 6.1: Summary of research methodology

Phase	Data source	Instrument	Data description
Process analysis	Farmers	Structured questionnaires	Primary data
	CIC	PRAP & TNA reports	Secondary data
Outcome analysis	Farmers	Structured questionnaires	Primary data
	CIC	Sample training aids, lesson plans etc.	Secondary data
Impact analysis	Farmers	Questionnaire, cognitive test, transect-walk, and informal discussion.	Primary data
	CIC	PRAP reports	Secondary data

6.1.2 Choice of evaluation models and techniques

This study used two evaluation models: participatory (Dart, 2000); and goal-based (Laverne et al., 1994; Petheram, 1998). The participatory model was used to involve the farmers in the study while the goal-based model was used to assess the agronomy and postharvest training objectives mentioned in the FDDE document, the PRAP reports and the TPs' lesson plans.

6.2 Instrumentation

Among the various quantitative and qualitative data collection methods, four approaches were employed: (i) structured face-to-face interview; (ii) cognitive testing; (iii) transect-walk observations and informal group discussions; and (iv) FDDE document review. A structured questionnaire was developed to accommodate the first two approaches. Dart board and focus group discussions were considered, but were not utilised due to time and financial constraints. High levels of illiteracy among the participants prevented the use of self-administered questionnaires.

6.2.1 Face to face interview questionnaire

Structured interviews enable the researcher to gain rich information about the study population and to make comparisons between the groups (Marshall and Rossman, 1999; Kumar, 2005). Questionnaires for both agronomy (Appendix 3) and postharvest (Appendix 4) were developed in English and then translated into Tok Pisin.

Consistent with the study structure, the body of the questionnaires had four main parts: (i) the process section assessed the TNA methods; (ii) the outcome section assessed the training program (topics covered, methods employed, and aids used); (iii) the impact section assessed the application of the acquired innovation and the impediments to the adoption of the acquired innovation; and (iv) the final section gathered some demographic and socio-economic information from the respondents. Except for the demographics section, which used open-ended questions, the three preceding sections had a mixture of opened-ended, dichotomous, and scaled questions.

6.2.2 Cognitive test questionnaire

The approach taken to assess the farmers' acquisition of knowledge from the agronomy and postharvest training was through the use of a structured quiz (Brace, 2004). The cognitive-quiz had ten multiple-choice questions for both the agronomic (Appendix 6.5) and postharvest (Appendix 6.6) training programs. Each question had three choices of which the farmers were expected to circle only one response which they thought was correct.

6.2.3 Instrument testing

The survey instrument was pilot tested in two sites: Western Australia and PNG.

Pilot test in Western Australia

Both the face-to-face and the quiz questionnaires were pilot-tested with some members of the PNG community, working and/or studying in Perth. The purpose of the pre-test was to confirm that the survey instruments translated into Tok Pisin were easily understood by native Tok Pisin speakers. It was found that several words used in some parts of the questionnaires were

not clear; hence the respondents' comments were incorporated before the instruments were taken to PNG, where the actual study was conducted.

Pilot testing in PNG

A farmer group (Fimito) located close to Goroka town in Eastern Highlands Province (EHP), PNG was selected to pilot-test the instruments. For this, the farmers were informed a week earlier. The Fimito farmers were an ideal group as they had participated in the PRAP survey and the agronomy and postharvest trainings. A total of 15 farmers participated in the pilot-test. Comments, confusions, and resistance experienced by the farmers were noted and the questionnaires were later refined.

6.3 Description of the population

Initially, the study was to be conducted in three Highlands Provinces of PNG: EHP, Chimbu, and Western Highlands (WH). However, only EHP and Chimbu were selected owing to financial and time constraints. EHP and Chimbu are adjacent to each other (Figure 6.1). This greatly reduced travel costs, enhanced farmer cooperation, and minimised ethnic diversity.

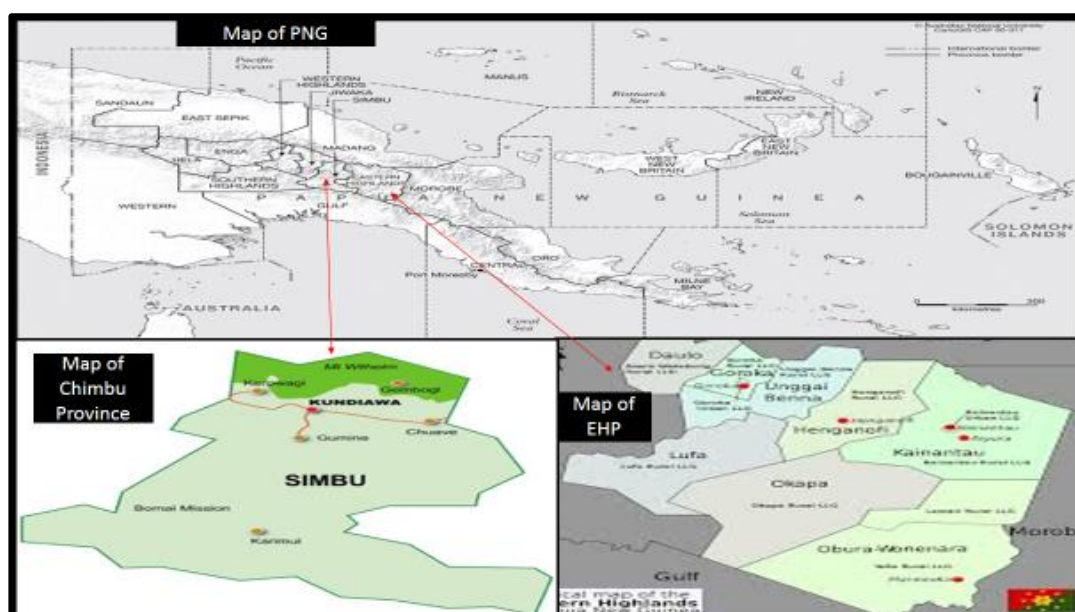


Figure 6.1: Maps of PNG, Chimbu and EHP (source: <http://asiapacific.anu.edu.au/map...>)

6.3.1 6.3.1 FDDE coverage and coffee production: EHP

The vast majority of coffee farmers in EHP are smallholders who collectively produce about 47 per cent of the total PNG exports (CIC, 2012). EHP has a land area of about 11,000 square kilometres and has a population of around 293,000 (2000 Census) (Hanson et al., 2001). The population is primarily rural where only 41% of the population is literate with illiteracy being higher among women (Akogere, 2005).

Due to the importance of coffee and the peaceful environment, EHP gets more FDDE training projects funded than any other coffee growing province in PNG. Towards the end of 2011, over 30 FDDE training programs had been contracted by the TPs, however only 12 training programs had been completed (L. Matei, 2009 pers. comm., 13th October 2009).

6.3.2 FDDE coverage and coffee production: Chimbu

Chimbu Province ranks fourth in coffee production. It contributes about 4.8 % of the total exports (CIC, 2012). Topographically, Chimbu is very mountainous and rocky. However, it has good limestone and volcanic soils for coffee cultivation and almost all smallholder coffee is organic. Coffee is the most important cash crop and plays a significant role in meeting almost all domestic and social obligations (CIC, 1994; Paula, 1996; Hanson et al., 2001). Chimbu province occupies an area of 6,000 km² and had a population of 182,000 (2000 census). At the time of the survey, more than 20 farmer groups had gone through the FDDE training. However, only nine groups had fully completed the agronomy and postharvest training (L. Matei, 2009 pers. comm. 13th October, 2009).

6.3.3 Sample population selection criteria

According to CIC (2002), each farmer group should have a minimum of 20 families prior to participating in the FDDE program. On average, a family will have five mature members, thus a group could have 100 active coffee farmers. There were 21 groups in the two selected provinces that had successfully completed the agronomic and post-harvest training (L. Matei, 2009 pers. comm. 13th October, 2009).

Criteria to select the farmer groups and the respondents within the groups were developed. The groups had to be: (i) easily accessible by road- this was necessary so the research team could easily drive to the groups and collect data; (ii) free from tribal fighting- so that the research team was not disturbed while collecting data; and (iii) cohesive and intact. The criteria for selecting the respondents were: (i) willingness to participate in the survey- to ensure that maximum number of respondents participated; (ii) personally involved in all the FDDE programs- to avoid errors from farmers who had not participated in the PRAP training process; (iii) farmers who were currently working in their coffee gardens – to ensure that the respondents had the opportunity to apply the acquired innovation; and (iv) farmers who were able to speak and understand Tok Pisin– to minimise interpretational errors.

The extension officers (EOs) of the CIC who were located in the target provinces were asked to identify the farmer groups. The EOs then asked the respective group leaders to identify suitable respondents. By chance, three groups each in both EHP and Chimbu satisfactorily met the first selection criteria. In EHP, the Tiredne, Gotomi, and Nagamiufa groups were selected. In Chimbu, the Tani, Mata and Mindima groups were selected. From the six groups identified,

three had completed the agronomic training and three had completed the postharvest training (Table 6.2)

Table 6.2: Farmer selection by province and training areas

Farmer group	Province	Training area	Ideal	No. farmers
Gotomi	EHP	Agronomy	30	15
Tiredne	EHP	Agronomy	30	19
Nagamiufa	EHP	Postharvest	30	15
Mata	Chimbu	Postharvest	30	15
Mindima	Chimbu	Postharvest	30	19
Tani	Chimbu	Agronomy	30	17
Total (N)			180	100

To improve the reliability of the survey, 180 respondents were suggested. Knowing that the group leaders were often with their respective farmer groups, they were given the opportunity to identify individuals who were suitable to participate in the survey. Each group leader with help from the EOs then recommended 30 participants from each group, which gave an initial sample population of 180. However, during the actual survey, the number was reduced to 100 because: (i) seventy participants from the sample population were not in the villages at the time of the survey; (ii) nine from the sample population refused to participate after realising that they had not fully participated in the PRAP survey and the training programs; and (iii) one refused to participate in the survey.

6.4 Data collection

The study was conducted in late October 2009, over six consecutive days: three days each in EHP and Chimbu. Five EOs assisted in the administration of the survey instruments. Daily pre-briefing and de-briefing sessions were held to discuss issues arising from the survey and to minimise human errors during data recording.

6.4.1 Recruitment and training of assistants

The first task was to recruit and train research assistants (RA). For these, three EOs and two research technical staff from the CIC were recruited. This was necessary because the officers were: (i) familiar with the FDDE training; (ii) had local knowledge which enabled them to talk to the farmers and to gain the farmer's confidence to complete the survey; (iii) able to explain the questionnaires to farmers in Tok Pisin; and (iv) able to record data.

The author went through the survey instruments with the RAs and allowed them to make comments. The RAs provided useful information which was used to refine the survey instrument without altering the original meaning. Prior to the actual survey, the RAs were inducted on how to interview and record the farmers' responses in Tok Pisin. Although most of the farmers could speak and understand Tok Pisin, reading and writing was problematic. Therefore, the RAs were allowed to interview 4-5 farmers, one at a time.

6.4.2 Data collection through face-to-face interviews

To facilitate the survey, each RA was given samples of the agronomy and postharvest training aids such as posters, handouts, and cut-out circles of various sizes. The sample posters and handouts were used to illustrate the training aids the TPs should have used during the training (most farmers would have seen the training aids if they had been used during the training). Cut-out cardboard circles were used to explain the questions with rating scales (1-5). PNG farmers in their every-day language associate *number 1* to mean very good, very satisfactory or very helpful, and upper *numbers* such as 5 to indicate very poor, unsatisfactory, or not helpful. Therefore five different size circles were used: the largest size with 1 on it to mean very good, and the smallest size with 5 to mean very poor. These circles were used to assist the farmers to answer the rating questions. The author played a supervisory role to ensure that the RAs were asking the questions correctly, the questionnaire aids were used properly and that the questionnaires were being filled in correctly by the RAs.

6.4.3 Data collection through cognitive quiz

The cognitive quiz was administered soon after the face-to-face interview. The RAs explained the purpose of the quiz to individual farmers. To avoid cheating among the farmers, the quiz was administered per farmer. The RA read and explained the questions and the corresponding responses. The responses indicated by the farmers were circled.

6.4.4 Data collection through ocular observation

Observation is a technique used in longitudinal studies such as ethnography and case studies (Malhotra et al., 2006). Although this study only employed 3-4 hours of observation around the coffee gardens of the respondents, the observation sessions were necessary to assess the application of the acquired innovations by the respondents and to cross examine the responses of the respondents on the face-to-face interview questionnaires. Opinion leaders were selected among the sample population for a transect-walk starting from one end of the village boundary to the other. Digital images of the farmers' coffee gardens were captured. At intervals, informal discussions were held while in the coffee gardens.

6.4.5 CIC documents review – secondary data

Sources of secondary data include letters, memorandums, meeting minutes, and progressive reports (Yin, 1994). For this study, PRAP reports and TP lesson plans were retrieved from the CIC extension files. The reason for reviewing the CIC FDDE documents were to: (i) identify the training lesson plans and the objectives and; (ii) to gather insights on the progress of the FDDE training from the EOs and the TPs perspectives.

6.4.6 Managing issues during data collection

No major obstacles were faced during data collection. However, a few minor problems were faced and addressed accordingly. These issues are discussed below.

Farmer incentives

Under the CIC approach to FDDE, the smallholder coffee farmers received incentives primarily through provision of food. Precedents were already set and therefore research activities such as this were no exception. Each respondent was given a K10 (A\$5), in addition to provision of lunch.

Illiteracy problems

Difficulties faced by this study included respondent boredom, illiteracy and respondents' inability to recall training topics that had been covered and training aids used. This was because a considerable amount of time has elapsed from the time they had attended the training to the time this study was conducted. Therefore, various techniques to overcome these problems were discussed with the RAs and appropriate approaches relevant to each situation were identified. For instance, the Tok Pisin questionnaire was lengthy. This was due to limitations in the Tok Pisin vocabulary, which sometimes requires many words to translate a single English word or a concept into Tok Pisin. As a result, the farmers were often bored. To overcome this, the research team had a thorough discussion on the objectives of the study and each question in relation to the objectives. After this, it was agreed that the questions would be simplified by using questionnaire aids such as posters and circles without interfering with the wording of the questions. This approach proved to be very useful and the farmers provided answers to the questions.

Incomplete responses

During the post-interview meetings, it was noted that the RAs had not completely recorded the farmers' responses. This was because most farmers had given the same answers and therefore the RAs thought that the author could easily work out the missing responses. This was misleading and immediately the missing responses were rectified by instructing the RAs to complete all the questionnaires, even though the responses from different farmers were the same. Furthermore, all the completed survey questionnaires were screened by the author and clarifications were sought immediately from the responsible RA on any unclear data or missing information such as place of interview, farmer code and responses which showed little variance, especially with the rating scales. This approach ensured that data collection was done accurately.

6.5 Data analysis

Two different approaches to data analysis were used: SPSS (various Anova tests and tools) and theme identification through pattern-matching and explanation-building (Yin, 1994). SPSS was used to analyse data from the structured questionnaires and quiz, while theme-identification and pattern-matching were used to analyse the data from ocular observations, daily discussions, and training reports.

6.5.1 Analysis using SPSS

The importance of raw data preparation is well documented by several authors (Malhotra et al., 2006; Coakes et al., 2008; Field, 2009). The data preparation process outlined by Malhotra et al., 2006, p. 502) was adopted. This process included the preparation of preliminary plan for data analysis, checking questionnaires, editing, coding, transcribing, data cleaning, statistically adjusting and data analysis. Each of these steps is discussed below

Questionnaire checking

Questionnaires can be pre-coded or post-coded (Aaker et al., 2005). After data collection, post-coding was done using a SPSS spreadsheet with the assistance of a codebook. Coding was necessary for easy data entry and to identify error sources within the data set. Since the author was with the research team throughout, data entry into the SPSS spreadsheet was easy. Further, the daily pre-briefing and de-briefing sessions played a critical role in minimising recording errors. Minimal recording errors were identified and rectified during data entry.

Data editing

According to Malhotra et al., (2006, p. 503), editing is ‘reviewing of the questionnaires with the objective of increasing accuracy and precision’. To maintain accuracy in the data collected, checking omission of questions, ambiguities in responses and errors through recording were checked. Raw data were entered directly into the SPSS spreadsheet. Each variable was categorised as nominal, ordinal, or scale (Field, 2009).

Data cleaning

Data cleaning involved checking the data after entry to ensure: (i) consistency in the data set; (ii) there were no missing values; and (iii) there were no entry errors in terms of extreme or out-of-range values (Aaker et al., 2005). One of the steps taken to clean the data after entering was to perform a frequency distribution. Frequency distributions helped in terms of identifying non-response items as identified by the missing values. Entry errors were easily identified with the presence of extreme values outside what had been coded. From the output of the frequency distribution analysis, it was found that the total number of farmers who have completed the agronomy and postharvest questionnaires did not add up to a 100: the grand total of farmers who have participated in the survey. Furthermore, even within both the agronomy and

postharvest surveys, there were variations and inconsistency in the total number of participants answering a particular question. For instance, frequency output for a question about TNA indicated that 76 farmers responded to the question, which implied that responses from 24 farmers were not recorded. To rectify this inconsistency, the whole data set was rechecked. It was found during the process that no coding was assigned to participants who did not answer questions regarding TNA. These non-response variables were regarded as missing values by the SPSS (Field, 2009). This issue was addressed by assigning number 99 to the missing values because this number was not used to code any variables in the data set.

Type of analysis

A number of tests were used in the data analysis. Frequency distribution was performed especially on the demographic information of the farmers. T-tests were performed to determine significant differences in the outcomes of postharvest and agronomy training program. ANOVA post-hoc analysis was done to compare the means of the different variables (TNA, topics, methods, aids, confidence levels, and impediment levels) within the postharvest and the agronomy groups (Coakes et al., 2008).

6.5.2 Pattern matching and explanation building

The research involved collection of information using observation, informal discussions with the farmers and reviewing of training reports submitted by the TPs. The data were analysed using pattern-matching and explanation building (Yin, 1994) and the results were incorporated into the discussions chapter of the study.

6.6 Study limitations

A number of constraints were experienced during data collection, analysis, and writing.

- (i) The study was planned and executed within 12 months of the approved scholarship.
- (ii) Data was collected from illiterate farmers whose responses were in Tok Pisin. The responses were tediously translated into English which consumed a lot of time.
- (iii) The survey was conducted during the off-season when the farmers had already completed harvesting and processing their coffee.
- (iv) Only 100/180 farmers were interviewed due to strict selection criteria and the non-availability of farmers. However, this did not affect the analysis

Although these were the limitations, the data was analysed and the next chapter gives the accounts of the results.

Chapter 7. Results

This chapter has six main sections of analysis: demography, needs, process, outcomes, impediments and motivational factors. The demographic section describes the farmers who participated in the study by province, training program, age, gender, level of education, number of years in coffee farming, and the number of trees owned. The needs analysis discusses the results of the Training Needs Analysis (TNA), in terms of farmers' participation, the TNA approaches used by the training providers (TPs), farmers' rating of the usefulness of the TNA and the justifications for the ratings. Process analysis examines the appropriateness of the training topics, training methods used and the appropriate use of training aids. Outcome analysis looks at the results of the cognitive quiz and face-to-face interviews. It examines results on how well the acquired innovations have been applied by the farmers. The impediment section looks at impediments to technology adoption in both the agronomy and postharvest groups. The farmer motivation section examines farmers' specific motivations for attending the training and whether these motivations were addressed by the agronomy and postharvest training programs.

7.1 Demographics of the sample population

7.1.1 Participation by province, training programs and gender

Of the 100 respondents, 96 were males and four were females (Table 1). The extension officers (EOs) involved in selecting the farmers indicated that it was difficult to recruit female farmers because most of the women who had participated in the training program were illiterates and they were unable to speak and understand 'tok pisin'. Local interpreters were not recruited due to constraints with time and money. Further, some women thought that going to their food gardens were more important than spending the whole day answering survey questions at the expense of their family's dinner. The agronomy training program had 51 respondents: males (47) and females (4) while the postharvest training program had 49 male respondents. EHP had three groups: Gotomi and Tiredne who participated in the agronomy training program, while the Nagamiufa group participated in the postharvest training program. Chimbu also had three groups: the Mata and Mindima groups participated in the postharvest training while the Tani group participated in the agronomy training.

Table 7.1: Number of respondents by province, groups and training areas

Province	Agronomy		Postharvest			Total	
	Group	Male	Femal e	Group	Male		Femal e
EHP	Gotomi	14	1			15	
EHP	Tiredne	18	2			20	
Chimbu	Tani	15	1			16	
EHP				Nagamiufa	15	0	15
Chimbu				Mata	15	0	15
Chimbu				Mindima	19	0	19
Subtotal		47	4		49	0	
Total		51			49		100

7.1.2 Number of coffee trees owned, level of education, age and years of farming

Number of coffee trees owned per farmer, education levels, age and years of coffee farming were assessed (Table 7.2).

Table 7.2: Farmer education level, age, years of farming and number of coffee trees

Variables	Categories of variables	EHP (n)				Chimbu (n)				Total (%)
		Go	Ti	Na	To	Ma	Mi	Ta	To	
Number of coffee trees	<1200	5	9	2	16	5	2	4	11	27
	1250-1800	2	6	2	10	4	2	4	10	20
	1900-2900	7	3	4	14	4	5	5	14	28
	+3000	1	1	7	9	2	10	4	16	25
	Total		15	19	15	49	15	19	17	51
Level of Education	No formal education	5	4	1	10	4	1	8	13	23
	Foundation education (Yr 1- 10)	10	11	13	34	11	17	8	36	70
	Tertiary education	0	4	1	5	0	1	1	2	7
	Total		15	19	15	49	15	19	17	51
Age of farmers	21-34	5	10	6	21	8	9	8	25	46
	35-46	7	7	5	19	5	7	3	15	34
	+47	3	2	4	9	2	3	6	11	20
	Total		15	19	15	49	15	19	17	51
Number of years of coffee farming	1-10 yrs	4	1	5	10	5	4	4	13	23
	11-15 yrs	2	8	3	13	6	5	2	13	26
	16-20 yrs	5	8	2	15	1	7	5	13	28
	21+ yrs	4	2	5	11	3	3	6	12	23
	Total		15	19	15	49	15	19	17	51

Key: Go = Gotomi, Ti = Tiredne, Na = Nagamiufa, Ma= Mata, Mi = Mindima, Ta= Tani, To = Total

Looking at the number of coffee trees owned, about one quarter of the farmers had less than 1200 trees (mostly from EHP) while a similar number of farmers had more than 3000 trees (mostly from Chimbu).

Some 77 per cent of the farmers had attained some level of formal education while 23 per cent of the farmers had no formal education. EHP had the highest number of farmers attaining tertiary level education (n=5). However, Chimbu had two more farmers (n=36) who have attained some foundation education than EHP (n=34).

About one half (46%) of the farmers were aged between 21-35 years, while less than a half (34%) were aged between 35-46 years. Only 20 per cent of the respondents were above the

age of 47 years. In terms of years of experience in coffee farming, about one quarter of the respondents had 10 years experience while a similar number of respondents had ‘more than 20 years’ experience. More than half of the farmers had more than 10 years and less than 20 of experience. A Pearson Chi-Square test ($p < 0.05$) was used to determine whether there was a significant difference between the number of coffee trees by educational levels, age and years of coffee farming.

7.1.3 Comparing the number of coffee tree by the level of education

No clear relationship ($p = 0.703$) was apparent between level of education and the number of trees owned by respondents (Table 7.3).

Table 7.3: Number of coffee trees by education levels

Category by # of coffee trees	No formal education	Foundation education (Yr 1- 10)	Tertiary level (Yr 11 – College)	Total (n)
<1200	6	19	2	27
1250 – 1800	6	13	1	20
1900 – 2900	6	22	0	28
3000+	5	16	4	25
Total	23	70	7	100

Chi = 8.996, df= 12, sig= 0.703

7.1.4 Comparing tree density by age

Similarly, there was no relationship ($p = 0.78$) between the age of the farmers and the number of coffee trees owned (Table 7.4).

Table 7.4: Number of coffee trees by age group

Category by # of trees	21 – 34 years	35 – 46 years	+ 47 years	Total
<1200	15	7	5	27
1250 – 1800	8	7	5	20
1900 – 2900	10	12	6	28
3000+	13	8	4	25
Total (n)	46	34	20	100

Chi = 3.239, df= 6, sig= 0.0.778

7.1.5 Comparing number of coffee trees by the number of years of farming

There was no relationship (sig: 0.269) between the number of years the farmers have cultivated coffee and the number of coffee tree owned by the respondents (Table 7.5).

Table 7.5: Number of coffee trees by the number of years of coffee farming

Category by # of trees	1-10 years	11 – 15 years	16-20 years	21+ years	Total
<1200	10	9	5	3	27
1250 – 1800	3	6	5	6	20
1900 – 2900	3	6	10	9	28
3000+	7	5	8	5	25
Total (n)	23	26	28	23	100

Chi = 11.102, df= 9, sig= 0.269

7.2 Needs analysis

7.2.1 Farmer participation in the TNA survey by training activity

When farmers were asked whether they had participated in the TNA, about half (48%) were found to have participated in the TNA survey (Table 7.6).

Table 7.6: Farmer participation in the TNA activities: postharvest and agronomy

Training areas	Yes	Total (%)
Postharvest	26	49
Agronomy	22	51
Total (%)	48	100

Although there are a number of reasons for the low participation in the TNA survey; the most likely cause is that the farmers were dispersed by distance (PNG scenario). Having to gather the entire group to participate in the TNA survey would have been too expensive in terms of time and money.

7.2.2 Assessment on the use of TNA approaches by training areas

Looking at the postharvest and agronomy training programs, 26 and 22 farmers respectively had participated in the group discussion. Some 25 farmers undertaking the postharvest training and 20 farmers participating in agronomy training indicated that a quiz had been used by the trainer. Some 23 farmers in postharvest and 21 farmers in the agronomy training indicated that an activity calendar had been employed. Some 19 farmers in postharvest and 20 farmers in agronomy had participated in a transect walk. In both the agronomy and postharvest training programs, group discussions had been widely used, while the transect walk was employed the least in both training programs (Table 7.7).

Table 7.7: Use of TNA approaches by agronomy and postharvest

TNA approaches	Agronomy (n)		Postharvest (n)		Total (n)
	Yes	Total	Yes	Total	Yes
Group discussion	22	22	26	26	48
Quiz	20	22	25	26	45
Activity calendar	21	22	23	26	44
Transect walk	20	22	19	26	39

7.2.3 Assessment of farmer participation in the TNA survey by province

By province, it was evident that a greater number of farmers in Chimbu participated in the TNA than in EHP. For the Chimbu groups, except for Mata who had less farmers participating in the TNA, the majority of the farmers in Mindima and Tani had participated in all of the TNA methods. In EHP, Tiredne had slightly more farmers participating in the TNA than Gotomi and Nagamiufa (Table 7.8).

Table 7.8: Farmer participation in the TNA approaches by group/province

TNA methods	Groups/Provinces	Number of participants	Total by province
Group discussion	Tiredne – EHP	4	
	Gotomi – EHP	4	EHP: 11
	Nagamiufa – EHP	3	
	Mindima- Chimbu	17	Chimbu: 37
	Tani – Chimbu	14	
	Mata – Chimbu	6	Total: 48
Cognitive quiz	Tiredne- EHP	4	
	Gotomi – EHP	2	
	Nagamiufa – EHP	2	EHP: 8
	Mindima- Chimbu	17	Chimbu: 37
	Tani – Chimbu	14	
	Mata – Chimbu	6	Total: 45
Social activity calendar	Tiredne- EHP	4	
	Gotomi – EHP	3	
	Nagamiufa – EHP	2	EHP: 9
	Mindima- Chimbu	15	Chimbu: 35
	Tani – Chimbu	14	
	Mata – Chimbu	6	Total: 44
Transect walk	Tiredne- EHP	4	
	Gotomi – EHP	3	
	Nagamiufa – EHP	1	EHP: 8
	Tani – Chimbu	13	Chimbu: 31
	Mindima- Chimbu	12	
	Mata – Chimbu	6	Total: 39

7.2.4 Farmers' rating of the usefulness of the TNA activities

The farmers were asked to rate the usefulness of the TNA methods on a five-point scale where 1 had been very useful and 5 had not been useful. An independent sample t-test ($p=0.05$) indicated that except for the transect walk which was significantly useful ($p= 0.029$), all the TNA methods were significantly not useful (Table 7.9).

Table 7.9: Rating helpfulness of training methods: postharvest and agronomy

TNA methods	Agronomy		Postharvest		Sig
	m	sd	m	sd	
Group discussion	1.08	0.272	1.14	0.351	0.512
Quiz	1.24	0.436	1.40	0.598	0.305
Activity calendar	1.63	1.012	1.85	0.875	0.475
Transect walk	2.22	0.422	1.71	0.956	0.029

m= mean, sd= standard deviation

7.2.5 Reasons for rating usefulness of the TNA activities

For both the postharvest and the agronomy training programs, the most positive aspects of the TNA were that it identified gaps in the farmers' knowledge and skills and it enabled the farmers to consolidate their groups before receiving the training. However, a few farmers thought that the TPs lacked the appropriate TNA skills and knowledge (Table 7.10).

Table 7.10: Reasons for rating the TNA approaches

Reasons for rating the TNA approaches	Postharvest	Agronomy
Facilitated identification of the farmers' knowledge and skills gaps	19	18
Facilitated the farmers to consolidate themselves into groups in anticipation of the trainings	11	11
The training providers lacked TNA skills and knowledge	4	4
No comments provided for rating	3	2
Total respondents (n)	26	22

7.3 Process analysis

Training topics analysis

The farmers were given a list of agronomy and postharvest training topics and were asked if the topics were covered. The results for the agronomy and the postharvest training programs were analysed separately and are presented under the headings: (i) coverage of the training topics; (ii) the usefulness of the training topics; and (iii) the reasons for rating the usefulness of the training topics.

7.3.1 Agronomy: coverage of topics

Farmers who had participated in the agronomy training program were asked if pruning systems, shade control, weed management, drainage, fencing, pest and disease control, fertilizer application and a typical coffee calendar were covered. For both the Tiredne and Tani groups, with the exception of just one respondent, all said the topics had been covered. However, in Gotomi, a greater number of farmers indicated that pest and disease control (n=4) and the coffee calendar (n=6) had not been adequately covered (Table 7.11).

Table 7.11: Response of farmers on coverage of agronomy training topics

Topics in the agronomy training program	Gotomi		Tiredne		Tani		Total (%)
	Yes	No	Yes	No	Yes	No	Yes
Pruning	15	0	19	0	17	0	100
Shade control	15	0	19	0	17	0	100
Fencing	15	0	19	0	17	0	100
Drainage	15	0	19	0	17	0	100
Weed control	15	0	19	0	17	0	100
Fertilizer application	17	0	19	0	16	1	98
Pest and disease	11	4	19	0	17	0	92
Coffee calendar	9	6	18	1	17	0	86

7.3.2 Agronomy: Rating usefulness of the topics

The farmers were asked to rate the usefulness of the training topics on a five-point scale where 1 had been very useful and 5 had been not useful. Using Anova (Duncan's HSD and Scheffes), the difference between the groups were assessed. There was no significant difference between

all the groups concerning shade control, fencing, drainage management, nutrition application, pest and disease control, weed management, and coffee calendar. Pruning was significantly different between Tani, Tiredne and Gotomi (Table 7.12).

Table 7.12: Testing usefulness of agronomy topics

Training topics	Tani	Tiredne	Gotomi	Sig
	Mean			
Pruning	1.06 ^a	1.00 ^a	1.40 ^b	0.007
Shade control	1.24 ^a	1.05 ^a	1.27 ^a	0.423
Fencing	1.59 ^a	1.47 ^a	1.47 ^a	0.891
Drainage	1.41 ^a	1.53 ^a	1.73 ^a	0.573
Nutrition	1.94 ^a	2.11 ^a	2.47 ^a	0.627
Pest and disease	1.88 ^a	1.53 ^a	1.67 ^a	0.691
Weed control	1.41 ^a	1.53 ^a	1.80 ^a	0.605
Coffee calendar	1.41 ^a	1.39 ^a	1.89 ^a	0.357

Agronomy: reasons for rating usefulness of topics

The farmers were asked to provide their reasons for rating the usefulness of the agronomy topics. The vast majority of the farmers have indicated that they have acquired new knowledge and skills in shade control (98%) pruning (84%), pest and disease control (82%), drainage (78%), the coffee calendar (75%), and weed control (71%). About 16 per cent of the farmers had observed vigorous growth in their coffee trees after pruning. However, some farmers (6%) indicated that the TPs lacked in-depth knowledge in some topics such as the coffee calendar, pest and disease control, and fertilizer application. Further, some farmers thought weeding (27%) and drainage (16%) were a mere revision, whereas for about 29% of the farmers, fencing was simply irrelevant. Most farmers in Gotomi and Tiredne thought that the TP lacked in-depth knowledge especially in the coffee calendar and pest and disease control, while a few farmers in Tani and Tiredne indicated that the TPs lacked knowledge and skills in shade control and shade management (Table 7.13).

Table 7.13: Reasons for rating usefulness of agronomy topics

Topics	Reasons for rating topics	Go	Ti	Ta	To (%)
Shade control	Acquired new knowledge	14	19	17	98
	The TP lacked in-depth coverage	1	0	0	2
Pruning	Had acquired new knowledge and skills	11	18	14	84
	Vigorous sucker growth and good yield	4	1	3	16
Fertilizer application	Acquired new information: fertilizer types and application methods	14	19	15	94
	The TP lack in-depth knowledge: did not cover well	1	0	2	6
Pest and disease	Acquired new knowledge and skills.	10	18	14	82
	The TPs lacked the in-depth coverage: did not cover well	5	1	3	18
Drainage	Acquired new knowledge on soil management	12	13	15	78
	Already knew: useful but a revision	3	4	1	16
	Irrelevant: cultivating coffee on slopes	0	2	1	6
Coffee calendar	Learnt something new	7	14	17	75
	The TP lacked in-depth knowledge: did not cover well	8	5	0	25
Fencing	Learnt reasons for fencing coffee.	14	11	12	73
	The topic was irrelevant: keeping livestock inside fences.	1	8	5	27
Weed control	Acquired new information on safe and effective use of pesticides and weed management in coffee	12	13	11	71
	Already knew the content of the topics and therefore was a revision	3	6	6	29

Key: Go= Gotomi Ti = Tiredne, Ta = Tani, To = Total

7.3.3 Postharvest: coverage of topics

When assessing the coverage of postharvest topics, with the exception of one farmer in Nagamiufa, all of the topics were discussed in the postharvest training program (Table 7.14).

Table 7.14: Response of farmers on the coverage of postharvest training topics

Were these topics covered during the postharvest training program?					
Postharvest topics	training	Nagamiufa	Mata	Mindima	Total (%)
		Yes	Yes	Yes	Yes
Harvesting methods		15	15	19	100
Fermentation		15	15	19	100
Washing/soaking		15	15	19	100
Drying methods		15	15	19	100
Parchment classes		15	15	19	100
Storage		15	15	19	100
Coffee pulper		14	15	19	98

Postharvest: rating usefulness of topics

The farmers were asked to rate the usefulness of the postharvest training topics on a five-point scale where 1 had been very useful and 5 had been not useful. Except for washing/soaking which was significantly different between Mata, Mindima and Nagamiufa, harvesting, pulping, fermentation, drying and moisture content were not significantly different between the three groups (Table 7.15)

Table 7.15: Ratings on the usefulness of postharvest topics

Training topics	Mata	Mindima	Nagamiufa	Sig
	Mean			
Harvesting	1.00 ^a	1.05 ^a	1.07 ^a	0.634
Pulping/pulpers	1.20 ^a	1.11 ^a	1.50 ^a	0.235
Fermentation	1.47 ^a	1.32 ^a	2.07 ^a	0.051
Washing/soaking	1.00 ^a	1.05 ^a	1.67 ^b	0.049
Drying	1.00 ^a	1.05 ^a	1.20 ^a	0.256
Moisture content	1.07 ^a	1.32 ^a	1.60 ^a	0.252
Storage	1.07 ^a	1.05 ^a	1.47 ^a	0.143

Reasons for rating usefulness of postharvest topics

The reasons for rating the usefulness for each of the postharvest topics were then assessed. The vast majority of the farmers indicated that they had acquired new knowledge and skills in harvesting (95%), parchment storage (94%), washing and soaking (89%), drying methods (88%), parchment classification (88%), pulping (87%), and fermentation methods (81%). There was also an element of revision for some topics: parchment storage, parchment classes, washing and soaking, fermentation, pulping and harvesting. A few farmers (6%) still lacked the confidence necessary to successfully repair a coffee pulper. It appeared that for the Mindima farmers, all the topics were new, whereas for the Nagamiufa and Mata farmers, a few farmers considered the topics as a revision (Table 7.16).

Table 7.16: Reasons for rating usefulness of the postharvest topics

Topic	Reasons	Na	Ma	Mi	To (%)
Storage	Learnt :coffee must be stored in smoke-free cool room for better quality	12	14	19	94
	Revision: knew importance of storage	3	1	0	6
Parchment classes	Learnt how to classify parchment	12	13	18	88
	Revision: knew the content of the topic	3	2	1	12
Washing/ Soaking	Learnt that soaking increases weight and removes hidden mucilage	12	11	12	71
	Learnt: washing/soaking require clean water	0	2	7	18
	Revision: already knew the reasons for washing/soaking	3	2	0	10
Fermentat- ion	New information: use non-metallic materials	8	11	15	69
	Learnt: poor fermentation results with sour flavours and off tastes in cup	4	1	1	12
	Learnt: mini wet factory is expensive	2	2	2	12
	Revision: knew content of topic	1	1	1	6
Pulping	Learnt how to repair & maintain pulper	9	9	14	67
	Learnt: pulper is used for pulping red ripe cherries	3	3	4	20
	Not confident in readjusting pulper	1	1	1	6
	Revision: knew content of topic	2	2	0	8
Harvesting	Learnt: pick red ripe cherries, pulp same day	8	8	11	55
	Learnt: unripe and over-ripe cherries become floaters, damage pulpers	5	7	8	40
	Revision: knew content of topic	2	0	0	4
Drying	Learnt: raised bed drying is good for quality	9	4	7	40
	Learnt: gradual drying prevents cracking	6	11	8	40
	Learnt moisture test techniques: teeth and rub	0	0	4	8

Key: Na = Nagamiufa, Ma= Mata, Mi = Mindima, To = Total

7.3.4 Training methods analysis

The use of lecture, group discussion, question and answer, field demonstrations, field excursions, expert inputs and follow-up visits were assessed. The results are presented under: (i) assessment on the use of methods; (ii) usefulness of the methods; and (iii) reasons for rating the usefulness.

Assessing use of training methods by agronomy and postharvest

In both the agronomy and postharvest training programs, the main training methods employed were lectures, group discussion, question and answer sessions, and field demonstration. The least used training methods were expert input, field excursion, and follow-up (Table 7.17).

Table 7.17: Use of training methods in agronomy and postharvest training programs

Training methods	Agronomy (n)	Postharvest (n)	Total (%)
	Yes	Yes	Yes
Lecture	50	49	99
Field demonstration	50	49	99
Group discussion	49	49	98
Question & answer	49	49	98
Expert input	30	14	44
Field excursion	39	15	54
Follow-up	28	31	59

Assessing use of training methods: agronomy and postharvest

In both agronomy and postharvest, the most widely used training methods were lecture, field demonstration, group discussion, and question and answer. The least used methods were follow-up, expert inputs and field excursions. Following the agronomy training program, it was evident that the majority of the farmers in Gotomi had not participated in any follow-up sessions. A similar situation was evident in Tani, where, in addition, the majority of the farmers had not participated in any field excursion or benefited from any expert inputs. For Tiredne, almost 50 per cent of the farmers indicated that they did not receive any expert input. For the postharvest training program, it was obvious that all the farmers in Mata and Mindima had not participated in all field excursions nor benefited from any expert input. In both Mata and Mindima, a similar situation was noted where more than half of the farmers indicated that they had not participated in any follow-up discussions (Table 7.18).

Table 7.18: Use of training methods by groups

Training methods	Agronomy				Postharvest								Total (%)				
	Go		Ti		Ta		Tot		Na		Ma			Mi		Total	
	Yes	No	Yes	No	Yes	No	Yes	No	Yes	No	Yes	No	Yes	No	Yes	No	Yes
Lecture	15	0	18	1	17	0	51	1	15	0	15	0	19	0	49	0	99
Field demonstration	14	1	19	0	17	0	50	1	15	0	15	0	19	0	49	0	99
Group discussion	14	1	18	1	17	0	49	2	15	0	15	0	19	0	49	0	98
Question/Answer	13	2	19	0	17	0	49	2	15	0	15	0	19	0	49	0	98
Field excursion	15	0	19	0	5	12	39	12	15	0	0	15	0	19	49	0	88
Expert input	15	0	10	9	5	12	30	21	14	1	0	15	0	19	48	1	87
Follow-up	4	11	17	2	7	10	28	23	15	0	7	8	9	10	32	17	60

Key: Go = Gotomi, Ti = Tiredne, Ta= Tani, Na = Nagamiufa, Ma= Mata, Mi = Mindima

Rating helpfulness of training methods: postharvest and agronomy compared

Using a five point scale, the farmers were asked to rate the usefulness of methods in the agronomy and postharvest training programs. The helpfulness of the methods between and within agronomy and postharvest was discretely analysed using independent sample test ($p = 0.05$). The null hypothesis was that there was no difference between training programs on the helpfulness of the training methods.

It is evident that except for expert inputs and follow-up when used were considered more helpful in both agronomy and postharvest, all the training methods were considered not helpful by farmers in both the agronomy and the postharvest training programs (Table 7.19).

Table 7.19: Assessing helpfulness of the training methods between training programs

Training methods	Agronomy		Postharvest		
	m	sd	M	sd	Sig
Lecture	1.43	0.860	1.69	0.962	0.171
Field demonstration	1.18	0.486	1.08	0.344	0.233
Group discussion	1.43	0.853	1.45	0.829	0.903
Question and answer	1.29	0.617	1.12	0.331	0.095
Field excursion	1.08	0.359	2.07	1.710	0.001
Expert input	1.00	0.000	3.13	1.598	0.000
Follow-up	2.00	1.523	2.20	1.710	0.648

m= mean , sd= standard deviation, sig.= significant

Reasons for rating the training methods

Farmers were asked to list their reasons for rating the various training methods and the reasons were analysed discretely.

Agronomy

Some 72 per cent of the respondents indicated that through field demonstrations they gained more confidence in pruning techniques, whereas about 51 per cent indicated that their questions were adequately answered by the TPs and by other farmers during demonstration sessions. Group discussions enabled the farmers to learn a great deal from the experiences of other farmers and the TPs. Through group discussions, farmers had the confidence to share their experiences. However, there was always the risk that discussions could be dominated by a few outspoken farmers. Lectures had the most benefit in clarifying the objectives and the content of the topics (74%). Further, lectures were able to deliver the key messages associated with the processes of rehabilitating a coffee garden. Some 57 per cent of the respondents indicated that field excursions to the Coffee Research Institute (CRI) - Aiyura had broadened their understanding of coffee management practices, while another 20 per cent indicated that a visit to a model farmer's coffee garden had helped them to learn good rehabilitation techniques. Through expert input from the CRI staff, the knowledge and skills acquired by the farmers during the theory sessions were re-enforced. A similar situation was also experienced by some farmers (20%) who visited a model farmer's coffee garden. Follow-up was useful in clarifying issues for some farmers (37%) who had doubts on coffee rehabilitation practices. However, it was evident that some farmers (20%) did not participate in the follow-up sessions. Question and answer sessions were most useful for 29 per cent of the farmers because the TPs used the sessions to clarify some issues on coffee rehabilitation practices. However, the TPs did not answer some questions well (Table 7.20).

Table 7.20: Reasons for rating helpfulness of the training methods: agronomy

Methods	Reasons	Ti	Go	Ta	(%)
Field demonstration	Grained confidence in the pruning techniques through observing demonstration and by actually having hands on experience	19	11	17	92
	Questions were adequately answered by the TP and farmers	12	6	8	51
	TP did not provide enough tool for all the participants	0	3	0	6
Group discussion	Learnt a lot through sharing experiences from farmers and TPs	16	1	17	90
	Session was dominated by a few outspoken farmers	2	1	0	6
Lecture	Clarified training objectives and content of the topic	17	10	11	74
	Key pruning techniques were clarified	1	5	6	24
Field excursion	Visited the PNG Coffee Research Institute (Aiyura) broaden by understanding on coffee management practices	19	10	0	57
	From a model farmer, Learnt good tips on the rehabilitation	0	5	5	20
Expert input	Tour with CRI staff around the estate re-enforced the coffee rehabilitation practices taught in class	10	10	0	39
	Learnt a lot from a model farmer on rehabilitation practices	0	5	5	20
Follow-up	TP clarified some doubts on coffee rehabilitation practices	11	3	5	37
	TP visited other farmers and not me	6	1	3	20
Question & answer	Clarified misunderstanding on the rehabilitation practices: pruning, shade control, fertilizer application	7	2	6	29
	The TP did not answer some questions well	0	5	3	16

Key: Ti = Tiredne, Go= Gotomi, Ta = Tani, % = Total percentage

Postharvest

Group discussions (90%) were of much benefit in conveying new information about fermentation, washing, and soaking. In group discussions, farmers shared ideas openly and gained confidence in speaking. However, without an appropriate leader, 10% of the respondents indicated that sessions were dominated by just one or two farmers. Lectures (67%) were useful in that they outlined the objectives and the content of the topics. However, in the lectures format, the TPs did most of the talking and there was little opportunity for farmers to ask questions or seek clarification. For field demonstration, some respondents (57%) indicated that it was a concrete learning experience for them where they actually did picking, pulping, fermentation, and moisture tests. For 43% of the respondents, field demonstration sessions had enabled them to gain the necessary confidence in adjusting a pulper. The question and answer sessions were beneficial to some respondents (53%) in that their doubts on the processing techniques were clarified while about 41% benefited from the question and answer session by gaining a lot of information through sharing experiences with other farmers. For follow-up, 43% of the respondents indicated that the TPs checked the farmers' parchment during follow-up sessions and demonstrated again the moisture test, while an 18% indicated that they missed out on the follow-up session. For field excursion, some respondents (18%) indicated that during a factory visit, they learnt how a factory was managed (Table 7.21).

Table 7.21: Reasons for rating helpfulness of the training methods: postharvest

Methods	Reasons	Nag	Mat	Min	To (%)
Group discussion	Learnt a lot of new information on fermentation, washing, soaking and storage from others	12	13	15	90
	Session was dominated by few out spoken farmers	3	2	0	10
Lecture	The TP outlined the content of the topics	11	10	12	67
	Teacher centred: the TP did most of the talking	4	5	5	29
	Key processing techniques (picking, pulping, fermentation, drying) issues were clarified	0	0	2	4
Field demonstration	Grained concrete experience by actually carrying out the picking, fermentation, and moisture tests	8	5	15	57
	Grained confidence & experience in adjusting the pulper through hands on experience	7	10	4	43
Question & answer sessions	Clarified were doubts picking, pulping, fermentation, drying, and parchment classification techniques	6	9	11	53
	Learnt a lot of new information through sharing experiences with other farmers	8	6	6	41
	Some questions were not answered well	1	0	2	6
Follow-up	The TP checked the parchments and demonstrated again the moisture test: reinforced what was already learnt	11	6	4	43
	I was not visited although others were	4	1	4	18
Field Trips	Learnt how a factory was managed during a factory visit	9	0	0	18
Expert input	Factory visited was complex: not suitable to my situation	3	0	0	6
	Learnt new information on (fermentation, washing, drying and storage from a factory owner	7	0	0	14
	Explanation on factory was too technical	4	0	0	8

Key: Nag = Nagamiufa, Mat = Mata, Min = Mindima, To = Total

7.3.5 Training aids analysis

The results of the agronomy and postharvest training aids are presented under: (i) use of the training aids; (ii) helpfulness of training aids; and (iii) reasons for ratings the usefulness of the training aids.

Agronomy: use of training aids assessment

For the agronomy training program, the pruning saw was the most widely used training aid (92%), followed by secateurs and pest and disease poster (75%). Some 72 per cent of the farmers indicated that rehabilitation poster was used. Knapsacks, pesticides and handout notes were the least used. For the Tani group, with the exception of one farmer, all the training aids were utilized. For the Tiredne group, although pruning saws and secateurs were employed, the other aids were reportedly used infrequently. For the Gotomi group, other than the use of a pruning saw, the rehabilitation poster and a pest and disease poster, the other aids were not used at all (Table 7.22).

Table 7.22: Use of agronomy training aids by groups

Training aids	Gotomi		Tiredne		Tani		Total (%)
	Yes	No	Yes	No	Yes	No	Yes
Pruning saw	11	4	19	0	17	0	92
Secateurs	3	12	19	0	17	0	75
Pest and disease poster	9	6	13	6	16	1	75
Rehabilitation poster	10	5	9	10	17	0	72
Knapsack	0	15	15	4	16	1	61
Pesticides	0	15	11	8	17	0	55
Handouts	0	15	8	11	17	0	49

Agronomy: Assessment on the helpfulness of training aids

Farmers were asked to rate the helpfulness of the agronomy training aids on a five point scale where 1 had been very helpful and 5 been not helpful. The helpfulness of the aids was tested at $p=0.05$ using post hoc test. Rehabilitation poster was found to be significantly helpful. For others, there were no significance differences between the groups on the helpfulness of the training aids. It was also noted that there was an insufficient respondents to determine the helpfulness of knapsack, pesticides and handouts (Table 7.23).

Table 7.23: Agronomy: assessment on the helpfulness of the training aids

Training aids	Mean for agronomy groups			Sig
	Tiredne	Gotomi	Tani	
Rehabilitation poster	1.00 ^a	1.33 ^a	1.35 ^a	0.046
Secateurs	1.06 ^a	1.50 ^a	1.41 ^a	0.124
Pest and disease	1.55 ^a	1.43 ^a	1.81 ^a	0.692
Pruning saw	1.06 ^a	1.33 ^a	1.53 ^a	0.081
Knapsack				
Pesticides				
Handouts				

Agronomy: reasons for rating helpfulness of training aids

The reasons for rating helpfulness of the agronomy training aids are given in Table 7.24. About 64 per cent of the respondents appreciated that the use of rehabilitation posters clarified the rehabilitation practices such as pruning. Some farmers (43%) understood the function and the purpose of the pruning saw. About 37 percent of the farmers indicated that by actually using it they had gained more confidence, although a few farmers indicated it was largely a revision. With regards to the use of secateurs, some farmers (37%) had learnt the function and the purpose of secateurs and, could also differentiate between the different types of secateurs. Using the pest and disease poster, about 33 percent of the farmers were able to clarify aspects concerning green scale and a further 29 per cent learnt about coffee leaf rust. However, a few farmers (14%) indicated that the content of the pest and disease poster was inadequate, while a 33 per cent of the farmers indicated that the use of knapsack enabled them to dismantle and re-assemble the knapsack. Some 16 per cent of the farmers thought that the TPs did not use the knapsack as a training aid. The use of pesticide posters clarified the safe and effective use of pesticide as indicated by 29 per cent of the farmers, while a few farmers (12%) understood the different pesticides on the market. However, 14 per cent of the farmers indicated that the poster was irrelevant as they did not use chemicals in their coffee gardens. The majority (33%) of the farmers indicated that handouts provided good reference materials and were easy to read, although, some farmers (12%) in Tani thought that the handouts were irrelevant because they were not written in Tok Pisin.

Table 7.24: Reasons for rating helpfulness of the training aids: agronomy

Training aids	Reasons	Go	Ti	Ta	To (%)
Rehabilitation Posters	Clarified rehabilitation practices such as pruning	8	9	17	67
	TP did not explain the poster properly	3	0	0	6
Pruning saw	Understood the functions/purpose of pruning saw	10	10	2	43
	Gain confidence in using pruning saw	0	9	10	37
	Revision: knew how to use pruning saw before	0	0	5	10
Secateurs	Knew how to use secateurs by actually using it	0	12	7	37
	Can identify different secateurs and know their functions	3	7	9	37
	Revision: Knew how to use secateurs before	0	0	1	2
Pest & disease Poster	Clarified green scale	8	7	2	33
	Clarified coffee leaf rust	0	5	10	29
Knapsack	TP did not explain the poster well	1	1	5	14
	Learnt dismantling and assembling of knapsacks	0	7	10	33
	TP only talked without a knapsack for demonstration	0	3	5	16
	Clarified safe and effective use of pesticides	0	4	1	10
Pesticide Poster	Female farmer: cannot use knapsack	0	1	0	2
	Clarified safe and effective use of pesticides	0	10	5	29
	Irrelevant: Do not use pesticides in my coffee garden	0	1	6	14
Handouts	Understood different chemicals (pesticides) on the market	0	0	6	12
	Good reference materials for future use	0	3	4	24
	Easy to read and understand	0	4	8	14
	Irrelevant: notes were not translated into Tok Pisin	0	0	6	12

Key: Key: Go= Gotomi, Ti = Tiredne, Ta = Tani, To = Total

Postharvest: assessment on the use of training aids

In the postharvest training program, parchment sample, sample cherries, parchment posters, and drying tables were the widely used training aids while fermentation boxes, harvesting posters, handouts, and pulping machines were the least used training aids. For the Mata group, all of the postharvest training aids recommended by the CIC were employed. For the Mindima group, except for the pulper (45%), fermentation box (26%) and harvesting posters (21%), all the respondents agreed that sample cherries, drying tables, processing handouts, sample parchment and parchment class poster had been used. For the Nagamiufa group, a mixture of responses was indicated: except for one farmer, all the farmers agreed that pulping machines had been used. Some three farmers and five farmers indicated that parchment sample and sample cherries respectively had never been used. Almost 50 per cent of the farmers indicated that harvesting posters, parchment class poster, drying table and fermenting boxes had been used. However, most (73%) of the farmers indicated that processing handouts had not been used (Table 7.25).

Table 7.25: Use of postharvest training aids by groups

Training aids	Nagamiufa		Mata		Mindima		Total	
	Yes	No	Yes	No	Yes	No	Yes	(%)
Parchment samples	12	3	15	0	19	0	46	94
Sample cherries	10	5	15	0	19	0	44	90
Parchment class poster	8	7	15	0	19	0	42	86
Drying tables	7	8	15	0	19	0	41	84
Pulping machine	14	1	15	0	10	9	39	80
Processing handouts	4	11	14	1	19	0	37	76
Harvesting posters	8	7	13	2	15	4	36	73
Fermentation boxes	6	9	15	0	14	5	35	71

Postharvest: Assessment on the helpfulness of training aids

Farmers were asked to rate the helpfulness of the postharvest training aids on a five point scale. The helpfulness of the aids was tested at ($p=0.05$) using one way Anova. It was evident that there was no difference between the groups concerning sample parchment, sample cherry, parchment poster, handouts, and harvesting poster. However, there was a significant difference between Nagamiufa, Mata and Mindima concerning drying materials. In regards to pulping machines and fermentation boxes, there was no significant difference between Mata and Mindima and Mata and Nagamiufa. However, there was a significant difference between Mindima and Nagamiufa (Table 7.26).

Table 7.26: Postharvest: assessment on the helpfulness of the training aids

Training aids	Mean for postharvest groups			Sig
	Mata	Mindima	Nagamiufa	
Sample parchment	1.13 ^a	1.11 ^a	1.33 ^a	0.342
Sample cherry	1.07 ^a	1.11 ^a	1.20 ^a	0.600
Parchment class poster	1.27 ^a	1.13 ^a	1.13 ^a	0.647
Drying materials	1.00 ^a	1.11 ^a	2.57 ^b	0.000
Pulping machines	1.20 ^{ab}	1.00 ^a	1.80 ^b	0.028
Handouts	1.47 ^a	1.32 ^a	1.33 ^a	0.795
Harvesting posters	1.07 ^a	1.07 ^a	1.00 ^a	0.796
Fermentation boxes	1.53 ^{ab}	1.15 ^a	2.60 ^b	0.024

Postharvest: reasons for rating helpfulness of training aids

Farmers were asked to provide the reasons for rating the helpfulness of the postharvest-training aids. With the help of parchment samples, farmers (76%) learnt about the different parchment classes and their respective characteristics. Further, techniques used in assessing moisture content of dry parchment were also learnt by some farmers. With regards to the use of the different drying materials, farmers (67%) realised that drying tables could be made from cheaper materials and still produce good quality dried parchment. From the use of the cherry sample, 90 per cent of the farmers learnt that only red ripe cherries must be harvested to produce a good quality coffee. Some farmers (57 %) gained new information concerning the use of non-metallic materials such as bags for fermentation. Some 69 per cent of the farmers indicated that the use of parchment posters clarified the processes employed in classifying the different classes of parchments. Regarding pulper repair and maintenance, some farmers (67%) had gained confidence in applying the acquired innovation by actually dismantling and re-assembling a pulper. Handouts provided good reference materials for about 49 per cent of the farmers because the handouts were easier to understand, although a few farmers (24%) indicated that the handouts were irrelevant because they were written in English. Regarding other training aids: drying materials, fermentation boxes and pulpers, the TPs either talked without using the appropriate training aids and/or lacked the in-depth knowledge to confidently demonstrate the appropriate use of a coffee pulper (Table 7.27)

Table 7.27: Reasons for rating helpfulness of postharvest training aids

Aids	Reasons	Na	Ma	Mi	To (%)
Parchment	Learnt: different parchment classes and their characteristics	11	14	3	76
Samples	Learnt: Moisture content test – rub and bite methods	8	4	7	20
Drying	Learnt: raised beds promote even drying of parchment	5	11	17	67
materials	Learnt: raised beds can be made from cheaper materials	0	2	2	8
	TP only talked without using drying materials	2	1	0	6
	Canvas is good for drying coffee but sweats	0	1	0	2
Cherry	Learnt: pick only red ripe cherries for good quality coffee	9	9	11	59
sample	Learnt: do not pick green cherries, it loses money	0	5	5	20
	Gained new knowledge on ripe test	1	1	3	10
Fermenting	Learnt: Use non-metallic materials for fermentation	2	12	12	53
box	TP only talked without using fermentation materials	4	1	1	12
	Learnt about the disadvantages of fermenting coffee in bags	0	2	0	4
Parchment	Clarified the characteristics of different parchment classes	4	10	6	41
Poster	Clarified the processes of classifying dry parchment	4	4	10	29
Pulping	Helped clarified tip on repair and maintenance of a pulper	6	7	6	39
Machine	Gained confidence in repair and maintenance of a pulper	4	7	3	29
	TP lacked in-depth knowledge on pulper	4	0	0	8
	Revision: Already knew all about a coffee pulper	1	0	0	2
Handouts	Good reference material	4	6	9	39
	Could not read because notes were in English	0	6	6	24
	Easy to read because notes were in Tok Pisin	0	2	3	10
	TP did not provide enough copies for all participants	0	0	1	2
Processing	Clarified the processing process (picking – storage)	3	6	10	39
poster	Clarified reasons for picking only red ripe cherries	5	8	5	37

Key: Na = Nagamiufa, Ma = Mata, Mi = Mindima, To= Total

7.4 Outcome analysis

The results of the outcome analysis were derived from the cognitive quiz and the farmers' confidence level in the application of the acquired techniques.

7.4.1 Cognitive test: agronomy

Looking at the responses from the participants on the entire agronomy quiz, 90 per cent of the respondents managed to answer all the questions correctly. However, some of the farmers gave wrong responses regarding shade control (27%), pest and disease (18%) and recycle pruning (17%). A few farmers gave wrong responses regarding fencing, fertilizer application, sucker selection, and pesticide applications. All the respondents managed to answer correctly a question regarding weed control (Table 7.28).

Table 7.28: Agronomy quiz analysis

Questions	Response choices	Correct choices (%)			
		Go	Ti	Ta	To
1. Which of this drainage spacing is recommended for coffee in water-logged soil?	a) Drainage should be closely apart and... b) Drainage should be far apart with... c) Coffee growing in clay or...	29	37	29	95
2. What type of shade level recommended for a smallholder coffee garden?	a) Very heavy shade level with ... b) Light shade level with about... c) Medium shade level with about...	20	24	27	71
3. When is the most appropriate time to do weed control?	a) Weed must be controlled routinely... b) When the price of coffee improves... c) Weeds do not harm the coffee tree...	29	37	33	99
4. Which statement is correct about fertilizer application in coffee?	a) Allow the coffee tree to grow... b) Before applying any form of... c) So long as you are applying...	25	37	33	95
5. Which of the following is an indicator that your coffee requires fencing?	a) When animals and people... b) When the villagers are... c) There is no need to...	27	33	31	91
6. When is the correct time to do recycle pruning?	a) The coffee trees are not meant to... b) When the yield starts to decline... c) Coffee trees must be recycled...	25	31	27	83
7. How many uprights should be allowed per stem after final sucker section...?	a) 4-6 uprights are recommended... b) There should be as many... c) The coffee trees should not be...	29	35	31	95
8. Which of the following tools are suitable to prune coffee?	a) Bush knives and axes... b) Secateurs and pruning saw... c) Any tool is suitable for pruning...	27	37	31	95
9. What is the best approach to take when controlling pest and disease in coffee?	a) Always apply the rehabilitation... b) Apply only the chemical method... c) Always follow advice of the pesticide...	18	35	29	82
10. What must the farmer do to protect oneself from pesticide poisoning while...?	a) Carry the knapsack filled with spray... b) The farmer must always wear... c) The farmer after spraying should...	29	35	31	95

Key: Go= Gotomi, Ti = Tiredne, Ta = Tani, To = Total

7.4.2 Cognitive test: postharvest

Looking at the responses from participants for the entire postharvest quiz, 96 per cent of the respondents managed to answer all the questions correctly. All the respondents in postharvest managed to answer correctly questions regarding when cherries needed to be picked, when to pulp the cherries, the type of water to be used for washing parchment, and how to tell the moisture content. Only a few respondents gave incorrect responses regarding fermentation and fermentation tests (9%), pulping machines (3%) and drying methods (1%) (Table 7.29).

Table 7.29: Postharvest quiz analysis

Questions	Response choices	Correct choices (%)			
		Nag	Mat	Min	To
1. Which type of cherry is must to be picked to produce good quality coffee?	a) Unripe and green cherries b) Over ripe and dry cherries c) Red ripe cherries only	31	31	38	100
2. To minimise wear and tear on coffee pulper, which type of cherries must be picked?	a) Any green or half ripe cherries b) Dried and rotten cherries c) Red ripe cherries only	31	31	35	97
3. When is the most appropriate time to pulp cherries so that coffee quality is not compromised?	a) On the same day as picked. If... b) Cherries do not go bad. You... c) In PNG, the cherries can be...	31	31	38	100
4. In order to produce good clean quality coffee, what type of water is required for washing/soaking coffee?	a) Muddy and dirty water is... b) Clean and running water is... c) Water polluted with chemical...	31	31	38	100
5. To produce good quality parchment, which type of fermenting materials is recommended?	a) Old rusty ferment boxes are... b) Wooden fermenting boxes... c) In bags and bury them together...	27	29	35	91
6. What are the major causes of uneven fermentation in coffee?	a) The presence of a lot of pulp... b) If the cherries are pulped well ... c) If good wooden fermentation...	22	31	35	88
7. How do you tell that the fermentation is successfully completed?	a) When fermented parchment is... b) If the parchment feels slippery ... c) There is no such thing as ...	27	27	37	91
8. Which method of parchment drying is good for the production of a good quality coffee?	a) Drying on canvas beside a road... b) Drying on a well ventilated... c) Dry your parchment using...	31	29	39	99
9). Which statement best describes the characteristics of a well dried parchment?	a) Parchment is clean, husk comes... b) The parchment is dirty, sticky... c) There is no way you can tell the...	31	31	38	100
10. Circle the answer that best describes the place to store well dried parchment	a) Inside the house you sleep. Rest... b) Inside a house, against rusty... c) In a cool and dry, well ventilated...	29	29	38	96

Key: Nag = Nagamiufa, Mat = Mata, Min = Mindima, Tot = Total

7.4.3 Face-to-face interview analysis: adoption of agronomy innovations

To assess the farmers' confidence level in applying the acquired innovations, the farmers were given a list of critical quality/quantity control techniques and were asked to indicate whether they were applying them. If yes, they were asked to rate their confidence level and why they were giving this rating. If not, farmers were asked to identify the impediments to adopting the acquired innovations.

From all three groups which participated in the agronomy training program, all farmers (100%) were applying the new skills and knowledge learnt in pruning, shade control, and weed control (Table 7. 30). While the farmers in Tani were all utilizing the coffee calendar, the majority of farmers from Gotomi group were not, and a few farmers (21%) from Tiredne had elected not to apply the coffee calendar. From the Gotomi group, about 33 per cent of the farmers were not using the recommended pest and disease control programs. In the Tiredne group, a

minority of the farmers (10 %) had chosen not to apply the new skills they had learnt in either drainage or pest and disease.

Table 7.30: Application of acquired techniques- agronomy

Agronomy techniques	Gotomi		Tiredne		Tani		Total (%)
	Yes	No	Yes	No	Yes	No	Yes
Pruning	15	0	19	0	17	0	100
Shade control	15	0	19	0	17	0	100
Weed control	15	0	19	0	17	0	100
Drainage management	15	0	17	2	16	1	94
Pest & disease control	10	5	17	2	14	3	80
Coffee calendar	6	9	15	4	17	0	75

Assessing confidence level in applying agronomy innovation

Farmers were asked to rate their confidence level in applying the innovations acquired during the agronomy training program. The farmer confidence levels were tested using post hoc test ($p=0.05$). There is evidence that the farmers were confident in applying all the innovation acquired in the agronomy training program and there was no significant difference between the groups (Table 7.31).

Table 31: Assessing the confidence level of applying agronomic techniques

Agronomy techniques	Mean for agronomy groups			Sig
	Gotomi	Tani	Tiredne	
Pruning	1.41 ^a	1.13 ^a	1.11 ^a	0.142
Pest and disease	2.20 ^a	1.43 ^a	2.11 ^a	0.269
Shade control	1.27 ^a	1.12 ^a	1.32 ^a	0.502
Drainage management	1.07 ^a	1.31 ^a	1.06 ^a	0.128
Weed control	1.00 ^a	1.00 ^a	1.05 ^a	0.439
Coffee calendar	1.14 ^a	1.47 ^a	2.00 ^a	0.134

Reasons for rating confidence level in applying agronomy innovations

The main reason majority of the farmers (73%) gave for having confidently adopted the new techniques in drainage, shade control, pruning systems, and weed control was the visual improvement in tree vigour and the subsequent increase in yield. Some 57 per cent of the farmers indicated that they could readily introduce the new knowledge and skills they had acquired to improve shade management, pruning, coffee calendar and pest and disease control with little additional help. Some farmers (33%) were able to confidently identify coffee leaf rust and green scales and therefore apply the appropriate control measures. However, some 25 per cent of the farmers thought that they were unable to implement the coffee calendar due to other commitments, while a few farmers (8%) reported an increasing incidence of rust, dieback and scales after modifying their shade management practices. For weeding, about 25 per cent of the farmers have been applying the weed control techniques before, and therefore, weed control had only been a revision. A further 22 per cent of the farmers complained that they

could not afford chemicals to control weeds and/or pest and disease because of the high cost (Table 7.32).

Table 7.32: Reasons for rating confidence level in applying agronomy innovations

Techniques	Reasons for rating confidence level	Go	Ti	Ta	To (%)
Drainage	Observing tree vigour after draining construction	12	12	13	73
	Revision: having been maintaining drainage in coffee	3	5	3	22
Shade control	Can confidently manage shade without help	8	12	15	69
	Seeing good tree vigour/response after weed control	5	5	2	24
	Coffee leaf rust and over bearing dieback are problems now	2	2	0	8
Pruning	Performing maintenance pruning without problems	7	14	12	65
	Performing recycle pruning: good yield from 3- 4 uprights	6	4	2	24
	Yet to compare yield: have done recycle pruning	2	2	3	12
Coffee calendar	Applying coffee techniques guided by the coffee calendar	5	10	12	53
	Have other commitments: do not follow the coffee calendar	1	5	5	22
Weed Control	Observing good tree vigour after weed control	6	8	5	37
	Seeing increase in yield after weed management	9	6	4	37
	Revision: have been practising weed control	0	5	8	25
Pest & disease control	Can now identify coffee leaf rust, pink disease and scales	7	7	3	33
	Can control pest & disease using cultural methods	2	7	4	25
	Chemical control is expensive: cannot afford	1	3	7	22

Key: Go= Gotomi, Ti = Tiredne, Ta = Tani, To = Total

Reasons for not applying agronomy innovations

Some 25 per cent of the farmers indicated that they still lacked knowledge and skills in developing a coffee calendar because the TPs had not adequately covered the material during the training program. A similar explanation was given by a similar number of farmers (25 %) for not applying the pest and disease innovations. Some three farmers indicated that they were not applying the innovations associated with drainage because they were farming coffee on hills (Table 7.33).

Table 7.33: Reasons for not applying agronomy techniques

Techniques	Reason for not apply the techniques	Go	Ti	Ta	To (%)
Coffee calendar	Coffee calendar was not covered: lack knowledge and skills	9	4	0	25
Pest & disease	Pest & disease was not covered well. Still lack the knowledge	5	2	3	20
Drainage	Growing coffee on sloping land: do not require drainage	0	2	1	6
Total		14	8	4	51

Key: Go= Gotomi, Ti = Tiredne, Ta = Tani, To = Total

7.4.4 Face-to-face interview analysis: adoption of postharvest innovations

The vast majority of the farmers (96%) who had undertaken the postharvest training had adopted the innovations that they had acquired. Some farmers in Nagamiufa (n= 7) and Mindima (n=1) were not applying the postharvest tests: pulper, fermentation, picking and moisture (Table 7.34).

Table 7.34: Assessing application of acquired postharvest techniques

Postharvest techniques	Nagamiufa		Mata		Mindima		Total	
	Yes	No	Yes	No	Yes	No	Yes	No
Pulping test	13	2	15	0	18	1	46	3
Fermentation test	12	3	15	0	19	0	46	3
Picking test	14	1	15	0	19	0	48	1
Moisture test	14	1	15	0	19	0	48	1

Assessing confidence level in applying postharvest innovations

Farmers were asked to rate their confidence level in applying the acquired postharvest innovations. The farmer confidence levels were tested ($p=0.05$) using Anova (post hoc). Except for Nagamiufa farmers who had no confidence in applying harvesting techniques, there was no significant difference in the application of the postharvest innovations: all the farmers were confident in applying the innovation (Table 7.35).

Table 7.35: Assessing the confidence level in applying postharvest innovations

Postharvest techniques	Mean for postharvest groups			Sig
	Mata	Mindima	Nagamiufa	
Fermentation test	1.00 ^a	1.26 ^a	1.29 ^a	0.499
Moisture content testing	1.00 ^a	1.11 ^a	1.00 ^a	0.202
Pulping test	1.07 ^a	1.26 ^a	1.67 ^a	0.192
Harvesting /ripe test	1.00 ^a	1.05 ^a	1.62 ^b	0.026

Reasons for rating confidence level in applying postharvest innovations

The main reason for confidently applying the postharvest innovations is that the farmers were able to apply the various postharvest tests. Some 90 per cent of the farmers indicated that they were able to confidently employ pulping and fermentation tests. However, four per cent of the farmers indicated that they still lacked the confidence to perform pulper trouble shooting, while a same number of farmers indicated that the fermentation test had been a revision. Majority (88%) of the farmers indicated that they were confident to carry out the moisture tests; while a further 10 per cent indicated that they were able to classify the parchment through an ocular observation of the parchment colour. About 84 per cent of the respondents indicated that they were able to supervise cherry harvesters to pick only red ripe cherries, while some respondents (18 %) indicated that they were able to check the overall quality of the harvest by pouring the harvested cherries onto a canvas (Table 7.36)

Table 7.36: Reasons rating confidence level in the application of postharvest innovations

Techniques	Reason for rating confidence level	Na	Ma	Mi	To (%)
Pulping test	Can perform pulper test during processing	11	15	18	88
	Still lack confidence in pulper adjustment/trouble shooting	2	0	0	4
Fermentation Test	Use the gritty test: see good fermentation after two days	12	15	17	88
	Revision: have been using the gritty test	0	0	2	4
Moisture Test	Can perform teeth and rub test to feel the moisture level	14	14	15	88
	Judge colour of parchment through ocular observation	0	1	4	10
Picking test	Now instructing family members to pick red ripe cherries	13	12	16	84
	Check quality of picking by pouring harvest on canvas	1	3	3	18

Key: Na= Nagamiufa, Ma = Tiredne, Ta = Mindima, To = Total

Reasons for not applying postharvest innovations

The main reason for not implementing the new knowledge for testing pulper was that about four per cent of the farmers did not own pulping machines, while a further four per cent did not adopt the fermentation test because they were selling cherries. Only a farmer was employing ocular observations to judge the fermentation. A similar reason was provided for not applying the moisture test: farmers were selling cherries. The difficulty faced by one farmer in calculating the picking test was the only reason for not employing the picking test (Table 7.37).

Table 7.37: Reasons for not applying postharvest techniques

Techniques	Reason for not apply the techniques	Nag	Mat	Min	To (%)
Pulping test	Lack pulper: cannot implement test	1	0	1	4
Fermentation test	Trading cherry: do not ferment parchment	2	0	0	4
	Use ocular observation: no need for fermentation test	1	0	0	2
Moisture test	Trading cherry: do not process parchment	1	0	0	2
Picking test	Mathematical calculations of picking test is difficult	1	0	0	2
Total		7	0	1	16

Key: Nag = Nagamiufa, Mat = Mata, Min = Mindima, Tot = Total

7.5 Impediment analysis

Williams (1994), Wanmali and Islam (1997), Minten (1999), Raymond (2004), Matuchke (2008) and Batt et al., (2009) show how the lack of tools and equipment, poor market accessibility, the lack of price incentives for quality, the lack of money, and poor training have prevented farmers from adopting improved technology. It was assumed that each of these impediments was faced by the farmers to various degrees. Farmers were subsequently asked to rate the seriousness of the impediments as they impacted upon the application of the acquired innovations.

7.5.1 Impediments to technology adoption: agronomy

When assessing the significant difference between the groups on the assumed impediments, there was no significant differences found between the groups regarding a lack of pruning saw, a lack of knapsack, low price, a lack of price incentives for quality, insufficient money and training too technical. Regarding poor road conditions, there was no significant difference between Tani and Tiredne and Tani and Gotomi (Table 7.38).

Table 7.38: Seriousness of impediments to innovation application: agronomy

Impediments to technology application	Mean			Sig
	Gotomi	Tani	Tiredne	
Lack of pruning saw	2.53 ^a	3.53 ^a	3.32 ^a	0.172
Lack of knapsacks	2.07 ^a	2.76 ^a	2.37 ^a	0.533
Poor roads	4.33 ^b	3.53 ^{ab}	2.79 ^a	0.036
Low price	2.73 ^a	2.29 ^a	2.05 ^a	0.365
No incentives for quality	1.60 ^a	1.71 ^a	1.89 ^a	0.761
Insufficient money	2.33 ^a	1.71 ^a	2.68 ^a	0.057
Training too technical	4.53 ^a	4.82 ^a	4.74 ^a	0.470

7.5.2 Impediments to technology adoption: postharvest

Farmers were asked to rate level of the seriousness of the impediments to applying the acquired postharvest innovations. The seriousness of the impediments were tested ($p=0.05$) using Anova (post hoc test). There was no significant difference between the groups regarding impediments: poor roads, technicality of the training, a lack of price incentives for quality, a lack of finance, and a lack of pulper. However, there was a significant difference between Nagamiufa and both Mata and Mindima regarding a lack of clean water. Regarding low price, there was a significant difference between Mindima and both Mata and Nagamiufa, whereas, between Mata and Nagamiufa, there was no significant difference (Table 7.39).

Table 7.39: Impediments to postharvest innovation adoption- analysis by group

Impediments to technology application: Postharvest	Mean			Sig
	Mata	Mindima	Nagamiufa	
Poor roads	3.00a	3.32a	2.73a	0.611
Training too technical	4.80a	4.68a	4.47a	0.383
Lack of price incentives for quality	1.53a	2.16a	1.73a	0.351
Lack of finance	1.87a	2.89a	2.00a	0.105
Lack of pulper	3.67a	4.42a	3.13a	0.054
Lack of clean water	4.07b	4.00b	2.80a	0.045
Low price	1.73a	3.05b	1.87a	0.008

7.5.3 Internal impediments: agronomy

Some 50 per cent of the farmers participating in the agronomy training program indicated that they had experienced some internal impediments that had limited their ability to adopt the improved management practices that they had learnt (Table 7.40). Farmers in Tani experienced

the greatest number of personal impediments while farmers in Tiredne experienced the least. For the farmers in Gotomi, just over 50 per cent had experienced some personal impediments.

Table 7.40: Assessment of internal impediments to innovation adoption: agronomy

Group	Yes	No	Total
Tiredne	6	13	19
Tani	11	5	16
Gotomi	8	7	15
Total	25	25	50

In Tani and Gotomi, cherry theft and the lack of resources respectively were the major impediments. However, all three groups reported that the lack of community cooperation was a constraint (Table 7.41).

Table 7.41: Internal impediments faced by farmers in adopting innovation: agronomy

Internal impediments faced by farmers	Gotomi	Tiredne	Tani	Total
Cherry theft	0	2	6	8
Lack of resources	5	2	1	8
Lack of community cooperation	3	2	3	8

7.5.4 Internal impediments: postharvest

Farmers were asked to indicate whether they were facing any personal impediments in applying the acquired innovations. Some 45 per cent of the farmers participating in the postharvest training program indicated that the adoption of the acquired innovations was impeded by some internal problems (Table 7.42). Farmers in Nagamiufa experienced the greatest number of personal impediments while farmers in Mata experienced the least. For the farmers in Mindima, 37 per cent had experienced some personal impediments.

Table 7.42: Assessment of internal impediments to innovation adoption: postharvest

Group	Yes	No	Total
Mindima	7	12	19
Nagamiufa	9	6	15
Mata	6	9	15
Total	22	27	49

Asked to specify the impediments (Table 7.43), cherry theft was a major constraint to the application of innovation in Mata and Mindima, whereas a lack of resources was a constraint to all the groups. A lack of community cooperation was a concern for some farmers in Nagamiufa and Mindima.

Table 7.43: Internal impediments faced by farmers in adopting innovation: postharvest

<i>Internal impediments faced by farmers</i>	Nagamiufa	Mata	Mindima	Total
Cherry theft	0	9	6	15
Lack of resources	4	3	2	9
Lack of community cooperation	2	0	1	3

7.6 Farmers' motivational factor analysis

Farmers were asked to identify their motivational factors for attending the postharvest and agronomy training programs. The farmers were then asked to assess the ability and capacity of the training programs to adequately address their motivational factors.

7.6.1 Farmers' motivational factors for attending the training

Some 58 per cent of the farmers from the study population indicated that they had a specific motivation for participating in their desired training program. However, the level of motivational factors varied not only between the agronomy and postharvest training programs but also between the groups. Generally, there was a higher level of motivation in the postharvest group compared to the agronomy group. Whereas the number of motivated farmers in Tiredne, Gotomi, Tani and Mindima was only marginally above 50 percent, for the Mata and Nagamiufa groups, it exceeded 60 per cent (Table 7.44).

Table 7.44: Did farmers have specific motives for attending the training programs?

Training area	Group	Yes		No		Total
		N	%	N	%	N
Agronomy	Tiredne	11	58	8	42	19
	Tani	9	53	8	47	17
	Gotomi	8	53	7	47	15
<i>Total</i>		28		23		50
Postharvest	Mindima	11	58	8	42	19
	Mata	10	67	5	33	15
	Nagamiufa	9	60	6	40	15
<i>Total</i>		30		19		49
Grand total		58		42		100

7.6.2 What were your motivations for attending the trainings?

Some 51 per cent of the farmers from the study population indicated that a lack of knowledge and skills had been the main motivational factor for attending the agronomy and postharvest training programs (Table 7.45). In the postharvest training program, the lack of appropriate knowledge and skills in marketing and a lack of knowledge on the proper use of tools were cited by nine per cent and five per cent of the respondents respectively.

Table 7.45: Motivational factors for attending the agronomy and postharvest training

Motivational factors	Agronomy				Postharvest				Grand Total	
	Ti	Ta	Go	To	Mi	Ma	Na	To	n	%
Lack of knowledge and skills: agronomy and postharvest	9	9	9	27	11	6	6	23	50	86
Lack of knowledge in coffee marketing	0	0	0	0	4	3	2	9	9	16
Lack of knowledge on proper use of tools & equipment	0	0	1	1	0	1	3	4	5	9

Ti= Tiredne, Ta= Tani, Go = Gotomi, Mi= Mindima, Ma= Mata, Na= Nagamiufa, To= Total

7.6.3 How well were the farmer motives addressed by the trainings?

The farmers were asked to rate the satisfaction level on how the agronomy and postharvest training programs addressed their core problems using a scale of 1-5 where 1 was ‘very satisfied’ and 5 was ‘not satisfied’. Using a sample t-test ($p=0.05$), the farmers’ motivational factors were analysed for both the postharvest and agronomy training programs. It was clear that there was no difference between the groups and that majority of the farmers indicated that the training program has satisfactorily addressed their motivational factors (Table 7.46).

Table 7.46: Training programs addressing farmer motivational factors

Satisfaction	Postharvest		Agronomy		Sig
	1.48	1.029	1.19	0.681	0.193

A lot of good insights were revealed by the results which is of benefit to the PNG coffee industry and especauilly for the extension team of the CIC to take not. The next chapter therefore discusses the insights which were gathered from analysing the results.

Chapter 8. Discussion

This chapter synthesises the literature and insights generated by the results and marries these to the seven objectives of the thesis. However, the seven objectives have been classified into four categories: (i) training needs analysis; (ii) process analysis; (iii) outcome analysis; and (iv) impediment analysis. The chapter begins by discussing the demographics of the respondents.

8.1 Demographics of the sample population

Weir and Knight (2000), Bandiera and Rasut (2001), the World Health Organisation (2010), UNESCO (2012), and Hojo (n.d) agree that the attainment of some formal education is essential in order for farmers to acquire and adopt innovations. It is for this reason that the educational levels of the respondents were assessed. It was evident that a high number of the respondents (77 %) had attained some formal education. However, this result does not reflect the actual smallholder population in the PNG coffee industry because half of the PNG population is illiterate and the vast majority of this population is located in the rural areas (World Health Organisation, 2010; UNESCO, 2012). The presence of a higher number of literate respondents in this study was a result of a strict criterion that was used to recruit the sample population. Illiterate farmers were eliminated from participating in the interviews to reduce recall and interpretational errors.

It is certain that 60 per cent of the respondents had less than 3000 coffee trees. Some 57 per cent of the respondents who have attained some formal education had less than 3000 coffee trees. This implies a number of things: (i) the sample population was a typical smallholder (CRI, 1994); (ii) young farmers have attained some formal education and fall under the smallholder category; and (iii) the extension section of the CIC has the opportunity to encourage more young farmers (who may be educated) to take active part in the Farmer Demand Driven Extension (CIC 2002) so that they may help members of the communities by extending their (educated farmers) acquired knowledge to illiterate farmers.

8.2 Training Needs Analysis

There is a distinct difference between information dissemination and facilitating life-long change (learning) through training. Information dissemination is the transferring of organised data or interpreted measurements in a raw form (Evans and Grub, 2007); while changes in the learners' behaviour, knowledge, skills and attitudes are indicators that learning has taken place as a result of participating in a curriculum (Knowles et al, 2005). A training needs analysis (TNA) provides one of the bases for a curriculum and training program development. To facilitate concrete learning experiences among adult learners, the development and the

execution of the training programs should be a joint effort between the TPs and the farmers (Williams, 1994; Kroehnert, 2000; Burns, 2002; Galbraith, 2004; Knowles, 2005; and UNASO, n.d). The main objectives for the TPs conducting a TNA with the agronomy and postharvest farmer groups were to: (i) assess the farmers' knowledge and skills deficiencies in agronomy and postharvest; (ii) involve the farmers in planning and executing the agronomy and postharvest training programs; and (iii) assess whether the groups were viable in terms of support such as cash contribution, food and accommodation. To undertake the TNA, the TPs should have used four activities: group discussion, a short quiz, developed a social activity calendar, and undertaken a transect-walk. Group discussions should have involved interactive discussions with the farmers and the TPs to establish the farmers' core problems for seeking the training and to establish a level of commitment by the farmers. The quiz should have been used to assess the farmers' knowledge gaps and develop lesson plans and training aids accordingly. A group activity calendar should have been discussed with the farmers to identify the ideal time for the training. A transect-walk should have been done to assess the application of recommended coffee farming practices on the farms.

At the outset, it is important to note that when the research was conducted, about 60 groups in the Highlands region had participated in the Farmer Demand Driven Extension (FDDE) adapted by the CIC. For this population, a reliable sample size would be between 50 – 500 (Hall, Malhotta, Shaw & Oppenheim, 2008). The results indicated that only 48 per cent of the respondents had participated in the TNA survey, of which 26 per cent were in the postharvest training program and 22 per cent were in the agronomy group. Although this study did not explore impediments to the implementation of an effective TNA survey including farmer attendance, a number of implications can be drawn from the fact that less than 50 per cent of the farmers participated in the TNA survey: (i) inaccessibility and geographic dispersion of the farmers may have prevented the majority of the farmers from attending the TNA survey; (ii) poor communication between the TPs, the CIC and the farmers may have prevented the farmers from attending. This could be the highly likely cause as word of mouth is the likely mode of communication and getting message to groups is often problematic; (iii) the TPs simply have not realised the importance of a TNA survey and thus may have not emphasised enough the importance of majority farmer participation in the TNA survey; (iv) the CIC Contract Management Unit (CMU) did not adequately provide the necessary logistics support, monitoring and supervision required by the TP in the TNA; and (v) perhaps the farmers have decided not to attend the TNA after securing the funds for the training programs.

The farmers who were involved in the TNA survey indicated that group discussion was the most common TNA method used (98%) while at least 80 per cent mentioned use of transect walk. It is quite possible that the cognitive quiz and seasonal activity calendar may have been

discussed orally during the discussion sessions, while transect walks would have been conducted on a few farms. This could be the likely scenario because a wider coverage of the entire village coffee gardens during a transect walk would be impeded by the dispersed locations of the farmers and rugged terrains which is of a typical PNG village. Further, budget constraints on the part of the CIC could have prevented the TP from having ample time to conduct a thorough TNA. Although less than 50 percent of the farmers have participated in the TNA survey, the outcomes of the training programs were very positive: farmers have acquired the necessary innovations. The results of the TNA indicate that except for the cognitive quiz, all the other TNA methods were judged to be useful by those farmers who participated in the TNA. Their knowledge and skills deficiencies in agronomy and postharvest were identified and their groups were consolidated in preparation for the trainings programs. To compensate for the minimal farmer participation in the TNA and for additional information, the PRAP reports for the groups could have been a reliable source of information to guide the development of the curriculum and the training programs, unless the TPs have not obtained a copy of the reports from the CIC-CMU.

8.3 Process analysis

In the PNG smallholder coffee sector, the major concern is the significant discount of 15-20 per cent for smallholder coffee on the New York Coffee exchange. The discount accounts for a loss of between K300-K400 (A\$1500 – A\$200) million per annum. This loss is the result of the inconsistent processing of quality coffee by smallholder farmers. Among other impediments, the lack of and/or incorrect application of agronomic and postharvest innovations contribute to this problem (Batt et al, 2008). Agronomic innovations are designed to facilitate an increase in the production of the coffee, while the postharvest innovations are designed to maintain the quality of the coffee through the implementation of desired postharvest practices. Ideally, the agronomy and postharvest training programs should have been jointly developed by the CIC-CMU, the TPs and farmers (Kroehnert 2000, and UNASO n.d). The discussion in this section will examine: (i) coverage of the essential topics in both agronomy and postharvest; (ii) the use of appropriate training methods; and (iii) the use of appropriate training aids in both the agronomy and postharvest training programs.

8.3.1 Training topics

The purpose of evaluating the training topics was to assess coverage of the recommended training topics. In agronomy, the topics should have been: pruning systems, shade control, weed management, drainage, fencing, pest and disease control, fertilizer application and a typical coffee calendar. In postharvest, the topics should have been: harvesting methods, pulping, fermentation, washing and soaking, drying, grading and storage.

The evidence indicates that most of the topics in both the agronomy and postharvest training programs were adequately covered and considered useful by the majority of the farmers. The reasons for rating the agronomy and postharvest topics useful were: (i) farmers had acquired new knowledge and skills; and (ii) some farmers after applying the acquired innovations on their farms, were observing positive impacts such as more vigorous tree growth, increased yields, and improvements in the weight and colour of their parchment. However, some farmers indicated that some of the topics were not useful because: (i) the content of some topics such as pruning systems, shade control, pest and disease control, the coffee calendar, fertilizer application and fermentation methods were not adequately covered; (ii) some topics such as drainage, cherry picking, pulping, washing and soaking and parchment storage were a mere revision; and (iii) the cost of applying some innovations such as constructing a mini-wet factory, purchasing a pulper and the application of chemicals on farms were too expensive. This implies that the TNA surveys were not conducted in sufficient depth to determine the appropriate levels at which these topics should have been prepared and delivered.

8.3.2 Training methods

Training methods are the means by which the content of the agronomy and postharvest topics were conveyed to the farmers (Kroehnert, 2000). The CIC recommends seven training methods which include: lectures, field demonstrations, group discussions, question and answer sessions, follow-up visits, field excursions and expert inputs. Lectures should have been used to introduce a topic and to explain new concepts. Group discussions should have been used to facilitate the sharing of ideas and experiences between the farmers. Question and answer sessions should have facilitated interaction between the farmers and the TPs. Field demonstrations should have involved the TPs demonstrating skills such as dismantling and reassembling a pulper, or demonstrating a pruning operation. Field excursions and expert inputs should have been utilised to re-enforce the content learnt in the classroom by using an expert on the subject area and to foster a working relationship with reputable operators such as planters, factory owners and processors. Follow-up visits should have been undertaken by the TPs to evaluate the application of acquired innovations by the farmers sometime after the trainings had been delivered.

For both the agronomy and postharvest training programs, the most consistently used training methods were lectures (99%) and field demonstrations (99%), followed by group discussions (98%) and question and answer sessions (98%). Conversely, expert inputs (44%), field excursions (54%), and the use of follow-up visits (59%) were employed more infrequently. However, field excursions and expert inputs were more widely used with the groups in EHP than in Chimbu. Chimbu farmers could have been disadvantaged by: (i) inaccessibility due to

poor roads; (ii) the high cost of travel; and (iii) the unwillingness of the farmers to travel long distances.

When assessing the usefulness of the training methods, except for the expert input, all of the training methods were found to be useful because the farmers had acquired new knowledge and skills.

8.3.3 Training aids

The main purpose of using training aids in a training program is to improve the clarity of the message being conveyed to the learners. Training aids help the learners to maximise learning through the use of the five senses: seeing, hearing, smelling, tasting and touching. In this way, participants are able to remember 90 per cent of the message that was covered during the training program (Kroehnert, 2000). The training aids for the agronomy training program should have included pruning saws, secateurs, pest and disease posters, knapsack sprayers, pesticides and handouts. The training aids for the postharvest training program should have included parchment samples, cherry samples, parchment class posters, drying tables, pulping machines, processing posters, harvesting posters, and fermentation boxes.

In terms of using the agronomy training aids, the majority of the farmers indicated that pruning saws (92%) and secateurs (76%) were widely used, while some farmers indicated that handouts (49%) and pesticides (55%) were the least used. In the postharvest training program, the majority of the farmers indicated that parchment samples (94%), cherry samples (94%), parchment posters (86%), drying tables (84%), and pulping machines (80%) were widely used, while fermentation boxes (71%), harvesting posters (73%), and handouts (76%) were least used. While the rehabilitation posters, pulping machines, fermentation materials, and drying tables which were found not to be very useful, the other training aids used in both the agronomy and postharvest training programs were found to be very useful because: (i) they clarified the concepts and functions of the tools and equipment used by the farmers and; (ii) the farmers were able to gain confidence, and self-esteem by practically using the aids. However, there was evidence to suggest that farmers did not benefit much from the rehabilitation posters, pest and disease posters, knapsacks, pulping machines, fermentation boxes, and drying materials simply because: (i) the materials were not used at all during the training programs; (ii) the aids were not explained well by the TPs; (iii) training aids such as pruning saws and secateurs had already been demonstrated to the farmers and were therefore revision; and (iv) handouts were irrelevant because the notes were written in English.

From this analysis it is evident that: (i) easily accessible and practically useful training aids such as parchment samples, cherry samples, pruning saws, and secateurs were widely used and considered useful, because the farmers could easily associate themselves with these aids;

(ii) some of the training aids such as fermentation boxes, pulpers and knapsacks were not used at all, and this implies a lack of communication and coordination between the TPs and the CIC-CMU; (iii) the TPs may have lacked the necessary knowledge and skills in the use of the training aids such as pulping machines and knapsack sprayers; and (iv) the inability of the CIC-CMU training section to adequately support the TPs with relevant training materials such as Tok Pisin handouts and posters.

8.4 Outcome analysis

Williams (1994) describes learning as gaining information, acquiring skills, increasing self-awareness and increasing aspirations. He admits that this type of learning is internal and is difficult to measure. Knowles et al. (2005) and Kroehnert (2000) agree with Williams by emphasising that if learning is to occur there must be some behavioural change in the learner as a result of applying the acquired innovations. Bennett (1977) indicated that outcome evaluation is done at the advanced stage of the evaluation hierarchy which looks at changes in norms, behaviour and the consequences of these changes at the societal level. In line with these theoretical propositions, the desired outcome of the training programs would be for the farmers to acquire new knowledge and skills in agronomy and postharvest leading to the increase in production of superior quality coffee as a result of application of acquired innovation.

There is evidence that the agronomy and postharvest training programs have facilitated change in terms of the farmers' knowledge, attitude, skills and aspirations. This is because a number of positive results have been noted from this study: (i) the training programs have adequately addressed the knowledge and skill deficiencies of the farmers in both agronomy and postharvest groups as demonstrated by the 88 per cent and 96 per cent accuracy rates in the agronomy and postharvest cognitive quizzes, respectively; (ii) the vast majority of the farmers in both the agronomy and postharvest training programs have indicated a significant level of confidence in applying the respective innovations; and (iii) as a result of the training, positive impacts have been observed on the farms such as more vigorous tree growth, an increase in yield, correct identification of pests and diseases by participants and improvements in the colour and weight of the coffee parchment produced for sales.

The evidence number three above is independently supported by Romalus (2012) who indicated that the Nagamiufa, Tiredne, Mindima and Tani groups, after receiving the agronomy and postharvest trainings, were able to produce improved parchment grades (AA/A) with superior cup qualities and achieved better prices for their coffee. This evidence reaffirms one of the recommendations proposed by Batt et al. (2009) that a well-structured training program can contribute to an improvement in the quality of the coffee produced by PNG smallholder farmers.

However, there is evidence to show that some farmers in the agronomy groups did not apply the coffee calendar, and pest and disease control, while some farmers in the postharvest training program were unable to calculate the picking losses, and could not correctly adjust pulpers. This is because these farmers still lacked the knowledge and skills in these areas because these topics were not adequately covered. It could also imply that since 23 percent of the farmers have not attained any formal education, low literacy and numeracy may have impeded this group of farmers from correctly calculating the picking losses and plan a proper coffee calendar.

8.5 Impediment analysis

Wanmali & Islam, (1997); Minten, (1999); Batt and Murray-Prior, (2006) and Batt et al. (2009) have identified poor roads, land tenure systems, and law and order problems as the major impediments to technology adoption. Consistent with these findings, the farmers in this study have constantly indicated that with the roadside traders, there was a lack of price incentives for quality. This resulted in farmers having inadequate finance to purchase the necessary fertilizers, chemicals, tools, and equipment to implement the acquired innovations on their farms. There was also a lack of cooperation in several communities as a result of cherry and parchment theft. In such a situation, mixed cherry harvesting was inevitable and proper parchment drying and storage in separate houses was not practical. Not unexpectedly, these practices compromised the quality of the coffee produced by smallholder farmers. However, this trend may not be universal in the PNG coffee industry as anecdotal evidence indicates that coffee theft is more prevalent in areas easily accessible by road and where roadside coffee trading is common. Furthermore, although the technical nature of the training programs was not a serious impediment for most farmers, some farmers still had problems in fully understanding the content of the training program with regards to pest and disease control, the coffee calendar, pulper repair and maintenance, knapsack sprayers, and wet processing. This implied that TPs lacked in-depth knowledge and skills on these topics, which may have impeded knowledge acquisition and adoption by farmers.

Poor roads were also identified as an impediment. However, anecdotal evidence indicates that remote farmers continue to produce coffee irrespective of the price they receive because coffee is their only means of income. On the other hand, farmers with easy road accessibility see coffee from the viewpoint of maximising financial returns per unit of land. For example, Sengere (2007) indicated that coffee is a seasonal crop where farmers realise an income from coffee once a year. Whereas vegetable crops such as broccolis, carrots, tomatoes, potatoes etc can be grown on a same size of land as coffee and farmers could earn more income by planting and selling vegetables more than once a year. Provided with this opportunity and also in light of the rapid economical growth, especially in PNG mining industry, some farmers especially

in EHP (Asaro) and WHP (Banz) were uprooting their coffee trees and replacing them with vegetables in order to make a good income from the piece of land which holds coffee. This infers that while better roads do play a role in facilitating access to other services, better roads do not necessarily lead to an improvement in coffee production.

8.6 Farmer motivational factors

Adults are motivated to learn if they know that their needs will be satisfied by undertaking training (Knowles et al., 2005). In line with this, there is evidence indicating that over 58 per cent of the farmers were motivated to participate in the agronomy and postharvest training because they lacked knowledge and skills in these areas. Further, some 16 per cent of the farmers lacked knowledge and skills in coffee marketing while nine per cent lacked knowledge and skills in proper use of tools and equipment. This implies that the vast majority of the farmers had participated in the training programs because they had a cognitive interest to satisfy an inquiring mind (Lieb, 1991). There is evidence that the agronomy training program has satisfactorily addressed the farmers' motivational factors (92%) while the postharvest training program has also done the same (72%). Therefore, the training programs have successfully addressed most of the motivational factors of the farmers, although market information had not been delivered, which is totally a different course not evaluated under this study.

Chapter 9. Conclusions and recommendations

The aim of this study was to evaluate whether the Farmer Demand Driven Extension (FDDE) model was facilitating farmer learning. The answer to this broad question was investigated by answering seven questions: (i) were the appropriate training need analysis (TNA) techniques used to identify farmer motives for learning; (ii) were the essential topics in agronomy and postharvest processing delivered during the training programs; (iii) were the training methods employed during the training programs appropriate to facilitate farmer learning; (iv) did the training providers (TPs) employ appropriate training aids during the agronomic and postharvest training; (v) did the farmers acquire the relevant knowledge and skills to improve coffee quality and quantity; (vi) if the farmers had acquired the innovations, were the farmers applying these innovations; and (vii) if the farmers were not applying the acquired innovations, what factors were impeding the adoption of the acquired information? The conclusions and the recommendations are outlined with regard to these objectives.

9.1 Were the appropriate TNA techniques used to identify farmer motives for learning?

Only 48 per cent of the study population indicated participating in the TNA survey, which implied that less than half of the total number of farmers in a typical group participated in the entire TNA survey. This outcome may reflect a most likely situation with the farmer groups who participated in the FDDE extension model because of PNG conditions such as the geographic dispersion of the smallholder farmers and the ineffective communications services such as poor postal mailing systems, low mobile phone coverage, lack of telephone land lines, and unreliable transfer of messages through word of mouth. These impediments have greatly affected effectiveness of farmer movements to gatherings such as TNA surveys. However, those who took part in the TNA survey indicated use of some TNA techniques such as group discussions (100%), Quiz (94%), Social Activity Calender (92%) and Transect walk (81%). These techniques were useful for two main reasons: (i) farmers' motivational factors for attending the training programs were identified; and (ii) the groups were consolidated and prepared for the training programs. A further analysis on farmer motivational factors indicated that farmers were motivated to attend the training programs to acquire knowledge and skills on all aspects of postharvest and/or agronomy (50%); nine per cent were motivated by their eagerness to learn more about the coffee marketing systems; and four per cent were interested to learn more about the proper use of tools and equipment. It can be assumed that the underlining factor behind the farmers' motives to acquire improved knowledge and skills in postharvest and agronomy was to help them produce better coffee with an intention of improving their financial returns. These reasons for farmers attending the agronomy and

postharvest training programs were the same reasons which were identified in the respective PRAP reports. The intent of the CIC and the TPs for conducting a TNA survey was to develop a better agronomy and postharvest training programs (curriculum) and to consolidate the groups. For this exercise, the CIC had committed K3000 (A\$1500) per farmer group. The results indicated that the TNA survey has achieved both purposes. A review of the PRAP reports compiled by the CIC CMU also indicated that farmers lacked agronomy and postharvest innovations and therefore training was required. For this the farmers were already consolidated through the efforts of the CIC extension officers even before the TNA was conducted by the TPs. After the training the percentage of farmer benefiting from the training in terms of knowledge acquisition and application was very high, contrary to the number of farmers who participated in the TNA survey (<50%) and positive results were observed when the acquired innovations were applied. Therefore, as far as farmer learning was concerned, it was not necessarily and entirely influenced by the TNA as the farmers were able to learn without fully participating in the TNA survey. Therefore, although the TNA would be beneficial for the TPs in terms of them knowing the members of the farmer groups and to appreciate the general appearance of the coffee plots of the farmers, TPs conducting a TNA with an intension to knowing farmer learning motives and developing an appropriate curriculum was a repetition of efforts already recorded in the PRAP reports for the respective groups. For this viewpoint, the TNA process conducted by the TP appears to be un-necessary. Further, it is common knowledge that smallholder farmers did not know the details of the knowledge and skills associated with the postharvest and agronomy training program: in other words, farmers did not know what they did not know. Therefore conducting a TNA survey with the smallholder farmers could have little value. For this reason, the TNA survey exercise or lack of it may not be critical to the training program and the CIC could potentially save the money.

9.2 Were the essential topics in agronomy and postharvest delivered during the training program?

Most of the topics in both the agronomy and postharvest training programs were adequately delivered and were considered useful by a clear majority of the farmers because they have acquired new knowledge and skills. However, there was an element of incompetencies in the delivery of some topics such as the repair and maintenance of pulping machines and knapsack sprayers, pest and disease control, developing a coffee calendar, and fertilizer application. This is not surprising because these topics were very technical and could not be fully covered within the few days of training. Although the study did not establish how many TPs have conducted the trainings, CIC records indicated that different TPs conducted the different trainings given the geographical locations of the groups, and the amount of time and effort required in

developing and executing the training programs. It is obvious that some TPs who were responsible for delivering the training programs may lack the in-depth knowledge and/or did not have good knowledge of the content of some of the topics delivered. Therefore, two approaches are recommended to address this problem: (i) the CIC could develop an in-service program for the TPs on areas that they were not confident in; and (ii) the CIC in collaboration with the TPs develop respective curriculums and programs on the areas which require more attention so that the farmer groups which indicated having problems may be trained again and also in future, trainings on the areas identified above can be delivered separately.

9.3 Were the training methods employed during the training programs appropriate to facilitate farmer learning?

Except for expert input, each of the training methods employed was considered useful because the farmers acquired new knowledge and skills and improved their level of confidence in using the tools and equipment through demonstrations. However field excursions and expert inputs were not utilised by all the groups in Chimbu, which implies that these farmer groups did not have an opportunity to see the operations of reputable operators. Some 40 per cent of the farmers indicated that follow-up was the least useful method. It implies that follow-up visits to the farmers were restricted by (i) geographical dispersion of the individual farms; (ii) lack of time and budget to visit each and every farmer in the groups; (iii) lack of effective communication services to have the farmer readily available for the visits; and (iv) a lack of reliable mobility such as public motor vehicle for the TPs to travel back and forth from follow-up sites. However, the CIC has funded this activity with K300 (A\$150) and four days allocation per group. There is evidence that more than 90 per cent of the farmers were able to confidently apply the acquired innovations without the need for external assistance. This implies that, although follow-up visits are an essential part of farmer learning, the TP's follow-up visits were not realised by all the farmers and still the vast majority of the farmers were able to apply the innovations without the supervision of the TP. In light of these results, three recommendations are made: (i) The TPs conducting the follow-up visits was limited to a few easily accessible farmers because the TPs' ability and capacity to visit all the farmers in the group were presumably impeded by dispersion of farmers, inaccessibility, poor roads, and lack of transport, tribal conflicts and bad wealth. In light of these, the K300.00 is not well spent. The CIC could potentially save the money used to fund the TPs on this exercise and the follow-up visit could become one of the core functions of the CIC contract management unit (CMU) at the provincial levels where follow-up advices are appropriately provided during their normal extension patrols to individual farmers who are still intact in their groups. It should be noted that those farmer groups who participated in the FDDE and the training programs could be developed into collaborative marketing groups (CMG) and could be there with the CIC for a

long while; (ii) expert input and field excursions could be optional activities depending on the group's specific needs; and (iii) the current training approach to innovation delivery appears to facilitate farmer learning and should be encouraged with more coaching given to the TPs on the areas of training methodologies and improving TPs' subject matter competencies.

9.4 Were appropriate training aids employed during the agronomic and postharvest training programs?

Most of the training aids used in both the agronomy and postharvest training programs were found to be useful and have facilitated farmer learning because the farmers had the opportunity to: (i) clarify the concepts and functions of the tools used; and (ii) gain confidence and self-esteem by using the aids. However, rehabilitation posters, pest and disease posters, knapsacks, pulping machines, fermentation boxes and drying materials proved not to be useful because these aids were either: (i) not used at all; (ii) not explained well by the TPs; (iii) a revision (pruning saw and secateurs); and (iv) written in English (handouts).

The CIC funds the TPs to develop the training aids with K1000 (\$A500) per group. From the results, a number of assumptions are made: (i) the money is not appropriately spent to develop and/or outsource the training aids such as posters, knapsacks, and pulping machines, and translate the handouts and posters into Tok Pisin; (ii) the TPs lacked the technical competency in developing appropriate aids and/or use postharvest and agronomy posters; and (iii) the CIC – CMU failed to check the quality of the training aids before they were delivered by the TPs.

A number of recommendations are made to address the weaknesses identified in the development and execution of the training aids: (i) the training aids such as posters and handouts should be developed in consultation with the CIC, the TPs, and the farmer groups and translated in appropriate dialect such as Tok Pisin instead of giving the responsibility to the TP entirely. This may result in appropriate use of the funds (K1000) in developing the training aids that suits the farmers' needs; (ii) training aids such as pulping machines, knapsacks and fermentation boxes should be purchased and distributed by the CIC- CMU to the TPs to use for the training programs; (iii) the TPs should be in-serviced on the proper use of the training aids; and (iv) the TP should make appropriate adjustments to the use of training aids to accommodate farmers who were new to using the training aids such as pruning saws and secateurs.

9.5 Did the farmers acquire the relevant knowledge and skills to improve coffee quality and quantity?

A number of positive results have been presented: (i) the training programs adequately addressed the knowledge and skill deficiencies of the farmers in both agronomy and postharvest as demonstrated by the 88 per cent and 96 per cent accuracy levels in the agronomy

and postharvest cognitive quizzes, respectively; (ii) the vast majority of the respondents have indicated an improved level of confidence in applying the respective innovations; (iii) positive impacts have been observed on the farms such as vigorous tree growth, an increase in yield, positive identification of pests and diseases by respondents without external help; and (iv) improvements in the colour and weight of the coffee parchment were realised.

However, some farmers were unable to apply some innovations regarding the coffee calendar, pest and disease control, picking calculations, and knapsack sprayers and pulper repair and maintenance. This was because some farmers still lacked the knowledge and skills in these areas as the topics were not covered adequately by the TPs. To some extent, not all the farmers were visited during the follow-up visits. This implies a number of things: coffee calendar, pest and disease control, picking calculations, knapsack and pulper repair and maintenance were too technical and have in-depth contents which may not be covered in a day's sessions. Therefore, three recommendations are made: (i) through a collaborative efforts (CIC, TP, and farmers) a separate training program and curriculum on coffee calendar, pests and diseases, knapsack repair and maintenance, and pulper repair and maintenance should be developed so that trainings on these areas are delivered in the future by the CIC extension officers during their normal extension visits; and/or (ii) the TP's should be inducted in the above mentioned areas by the CIC so that the TPs are knowledgeable to again conduct trainings in all these areas which the farmers groups have indicated the deficiencies. After all, lack of knowledge and skills in these critical areas may result in the production of poor quality coffee and low yield.

9.6 Were there any impediments to innovation adoption?

A number of impediments to innovation adoption have been identified: (i) a lack of price incentives for quality (road-side trading); (ii) a lack of tools and equipment; (iii) some training modules were too technical; (iv) poor roads; and (v) cherry theft.

Poor roads impede the movement of produce out of the villages and the flow of inputs to the farms. Furthermore, poor roads impede on the timely movement of services providers such as the TPs. However, improving the road conditions is a government function which the CIC cannot directly address. Cherry and parchment theft is a law and order issue, although the CIC is currently enforcing a cherry ban policy. Further, the CIC under the current FDDE program conducts personal viability trainings for viable farmer groups whereby some of these groups develop community laws in order to control issues such as cherry theft. A lack of price incentives for quality leads to farmers having inadequate finances to purchase farm inputs. However, the lack of price incentives for quality is a problem associated with roadside buyers.

Three recommendations are made in regards to enabling farmers to realise a price incentive for quality: (i) the CIC should emphasise the need for farmer groups to form strategic alliance

(CMG) with appropriate traders of their choice and a long-term marketing relationship nurtured; (ii) where appropriate, the CMG trade cherry to the strategic partner (trader) so that farmers may receive a 34 per cent better price than parchment sales (Batt et al., 2009); (iii) for farmers in inaccessible areas and where cherry trade is not possible, central mini wet factories should be constructed at convenient locations where members of the CMG may collectively pulp their cherries, and dry them using the CIC recommended methods. In this way, quality of coffee is improved and the farmers may be rewarded with better price incentives for quality by their strategic partners (Batt et al., 2009).

9.7 Further research

Two issues have emerged from this study. Firstly, the study should also have been conducted from the perspective of the TPs to assess their capacity and ability to develop the agronomy and postharvest curriculum and deliver the training program. The level of support they receive from the CIC and the farmers was not assessed due to time and money limitations. However, the TPs play a determining role in the success of the training program and it is recommended that a study be conducted to evaluate the success of the training programs from the perspective of the TPs. Secondly, innovation application by the farmers was determined primarily by how much extra money the farmers could make from selling their coffee. Price incentives for good quality coffee can only be realised when the farmer groups form a long-term strategic alliance with a reputable trader. Therefore, further research should be conducted to identify existing strategic alliance with traders and CMGs and evaluate successes of these partnerships.

References

- Aaker, D., Kumar, V., Day G. & Lawley, M. 2005, *marketing Research: the Pacific Rim edition*, John Wiley & Sons, Australia.
- ACIAR, 2008, *Indicative ACIAR Program Priorities: Papua New Guinea*. Retrieved: 17th February 2009 from <http://www.google.com/search?q=impact+on+agriculture+infrastrastrature>
- Apety, J. 1998, *Technical Advisory Circular No.9 – Integrated Management of Green Scale Complex, Coccus celatus De Lotto and C. Viridis (Green) (Hemiptera: Coccidae) on Coffee (coffea sp.) in Papua New Guinea*. CIC, Coffee Research Institute, Kainantu.
- Akogere, 2005, *Facts- Eastern Highlands*. Retrieved: 31st December 2009 from <http://www.easternhighlands.com.pg/facts.htm>
- Anderson, J.R., Feder, G. & Ganguly, S. 2006, *The Rise and Fall of Training & Visit Extension: An Asian Mini-drama with an African Epilogue*, World Bank Report, Washington DC, USA
- ARDSF, n.d., *AIGS Project Proposal Writing Module*, Port Moresby, PNG.
- Armajaro Trading, n.d., *Commodities: Coffee Overview*. Retrieved: 22nd February, 2013, from <http://www.armajarotrading.com/>
- Aroga, L., 2008^a, *Coffee Units – Lower and Upper Secondary (Grades 9-12) Coffee Teaching Resource Book*, CIC, Coffee Research Institute, PNG.
- Aroga, L., 2008^b, *Coffee Units – Upper Primary (Grades 6-8) Coffee Teaching Resource Book*, CIC, Coffee Research Institute, PNG.
- Artur, C., Timothy K. & Jose. 1998, 'Developing and delivering extension programmes' in B. Swanson., P. Bent. & J. Sofranko (eds), *Improving agricultural extension: A reference manual*, Food and Agricultural Organisation of the United Nations, Rome.
- Axin, G.H. & Thorat, S.1972, *Modernizing World Agriculture: A Comparative Study of Agriculture Extension Education Systems*, New Delhi: Oxford & IBH.
- Bandiera, O. & Rasut, I. 2001, *Social Networks and Technology Adoption in Northman Mozambique*, Retrieved: 11 February, 2012, from <http://riab.lse.ac.uk/opening/paper/bandiera.pdf>
- Baker, PS. (ed), 2001, *Coffee Futures: A source book of some critical issues confronting the coffee industry*, Commodities Press, Firiva S.A. Cali, Colombia.
- Batt J, P. & Murray-Prior, R. 2006, *Building Capacity within the PNG Coffee Industry to Improve Returns for Smallholder Coffee Producers*, Retrieved: 11 February, 2009, from http://www.afmaasia.org/malaysia_2006?Annex-7.pdf
- Batt P.J. & Murray-Prior, R. 2008, *Assessing and Extending Schemes to Enhance the Profitability of the PNG Coffee Industry via Price Premiums for Quality*, Retrieved: 18th February 2009, from <http://www.fao.org/Ag/ags/subject/en/agmarket/linkages/Bali/Batt.pdf>.
- Batt J, P., Murray-Prior R., Dabui, C., Api, F. & Aroga, L. 2009, *ACIAR Final Report: Assessing and Extending Schemes to Enhance the Profitability of the PNG Coffee Industry via Price Premiums for Quality*, Retrieved: 18th February 2009, from <http://www.fao.org/Ag/ags/subject/en/agmarket/linkages/Bali/Batt.pdf>.
- Benor, D. & Harrison, J.Q. 1977, *Agricultural Extension – The Training and Visit System*, World Bank – Washington, D.C, USA.

- Blackburn, D. (eds) 1994, *Extension Handbook – Processes and Practice*, second edition, Thompson Educational Publishing, Inc, Toronto.
- Boyd, R.D. & Apps, J.W. 1980, *Redefining the Discipline of Adult Education*, San Francisco: Jossey-Bass.
- Brace, I. 2008, *Questionnaire Design: How to plan, structure and write survey material for effective market research*, Kogan Page, London.
- Burns, R. 2002, *The Adult Learner at Work: The challenges of lifelong education in the new millennium* (2nd edition), Allen & Unwin, Crows Nest, NSW, Australia.
- Byrn, D., Fessenden, J., Frutchey, F., Gallup, G., Mathews, J., Forter, W., Raudabaugh, N. & Sabrosky, L. 1967, *Evaluation in extension*, Division of Extension Research and Training, Federal Extension Services, United States Department of Agriculture, USA.
- Canadian Food Grain Bank, n.d., *The Problem Tree*, Retrieved 27th March, 2012 from: <http://www.foodgrainbank.ca/uploads/tips103.pdf>
- Cannell. 1985, 'Physiology of the Coffee Crop in M.N Clifford & K.C. Willson (eds), *Coffee: Botany, Chemistry and Production of Beans and Beverages*, The AVI Publishing Company Inc. Westport, Connecticut, London/Sydney, pp.109 -128
- Cartledge, I. 1976, *History of the Coffee Industry in Papua New Guinea*, Canberra, A.C. T.
- Chambers, R. 1989, '*Farmer-first: a practical paradigm for the third agriculture*', farmer innovation and agricultural research, intermediate technology publications,
- Chris, G. 2004, 'Demand led-approaches' in W. Rivera & G. Alex (eds), *Volume 3-Demand-Driven Approaches to Agriculture Extension: Case Studies of International Initiatives*, The World Bank 1818 H Street, NW, Washington DC. Pp 3-6.
- CIC. 2002, *Proceedings and Recommendations of the National Coffee Workshop – Raising Production and Quality of PNG Coffee In the new Millennium*, Goroka, PNG.
- CIC. 2004, *Coffee Growers Support Services Program: Policy Guidelines and Implementation Procedures*, Coffee Industry Corporation Limited, R&GSD, Goroka, PNG.
- CIC. 2005, *The Coffee Growers Support Services Manual: Procedures and Guidelines of Farmer Demand Driven Extension in the Coffee Industry of Papua New Guinea*, Goroka, PNG.
- CIC. 2006, *Research & Growers Services Division - Reports for the 31st Coffee Research & Extension Advisory Committee Meeting*, Goroka, PNG.
- CIC. 2007a, 2007 Annual Report, Goroka, PNG.
- CIC. 2007^b, Industry Operations Division, Coffee Report NO. 70 Goroka, PNG.
- CIC. 2008, *Papua New Guinea Coffee Industry Strategic Plan – 2008 – 2018*, Goroka, PNG.
- CIC- Industry Operations Division. 2008, *Coffee Report No. 72*, Goroka, PNG.
- CIC. 2009^a, *CIC Farmer Training & Development – Coffee Training Report for CIC Management – Tired-ne Cooperative Society, Project # EH 005/06*, CIC Goroka, PNG
- CIC.2009^b, *PRAP Farmer Group Achievements*, Retrieved: 4th January 2010, from <http://www.coffeeorg.pg/prapachie.html>
- CIC. 2009^c, *Media Release: Record Coffee Export Earnings*, Retrieved: 28th April 2009, from <http://www.coffeecorp.org.pg/medreles.html>
- CIC, 2012, Industry Operations Division, Coffee Report No. 84, Goroka, PNG

- Clarke, R, J. 1985, 'Green Coffee processing' in M.N Clifford & K.C. Willson (eds), *Coffee: Botany, Chemistry and Production of Beans and Beverages*, The AVI Publishing Company Inc. Westport, Connecticut, London/Sydney, pp.230 -248.
- Coakes, S., Steed, L., & Price J. 2008, *SPSS version 15.0 for Windows: Analysis without Anguish*, John Wiley & Sons Australia Ltd, Queensland.
- 'Coffee export earnings record K927 million', 2012, *The National*, 23 March, p.70.
- Connelly M. 2004, 'Private Extension and Public-Private Partnerships: Privatized, Contracted, and Commercialized Approaches' in W. Rivera & G. Alex (eds), *Volume 2. Privatization of Extension Systems: Case Studies of International Initiatives*, The World Bank 1818 H Street, NW, Washington, pp. 1-6.
- Connor, D. 1996, *Diagnosing Community Problems*, Ottawa Development Press.
- Conner, M.L. 2004, *Andragogy + Pedagogy*, Retrieved: 28 October 2008, from <http://agelesslearner.com/intros/andragogy.html>
- Coste, R. 1992, *Coffee: the plant and the product*, the Macmillan Press Limited, London and Basingstoke.
- Coulthard, M., Howell, A. & Clarke, G. (1996), *Business Planning: The key to success*, MacMillan Education, South Melbourne, Australia.
- CRI (Coffee Research Institute). 1994, *The Papua New Guinea Coffee Handbook*, Goroka Printery EHP, PNG.
- Crow, J., Kavanagh, K. & Ashby, M (eds), 1995, *Oxford Advanced Learners' Dictionary of Current English*, Oxford University Press.
- Crow, L.D. & Crow, A. (eds.) 1963, *Reading in Human Learning*, New York: McKay.
- DAL-PNG (Department of Agriculture & Livestock - Papua New Guinea) & ADB (Asian Development Bank). 1991, *Proceedings of the Seminar on Agricultural Development in Papua New Guinea: Policies and Issues*, Port Moresby, Papua New Guinea
- Dambui, C., Ramalus, R., Alu, M. & Wheeler, M. 2005, *PNG CIC- Coffee Report NO. 6*, CIC Printery, Goroka – PNG.
- Dart J. J. 2000, 'Stories for Change: A New Model of Evaluation for Agricultural Extension project in Australia', Institute of Land and Food Resources, the University of Melbourne.
- Dart J., Petheram J. & Straw, W. 1998, *Review of Evaluation in Agriculture Extension – Rural* Institute of Land and Food Resource, Victoria – Australia.
- David, D. 1998, 'Evaluating Extension Programmes', in B. Swanson., P. Bent. & J. Sofranko (eds), *Improving agricultural extension: A reference manual*, Food and Agricultural Organisation of the United Nations, Rome, chapter 11.
- Dempsey, J. & Campbell R. 2005, *A Value- Chain Approach to Coffee Production: Linking Ethiopian Coffee Producers to International Markets*, Retrieved: 11 February 2009, from <http://www.acdivoca.org/852571DC00681414/looku>
- Derny, D. & Frazer C. 2007, *Learning Styles Manual for Adult Learners*, Retrieved: 6th May 2012, from: http://acenetwork.remote_learner.net/file.php/1/Program_Resources/finallearningstylemerged.
- Devenish, K. 2006, *The spoken wagon wheel model of extension for change in agriculture*, Retrieved: 6th November, 2008, from http://www.region.org.au/au/apen/2006/refeed/6/2912_devenish

- DOF. 1991, *Handbook of Cost benefits Analysis*, Department of Finance, Australian Government Publishing Service, Canberra.
- Donald J. B. & Joan F. 1994, Historical Roots in J. D. Black (ed), *Extension Handbook: Processes and Practices*, Thompson Educational Publishing, Inc. Toronto, p. 1.
- David, D. 1998, Evaluating Extension Programs in B. Swanson, P. Bent & J. Sofranko (eds), *Improving agricultural extension: A reference manual*, Food and Agricultural Organisation of the United Nations, Rome, chapter 11
- Douglah, M. 1998, *Developing a Concept of Extension Program Evaluation*, University of Wisconsin-Extension. Retrieved: 13th March 2009, from <http://learningstone.uwex.edu/pdf/G3658-7.PGF>
- Ecom Trading, n.d., *About Ecom Coffee*, Retrieved: 21st February, 2013, from <http://www.ecomtradeing.com/en/our-products/coffee/about-ecom-coffee-113.html>
- Ehmke, C., Fulton, J. & Lusk, J. n.d., *Marketing's Four P's: First Steps for New Entrepreneurs*, Retrieved: 5th April 2012, from <http://www.ces.purdue.edu/extmedia/ec/ec-730.pdf>
- Eltayeb, M.E. 2005, 'Agricultural extension in Sudan, policies and reality- the case the Khartoum state', Agricultural Sciences, Masters Dissertation no.27, Swedish University.
- B van, E. 2000, Organic coffee in PS Baker (ed). *Coffee Futures; A source book of some critical issues confronting the coffee industry*, pp.76.
- Evans D. & Gruba, P. 2007, *How to write a better thesis*, Melbourne University Press, Australia
- FAO. 1984, *Agricultural Extension – a reference manual*, second edition.
- FAO. (n.d)^a, *Alternative Research and Extension Systems – Technology Transfer Model*, Retrieved: 14th October 2008, from www.fao.org/docrep/w7508e0d.htm-8k
- FAO. (n.d)^b, *Building Capacity for Agriculture Sector's Response to Aids- A training Manual for Agriculture Sector Workers, Module 11: Program Monitoring and Evaluation*, Retrieved: 9th March, 2012, from <http://www.fao.org/docrep/013/am022e11.pdf>
- Feder, G. & Slade, R. 1986, *The Impact of Agricultural Extension: The Training and Visit System in India*, Retrieved: 14th October 2011, from <http://www.google.com/url?sa=t&rct=j&q=&esrc=s&frm=1&source=web&cd=3&ved=0CFsQFjAC&url=http%3A%2F%2Fwww.fao.org/docrep/013/am022e11.pdf>
- Felgenhauer, K. & Wolter, D. n.d., *Out-grower Schemes – Why Big Multinationals Link up with African Smallholders*, Retrieved: 14th October 2008, from <http://www.oecd.org/dataoecd/47/27/41302136.pdf>
- Field, A. 2009, *Discovering statistics using SPSS (third edition)*, Sage Publications Ltd, London.
- Galbraith, M. 2004, *Adult Learning Methods – A Guide for Effective Instruction*, Krieger Publishing Company, Florida, USA.
- Gerster. 2006, *Agriculture Extension Down the Ages, Universitat Hohenheim 430 Fachgebiet: Landwirtschaftliche Kommunikations -und Beratungslehre*, Retrieved: 20th September 2008, from <https://www.uni-hohenheim.de/i430a/lehre/veranst/download/skripten/rce/RCE-01.pdf>
- Gianatti, M.T. & Carmody, P. 2006, *Grower Group Networks Working Together with Researchers*, University of Western Australia, Faculty of Natural Agricultural Sciences, Australia.

- Gibson, T., L. (Ed), 2001, *Cooperative Extension Program Planning in Wisconsin*, North Lake Street, Madison, USA.
- Gimbol C.K. 2001, *Coffee Industry In Papua New Guinea – Current status, Prospects, Constraints, and Strategies for Sustainable Development: A Paper Presented at the Regional Workshop on the Constraints, Challenges, and Prospects for the Commodity-Based Development & Diversification in the Pacific Islands Economics*, Retrieved: 10th April, 2009, from <http://www.unctad.org/inforcomm/diversification/nadi>
- Godbold, K. 2005, *The Didiman and Agricultural Policy; Creating Social Change in Papua New Guinea, 1945-1975*, Retrieved: 4th November, 2008, from [Http://eprints.gut.edu.au/archive/00003431/01/3431.pdf](http://eprints.gut.edu.au/archive/00003431/01/3431.pdf)
- Gwyn, E. J., 1998, The history, development, and future of agricultural extension in B. Swanson, P. Bent & J. Sofranko (eds), *Improving agricultural extension: A reference manual*, Food and Agricultural Organisation of the United Nations, Rome, chapter 1.
- Haarer, A.E. 1962, *Modern Coffee Production*, Leonard Hill [Books] Limited
- Hanson, L.W. Allen, B.J. Bourke, R.M. & McCarthy T.J., 2001, *Papua New Guinea Rural Development Handbook*, Australian National University, Canberra.
- Hagmann, J., Chuma, E., Murwira, K. & Connolly, M. 1999, *Putting Process into Practice: Operationalising Participatory Extension*, Retrieved: 14th October 2008, from http://www.odi.org.uk/networks/agren/papers/agrenpaper_94.pdf
- Hall., Malhotra., Shaw & Oppenheim, 2008, *Essentials of Marketing Research: An Applied Orientation*, Pearson Education, NSW, Australia.
- Hair., Bush., & Ortinau. 2003, *Marketing Research Within a Changing Information Environment*, McGraw-Hill Companies, New York, USA.
- Harding P, E. 1988, Rehabilitating Smallholder Coffee Gardens in Papua New Guinea: The Effect on Yields During the First Year Following Rehabilitation, *PNG Coffee Journal* –vol 7, no. 1, pp 79 – 91.
- Hilgard, R. & Bower, H. 1966, *Theories of learning*, New York: Appleton-Century-Crofts.
- Hojo, M. n.d, *Farmer Education and Technology Adoption: The Choice of Education Measures*, Retrieved: 28^h March 2011, from <http://www.eco.niigata-u.ac.jp/~hojo/farmer.pdf>
- IFAD. 2007, *Evaluation of Organic Agriculture: A promising alternative for small farmers*, Retrieved: 28^h March 2011, from http://www.ifad.org/evaluation/public_html/eksyst/doc/thematic/organic/organic.htm
- Intercontinental Exchange. n.d, *ICE Futures U.S: Coffee “C”*, Retrieved: 17th March, 2013, from http://www.theice.com/publicdocs/ICE_Coffee_Brochure.pdf
- Indaba-network. n.d., *Problem Tree/Objective Tree*, Retrieved: 28^h March 2012, from <http://www.indabanetwork.files.wordpress.com/2011/07/problemobjectivetree.pdf>
- ICO (International Coffee Organisation) (2012), Trade Statistics: Production, Retrieved: 12th February 2013, from http://ico.org/trade_statistics.asp
- International Federation of Red Cross and Red Crescent Societies, 2010, *Project/Program Planning: Guidance Manual*, Geneva, Switzerland.
- International Trade Centre 2002, *Product and Market Development – Coffee: An Exporter’s Guide*, Geneva.

- Jules, PN.P. & Simplice D.V. 1998, Using Rapid or Participatory Rural Appraisal in B. Swanson, P. Bent & J. Sofranko (eds), *Improving agricultural extension: A reference manual*, Food and Agricultural Organisation of the United Nations, Rome, chapter 6.
- Kaplan, R. S., Norton, D. P. & Barrows Jr, E. A. 2008, *Balanced Scorecard Report: The Strategy Executive Sources- Developing the Strategy: Vision, Value Gaps, and Analysis*, Harvard Business School Publishing, USA.
- Kimani, M., Little, T., & Vos, J., M. 2002, *Introduction to Coffee Management through Discovery Learning*, Retrieved: 2nd November, 2011, from <http://www.bionica.info/biblioteca/Kimani2002cafe.pdf>
- Knowles, S.M., Holton III, F.E. & Swanson, A.R. 2005, *The Adult Learner: The definitive Classic in Adult Education and Human Resource Development*, Elsevier Butterworth Heinemann, USA.
- Kolter, P., Adam, S., Brown L. & Armstrong G, 2006, *Principles of Marketing*, Pearson Education, Australia.
- Kroehnert, G. 2000, *Basic Training for Trainers: A Handbook for New Trainers (3rd edition)*, The McGraw-Hill Companies Inc. NSW, Australia.
- Kukhang, T. 1996, *Toksava long kamapim pikinini Robusta Kopi long Kru Kopi*, CRI, PNG.
- Kumar, R. 2005, *Research Methodology: A step-by-step guide for beginners*, Pearson Education -Australia.
- Kuri, A. 2000, *The quality of the raw, roast and liquor for the export grades of Arabica coffee (Coffea arabica) from Papua New Guinea*, PNG Coffee Journal, vol 10, no. 2, pp. 16-31.
- Lahis, S.B. 2005, *Output-based Contract Extension Delivery System: SSSPP Experience in the Eastern Highlands and Morobe Provinces*, Konedobu, Papua New Guinea.
- Laverne B, F., Robert E. B. & Gwenna M.M. 1994, 'Program Evaluation' in Blackburn, D (ed). *Extension Hand Book, Process and Practice*, Thompson Educational Publishing, Inc, Toronto. p 177-189.
- Laverne B, F. & Harold R.B. 1994, 'The Program Planning Process in Blackburn, D (ed). *Extension Hand Book, Process and Practice*, Thompson Educational Publishing, Inc, Toronto, pp. 86-99
- Ledoux. H. & Melesse, M. 1995, *Marketing Information: A literature Review*, Retrieved: 28th March 2012, from <http://idl-bnc.ca/dspace/bitstream/10625/1/103725.pdf>
- Leedy, P.D. & Ormrod, E. J. 2005, *Practical Research: Planning and Design*, Person Education Ltd, New Jersey.
- Lees J.W. 1990, *More than accountability*, The Rural Development Centre University of New England, Armidale.
- Levin B., Giorannucci D., & Varangris P. 2004, *Coffee Market: New Paradigms in Global Supply and Demand*, World Bank, Washington D.C, 20433, USA.
- Lieb, S. 1991, *Principles of Adult learning*, Arizona Department of Health Services, South Mountain Community College. Retrieved: 28th October 2008, from <http://Honolulu.hawaii.edu/committees/FacDevCom/guiebk/teachtip/adult-2.htm>
- LMC International. 2006, *Enhancement of Coffee Quality: Socioeconomic study*, Retrieved: 5th December 2011, from http://www.coffee-ota.org/cd_quality/app/files/Annex%20E.12.pdf

- Long, H. 2004, 'Understanding Adult Learners' in M.Galbraith (eds), *Adult Learning Methods: A guide for Effective Instructions*, Krieger Publishing Company, Florida, pp.23.
- Louis Dreyfus, n.d, *Commodities: Coffee*, Retrieved: 21st February, 2013 from <http://www.louisdreyfus.com/>
- Loveridge, S., Baptiste, J. & Shingiro, E. 2003, *Decaffeinated? Situation, Trends and Prospects for Smallholder Coffee Production in Rwanda*. Retrieved: 11 February 2009, from http://www.aec.msu.edu/fs2/Rwanda/ps_5e.pdf
- Malhotra,N., Hall, J., Shaw, M. & Oppenheim, P. 2006, *Marketing Research 3rd Edition*, Pearson Education, Australia, French Forest, N.S.W.
- Manzan, T. 2000, 'Review of the impact of weeds on coffee, their management and research implications in PNG', PNG Coffee Journal, vol 10, no. 2, pp. 3-15.
- Mark, W., & G.A.B, M, 1994, 'New Extension Technologies' in Black J. D (ed), *Extension Handbook: Processes and Practices* Thompson Educational Publishing, Inc. Toronto, p. 159 – 169.
- Marshall C. & Rossman B. G. 1999, *Designing Qualitative Research* (3rd Edition), Saga Publications Thousand Oaks London.
- Maslow, H.A. 1970, *Motivation and Personality*, Harper & Row Publisher, New York.
- Matuschke, I. 2008, *Evaluating the Impact of Social Networks in Rural Innovation Systems – An overview*. Retrieved: 18th February 2008, from <http://www.ifpri.org/pubs/dp/IFRIDP00816.pdf>
- Mercon Coffee Corporation n.d., Members and Affiliated Companies. Retrieved: 22nd February, 2013 from <http://www.merconcoffeegroup.com/>
- Mburu, J, K. 1995, 'Notes on coffee processing procedures and their influence on quality' in Kenya Coffee: The Coffee Board of Kenya Monthly Bulletin, vol 60, no. 710, pp. 2131 -2135
- McCaslin N.L & Jovan P.T. 1998, Assessing target group needs, in B. Swanson, P. Bent & J. Sofranko (eds), *Improving agricultural extension: A reference manual*, Food and Agricultural Organisation of the United Nations, Rome, chapter 5.
- Cunningham M., n.d, Coffee Barometre. Retrieved: 17th March, 2013, from http://www.newforesight.com/sites/default/files/newforesight/TCC_coffeeBarometre2012.pfd
- Minten, B. 1999, *Infrastructure, Market Access and Agriculture Prices: Evidence from Madagascar*. Retrieved: 17th February 2009, from <http://www.ifpri.org/divs/mtid/pd/papers/dp26.pdf>
- Misra, D, C. 1998, Monitoring extension programs and resources, in B. Swanson, P. Bent & J. Sofranko (eds), *Improving agricultural extension: A reference manual*, Food and Agricultural Organisation of the United Nations, Rome, chapter 17.
- Mortiss, P.D. 1988, *Agricultural Extension: a practical manual*, Department of Primary Industries, Queensland Government Brisbane.
- Muraskin, L. D. 1993, *Understanding Evaluation: the Way to Better Prevention Programs*, Retrieved: 19th March, 2012, from <http://www.2.ed.gov/PDFDocs/handbook.pdf>
- Murray-Prior R. & Peter J.B. 2008, *Improving Quality in Coffee Chains in Papua New Guinea*, Retrieved: 19th February, 2009, from: <http://www.actahort.org/members/showpdf?session=10040>

- Murray-Prior, R., Batt P., Api, F., Aroga, L. 2008, *Establishing Partnerships Between Private sector and Government to Deliver Extension and Training to Smallholder farmers in PNG Coffee Industry*, Retrieved: 19th March, 2011, from <https://www.google.com/#hl=en&output=search&scient=psy-ab&q=Establishing+partnership+Between+Private+Sector+and+Government+to> o.
- NAASU - National Agricultural Advisory Services of Uganda. 2003, *Promoting and Strengthening of Sustainable Farmer Groups and Associates*. Retrieved: 18th February 2008, from <http://www.naads.or.ug/pdfs/midterm.pdf>
- Nake, S., Naged, T., & Sengere, R. 2005, *Robusta Coffee Notes: A Guide to Farming Robusta Coffee*, PNG Coffee Research & Grower Support Division, Goroka.
- Nake, S., Hombunaka, P., & Daiyan, M. 'Nutritional Requirements of Unshaded Plantation Coffee at Aiyura, Eastern Highlands Province, PNG', PNG Coffee Journal, vol 12, no. 1& 2, pp1-7.
- Nall, M., Prince, R., Davis, J. & Murray D. n.d., *Program Implementation*. Retrieved: 29th March 2012, from <http://www.ca.uky.edu/Agpad/progimp.pdf>
- Neumann Kaffee Gruppe, n.d., Group Companies. Retrieved: 21st February, 2013, from <http://www.nkg.net/groupcompanies>
- NIC, n.d., *New Guinea Islands Coffee, Papua New Guinea – A Land of Coffee*, Retrieved: 20th September 2008, from http://www.nghce.pg/png_coffee
- NRI-CIRAD-WUD. 2007, *Empowering Smallholder Farmers in Market: Changing Agricultural Marketing Systems and Innovative Responses by Producers' Economic Organisation*. Retrieved: 6th June, 2009 from http://www.esfim.org/download/Brief_ESFIM_WP_2_english.pdf
- NSO-PNG (National Statistical Office of Papua New Guinea). n.d., *Population & Social*, Retrieved: 18th February 2008, from <http://www.nso.gov.pg/>
- Olam, n.d, *Coffee*. Retrieved: 21st February, 2013, from <http://olmonline.com/products-services/confectcionery-beverages-ingredient/coffee>.
- Owen J.M. & Rogers P.J. 1999, *Program evaluation forms and approaches*, Allen and Unwin: St Leonard, NSW, Australia.
- Owen, J. M. 1993, *Program Evaluation, Forms and Approaches*, Allen and Unwin, St Leonards, NSW, Australia.
- Palmer, K. 2004, *Supporting Infrastructure Investment in Developing Countries*, Retrieved: 17th February 2009, from <http://www.google.com/search?hl=en&rls=com.microsoft:en-au&q=impact+on+agriculture+innovation+adoption+in+png&start=10&sa=N>
- Patton, M.Q. 1997, *How to Use Qualitative Methods in Evaluation*, Sage, Newbury Pak, USA.
- Paula, B. 1996, *Free Chimbu Information*, Encyclopedia.com, Retrieved: 5th January 2010, from <http://www.encyclopedia.com/doc/1G2-3458000290.html>
- Petheram, R.J. 1998, *Review of Evaluation in Agricultural Extension*, Institute of Land and Food Resources, Victoria. Retrieved: 10th March 2009, from: http://ntru.aiatsis.gov.au/ifamp/research/pdfs/Pertheram_1998.pdf
- Philemon, O. 2013, 'Naru urged to called a meeting on agriculture', The Post Courier, 8th April, 6.

- Place F., Kariuki G., Wangila K., Makauki A., & Ndubi, J. 2004, *Assessing the factors underlining differences in achievements of farmer groups: methodological issues and empirical findings from the highlands of Central Kenya*. Retrieved: 19th February 2009, from <http://www.ilri.org/Link/Files/InnovationWorks/Files/Place%20et%20al%20Collective%20...>
- PMCCI - Port Moresby Chamber of Commerce and Industry.2002, *Economic Overview of Papua New Guinea*. Retrieved: 10th April, 2009 from <http://www.pomcci.org.pg/pngoverveiw.html>
- PNG - Papua New Guinea National Road, 2003, *National Road Improvement Project*, Retrieved: 17th February 2009, from http://www.jica.go.jp/english/opertaions/evaluation/jbic_archive/post/2003/pdf/2-33...
- Prakash. n.d., *Capacity Building of Agricultural Cooperatives to Meet the Market and Human Resources Development Demands: A step-by-step Approach*, Retrieved: 19th February, 2009, from http://www.uwcc.wisc.edu/info/intl/daman_cbac.pdf
- Qamar K.M. 2004, *Demand -for- Services Planning by Villagers: A case study from Pakistan*, Research, Extension and Training Division Sustainable Development Department, Food and Agriculture Organisation of the United Nations, Rome, Italy.
- Qamar K.M., 2005, *Modernizing National Agricultural Extension Systems: A Practical Guide for Policy-Makers of Developing Countries*, Research, Extension and Training Division Sustainable Development Department, Food and Agriculture Organisation of the United Nations, Rome, Italy.
- Quirke, D., Harding, M., Warner, B. & Davis, J. 2007, *Papua New Guinea Coffee and Cocoa policy linkages: Australian Centre for International Agricultural Research Final Report*, ACIAR – Canberra ACT 2601, Australia.
- Rabey G.P., 1985, *Manager*, Paige Production, Wellington, New Zealand
- Rainforest Alliance., n.d, *The Rainforest Alliance Certified Difference: Sustainable Agriculture Certification*, Retrieved: 22nd March, 2013 from, <http://www.rainforest.alliance.org>
- Rajalahti, R., Woelcke, J., & Pehu, E. 2005, *Monitoring and Evaluation for World Bank Agricultural Research and Extension Projects: A Good Practice Notes*, Washington DC.
- Raymond, W., 2004, 'Creating Motivating Learning Environment', in M. Galbraith (eds). *Adult Learning methods: A Guide for Effective Instruction-* Third Edition, pp. 141-164
- Rivera, W. 2006, *Global Reform of Agriculture Extension for Rural Development*, Retrieved: 20th October 2008, from ip.cals.cornell.edu/course/iard402/2006fall/mexico/.../7
- Roger, E.M. & Shoemaker, F.F. 1971, *Communication of Innovation: A cross-Culture Approach*, The Free Press, New York.
- Romalus, R, 2012, *Best Practices in Coffee Processing: Manual*, The Coffee Industry Corporation Ltd, Goroka, PNG.
- Scoones, I. & Thompson, J. (eds) 2000, *Beyond Farmer First: Rural people's knowledge, agriculture research and extension practice*, International Technology Publications Ltd, London.
- Selender, D., Endra, N., & Carvajal, J. 1999, *Participatory Rural Appraisal and Planning*, International Institute of Rural Reconstruction, Ecuador, Kenya

- Selvanathan, A., Selvanathan, S., Keller, G. & Warrack, B. *Australian Business Statistics (4th edition)*, Thomson Nelson Australia Pty Ltd, South Melbourne – Victoria.
- Semana, A. R. 1993, *Agriculture Extension Services at Crossroads: present dilemma and possible solutions for future in Uganda*, Department of Agriculture Extension & Education - Makerere University, Retrieved: 20th September 2008, from <http://www.codesria.org/Links/conference/ifs/Semana.pdf>
- Sengere, R. 2007, 'Communicating technology and innovations in the PNG coffee industry', Master's dissertation, University of Sydney, Australia.
- Sheila, A., B. 1994, 'Marketing Programs', in Blackburn, D (ed). *Extension Hand Book, Process and Practice*, Thompson Educational Publishing, Inc, Toronto, pp. 69-78.
- Sinclair, J. 1995, *The Money Tree – Coffee in Papua New Guinea*, Crawford House Publishing, Bathurst 2795, Australia.
- Skinner, B.F. 1968, *The technology of Teaching*. New York: Appleton-Century-Crofts, 1968
- Slob, B. n.d, *A Fair Share for Coffee Producers: Fairtrade and Coffee Report 2012*, Retrieved: 21st February 2013 from <http://www.Fairtrade.org.uk/FT>
- Smith D.G.V. 1991, 'Coffee Discussion Paper # 3: Coffee Market Margins in Papua New Guinea' A Workshop paper presented at National Centre for Development Studies, Australia National University.
- Smith, R. M. 1982, *Learning How to Learn*, Englewood Cliffs, NJ: Cambridge
- Soanes and Hawker (edited). 2006, *Compact Oxford English Dictionary for University and College Students*, Oxford University Press, New York.
- Spreckley, F. n.d., *A Project Cycle Management and Logical Framework Toolkit: A Practical Guide for Equal Development Partnerships*, Priestley House, Birmingham, UK.
- Stapleton, G. 1997, *Plantation Cost of Production Survey 1995: Coffee Discussion Paper # 19*, Coffee Industry Corporation Limited, Industry Affairs Division, Goroka, PNG.
- Stosch L. & Hyman E. 2004, *Increasing the Volume and Value of Smallholder Coffee in El Salvador*, Retrieved: 15th February 2009, from http://www.idrc.ca/fr/ev-30562-201-1-DO_TOPIC.html
- Surber K. 2005, *An Introduction to Fair Trade and Cooperative: A methodology – Fair-trade*. Retrieved: 16th February 2009, from <http://www.qmul-fairtradeproject.org/openaccess/Kate%20Suber%202005%20fairtrade%20methodology%20&%20Technology.pdf>
- Sucafine, n.d., *Sucafine, A tradition of Excellence*. Retrieved: 22nd February, 2013, from <http://www.sucafine.ch/index.aspx>
- Suvedi, M., Heinze, K.& Ruonavaara, D. 1999, *How to Conduct Evaluation of Extension Programs*, ANRECS Centre for Evaluation Studies, Michigan State University Extension, East Lansing. Retrieved: 12th March 2009, from <http://www.canr.msu.edu/evaluate/SourcesFiles/Training%20Manual.htm>
- Swanson, B., Bentz, R. & Sofranko, A. (eds), 1997, *Improving Agricultural Extension – A Reference Manual*, Food and Agricultural Organisation of the United Nations, Rome.
- The World Bank. 2004, *Monitoring & Evaluation: Some Tools, Methods & Approaches*, Washington DC, USA.
- Tolopa, P. 1998, *General Recommendation on Pruning Arabica Coffee in PNG*, Technical Advisory Circular No. 4, CRI, Aiyura, PNG

- Ukers, H., W. 1922, *All about coffee*. Retrieved: 3rd November, 2011, from <http://www.munseys.com/diskseven/alfe.pdf>
- UNASO – Uganda Network of Aids Services Organization, n.d., *Planning & Implementing Training: A community Handbook*, Retrieved: 31st December 2009, from http://www.world.org/docs/Publication/Training/planning_and_implementing_training_community_handbook.pdf
- UNESCO, 2012, *Adult and Youth Literacy, 1990 – 2015: Analysis of data for 41 selected countries*. Retrieved: 12th December 2012, from <http://www.uis.unesco.org/literacy/Documents/UIS-literacy-statistics-1990-2015.en.pdf>
- Uwe J. N. 1998, Alternative approaches to organising extension in B. Swanson, P. Bent & J. Sofranko (eds), *Improving agricultural extension: A reference manual*, Food and Agricultural Organisation of the United Nations, Rome, chapter 2.
- Van Damme, P. & Dirckx. T. 2000, *Linking Small-scale farmers to Commercial Sector*
- Van den Ban, A.W. & Hawkins, H.S. 1996, *Agriculture Extension*, second edition, Blackwell Science Ltd, London.
- Van den Ban, A.W., Hawkins, H.S., 1997, *Agriculture extension*-second edition, Blackwell Science Ltd, London.
- Van den Ban. A.W. & Mkwawa, D.S. 1997, *Towards a Participatory and Demand Driven Training Visit and Training (T&V) Agriculture Extension System: A case of Tanzania*, The Journal of Agricultural Education and Extension. Retrieved: 22nd April 2009, from <http://www.informaworld.com/smpp/title/content~content=a780935577>
- Volcafe Group, n.d, *Volcafe Group: The Coffee Division of ED & Man*. Retrieved : 21st February, 2013, from <http://www.volcafe.ch/>
- Wall J. E., n.d., *Program Evaluation Models: 9-Step Process*, Retrieved: 22nd April 2012, from <http://www.home.earthlink.net/~sagasolutions/9%20steps%20Evaluation%20Model%20Paper>.
- Wallace, I. & Nilsson, E. 1997, *The Role of Agricultural Education and Training in Improving the Performance of Support Services for the Renewable Natural Resource Sector*, Natural Resource Perspective – Overseas Development Institute. Retrieved: 22nd April 2009, from <http://www.odi.org.uk/resources/download/2132.pdf>
- Waller, J, M. 1985, ‘Control of Coffee diseases’ in M.N Clifford & K.C. Willson (eds), *Coffee: Botany, Chemistry and Production of Beans and Beverages*, The AVI Publishing Company Inc. Westport, Connecticut, London/Sydney, pp.219 -228
- Wanmali, S., & Ismal Y. 1997, *Rural Infrastructure and agricultural development in Southern Africa: a centre-periphery perspective*. Retrieved: 17th February 2009, from <http://www.questia.com/googleScholar.qst;jsessionid=JhtxT#H2ypxfQYjhQNafy24zvx1ph>.
- Wayne, L. & Don. S. 1994, ‘Diffusion and Adoption: Basic Process for Social Change’, in Blackburn, D (eds). *Extension Hand Book, Process and Practice*, p 46 - 56.
- Sharada Weir, S, & Knight, J. 2000, *Adoption and Diffusion of Agricultural Innovations in Ethiopia: The Role of Education*, Retrieved: 5th May 2012 from, <http://www.csae.ox.ac.uk/workingpaper/pdfs/20-50text.PDF>
- West, P. 2010, *Making the Marketing: Specialty Coffee, Generation Pitches, and Papua New Guinea*, Retrieved: 5th May 2012 from, [http://bc.barn.edu/~pwest/articles%20link\(AH\)/making%20th%20market.pdf](http://bc.barn.edu/~pwest/articles%20link(AH)/making%20th%20market.pdf)

- Wheeler, M. 2002, Papua New Guinea Coffee – An Integrated Market Development Strategy, CIC, Goroka, PNG.
- Wheeler, MA. 2001, 'The Specialty Coffee Market' in PS Baker (ed), *Coffee Futures; A source book of some critical issues confronting the coffee industry*, p 66- 73.
- Williams, S. G. 1994, 'Applying Learning Theory in Extension Work' in Blackburn, D (ed). *Extension Hand Book, Process and Practice*, Thompson Educational Publishing, Inc, Toronto pp. 18-26.
- Williams, S. G. 1994, 'Understanding and Applying Motivational Research' in Blackburn, D (ed). *Extension Hand Book, Process and Practice*, Thompson Educational Publishing, Inc, Toronto pp. 27-35.
- Williamson, L. & Stegelin, F. 1987, *The Farmer's Cooperative Yardstick: How to Start a Cooperative*, Retrieved: 17th February 2009, from http://www.uky.edu/Ag/AgEcon/pubs/ext_ca/aec43.pdf
- World Health Organisation, 2010, *Papua New Guinea Cooperation Strategy at a Glance*, Retrieved: 17th May 2012, from http://www.who.int/countryfocus/cooperation_strategy/ccsbrief_png_en.pdf
- Yin, K. 1994, *Case study Research: Design and Methods*, Sage Publications, Thousand Oaks, London.
- Yogiyo, J., Bahude, J. & Kaile, A. 1996, *Look after your coffee: coffee calendar*, Coffee Industry Corporation, Extension Services Division, Goroka, EHP
- Yogiyo, J., & Dingu, R. n.d., *History of Coffee Introduction, Selection, and Evaluation in Papua New Guinea 1800-18985*, CRI, Aiyura.
- Yogiyo, J. 2002, 'Extension Services Strengths & Weakness' in *Proceedings and recommendation of the national Coffee Workshop: "Raising Production and Quality of PNG Coffee in the New Millennium"*, PNG Coffee Industry Corporation, 22nd-24th April, pp.52-58.

Appendix 1: Supporting tables

Table A 1: PNG parchment standards

Classes	Colour/appearance	Silver skin/green bean	Defects/foreign matter
Class 1 "Premium"	A very pale and even colour. Free from defects	Clean and translucent silver skin. Clean jade to olive coloured green beans	Up to 12 defect/100 grams No foreign matter
Class 2 "Good"	An even colour Few defects	Clean and translucent silver skin Clean jade to olive coloured green beans	Up to 70 defects per 100 grams
Class 3 "FAQ"	An uneven and mixed colour Some defects	A dirty and discoloured silver skin hard to removed Yellow green to brownish green bean	Up to 35 defects per 100 grams. Substantially free from foreign matter
Class 4 "Rejects" or "T"	Discoloured and dirty. Excessive defects and foreign matter	Very dirty and discoloured silver skin hard to remove Very uneven coloured green bean	More than 70 defects per 100 grams. Some foreign matter

Source: CRI, 1994

Table A 2: Arabica green bean specifications

Grade	Bean size	screen	Uniformity	Total equivalent	defectsRaw colour	bean Odour
AA	>18		Good uniformity	Up to 10	Bluish/green	Fresh/Mild
A	>17		Good uniformity	Up to 10	Bluish/green	Fresh/Mild
AB	50% >17 50% >16		Good uniformity	Up to 10	Greenish	Mild
B	>16		Good uniformity	Up to 10	Greenish	Mild
C	>15		Good uniformity	Up to 25	Greenish	Mild
PB	8- 14		Good uniformity	Up to 10	Greenish	Mild
X	Mixed		Good uniformity	15- 20	Greenish	Mild
Y1	Mixed		Mixed	Up to 70	Greenish/greyish	Mild
Y2	Mixed		Mixed	Up to 150	Faded green	Some mild
T	Mixed		Mixed	> 30 or 3 % defects of foreign matter	Yellowish Faded green	No excessive foreign colour or flavour

Source: CRI, 1994

Appendix 2: The Farmer Demand Driven Extension Approach in the CIC

A2.1 Introduction

The main strength of the FDDE approach in the CIC relies on the cohesive of the farmer groups. The FDDE was accepted with mixed reactions by both the employees and the coffee growers. In recognition of the lack of linkage between farmers and the CIC, the CIC board had decided to introduce the FDDE concept which was adopted by the National Agricultural Extension Services (NAES). The NAES was piloting the FDDE approach in Morobe and EHP under the Smallholders Support Services Pilot Program (SSSPP) funded by the ADB (Murray –Prior et al, 2008).

As there is no concrete literature available on how the FDDE approach is implemented in the PNG CIC, the following section is a narrative description of the author's seven years experience working with the FDDE approach in the CIC.

A2.2 Components of the FDDE

There are generally eight main steps in the FDDE process and each process is described in brief.

Awareness

The success of the FDDE depends on effective awareness through national television stations, provincial radio stations, local newspapers, local notice boards, and word of mouth, field days, and brochures distribution. The main message to the farmers is that in order to access the CIC services, the farmers must meet the following criteria:

a) Farmers must be coffee growers: The farmers must have coffee as a priority farming activity. The farmer and/or the household should have more than 700 coffee trees. Farmers and/or households having less than 700 coffee trees are regarded as new farmers and receive only advisory services.

b) The farmers must be in groups: The farmers must be in groups with more than 20 households or 100 members. The groups can be either formal or informal. For a group to be formal, it must be registered with the National Investment Promotion Authority (NIPA), must have a constitution, a bank account, and democratically elected leaders. An informal group is the opposite of formal group but one who is in the process of becoming formal. Whether formal or informal, all groups must have leaders who are honest, hardworking, and have good community reputation and must

be recommended by a priest, a pastor, and/or the village elders. A group which is influenced by individuals with motives other than to promote coffee are discouraged from participating in the FDDE.

c) Farmers must contribute sweat equity: The FDDE approach promotes self-reliant among the farmers. Unless the farmers are serious about positive personal and community change through commitment of their resources such as, time, labour, money, food, land, etc, the CIC's drive for poverty alleviation through coffee farming will not produce anticipated results. Therefore, groups must show that they are prepared to provide free services such as security for the visiting development workers, contribute cash, food, fuel and water to compliment ratios and funding provided by the CIC. Furthermore, the farmers are required to provide free training venue and village accommodation for EOs and the TPs during trainings and visits. As a general rule, each group member must contribute K10.00 (A \$5) towards the extension program.

d) Groups must be free from tribal fighting: Tribal warfare is common in the Highlands of PNG. The CIC believes that one way of addressing tribal warfare is through the FDDE approach. The farmers are told during the awareness that farmer groups who have not been involved in tribal fighting for the last three years and who refuse to participate in any tribe fighting are eligible to participate in the program.

e) Groups must be accessible: Some remote parts of PNG are suitable for growing coffee but cannot be accessible by transport. Therefore one of the criteria of the FDDE approach is that farmers must be conveniently accessible by the cheapest mode of transport (land, water, sea and air).

f) Gender equity: In PNG, most of the work in coffee is done by women as smallholder coffee is intercropped with food crops. This allows women to care for the coffee as they attend to their gardens. However, it is men who mostly sell the coffee and make the decision to spend the money. Therefore, as a requirement, one-quarter or more of the group membership must be females so that the income from coffee is equally distributed.

g) Others: FDDE approach relies heavily on TPs to deliver the trainings. Therefore, the farmer group must identify a reliable and capable TP (a retired EO, agricultural officer, or any person who has the relevant qualification and experience) who lives within the proximity of the group. However, this requirement is not necessary as TPs are sourced by the CIC.

A2.3 Preliminary group bio-data

Farmers aware of the FDDE approach visit the nearest CIC extension office and register their interest. Upon receiving the expression of interest from the farmer groups, the local CIC EOs make a preliminary visit to the group to verify the eligibility of the farmer group. During the preliminary visit, the EOs conduct a meeting and collect certain information: (i) farmer demography; (ii) number of coffee trees per farmer, (iii) leadership profile; (iv) details of infrastructure; (v) training venues, and (vi) group business records (bank account, IPA number, by-laws etc).

A2.4 Preliminary report

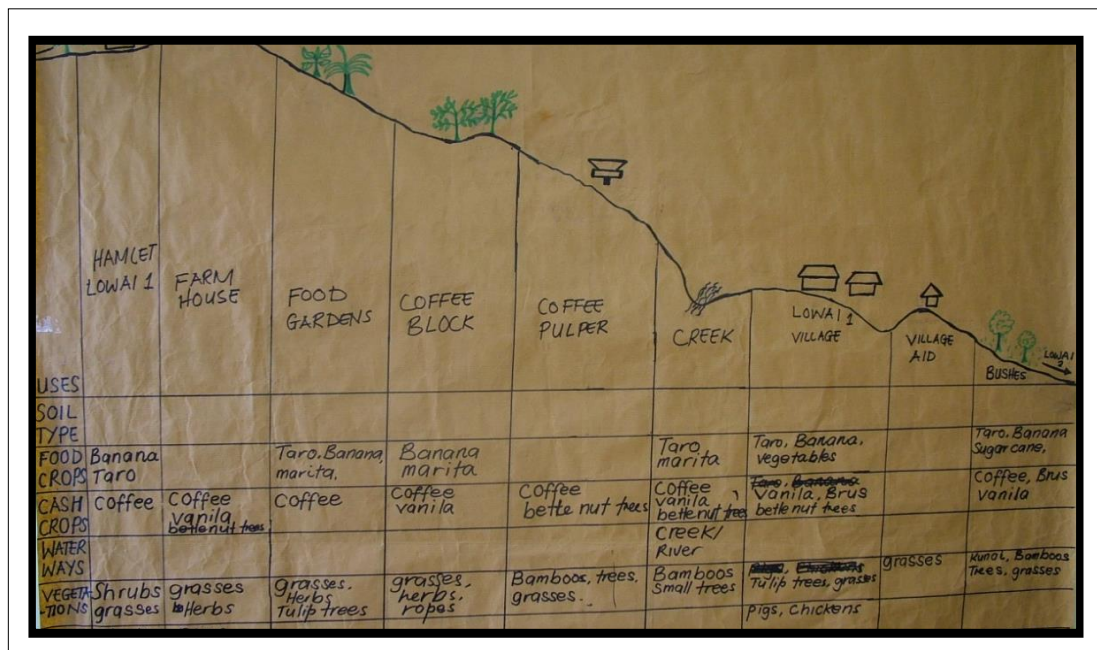
After the preliminary visit, the EOs compile a report. The report must contain factual information about the farmer group. The format of the report is a narrative description of the criteria mentioned in the awareness section with an addition of a map with vital features such as schools, church, road, coffee and food gardens, etc. The compiling officers make their recommendation whether the report should be positively considered. The report is then submitted to the CIC PEC which is made up of senior extension, research, and marketing staff (usually based at the head office). The PEC deliberates on the report. If the report is approved, the EOs proceed with the next step in the FDDE approach. If the report is not approved, the farmers are told to improve on certain selection criteria which are found to be lacking in the report and resubmitted.

A2.5 The PRAP survey

Farmer groups who had their preliminary report approved participate in a survey called PRAP. The PRAP is a series of situational analysis methods used to identify farmers' social, environmental, economical and agricultural potentials and constraints which are used to develop a program plan, including training. The PRAP process takes between three - five days depending on the experience of the facilitators and cooperation of the groups. Ten techniques used in PRAP process. The first 5: transect walk, historical profile, Venn diagram, seasonal activity calendar, and village map have no preferred order of implementation. The next five approaches: SWOT analysis; problem identification; problem voting, ranking and prioritisation; action planning; and report writing are implemented in the order listed.

1. Transect walk: This is an informal survey. It involves transverse cut or ‘walk through’ the village or farm to observe, analyse and document socio-economical and agricultural features of the farm. The observations are focussed on but not limited to; farming practices, landscape, soil types, vegetation, infrastructure, and economical potentials. Some members of the group are involved in the transect walk with the EOs. The EOs using a digital camera and note pad to record what is been observed. Particular attention is given to the coffee trees: the management practices applied, innovation deficiencies, processing facilities, water source, soil type, and the physical topography. Through the transect walk, questions are asked regarding farming practices including coffee, community attitude in regards social issues, religion, politics, business, etc. After the transect walk, all the information collected is transferred onto a large sheet of paper by the participating members and is presented to the entire group for verifications before accepting it as a true record of the farm. Figure 1 shows how information from the transect walk is transferred onto a large sheet of paper.

Figure 1: An example of a transect walk chart



Source: Aroga 2006

2. Historical profile: This is another informal survey used and involves developing a chronological time line of events that have occurred in the village and/or group. The historical profile allows the farmers to reflect back to the past and recall events that have significant impacts on the group and the community. Furthermore, historical

profile allows the farmers to realise the lost opportunities or gains made over the years. In doing the group is encouraged to be positive about the future. Old people are encouraged to participate as they are able to recall most of the events that took place in the village. The main information that must be noted are: introduction of coffee, church, schools, health services, infrastructure, first contact by foreigners, etc. Positive and negative implications of all the events that had happened are highlighted. Farmers are encouraged to express their views to address the negative implications. The EOs facilitate the session so that it is interactive and informative. Information generated is recorded on a big sheet of paper and a group member presents it to the group for verification before accepting it as a true record. Figure 2 is an example of a historical profile.

Figure (iii): An example of a historical profile

2000	ATTENDED YANGPELA DIDIMAN WOKABAUT SCHOOL	- ESTABLISHMENT OF WARUP PEOPLE'S ASSOCIATION - GAINED GENERAL AGRICULTURAL KNOWLEDGE
2001	FIRST GROUP COFFEE SALES	- RECEIVED BETTER PRICES - ESTABLISHED RELATIONSHIP WITH CIC
2002	ESTABLISHMENT WARUP PEOPLE'S ASSOCIATION	- CORPORATION AMONG GROUP MEMBERS - INCREASE IN MEMBERSHIP & GROUP MORALE - GROUP MARKET IN LARGE QUANTITIES
2003	- CONSTRUCTION OF SOLDP BRIDGE + TINIBI TO NIMARA ROAD - - 1 st SALES OF 340 BAGS OF GREEN BEAN UNDER WARUP ASSOCIATION	- EASY ACCESSIBILITY OF GOODS AND SERVICES - ENCOURAGEMENT OF SMALL BUSINESS ACTIVITIES - BETTER CASH RETURNS - IMPROVE CASH FLOW IN THE COMMUNITY
2004	- 2 nd SALES OF 100 BAGS OF PARCHMENT UNDER WARUP ASS. - RECEIVED COFFEE QUALITY CONTROL TRAINING FUNDED BY SSCF.	- RECEIVED INCREASED PRICES - GROWER MORALE BOOSTED - ABLE TO MEET SCHOOL FEES - LEARNED THE BASIC STEPS ABOUT COFFEE QUALITY CONTROL - TRAINED FARMERS ARE ABLE TO ON TRAIN OTHER FARMERS IN THE COMMUNITY
2005	- ESTABLISHMENT OF WATER SUPPLY BY ADRA. - VANILLA TRAINING BY LDS - CONDUCTING OF PRAP BY CIC	- CLEAN WATER AVAILABLE IN THE VILLAGE - REDUCE STRESS ON MOTHERS & CHILDREN - IMPROVE HEALTH AND HYGIENE - BETTER KNOWLEDGE ON VANILLA HUSBANDRY POST HARVEST TECHNIQUES - PENDING

Source: Aroga, 2006

3. Venn diagram: This involves use of varying sizes and colours of circles to indicate relationships of the groups and surrounding organisations and/or individuals. Males and female members of the group are given equal opportunity to draw a Venn diagram. Each group is given three different types of coloured cards with three different sizes. The colours have meaning and example: a red coloured card would mean organisation(s)/individual is a threat to the group. White coloured cards would represent the organisation(s)/individual is friendly, while green coloured cards would

farmers are told to fill in the table. The amount of time spent on each activity is clearly stated and the benefits as a result of investing the resources. The farmers also highlight the dates and activities labour is most intensive and part of the year economical activities are high. Positive and negative implications of inputs and outcomes are also recorded. When the survey is completed, a representative from each gender group presents the work to the audience before the report is taken as a true record. Figure 4 is an example of a seasonal activity calendar.

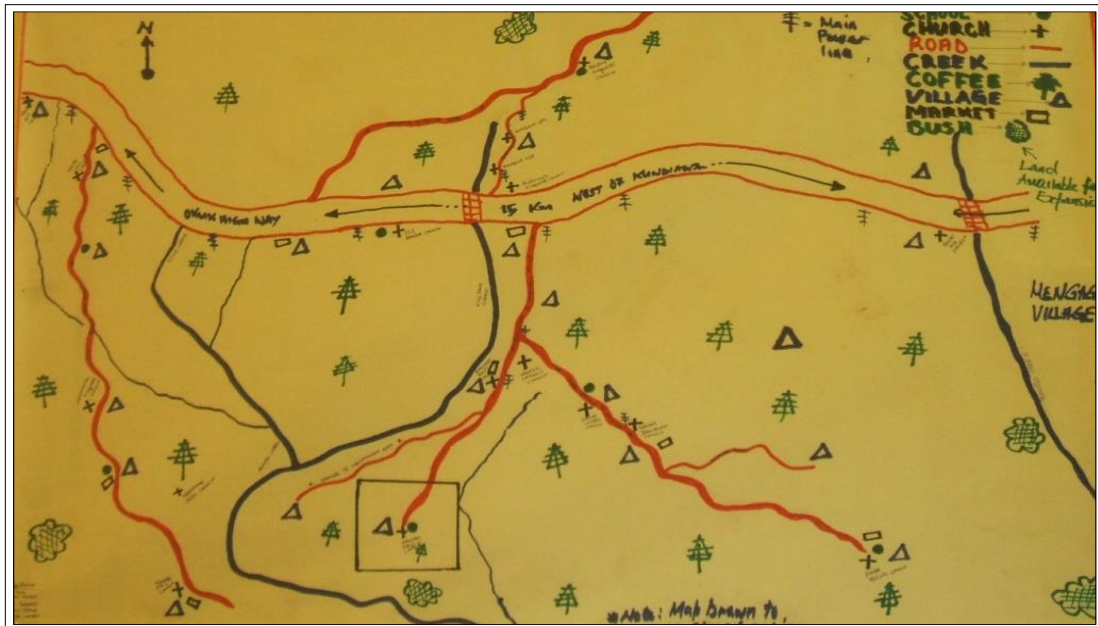
Figure 4: Seasonal activity calendar

MONTH	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC
WEATHER				▷						▷		
ACTIVITY												
GENERAL GARDENING				▷ ALL YEAR AROUND								▷
NEW GARDEN	BUSH CLEARING AND PLANTING			LEFT TO DRY	WEEDING	HARVESTING						▷
HOUSEHOLD DUTIES	EVERY MORNING AND AFTERNOON											
COFFEE ACTIVITIES	WEEDING			HARVESTING + PROCESSING			COFFEE DRY		COFFEE SELLING			
MARKET	VEGETABLE SALES					TABACCO SALES		BETELNUT SALES				
COMMUNITY WORK	MONDAY		WEDNESDAY, FRIDAY	ALL YEAR AROUND								▷
YAM PLANTING	WEEDING + STACKING		LEFT TO MATURE		HARVESTING	BUSH CLEARING	BURNING	▷			WEEDING STAGING	
PROGRAMME CHURCH CAMP			WORLD PRAYER DAY	EASTER CAMP	MAYDAY YOUTH GATHERING		DISTRICT CONFER.			PARTIAL CONFERENCE	CHRISTMAS LOTU	
GENERAL CHURCH ACTIVITIES	SUNDAY, TUESDAY		LOTU	SATURDAY WORK		ALL YEAR AROUND						
SOCIAL ACTIVITIES				EASTER GAMES				INDEP CELL	MORRIS STROG		CHURCH CLEVER	
VANILLA												
CASH FLOW	LOW					HIGH			MEDIUM			
LABOUR DEMAN	HIGH											▷

Source: Aroga 2006

5. Village map - A drawing symbolically showing external features of the village and its surrounding community. It shows the location of the village and also compliments the transect walk by clearly indicating the coffee tree, food gardens, rivers, sea, forest, mountains, schools, health centres, churches, infrastructure, government stations, and other features. The farmers are given the opportunity to indicate natural resources which are useful for development. After completing the village map (Figure 5), the participants are asked to explain positive and negative implications that can be identified on the map. Before accepting the map as a true record, a group member presents the map.

Figure 5: Village map



Source: Aroga, 2006

6. SWOT analysis – This is the core of the PRAP and is used to assess **Strength**, **Weakness**, **Opportunity** and **Threats** of the group. SWOT identifies the external and internal factors that favour or impede progress of the group. Items under strengths and opportunities are categorised helpful while items under weaknesses and threats are categorised harmful. Strengths are internal attributes within the group which can be used to progress the group. Examples of strengths are coffee trees, other cash crops, food gardens, livestock, family labour, land, forest, clean water, etc. Weaknesses are internal attributes of the group which may impede progress. Examples of weakness are weak group leadership, lack of cooperation from members, laziness, poor time management, carelessness in managing resources, tribal fights, compensation payments, cultivation and consumption of marijuana etc. Opportunities are external attributes which are helpful to the farmers. Examples are road, airstrips, wharfs, coffee buyers, agricultural stores, banks, donors, government funding, NGOs etc. Threats are external attributes that can impede group progress. Examples are enemy tribe, disease outbreak, natural disasters, law & order issues, poor leadership in the group etc. The farmers list all their strengths, weakness, opportunities and threats using a matrix table (Table 1).

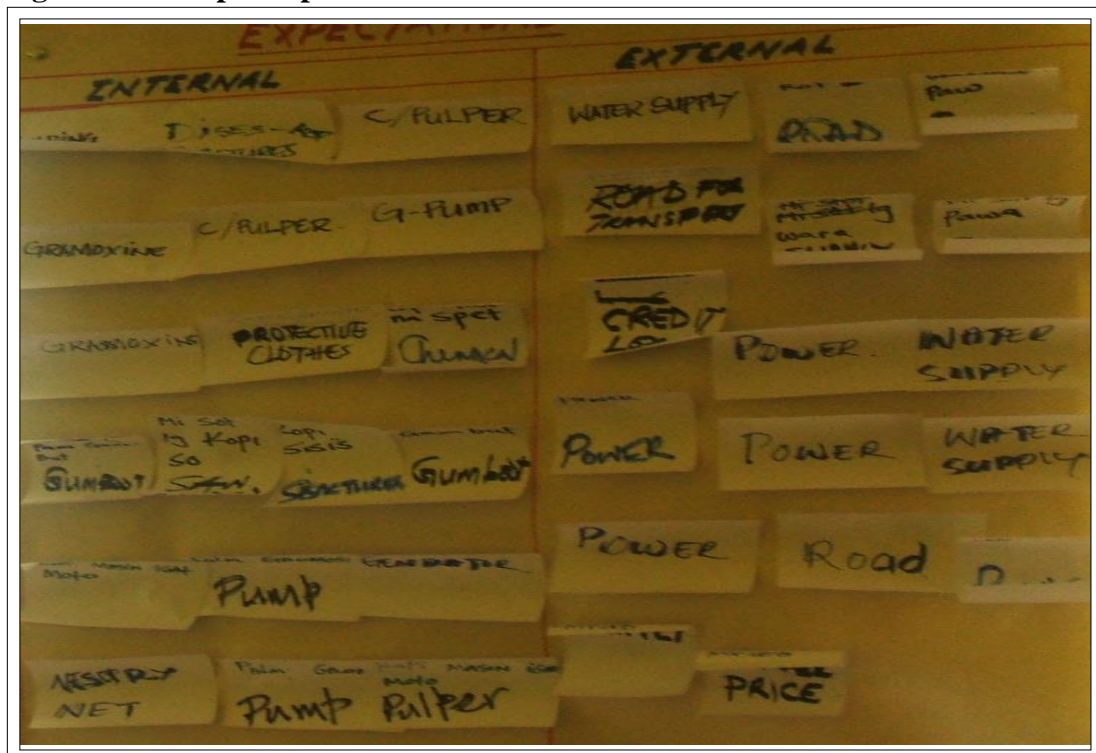
Table (1): SWOT matrix table

Internal strengths	Internal weakness
S	W
External opportunities	External threats
O	T

Source: Aroga, 2006

7. Problem identification: The farmers are told the weaknesses and threats identified in the SWOT are problems. These problems are written on pieces of paper and explained to the farmers. The farmers are asked to discuss negative implications the problems could have on the group. The problems are listed under two categories: internal and external. The farmers are told, internal problems will be addressed by themselves while the external problems will be addressed by external partners such as the CIC. Figure 6 is an example of problem identification.

Figure 6: Example of problem identification in PRAP



Source: Aroga, 2006

8. Problem voting, ranking, and prioritising: From the list of problems identified in the under the threat and weakness in the SWOT, the farmer prioritise the problems by democratically voting on the issues. To avoid bias, the farmers are divided into male and female. In the gender groups, farmers vote independently. Each problem is clearly written out on a piece of paper and displayed clearly. Under each problem, containers are placed so that the farmers could place their votes. Illiterate farmers are assisted by literate members. Each farmer is given 10 dices (stones, sticks, beans etc) and to cast votes for only four problems which are most important to them. The farmers are told to cast 4 dices for the very serious problem, 3 dices to the most serious problem, 2 to the next serious problem and 1 to the least serious problem. Females vote first followed by the males. After the votes, the dices under each problem are counted and recorded. The votes from the male and females for each problem are totalled and the figures made known to the group. The farmers accept the results as fair and reflect the thoughts of the farmers. The farmers are asked to prioritise the group's problems by ranking starting with the problem with highest number of votes as problem number 1 and so on. Figure 7 shows female farmers participating in a voting session. Problem voting and ranking is done for both the internal and external problems separately as indicated in Figure 8.

Figure 7: Female farmers casting votes



Source: Aroga 2006

Figure 8: Results of problem voting session in PRAP

NO. *	INTERNAL PROBLEMS	NUMBER OF VOTES			RANK
		MALE	FEMALE	TOTAL	
1	Gambling	32	10	42	5
2	Drugs	23	20	43	4
3	Alcohol	21	6	27	7
4	Stealing	146	40	186	1
5	Time Management	86	26	112	2
6	Low level of Literacy	38	0	38	6
7	Poor Financial Management	59	9	68	3
8	Low Cooperation level	10	11	21	8
9	Jealousy	13	3	16	9
10	Incompetency	6	7	13	10
11	Tools and Equipment	6	0	6	11
12	Nursery	3	0	3	12
13	Road Maintenance	18	9	27	7

NO. *	EXTERNAL PROBLEMS	NUMBER OF VOTES			RANK
		MALE	FEMALE	TOTAL	
1	Poor Coffee Quality (Knowledge)	65	1	66	4
2	Electricity (Main Power line)	5	17	22	5
3	Health Service	0	0	0	8
4	Unfavourable Coffee Price	77	22	99	3
5	Central Wet Mill	171	61	232	1
6	Coffee Husbandry	16	2	18	6
7	Intermediate Transport	112	39	151	2
8	Water Supply	4	8	12	7

Source: Aroga, 2006.

9. Action plans: This involves developing a work program basing on the problems identified. The farmers are responsible for developing internal work program while the CIC officers develop the external work program to address the internal and external problems respectively. Each work programs must have milestone with specific objectives and accomplishment dates. The CIC officers ensure the internal action plans are implemented by the farmers during the extension patrols.

10. Reporting: The final step in the PRAP process is compiling a report by the EOs for the PEC for screening. An approved PRAP report becomes an official and public document for the group. Each of the external problems is regarded as projects. All coffee related problems become the CIC's extension priority projects while the other problems beyond the scope of the CIC are referred to appropriate organisations.

A2.6 Project tendering and bidding

The PEC screens the PRAP report and summarises coffee problems. In most cases, coffee problems are technical in nature and trainings are considered to address the problems. In consultation with the provincial CIC offices, the PEC develops Terms of Reference, tentative training schedule, and a budget. Thereafter, the projects are advertised through local notice board, radio and word of mouth. The tenders are

screened by the provincial CIC office short listed candidates are submitted to the PEC for further deliberations. The PEC then notifies the successful bidders through the provincial CIC offices.

The bidders are usually retired CIC, DAL, unemployed agricultural graduates and experienced coffee farmers. A data base of the bidders is created for future contracts.

A2.7 Project implementation and supervision

Project implementation concerns how the CIC addresses the problems identified in the PRAP report. For coffee training, contract milestones are identified: (1) TNA survey; (2) program development; (3) training delivery; (4) reporting; (5) payments, and (6) conclusion. These procedures are detailed.

1) TNA survey – The first milestone is the TNA. A TNA is a pre-training survey conducted to identify the innovation gap of the farmers prior to developing a training program. During the TNA, the TPs would ask questions and making ocular observation of the coffee gardens.

2) Training program- A training program is developed thereafter and submitted the CIC provincial office. Recently, the CIC has standardised the coffee training materials.

3) Training delivery: Trainings are delivered and include theory and practical. Anecdotal evidence indicates that under PNG conditions, farmers learn effectively through hands on experience. Therefore the TPs are encouraged to allocate 60% of the training time for practical sessions.

4) Milestone reports- The TPs compiles a training report to the PEC. The report covers farmer attendance, attitudes towards acquisition of innovations, impediments. The EOs and group leaders write independent evaluation reports about the farmers and the TPs.

5) Payment: If the PEC is satisfied with the reports, payments are released to the TPs.

6) Project conclusion- A project can last a year, depending on the nature of the problem. Certificate of attendance are issued to the farmers to conclude the projects.

A2.8 Advantages and disadvantages of FDDE

The FDDE promotes group mobilization and reduces extension administrative costs. However, the extension process is long and requires a readily-available funding. Table 2 gives the advantages and disadvantages.

Table 2: Advantages and disadvantages of the FDD-PRAP

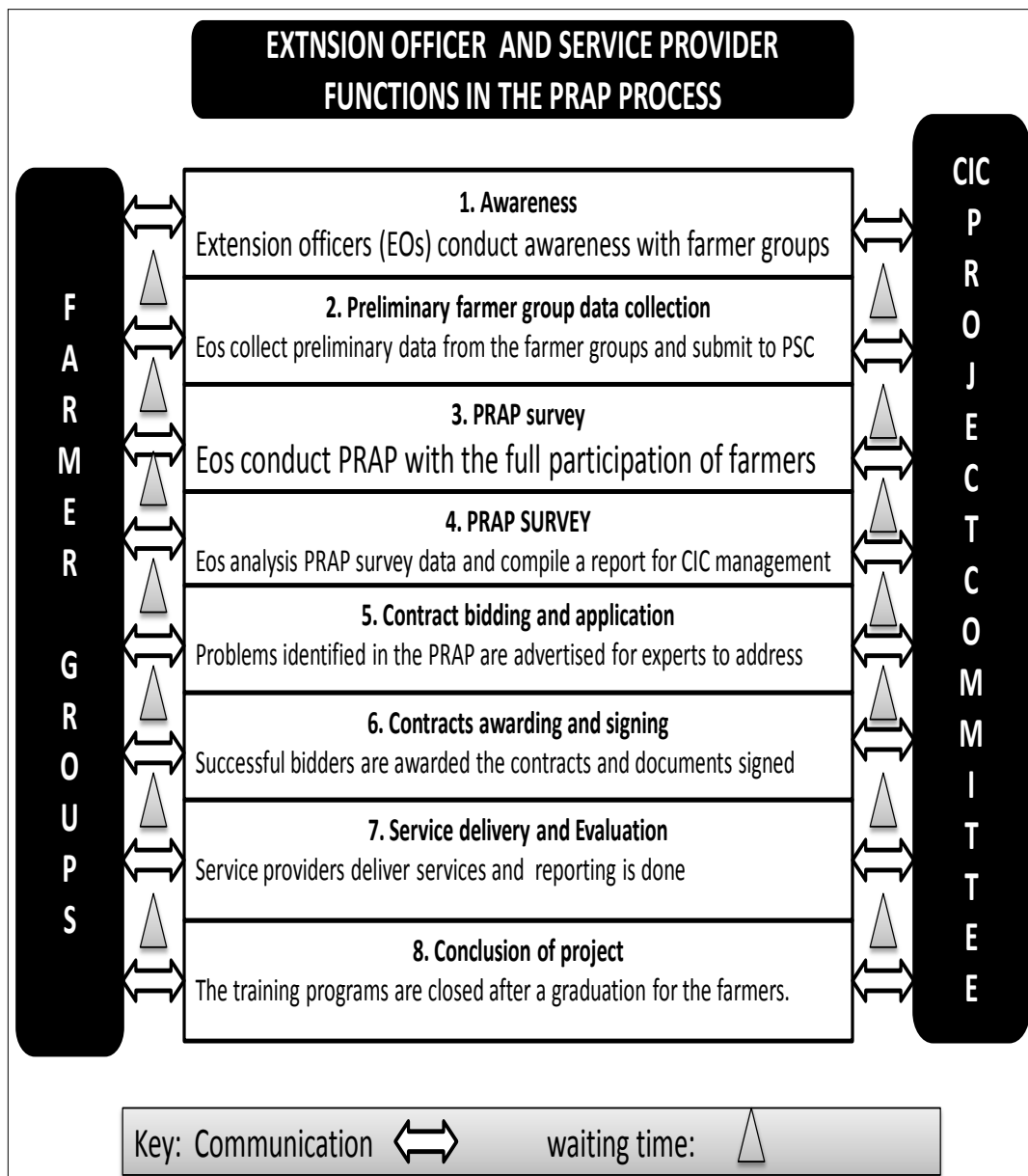
Advantages	Disadvantages
Promotes farmer mobilization	The process is too long and frustrating
Reduces farmer: EOs ratio. Farmer groups rather than individuals	Individual farmers may not get extension services specific to their needs
Promotes identification and ownership of collective problems	Good leadership is critical for group cohesiveness
Reduction in unmonitored administrative and operational costs	TPs may quit in the middle of the contract, resulting in loss of time
Programs are measurable and accountable	Dishonouring of contract documents may result in legal battle
Promotes farmer entrepreneurship	Continual CIC support is required: cost
Coffee quality, quantity and consistency are addressed	Farmers are price response

Source: Author's experience

A2.9 FDDE Summary

The eight major steps in the FDDE are summarised in Figure 8. The steps are awareness, bio-data collection, PRAP survey, PRAP survey reporting, contract advertising, contract awarding, contract delivery and evaluation, and project conclusion. The communication channel and the waiting periods are included.

Figure 8: Summary of FDDE approach



Source: Author's experiences

Appendix 3: Sample agronomy questionnaires and quizzes

Sample Questionnaire of Agronomy: English Version

REHABILITATION TRAINING SURVEY QUESTIONNAIRE

Impact Assessment: Smallholder Coffee Agronomy and Postharvest Trainings in the Highlands of Papua New Guinea.

Good morning to you all. My name is Mr. Leo Aroga, and I am a Training Officer with the Coffee Industry Corporation (CIC) but currently studying at the Curtin University of Technology, Western Australia. I am pleased to see you all thank you for coming. I am told by our extension officer [name] that you have been informed of the purpose of this meeting. For the benefit of the few who may not be aware, let me clarify the purpose of this meeting.

I am conducting a research and it is about evaluating the Rehabilitation training that was conducted by the CIC through the Farmer Demand Driven Extension program. The aim of this study is to find out whether you have taken part in the training have learnt the important concepts in Rehabilitation. The study further aims to find out whether you are implementing the knowledge and skills, and if not, what are the obstacles preventing you.

Your group is part of the training program. Your group was chosen because you have completed the Rehabilitation training. Furthermore you were chosen among the other members of your group because you have volunteered to take part in this survey. I am very grateful of your decision. There has never been a study conducted by the CIC to assess the impact of the training on the coffee farmers in PNG. Therefore this study will be the first. You are special as you will share important information which the CIC will use to improve the training program.

Your identity will be strictly confidential and the information you provide will NOT be used in any way that will embarrass or bring emotional discomfort to you, your group and/or your associates. False names will be used if and when the information you provide need publication. Your involvement in this study is totally VOLUNTARY and you have the right NOT to take part in this research. Even if you are already into answering the questions but decide to change your mind not to continue, you can feel free to withdraw at any time. Furthermore, if you feel uncomfortable to answer any question, please feel free to express your concerns and request your interviewer to ignore that question and move on with the other questions. However, if you want your information to be processed and used by the CIC, you are recommended to complete the survey as incomplete surveys will not be used.

There are 3 components to this research: face-to-face interview and short quiz. Details of each component will be explained during the sessions. All the components will take approximately 3-4 hours. The extension officer will bring around copies of this paper which I have just read. If you still want to be part of this survey, please sign this paper and we can begin the survey. Farmers who participate and COMPLETE ALL of the research activities will be provide a cut lunch and a cash incentive of K10.00 each. If you want to participate, please sign below.

- a) I WANT TO take part in this research
- b) I wish to WITHDRAW from this research

Participant signature:.....Date:/...../.....

REHABILITATION QUESTIONNAIRE – FACE-TO-FACE INTERVIEW

Instruction to the interviewer:

Each interviewer and the farmer group will be given different ID numbers. The ID numbers, the name of the province, the village name, and the date on which this survey is conducted must be completed before starting the survey. This is very important.

Each interviewer will interview about 5-6 farmers and therefore will take two hours will be required to complete the entire questionnaire. The interviewer must read and explain very carefully each question to the farmer. The interviewer must then record on the questionnaire sheet the farmer's responses for each question. Once the first farmer is completed, the next farmer must be interviewed immediately using the same procedure until all the 5-6 farmers have been completely interviewed.

*How to execute the questionnaire is self explanatory as all the instructions are given. However, the following must be noted: instructions for the interviewer are written in italic within a closed bracket []. Statements and/or questions the interviewer will be asking the farmer are written in **bold** with an open & closed exclamation mark (""). It is very important to ask the questions very carefully without altering them. Farmer responses must be carefully recorded. The interviewer must not introduce his/her opinion while asking the questions or while recording the farmer's responses. If this is done, bias will be introduced which will affect the results.*

We will also go through the questionnaire thoroughly so that you are completely familiar with the questions and the questionnaire layout. During the interview, the farmers and/or the interviewers may raise issues that may need immediate explanation from the researcher. For this reason, the researcher will not interview the farmers but instead will closely supervise the interviewer.

There are 4 parts to this questionnaire and they are as follows:

Part A: Training Need Assessment (TNA)

This section aims to find out whether a TNA survey has been conducted. If no TNA survey had been conducted for the group, Part A will automatically be skipped and continued with Part B. If however, TNA had been conducted, the main purpose of the TNA must be explained to the farmer and proceed with asking the questions.

Part B: Actual Training Session Assessment

This section has three main areas to be assessed: (i) training aids (ii) training topics and, (iii) training methods. Training aids aims to assess how helpful the aids were in facilitating farmer learning. Questions on the training topics and the training methods aim to assess how useful the topics and the methods were in terms of helping the farmers to address their problems in coffee Rehabilitation.

Part C: Implementation of Knowledge & Skills Assessment

This section has 3 main areas of assessment: (i) assessing whether farmers are implementing the knowledge & skills (ii) assessing factors preventing implementation of the knowledge & skills and (iii) Assessing farmers' current Rehabilitation practices.

Part D: Farmer background information.

This section aims to collect the farmer's basic demographic information.

REHABILITATION TRAINING SURVEY QUESTIONNAIRE.

Province:.....Place:.....Date:

Farmer ID: Group ID: Recorder ID:.....

Introduction:

[Briefly introduce yourself, parts of this survey, time required to complete the survey and the rights of the farmer in taking part in this survey].

“Good morning. My name is..... “[give your name]. “I am sure that you are aware of the purpose of this survey and also your rights to participant. Before we start, let me explain what is expected in this survey. This survey will take approximately 20 minutes. There are 4 parts to this survey:

Part A: Training Need Analysis Assessment

Part B: Training Session Assessment

Part C: Assessment of Knowledge & Skills Implementation

Part D: Farmer Background Information.

I will explain carefully the purpose of each part of the survey when we come to each section in the questionnaire”.

[Allow the farmer to ask questions if any. If you get any questions that are difficult to answer, please inform the researcher. If there are no issues to address, please proceed with the questionnaire].

“Before we begin with Part A, any questions?” *[If no questions, start with Part A].*

PART A: TRAINING NEED ASSESSMENT

“The first part of this survey is assessing the Training Need Assessment. Before conducting the Rehabilitation training, your trainer may have conducted a TNA. The TNA is a survey which the CIC has asked the trainer to conduct before actually conducting the Rehabilitation training. During the TNA, the trainer may have asked the farmers about their problems in Rehabilitation. Rehabilitation training programs may also have been discussed taking into account the farmers’ social and day-to-day activities. Basing on this information, the trainer may have gone ahead with planning the training program. The answers you will be providing to the TNA questions will be based on your experiences during the TNA survey”.

“Let’s begin with our first question”.

Q1. “Was there a TNA survey conducted for your group? Please select only one option from the possible answers which I will read out”. *[Read aloud the options given below and circle the option identified by the farmer. Then follow the instruction given per the option selected].*

- a) **“Yes”**..... *[If the answer is yes, please go to Q2]*
- b) **“I am not sure”**..... *[If the answer is not sure, please go to Q3]*
- c) **“No”**..... *[If the answer is no, please go to Q3]*

Q2. “Did you take part in the TNA survey?” *[Read aloud the options given below and circle the option identified by the farmer. Then follow the instruction given per the option selected].*

- a) **No**..... *[If the answer is no, please go to Q3 – Part B].*
- b) **Yes**..... *[If the answer is yes, ask the farmer the questions below].*

I will explain some TNA approaches which the trainer may have used to collect information in order to plan the Rehabilitation training. After that, few questions on each approach will be asked. [Explain the TNA approaches given in the table below and ask the questions that follow]:

Was this method.....used by the trainer?"
[Mention name of the TNA approach (i) given in the table below] [Circle farmer's answer in table (ii)]

- a) **No...** *[If no, repeat the question above for the next TNA approach given in the table (i)]*
- b) **Yes...** *[If yes, circle 'yes' in the table (ii)].... and ask the questions given below]:*

On a scale of 1-5 where 1 is..... [Explain the rating scale]:

1= very useful, 2 = useful, 3 = fairly useful, 4 = slightly useful, 5 = not useful

"How useful was the ... in helping you to contribute positively to the planning of the training?"
[Mention TNA method in the table (i) and circle the response in the table (iii)]

"What is your reason for giving this rating to?"

(i) Rehabilitation TNA approaches	(ii) Used	(iii) Rating #	(iv) Main reason
Group discussion: This refers to the trainer facilitating a group discussion to investigate farmers' problems in rehabilitation and their expectations of the training program.	No		
	Yes		
Short quiz: This refers to the trainer asking the farmers few questions either orally or written to understand the farmers' level of knowledge in Rehabilitation techniques.	No		
	Yes		
Social activity calendar: This refers to the trainer seeking information in relation to the farmers' major activities and events which may interfere with the training program.	No		
	Yes		
Farm observation: This refers to the trainer randomly visiting the farmers' coffee gardens to assess the application of Rehabilitation techniques in their coffee.	No		
	Yes		

[Name the TNA approach and record farmer's reasons in the table (iv)]

PART B: ACTUAL TRAINING SESSION ASSESSMENT.

(Explain the aims and content of Part B as stated below).

“The second part of this survey is assessing the actual training sessions which you have attended. This section has three main areas to be assessed: (i) the training aids (ii) the training topics (iii) the training methods. The general aim of assessing the training aids, the training topics and the training methods is to find out how helpful they were in facilitating your learning”.

[Question 3 has two sub-questions. Read the main instruction to the farmer and ask the sub-questions. Record the responses from the farmer for each sub-question in the respective section in the table provided below].

“Let’s start with the training aids. I will mention one-by-one the names of the Rehabilitation training aids which may have been used by the trainer during the training. For EACH of the training aids mentioned, please answer the following questions: [Mention names of training aids given in the table (i) below]

Q3. “Were..... us ed?”

[Name of training aid given in the table (i) below. Repeat same question for the 7 training aids]

a) **“No.....”** *[If no, circle ‘no’ in the table (ii) and repeat above question for the next training aid]*

b) **“Yes.....”** *[If yes, circle ‘yes’ in the table (ii) and ask the questions given below]:*

“On a scale of 1 – 5, where 1.....” *[Explain rating scale]:*

1 = very helpful 2 = helpful 3 = fairly helpful 4 = slightly helpful 5 = not helpful

How helpful was the..... in helping you to learn more about Rehabilitation?”

[Mention and explain the training aids given in the table (i). Record the rating value in table (iii)]

“What is your main reason for giving this rating?” *[Record farmer’s response in the table (iv)]*

[Repeat the same procedure for all the 7 training aids mentioned in the table below].

(i) Training aids	(ii) Used?	(iii) Rating #	(iv) Main reasons for rating
Rehabilitation handouts	No/Yes		
Rehabilitation posters	No/Yes		
Pesticide posters	No/Yes		
Pest & disease Poster	No/Yes		
Knapsack sprayer & parts	No/Yes		
Pruning saw	No/Yes		
Secateurs	No/Yes		

[Question 4 has two sub-questions. Read the instructions of the question to the farmer and then ask the sub-question. Record the farmer’s response for each sub-question in the respective section of the table provided below].

Q4. “Were other Rehabilitation training aids used apart from those we have just discussed?”

[Circle farmer’s response with only one of the options given below].

a) No..... *[If the answer is no, please go to Q5]*

b) Yes..... *[If the answer is yes, ask the farmer the following questions]:*

“Please name and/or briefly describe the other training aids used?” [Record the farmer’s responses in the table (i)].

“On a rating scale of 1 – 5 where 1 is [Explain the rating scale]:

1= very helpful 2= helpful 3= fairly helpful 4 = slightly helpful 5 = not helpful

“How helpful was.....in helping you to learn more about Rehabilitation?”
[Mention the ‘other’ training aid described by the farmer][Record the rating value in table (ii)]

“What is your main reason for giving this rating?” [Record farmer’s response in the table (iii)]

[Repeat steps b) ii and b) iii) for all the other training aids named].

(i) Other Training aids	(ii) Rating #	(iii) Main reason for rating

[This question aims to assess the training topics given in the table below. Read the main instruction of Q5 to the farmer and then ask the questions. In the appropriate sections of the table below record the farmer’s responses].

“Let’s look at the training topics. I will mention names of the training topics which may have been covered during the Rehabilitation training. I will read and explain each one of them one-at-a-time and then will ask few questions for you to answer”. [Name and explain the training topic given in the table below and then ask the questions below].

Q5. “Was covered during the Rehabilitation training?” [Name of the topic given in the table (i)] [Circle farmer’s response in the table (ii)]

a) **“No,.....”** [If no, ask again the above question for the next training topic].

b) **“Yes,.....”** [If yes, explain the rating scale and ask the questions that follow]:

“On a scale of 1 – 5, where 1 is..... [Explain the rating]:

1= very useful 2= useful 3= fairly useful 4 = slightly useful 5 = not useful

How useful was the.....in helping you learn more about Rehabilitation techniques?”
[Name the training topic given in the table (i)] [Record the rating in table (iii)]

“What is your main reason for giving this rating?” [Record farmer’s response in the table (iv)]

(i) Training Topics	(ii) Covered	(iii) Rating	(iv) <u>Main</u> reason for rating
“Pruning: This may have included; advantages & disadvantages of pruning, types and timing of pruning, tree density per hectare and/or root stock and sucker section”.	No Yes		
“Shade: This may have included; reasons for shade control, shade management, advantages & disadvantages of shading, and types of shade”.	No Yes		
“Fencing: This may have included; importance of fencing and types of fences”.	No Yes		
“Drainage: This may have included; factors of drainage, drains for different soil types, and marking drains”.	No Yes		
“Nutrition: This may have included; sources & types of fertilizers, importance of fertilizer, fertilizer application methods, and common nutrition deficiency symptoms”.	No Yes		
“Pests & disease: This may have included; common pests & diseases such as Coffee Leaf Rust, Pink disease, and Green scale”.	No Yes		
Weed control: This may have included; facts about weeds, effects of weeds on coffee, and method of weed control”.	No Yes		
Coffee calendar: This may have included’ Defining coffee calendar, the coffee cycle, management inputs into coffee calendar, and how to develop a simple coffee calendar”.	No Yes		

Q6. Were other Rehabilitation training topics covered during the training apart from the ones we have just discussed?” [Circle farmer’s response with only one of the options given below].

a) No..... [If the answer is no, please go to Q7]

b) Yes..... [If the answer is yes, ask the farmer the following leading questions]:

“Name and/or briefly describe the other Rehabilitation topics?” [Record farmer’s responses in the table (i)].

“On a rating scale of 1 – 5 where 1 is” [Explain the rating scale below]:

1= very useful 2=useful 3= fairly useful 4 = slightly useful 5 = not useful

“How useful was the.....in helping you to learn more about Rehabilitation techniques?”
[Mention name of ‘other’ training topic given by the farmer (i)] [Record rating of topic in the table (ii)]

“What is your main reason for giving this rating?” [Record farmer’s response in the table (iii)]

(i) Other training topics	(ii) Rating	(iii) <u>Main</u> reason for rating

[This question aims to assess the training methods (given in the table below) that may have been used by the trainer during the Rehabilitation training. Carefully read and explain the main instruction to the farmer and then ask the questions. Record the farmer’s responses in the appropriate section of the table given below].

“This question is about assessing the training methods that may have been used by the trainer during the training. I will mention names of some training methods and explain them one-by-one. After each training method, I will ask some questions”. [Name and explain one-at-a-time the training methods given in the table below and then ask the questions].

Q7. “Was this method.....used during the training?” [Name of the training method (i)] [Then circle farmer’s response in the table (ii)]

a) “No.....” [If no, ask again the above question for the next method given in the table (i)].

b) “Yes.....” [If the answer is yes, explain the rating scale & ask the questions that follow]:

“On a rating of 1-5 where 1 is’ [Explain the rating]:

1= very helpful 2= helpful 3= fairly helpful 4 =slightly helpful 5 = not helpful

How helpful was the.....in helping you to learn more about Rehabilitation?” [Mention & explain the training method given in the table (i). Record farmer’s rating in table (iii)]

“What is your main reason for giving this rating?” [Record farmer’s response in the table (iv)]

[Repeat all the steps above for all the 7 training methods].

(i) Training methods	(ii) Used?	(iii) Rating	(iv) Reason for rating
“ Lecture is when the trainer explains new and/or difficult concepts. The trainer does most of the talking while the farmers only listen without much contribution”.	No Yes		
“ Small group discussion is where the farmers discuss important concepts relating to the topic (s) in small groups. Farmers may presentation their discussions and share experience to the whole class”.	No Yes		
“ Question & answer session is when farmers raise questions and the answers are either provided by the farmers or by the trainer based on their experiences”.	No Yes		
“ Demonstration is presentation of a prepared task. It involves the trainer showing farmers certain procedures and the farmers repeat the trainer’s action in a step-by-step approach. (E.g. pruning steps)”.	No Yes		
“ Field trip is a visit to a coffee plantation or a model farmer’s coffee to observe important aspects of coffee farming”.	No Yes		
“ Expert’s input is when experienced coffee farmers and/or specialists are brought in to explain important concepts to re-enforce what the farmers are learning”.	No Yes		
“ Follow-up is where the trainer visits the farmer(s) after the training to provide additional technical assistance on the field”.	No Yes		

PART C: APPLICATION OF THE ACQUIRED KNOWLEDGE AND SKILLS.

[There are three areas to be evaluated in this section: rehabilitation knowledge & skills application; factors preventing application of rehabilitation techniques; and farmer's current ways of coffee farming. Evaluation of knowledge & skills application aims to assess whether the farmers are applying the recommended rehabilitation techniques. Factors preventing implementation of knowledge and skills aims to assess the constraints that may prevent farmers from applying the techniques. Evaluating farmers' current ways of coffee farming aims to assess farmer's current ways of rehabilitation and the reasons behind applying these practices].

“This section is about assessing whether you are applying the Rehabilitation techniques. Questions will be asked on three main areas and I will explain these areas as we go through the questions. I will name and explain 6 main Rehabilitation techniques which may have been covered during the Rehabilitation training. After that, I will ask you some questions”. [Explain one-at-time the Rehabilitation techniques given in the table below and then ask the questions]:

Q8. “Are you applying this technique..... in your coffee? [Name of Rehabilitation technique given in the table (i) below] [Circle farmer's response in the table (ii)]

- a) **“No....” [If no, ask] “What is your MAIN reason for NOT applying?”**
 [Name of Rehabilitation technique (i)][Record response in table (iv)]
- b) **“Yes.....” [If the answer is yes, explain the rating scale below & ask the questions that follow]:**

On a scale of 1-5 where 1 is” [Explain the rating scale]:

1= very confident 2=confident 3= fairly confident 4 =slightly confident 5= not confident

“How confident are you in applying?”[Name of Rehabilitation technique (i)][Record response in table (iii)]

“What is your main reason giving this rating?” [Record farmer's response in the table (iv)]

[Repeat the whole procedure for all the Rehabilitation techniques given in the table below]

(i) Important Rehabilitation technique	(ii) Applying No Yes	(iii) Rating	(iv)Reason for not applying /or for rating
“Pruning technique is knowing when to do recycle pruning, deciding how many trees /hectare and/or uprights/ stem”.	No Yes		
Pest/disease control is identifying coffee pests & diseases and applying appropriate control measures.	No Yes		
Shade control is identifying shade problems & applying appropriate control measures.	No Yes		
Drainage control is identifying problems associated with water logging and applying recommended drainage spacing	No Yes		
Weed control is identifying impact of weeds on coffee and applying appropriate weed control methods.	No Yes		
Coffee calendar is understanding the coffee crop cycle and planning coffee farming activities per crop cycle.	No Yes		

[This question aims to assess the seriousness of assumed problems that may prevent the farmers from applying the Rehabilitation techniques. Explain the questions below and write the farmer's responses in the table provided].

“Farmers are often prevented from applying the Rehabilitation techniques. Most of the problems are often external which the farmers have no control over. I will mention some external issues which are assumed to prevent application of knowledge & skills. After each issue, I am going to ask you some questions. [Explain one-at-a-time the problems given in the table below].

Q9. On rating scale of 1 -5 where 1 is..... [Explain rating]

1 = very serious 2 = serious 3 = fairly serious 4 = slightly serious 5 = not serious

“How serious is this problem..... to you?” [Mention the problems given in the table below][Circle farmer's answer with the rating given in the table]

[Repeat the procedure until all the problems given in the table are completed]

Assumed problems	very serious	serious	fairly serious	slightly serious	not serious
I do not have the proper pruning tools and this affects me from implementing the pruning techniques	1	2	3	4	5
I do not have the proper chemicals and knapsack and this affects me in controlling the pests & diseases.	1	2	3	4	5
The road system is so bad and this discourages me from implement the rehabilitation techniques in my coffee.	1	2	3	4	5
The price of coffee is so low that I am discouraged from putting in resources needed to produce quality coffee.	1	2	3	4	5
There is lack of incentive such as better price for quality and this discourages me from applying the skills.	1	2	3	4	5
I do not have enough money to buy tools & equipment. This makes it difficult for me to apply the techniques.	1	2	3	4	5
The knowledge and skills I have learnt during the Rehabilitation training were too technical and I do not fully understand them	1	2	3	4	5

Q10. “Are there other problems preventing you from applying the Rehabilitation techniques apart from those that I have just asked? [Circle farmer's response with only one of the options given below].

- a) **“No.....” [If the answer is no, please go to Q11]**
- b) **“Yes.....” [If the answer is yes, ask the farmer the following questions]:**

“Please name and/or describe the other problems”. [Record farmer's response in the table (i).

“Briefly describe the main reason..... preventing you from applying the techniques?”
[Mention the problem given by the farmer][Record farmer's reason in the table (ii)]

Name the other problems (i)	Main reason (ii)

Q11. “Before you attended the training on Rehabilitation, did you have any PROBLEMS which you were expecting the Rehabilitation training to address? [Circle only one response as given below].

- a) “**No**.....” [If the answer is no, please go to Q12]
 b) “**Yes**.....” [If the answer is yes, ask farmer the following questions]:

Please name and/or briefly describe your problems. [Record farmers answers in the table (i)]
On a scale of 1 – 5 where 1 is..... [explain rating scale]:

1= very satisfied 2=satisfied 3= fairly satisfied 4 = slightly satisfied 5= not satisfied

“How satisfied are you that your problem..... has been addressed by the training?
 (Mention problem given in the table (i) below). [Record farmer’s responses in the table (ii)]

“What is your main reason for giving this rating?” [Record farmers response in the table (iii)]
 [Repeat b) ii. and b) iii. for all the problems the farmer indicates]

(i) Problem & description	(ii) Rating #	(iii) Main reason for rating

On a scale of 1-5 where 1 is..... [Explain the rating scale]:

1= very high 2=high 3= fairly highly 4= slightly high 5= not high

“How would you recommend the Rehabilitation training to other farmers with similar rehabilitation problems?” [Record farmer’s responses in the table (i)]

“What is your main reason for rating your answer?” [Record farmer’s responses in the table (ii)]

Rating (i)	Main reason (ii)

[Farmers rehabilitate their coffee using methods that best work for them. Therefore this section aims to find out the farmer’s CURRENT ways of farming coffee and why he or she is using these methods. Ask the farmer one-at-a-time the questions given in the table (i) below. For each question asked, write its corresponding answers in section (ii) of the table. First read Q12 and explain to the farmer. When the farmer is familiar with the type of information you are after, proceed with the other sub-questions].

Q12. “Farmers do not always follow what the CIC or the trainer tells them about how to farm coffee. This is because, farmers have been farming coffee for a long time and they believe in what they are doing. This question aims to find out how you are currently farming your coffee and why you are doing. I will ask you 6 simple questions about the general rehabilitation practices. For each practice, you are to tell me what you are currently doing and why you are applying the technique. For each question, please provide only one main answer which you think is most important.

[Go through the Rehabilitation techniques]

(i) Questions on Rehabilitation techniques	(ii) Farmer's responses to question
"What are your common tools used for pruning coffee?" (That is bush knife, secateurs, saw)	"What is your main reason for <u>using</u> these tools?"
How do you do you recycle pruning?	Why do you do your recycle pruning like this?
How do you do your maintenance pruning?	Why doing maintenance pruning like this?
"What is your main method of controlling pests and diseases of coffee?" (Chemical?)	"What is your main reason for using this method of <u>pest & disease control</u> ?"
"What is your main method of shade control?" (Trimming, thinning, replanting,)	"What is your main reason for using this method?"
"What is your main method of drainage management?" (Slashing, maintenance,)	"What is your main reason for using this method of <u>drainage management</u> ?"
"What is your main method of weed <u>control</u> ?" (Slashing, spraying, cover crop)	"What is your main reason for using this method of <u>weed control</u> in your coffee?"
"What is your main method of planning your work program in coffee? (Coffee calendar,)	"What is your main reason for using this method to plan your coffee work program?"

PART D: FARMER BACK-GROUND INFORMATION

[This section is about collecting additional information from the farmer. Therefore it is very important that the questions are asked carefully and the answers are correctly recorded].

Q13. "For how many years have you been farming coffee?" [Record farmer's response]

Q14. "How many coffee trees do you have?" [Record farmer's response]

Q15. Are you increasing or planning to increase the number of coffee trees?" [Circle only one option]

- a) Increasing
- b) Planning to increase
- c) No

Q16. What is your highest level of formal education? [Match farmer's response with the category provided and circle only the correct category]

- a) I have NEVER gone to school
- b) Primary education level – (Grades 1 – 6)
- c) High school education level – (Grades 7 – 10)
- d) Senior high school educational level (Grades 11 - 12)
- e) Tertiary education level (vocational school, college and/or university)

Q17. "How old are you?" [If the farmer is not sure, ask him/her to make an estimate]

Q18. "Are there any other comments you would like to make about the Rehabilitation training?"

- a) *[If the answer is no, refer to Q19 and circle the gender of the farmer]*
- b) *[If the answer is yes, ask]...*

Would give me your comments? *[Record farmers response]*

.....

Q19. “Are you interested to know the result of this survey?” *[Circle only one option]*

- a) **Yes**
- b) **No**

Q20. *[What is the gender of the farmer you are interviewing? Please circle the option below]*

- a) **Male**
- b) **Female**

THE END OF SURVEY – *[Thank the farmer and remind him or her that it will take few minutes before we can move onto the next activity]*

Sample Agronomy Questionnaire: Tok Pisin

Gutpela monin tru . Mi Leo Aroga, Trening Ofisa bilong CIC. Nau mi skul long Curtin University long Australia. Mi hamamas tru na tenkyu long kam long dispela bung. Extensen ofisa (Mr..... [Name]) i bin tok save long yupela pinis long as bilong dispela bung. Mi mekim wanpela wok panimaut o 'research' makim wok extensen na treinin seksen bilong CIC. CIC i mekim wok extensen andinit long nuipela tingting, Fama Dimand Driven Extensen (FDDE). Wantaim halpim bilong ol sevis provaida (SP) CIC i bin skulim planti kopi fama group long kopi. Yupela tu i bin go insait long dispela skul pinis na nau mipela olgeta i kam bung long skelim olsem wanem dispela skul i halpim ol fama long kisim gut save. Tupela eria we planti fama i bin kisim skul long en em: (i) wok bilong lukautim gut kopi diwai na (ii) 'Postharvest' o wok bilong pikim, masinim, na draim gut kopi seri na pasmen. Mi klia olsem yupela bin kisim skul long Riabilitesen. Olsem na dispela 'survey' i laik panim aut yu lanim gut save bilong Riabilitesen o nogat. Dispela 'survey' bilong luksave olsem ol fama i lanim gut save bilong kopi Riabilitesen o nogat i kamap nambawan taim long nau na yu i wanpela bilong ol dispela nambawan kopi fama long sekelim dispela FDDE fama trening. Bikpela ol as tingting bilong dispela 'survey' long Kopi Riabilitesen skul em olsem CIC i laik luksave:

- 1) Ol fama bin lanim gut save bilong lukautim gut kopi insait long Kopi Riabilitesen skul o nogat?
- 2) Ol fama i bihanim o yusim ol dispela gutpela save bilong lukautim gut kopi diwai o nogat?
- 3) Ol fama i panim hevi long bihanim ol save ol i bin kisim long Kopi Riabilitesen skul o nogat?
- 4) Sapos ol fama i panim hevi, wanem ol hevi i stopim ol long yusim save bilong Riabilitesen?

CIC i makim yu long stap insait long dispela 'survey' long wanem: (i) Grup bilong yu i bin kisim pinis skul long Kopi Riabilitesen; (ii) CIC save olsem yu bin stap insait long dispela Kopi Riabilitesen trening; na (iii) CIC i save olsem yu igat laik long stap insait long dispela 'survey' long wanem yu bin tok olsem yu laik stap insait long dispela 'survey' taim ofisa i kam tok save olsem dispela 'survey' bai kamap. Ol tingting yu givim long dispela 'survey' em impotent tru, long wanem, ol dispela tingting bai halpim CIC long stretim kopi trening long PNG. Olsem na taim ol ofisa i askim long ol tingting bilong yu long Kopi Riabilitesen, yu mas tokaut stret. Lo bilong dispela 'survey' i tok klia olsem nogat wanpela man imas save long husait fama igivim ol dispela tingting. Olsem na yu i fri tru long givim olgeta tingting yu gat long Kopi Riabilitesen Trening. Sapos yu ino laik long stap insait long dispela 'survey', yu fri tru long lusim. Tasol sapos yu laik bai CIC i ken yusim ol tingting bilong yu long stretim gut wok kopi extensen, orait yu mas pinisim olgeta wok i kamap long dispela 'survey'. Dispela projek bai givim yu belo kaikai na K20.00 long wanwan fama husait i pinisim olgeta wok bilong survey. Dispela kaikai na moni em long tok tenkyu long taim bilong yu long stap insait long 'survey'. Sapos yu laik stap long dispela 'survey', orait yumi bai pinisim tri-pela wok: 1. 'Interview', 2. 'Quiz', 3. 'Dartboard'. Mi bai kliaim as tingting bilong ol dispela wok bihain. Dispela wok 'survey' bai kisim klostu 4 -pela hauwa. Sapos yu hamamas long stap insait long dispela 'survey', orait yu mas sainim wanpela pepa we ofisa bai kisim raun.

- a) Mi laik stap insait long dispela "survey"
- b) Mi laik pulaut long dispela "survey".

Signature: Date:/...../09

REHABILITATION QUESTIONNAIRE – FACE-TO-FACE INTERVIEW

Instruction to the interviewer:

Each interviewer and the farmer group will be given different ID numbers. The ID numbers, the name of the province, the village name, and the date on which this survey is conducted must be completed before starting the survey. This is very important.

Each interviewer will interview about 5-6 farmers in total. To complete the face-to-face interview with the 5-6 farmers, a total of 2 hours will be required. The interviewer must read and explain very carefully each question to the farmer. The interviewer must then record on the questionnaire sheet the farmer's responses for each question. Once the first farmer is completed, the next farmer must be interviewed immediately using the same procedure until all the 5-6 farmers have been completely interviewed.

*The questionnaire is self explanatory as all the instructions on how to use the questionnaire are given. However, the following must be noted: instructions for the interviewer are written in italic within open and close brackets []. Statements and/or questions the interviewer will be asking the farmer are written in **bold** with an open & close quotation mark (“”). It is very important to ask the questions very carefully without altering them. Farmer responses must be carefully recorded as the farmer gives them. The interviewer must not introduce his/her opinion while asking the questions or while recording the farmer's responses. If this happens, bias will be introduced which will affect the interpretation of the data.*

We will also go through the questionnaire thoroughly so that you are completely familiar with the questions and the questionnaire layout. During the interview, the farmers and/or the interviewers may raise issues that may need immediate explanation from the researcher. For this reason, the researcher will not directly interview the farmers but instead will closely supervise the interviewers so that questions or issues raised during the course of the survey are immediately addressed.

There are 4 parts to this questionnaire and they are as follows:

Part A: Training Need Assessment (TNA)

This section aims to find out whether a TNA survey has been conducted by the service provider. If no TNA survey was conducted for the group, Part A will automatically be skipped and continued with Part B. If however, TNA was conducted, the main purpose of the TNA must be explained to the farmer and proceed with the interview.

Part B: Actual Training Session Assessment

This section has three main areas to be assessed: (i) training aids (ii) training topics (iii) training methods. Training aids aim to assess how helpful the aids were in facilitating farmer's learning. Questions on the training topics and the training methods aim to assess how useful the topics and the methods were in terms of helping the farmers to address their problems in coffee Rehabilitation.

Part C: Implementation of Knowledge & Skills Assessment

This section has 3 main areas of assessment: (i) assessing whether farmers are implementing the knowledge & skills (ii) assessing factors preventing implementation of the knowledge & skills and (iii) Assessing farmers' current Rehabilitation practices.

Part D: Farmer background information.

This section aims to collect the farmer's basic demographic or background information.

REHABILITATION TRAINING SURVEY QUESTIONNAIRE

Province:..... **Place:**.....**Date:**

Farmer ID: **Group ID:** **Recorder ID:**.....

[Briefly introduce yourself, parts of this survey, time required to complete the survey and the rights of the farmer in taking part in this survey].

“Gutpela monin tru. Nem bilong mi em.....” *[Give your name].* Man husait igo pas long dispela wok panim aut or ‘research’ i kliaim yumi pinis long as tingting bilong dispela ‘survey’. Mi ino inap go gen long ol toktok em i bin karamapim pinis”.

Dispela ‘interview’ bai kisim klostu 20 minit. Igat 4-pela hap bilong dispela ‘interview’:

1. Bai mi askim sampela kwesten long hau treina i bin askim ol hevi bilong yu long Riabilitesen, na hau em i bin kisim ol tinting bilong yu long halpim em plenim Riabilitesen trening.
2. Bai mi askim sampela kwesten long hau treina i bin lanim yupela insait long Kopi Riabilitesen skul.
3. Bai mi askim sampela kwesten long kisim tingting bilong yu long hevi we i stopim yu long yusim ol save yu bin kisim long Kopi Riabilitesen skul.
4. Bai yumi pinisim dispela ‘interview’ wantaim sampela ol sotpela askim long yu”.

[Allow the farmer to ask questions if any. If you get questions that are difficult to answer, please inform the researcher. If there are no issues to address, please proceed with the questionnaire].

“Bipo long yumi stat, nogut yu gat sample askim?” *[If no questions, start with Part A].*

PART A: TRAINING NEED ASSESSMENT

“CIC i bin askim treina bilong Kopi Riabilitesen long skelim na luksave long hevi bilong ol fama bipo long Kopi Riabilitesen trening. Olsem na nambawan hap bilong dispela ‘survey’ em long skelim hau treina i bin askim long ol hevi bilong yu long lukautim gut kopi diwai. Dispela seksen tu bai kisim ol tinting yu bin givim long treina long plenim Kopi Riabilitesen trening”.

[Begin the survey]

“Yumi statim ‘survey’ bilong yu”.

Q1. “Treina bilong Kopi Riabilitesen i bin kam long ples na kisim hevi o skelim tingting bilong ol fama bipo long Kopi Riabilitesen trening o nogat? Plis tokim mi wanpela bilong ol dispela ansa mi bai kolim”: *[Read aloud the options given below and circle the option identified by the farmer. Then follow the instruction given per the option selected].*

- a) **“Yes – em i bin kam”**.....*[If the answer is yes, please go to Q2]*
- b) **“Mi no save”**.....*[If the answer is mi no save, please go to Q3]*
- c) **“Nogat – em ino bin kam”**.....*[If the answer is nogat, please go to Q3]*

Q2. Yu bin stap insait long dispela bung taim treina i bin kam kisim hevi na tingting bilong ol fama bipo long ronim Kopi Riabilitesen trening o nogat?” *[Read aloud the options given below and circle the option identified by the farmer. Then follow the instruction given per the option selected].*

- a) **“No, mi no bin stap”**..... *[If the answer is no, please go to Q3].*
- b) **“Yes, mi bin stap”**..... *[If the answer is yes, ask the farmer the questions below].*

Q3. “Bai mi kolim nem bilong sampela wei or pasin we treina inap yusim long kisim tingting na hevi bilong yu bipo long ronim Kopi Riabilitesen trening. Plis tok yes sapos treina i bin yusim dispela pasin o no sapos treina ino bin yusim. “Treina i bin o nogat?” [Complete the question with the statement provided in the table (i) below]

a) **“No, em ino bin mekim”.** [If no, circle ‘no’ in the table (ii)] [repeat the question for next approach]

b) **“Yes, em i bin mekim”...** [If yes, circle ‘yes’ in the table (ii)].... and ask the questions given below]:

Long skel bilong 1 igo inap long 5, we 1 i makim..... [Explain the rating scale]:

1 = gutpela tru, 2 = gutpela, 3 = namel, 4 = gutpela liklik, 5 = ino gutpela

“Wanem skel yu givim long hau treina i bin?”

[Ask the question mentioned in the table (i)] [Record the rating given by the famer in the table (iii)].

“Plis givim tasol wanpela rison bilong wanem yu givim dispela skel o namba?” [Record farmer’s reason for the rating in the table (iv)] [Repeat this procedure for all the 5 TNA approaches]

(i) The TNA approaches	(ii) Used?	(iii) Rating #	(iv) Main reason for rating
Diskasim ol hevi fama i save fesim long lukautim gut kopi gaden bipo long ronim Kopi Riabilitesen trening.....	No Yes		
Panim aut Riabilitesen save bilong fama wantaim liklik test o askim ol kwesten long maus o askim ol fama long tokim em wanem samting ol i laik lanim long Kopi Riabilitesen trening.....	No Yes		
Askim ol fama long wanem taim ol i save mekim ol bikpela wok o holim kibung insait long hauslain bipo em i ken plenim Kopi Riabilitesen trening....	No Yes		
Go insait long kopi gaden na luksave long wok fama mekim long kopi bilong ol bipo long trening?	No Yes		

PART B: ACTUAL TRAINING SESSION ASSESSMENT.

(Explain the aims and content of Part B as stated below).

“Namba tu hap bilong dispela ‘survey’ bai panim aut hau skul bilong Kopi Riabilitesen i bin ron. Igat 3-pela as tingting long dispela seksen: (i) yumi bai skelim hau treina i bin yusim ol ‘training aid’ or ol samting olsem ol posta, sisis, so, buk, pen na pepa. (ii) Yumi bai skelim ol het tok o topic insait long Kopi Riabilitesen (iii) Yumi bai skelim ol pasin o wei bilong lanim ol fama treina i nap yusim insait long Kopi Riabilitesen skul. As tingting bilong dispela seksen em bilong panim aut hau ol wei bilong skul i halpim yu long save moa long Riabilitesen.

[Question 3 has two sub-questions. Read the instruction to the farmer and ask the sub-questions. Record the responses from the farmer for each sub-question in the respective section in the table provided below].

Yumi stat wantaim ol samting bilong halpim treina long skulim ol fama gut long Kopi Riabilitesen. Mi bai kolim nem bilong wanwan ‘training aid’ we mi bilip treina i mas yusim. Bihain mi bai askim sample kwesten. [Mention names of training aids given in the table (i) below]

Q3. “Treina i yusim olo nogat?”

[Name of training aid given in the table (i) below. Repeat same question for the 7 training aids]

a) “No em ino bin yusim” [If no, circle ‘no’ in the table (ii) and repeat above question for the next training aid]

b) “Yes em i bin yusim” [If yes, circle ‘yes’ in the table (ii) and ask the questions given below]:

Long skel bilong 1 igo inap long 5, we 1 i makim..... [Explain the rating scale]:

1 = bikpela halpim tru, 2 = halpim, 3 = namel halpim, 4 = liklik halpim, 5 = nogat halpim

“Hau i halpim yu save moa long lukautim gut kopi diwai?”

[Mention and explain the training aids given in the table (i). Record the rating value in table (iii)]

“Plis givim wanpela rison bilong wanem as yu givim dispela skel o namba?” [Record farmer’s response in the table (iv)] [Repeat the same procedure for all the 7 training aids mentioned in the table below].

(i) Training aids	(ii) Used	(iii) Rate #	(iv) Main reason for rating
Riabilitesen ‘handout’: ol pepa we treina i save givim ol fama long taim bilong trenin	No Yes		
Riabilitesen Posta: Piksa pepa i sowim hau long prunim kopi, stretim baret, seid, na banis.	No Yes		
Kemikol [pesticides] Posta: Piksa pepa soim hau fama i ken lukautim em yet long taim bilong spreit.	No Yes		
Kopi Binatang & sik posta: Piksa pepa we igat ol piksa bilong binatang na sik bilong kopi.	No Yes		
Nepsak pam: pam masin bilong mixim marasin bilong kilim grass, binatang na sik bilong kopi	No Yes		
Pruning so: Tul bilong prunim han bilong kopi diwai o katim ol bikpela kopi diwai.	No Yes		
Sisis bilong prunim kopi: Dispela em sisis bilong katim ol liklik han bilong kopi diwai	No Yes		

[Question 4 has two sub-questions. Read the question to the farmer and then ask the sub-question. Record the farmer's response for each sub-question in the respective section of the table provided below].

Q4. “Treina i bin yusim ol arapela ‘training aids’ long skulim ol fama long Kopi Riabilitesen o nogat?” [Circle farmer's response with only one of the options given below].

a) “No, em ino bin yusim”.... [If the answer is no, please go to Q5]

b) “Yes, em i bin yusim”.... [If the answer is yes, ask the farmer the following questions]:

“Plis kolim nem o kliaim ol arapela ‘training aid’ treina i bin yusim?”

[Record the farmer's responses in the table (i)].

“Long skel bilong 1 igo inap long 5, we 1 i makim..... [Explain the rating scale]:

1 = bikipela halpim tru, 2 = halpim,. 3 = namel halpim 4 = liklik halpim, 5 = i no gat halpim

“Hau dispela i halpim yu save moa long lukautim gut kopi diwai?”

[Mention name of the ‘other’ training aid described by the farmer] [Record the rating value in table (ii)]

“Plis givim tasol wanpela rison bilong wanem yu givim dispela skel o namba?” [Record farmer's response in the table (iii)]

[Repeat steps b) i, b) ii and b) iii) for all the other training aids named by the farmer].

(i) Other training aids	(ii) Rating #	(iii) Main reason for rating

[This question aims to assess the training topics given in the table below. Read the instruction of Q5 to the farmer and then ask the questions. In the appropriate sections of the table below record the responses].

“Nau bai yumi lukluk long ol het tok o (topic) bilong kopi Riabilitesen we mi bilip treina imas skulim ol fama. Mi bai kolim nem na kliaim ol het tok na bihain long wanwan het-tok, mi bai askim sampela kwesten”. [Name and explain the training topic given in the table below and then ask the questions below].

Q5. “Treina i bin karamapim dispela het-tok.....long Riabilitesen trenin o nogat?” [Name of the topic given in the table (i)] [Circle farmer's response in the table (ii)]

a) “No, em ino karamapim” [If no, ask again the above question for the next training topic].

b) “Yes, em i bin karamapim” [If yes, explain the rating scale and ask the questions that follow]:

“Long skel bilong 1 igo inap long 5, we 1 i makim..... [Explain the rating scale]:

1 = gutpela tru, 2 = gutpela, 3 = namel, 4 = gutpela liklik, 5 = i no gutpela

“Hau dispela het tok i halpim yu save moa long lukautim gut kopi diwai?”

[Name of training topic given in the table (i)] [Record the rating in table (iii)]

“Plis givim wanpela rison bilong wanem yu givim dispela skel o namba? [Record farmer's response in the table (iv)]

(i) Rehabilitation training topics	(ii) Covered	(iii) Rating #	(iv) Main reason for rating
Pruning: dispela i karamapim; wei bilong katim han kopi, ol gutpela bilong katim han kopi, ol hevi bilong kopi diwai taim yu ino prunim, namba bilong kopi diwai long wanpela mama ass (diwai) o long wan hekta.	No Yes		
Seid: dispela i karamapim; ol gutpela bilong givim seid long kopi diwai, ol hevi bilong kopi diwai taim i nogat seid, ol kainkain seid diwai.	No Yes		
Banis: dispela i karamapim; ol gutpela bilong banism kopi gaden, ol kainkain banis na hevi bilong kopi taim kopi gaden i nogat banis.	No Yes		
Baret: dispela i karamapim; kainkain baret bilong kainkain graun, ol gutpela bilong baret, hevi long kopi diwai taim igat planti wara, hau long lukautim baret.	No Yes		
Fetilaisa: dispela i karamapim ol kainkain fetilaisa o kaikai bilong kopi diwai, hau long givim fetilaisa long kopi, sik bilong kopi taim ino gat fetilaisa long graun.	No Yes		
Binatang & sik bilong kopi: dispela i karamapim ol sik olsem kopi lif ras na binatang olsem grin skeil na hau long daunim ol, kainkain wei bilong daunim sik.	No Yes		
Daunim gras nogut: dispela i toktok long hevi bilong kopi diwai taim gras nogut i karamapim ol, na wei o rot bilong daunim gras nogut.	No Yes		
Kopi Kalenda: dispela i toktok long ol taim we kopi i save karim flawa, seri na wanem taim seri i save mau. Wanem taim fama is ken prunim kopi, klinim gras, stretim baret, na daunim sik & binatang bihanim sison bilong kopi diwai.	No Yes		

Q6. “Treina i bin yusim ol arapela het tok long skulim ol fama long Kopi Riabilitesen o nogat?”

[Circle farmer’s response with only one of the options given below].

a) “No em ino bin yusim”.... [If the answer is no, please go to Q7]

b) “Yes em i bin yusim”.... [If the answer is yes, ask the farmer the following questions]:

i. “Plis kolim nem o kliaim ol arapela ‘het tok’ treina i bin karamapim long trening?”

[Record the farmer’s responses in the table (i)].

“Long skel bilong 1 igo inap long 5, we 1 i makim..... [Explain the rating scale]:

1 = gutpela tru, 2 = gutpela, 3 = namel, 4 = gutpela liklik, 5 = i no gutpela

i. “Hau dispela het tok i halpim yu save moa long lukautim gut kopi diwai?” [Mention name of ‘other’ training topic given by the farmer (i)] [Record rating of topic in the table (ii)]

iii. “Plis givim tasol wanpela rison bilong wanem yu givim dispela skel o namba? [Record farmer’s response in the table (iii)] [Repeat steps b) ii and b) iii) for all the other training topics].

(i) Other Rehabilitation training topics	(ii) Rating #	(iii) Main reason for rating

[This question aims to assess the training methods (given in the table below) that may have been used by the trainer during the Rehabilitation training. Carefully read and explain the main instruction to the farmer and then ask the questions. Record the farmer's responses in the appropriate section of the table given below].

“Dispela kwesten bai lukluk long ol kainkain wei or pasin bilong skulim ol fama long Kopi Riabilitesen. Bai mi kolim nem na kliaim sampela bilong ol dispela pasin na bihain bai mi askim sampela kwesten. [Name and explain one-at-a-time the training methods given in the table below and then ask the questions].

Q7. “Treina i bin yusim.....long skulim ol fama o nogat?”
 [Name of the training method (i)]. [Then circle farmer's response in the table (ii)]

a) **“Nogat, ino yusim”** [If no, ask again the above question for the next method given in the table (i)].

b) **“Yes, em i bin yusim”** [If the answer is yes, explain the rating scale & ask the questions that follow]:

“Long skel bilong 1 igo inap long 5, we 1 i makim..... [Explain the rating scale]:

1= bikipela halpim tru, 2 = halpim, 3 = namel halpim, 4 = liklik halpim, 5 = no gat halpim

“Hau dispela..... i halpim yu save moa long lukautim gut kopi diwai?”
 [Mention & explain the training method given in the table (i). Record farmer's rating in table (iii)]

Plis givim tasol wanpela rison bilong wanem yu givim dispela skel o namba?” [Record farmer's response in the table (iv)]

[Repeat all the steps above for all the 7 training methods].

(i) Training methods	(ii) Used?	(iii) Rating #	(iv) Main reason for rating
Lecture: Treina i mekim olgeta toktok bilong riabilitesen insait long klasrum o fil na ol fama i harim tasol. Fama bai ino putim tingting or skelim expiriens bilong en long dispela kain wei bilong skul.	No Yes		
Grup diskasen: Ol fama i diskasim long grup save bilong riabilitesen ol i kisim long skul na expiriens ol igat. Bihain ol i skelim tingting wantaim ol arapela fama	No Yes		
“Askim na save seson: Ol fama i askim kwesten long riabilitesen na treina i bekim ol askim o ol arapela fama husait i klia long ansa bilong kwesten i bekim	No Yes		
“Han wok o prectikol seson: Tisa i tokim na i sowim ol fama long hanwok na ol fama i harim, lukim na bihanim wankain olsem treina is sowim.	No Yes		
Fil trip: Treina i kisim ol fama igo aut long plantesen or kopi gaden bilong expiriens fama na ol fama lukim hau plantesen o expiriens fama i aplaim Riabilitesen save long kopi bilong ol.	No Yes		
Ges spika: Treina i askim man or meri husait igat save na expiriens long wok kopi na dispela expiriens man/meri i skelim save na expiriens bilong ol wantaim ol fama	No Yes		
‘Follow-up’: Treina i kam bek gen long fama bihain long trening na sekim hau ol fama i mekim wok long kopi gaden. Treina igivim stia tingting long fama long ol eria fama ino klia tumas.	No Yes		

PART C: APPLICATION OF THE ACQUIRED KNOWLEDGE AND SKILLS.

[There are three areas to be evaluated in this section: rehabilitation knowledge & skills application; factors preventing application of rehabilitation techniques; and farmer's current ways of coffee farming. Evaluation of knowledge & skills application aims to assess whether or not the farmers are applying the recommended rehabilitation techniques. Factors preventing implementation of knowledge and skills aims to assess the constraints that may prevent farmers from applying the rehabilitation techniques. Evaluating farmers' current ways of coffee farming aims to assess farmer's current ways of rehabilitation and the reasons behind them applying these practices].

“Dispela seksen i laik panimaut olsem fama i aplaim ol save bilong kopi riabilitesen long kopi gaden o nogat. Sapos nogat, wanem ol hevi fama i gat na em ino aplaim ol save bilong en long Kopi Riabilitesen. Mi bai kliaim 6-pela as tingting o save bilong lukautim gut kopi diwai na bihain mi bai askim sampela kwesten. [Explain one-at-time the Rehabilitation techniques given in the table below and then ask the questions]:

Q8. “Yu aplaim save bilong..... long kopi gaden o nogat?” *[Name of Rehabilitation technique given in the table (i) below] [Circle farmer's response in the table (ii)]*

a) “Mi no aplaim” *[If no, ask]... Wanem as na yu ino aplaim*

[Name of Rehabilitation technique (i)][Record response in table (iv)]

b) “Yes, mi aplaim” *[If the answer is yes, explain the rating scale below & ask the questions that follow]:*

“Long skel bilong 1 igo inap long 5, we 1 i makim..... *[Explain the rating scale]:*

<i>1 = bikpela bilip tru 2 = bilip 3 = namel bilip 4 = liklik bilip 5 = nogat bilip</i>

Wanem kain bilip yu gat olsem yu aplaim stret save bilong.....?”

[Name of Rehabilitation technique (i)][Record response in table (iii)]

Plis givim tasol wanpela rison o as tingting watpo yu givim dispela skel o namba?

[Record farmer's response in the table (iv)]

[Repeat the whole procedure for all the Rehabilitation techniques given in the table below]

(i) Rehabilitation techniques	(ii) Applying	(iii) Rating #	(iv) Main reason for rating
Pruning: fama imas save hau long; prunim kopi na katim ol bikpela kopi diwai; klia long wanem taim long prunim kopi diwai; save long hamas kopi diwai wangepa mama ass i ken holim o hamas kopi diwai long wangepa hekta.	No Yes		
Daunim sik & binatang: Fama imas klia long ol binatang o sik bilong kopi na save long daunim ol.	No Yes		
Seid kontrol: Fama i mas save long gutpela na nogut bilong seid diwai na hau long stretim ol.	No Yes		
Wokim baret: Fama imas save long wok bilong baret na birua kopi diwai inap panim sapos ino gat gutpela baret.	No Yes		
Daunim gras nogut: Fama imas save long hevi bilong gras nogut na imas save long daunim ol gras nogut.	No Yes		
“Kopi Kalenda: Fama imas klia long sison bilong kopi na mas save long wanem taim long mekim wanem kain wok long kopi. Fama imas klia long kamapim kopi kalenda”	No Yes		

[This question aims to assess the seriousness other problems that may prevent the farmers from applying the Rehabilitation techniques. Explain the questions and write the responses in the table provided].

“Planti fama ino aplaim ol tingting o save bilong Riabilitesen long kopi gaden long wanem ol i panim planti hevi. Planti long ol dispela hevi i winim pawa o strong bilong fama long daunim. Bai mi kolim nem bilong sample hevi wei inap pasim yu long aplaim save bilong Riabilitesen. Bihain mi bai askim sampela kwesten long ol dispela hevi. [Explain one-at-a-time the problems given in the table below].

“Long skel bilong 1 igo inap 5, we 1 i makim.....” [Explain the rating scale below]

1 = bikpela hevi tru 2 = bikpela hevi 3 = namel hevi 4 = liklik hevi 5 = nogat hevi

Q9. Wanem level bilong dispela hevi..... i stopim yu ino ken aplaim save bilong Kopi Riabilitesen?” [Mention the problems given in the table below] [Circle farmer’s answer with the rating]

[Repeat Q9 for the rest of the problems given and circle the farmers rating in the table below]

Problems	1	2	3	4	5
“ Nogat tuls: Mi nogat ol tuls long prunim han kopi o katim ol bikpela kopi diwai olsem na mi ino aplaim ol save bilong prunim” kopi”.	1	2	3	4	5
“ Nogat nepsak: Mi nogat pam masin long kilim gras, sik, na binatang bilong kopi. Olsem na mi ino aplaim ol save bilong Riabilitesen.	1	2	3	4	5
“ Rot i bagarap: Rot bilong kisim kopi igo long maket i bagarap olgeta na dispela i mekim mi les long aplaim save bilong Riabilitesen”.	1	2	3	4	5
Liklik kopi prais: Prais bilong kopi i daun tumas na mi save hat wok nating. Olsem na mi ino aplaim tumas save bilong Riabilitesen”.	1	2	3	4	5
Nogat hamamas prais long “quality” kopi: Ol baiya i baim gutpela na nogut kopi long wankain prais tasol. Dispela i save stopim mi”.	1	2	3	4	5
“ Nogat moni: Mi ino gat moni long baim ol tol o kemikol o peim ol wok man long halpim mi long kopi. Dispela i save pasim mi”.	1	2	3	4	5
“ Skul i hat: Treina i bin yusim hatpela toktok long skul na mi ino klia long planti samting long Riabilitesen”. Dispela i stopim mi.	1	2	3	4	5

Q10. Yu fesim ol arapela hevi i pasim yu long aplaim ol save o tingting bilong Riabilitesen long kopi o nogat? [Circle farmer's response with only one of the options given below].

a) "No, ino gat ol arapela hevi....." [If the answer is no, please go to Q11]

b) "Yes, mi fesim ol arapela hevi....." [If the answer is yes, ask farmer the following questions]:

"Plis tok klia long ol arapela hevi i pasim yu long aplaim save bilong Kopi Riabilitesen?"

[Record the farmer's responses in the table (i)].

"Plis tok klia hau dispela hevi i pasim yu long aplaim Kopi Riabilitesen save long kopi?"

[Mention the problem given by the farmer][Record farmer's reason in the table (ii)]

Other problems (i)	Farmer's explanation of the problem (ii)

Q11. Bipo yu igo insait long Riabilitesen treinin, yu bin igat sample hevi o 'problem' long lukautim gut kopi gaden we yu bin laik bai dispela Kopi Riabilitesen treinin i ken halpim yu?" [Circle only one response given below].

a) "No, mi ino bin igat ol hevi"..... [If the answer is no, please go to Q12]

b) "Yes, mi bin igat ol sampela hevi"..... [[If the answer is yes, ask farmer the following questions]:

"Tokim mi ol hevi yu bin igat bipo long Riabilitesen treinin na yu bin laik bai treinin i halpim yu?"

[Record farmer's problems or responses in the table (i)]

"Long skel bilong 1 igo inap 5, we 1 i makim....." [Explain the rating scale below]

1= bikpela hamamas tru, 2= hamamas, 3= namel hamamas, 4 = liklik hamamas 5= nogat hamamas

Wanem level o mak bilong hamamas bilong yu olsem Kopi Riabilitesen treinin i inapim truhevi o 'problem' we yu bin igat bipo long treinin?"

(Mention farmer's problem given in the table (i) below). [Record farmer's responses in the table (ii)]

Plis givim tasol wangepela rison o as tingting watpo yu givim dispela skel o namba?

[Record farmers response in the table (iii)]

[Repeat b) ii. and b) iii for all the problems the farmer indicates]

(i) Farmers previous problems	(ii) Rating #	(iii) Main reason for rating

“Long skel bilong 1 igo inap 5, we 1 i makim [Explain the rating scale below]

1= bikpela hamamas tru 2= hamamas 3= namel hamamas 4 = liklik hamamas 5= nogat **yu**

long tokim fren bilong yu long kisim wankain trening?” [Record farmer’s responses in the table (i)]

“Bilong wanem yu givim dispela kain level o skel? Plis Kliaim skel o mak yu givim”?

[Record farmer’s responses in the table (ii)]

Rating (i)	Main reason (ii)

[Farmers rehabilitate their coffee using methods that best work for them. Therefore this section aims to find out the farmer’s CURRENT ways of farming coffee and why he or she is using these methods. Ask the farmer one-at-a-time the questions given in the table (i) below. For each question asked, write its corresponding answers in section (ii) of the table. First read Q12 and explain to the farmer. When the farmer is familiar with the type of information you are after, proceed with the other sub-questions].

Q12. “Ol fama igat we bilong ol yet long aplaim save bilong kopi riabilitesen long kopi bilong ol, long wanem, ol i wok wantaim kopi long-pela taim na ol i bilip long samting ol i mekim. Dispela kwesten i laik panimaut wanem ol save o tingting yu nau aplaim long kopi gaden bilong yu.

Mi bai kolim 6-pela eria bilong wok riabilitesen na bai mi askim yu wanpela kwesten long wanwan eria mi kolim. Yu mas tokim mi hau yu wok long ol dispela eria long kopi gaden bilong yu. Long wanwan eria, plis tokim mi wanpela wei o pasin tasol hau yu mekim wok. Ol 6-pela eria em olsem.....

[Go through the Rehabilitation areas]

(i) Rehabilitation areas	(ii) Farmer’s current ways of applying Rehabilitation techniques
“Wanem wei yu save yusim olgeta taim long prunim kopi bilong yu?”	“Wanem as tingting bilong yu long prunim kopi olsem?”
“Wanem wei yu save yusim olgeta taim long daunim sik o binatang bilong kopi?”	“Wanem as tingting bilong yu long daunim sik na binatang olsem?”
“Wanem wei yu save yusim olgeta taim long kontrolim seid diwai long kopi?”	“Wanem as tingting bilong yu long kontrolim seid diwai olsem?”
“Wanem wei yu save yusim olgeta taim long lukautim baret long kopi bilong yu?”	“Wanem as tingting bilong yu long lukautim baret long kopi olsem?”
“Wanem wei yu save olgeta taim daunim grass long kopi gaden bilong yu?”	“Wanem as tingting bilong yu long daunim grass nogut olsem?”
“Wanem wei yu save olgeta taim bihanim long wok kopi long gaden bilong yu?”	“Wanem as tingting bilong yu bihanim dispela pasin“

PART D: FARMER BACK-GROUND INFORMATION

[This section is about collecting additional information from the farmer. Therefore it is very important that the questions are asked carefully and the answers are correctly recorded].

“Nau, yumi pinisim ‘survey bilong yumi wantaim ol sotpela kwesten”.

Q13. “Long amas krismas yu bin wok long kopi?”..... *[Record farmer’s response]*

Q14. “Hamapela kopi diwai yu gat long kopi gaden bilong yu?” *[Record farmer’s response]*

Q15. Long nau yu planim ol yangpela kopi diwai long gaden o nogat? Bai mi givim yu tingting na yu tokim mi”. *[Circle only one option below as indicated by the farmer].*

- a) Yes, mo wok long planim
- b) Yes mi plan long planim sampela bihain taim
- c) No, mi inap wantaim ol kopi mi gat nau

Q16. Wanem level bilong skul yu bin pinisim? Bai mi givim yu tingting na yu tokim mi *[Mention the options given below to the farmer and circle only the correct category indicated by the farmer].*

- a) Mi ino bin go long skul
- b) Mi pinisim prameri skul level (1-6)
- c) Mi pinisim hai skul level (7-10)
- d) Mi pinisim sinia hai skul level (11-12)
- e) Mi pinisim bikpela skul (Colis o univesiti)

Q17. “Wanem krismas bilong yu?”..... *[If the farmer is not sure, ask him/her to make an estimate]*

Q18. “Yu gat sampela toktok long mekim long dispela Riabilitesen skul o nogat?

- a) **“No gat”** ..*[If the answer is no, refer go to Q19]*
- b) **“Yes mi gat sampela toktok long mekim”.** *[If the answer is yes, ask]...*

Plis tokim mi wan o tupela bikpela tingting bilong yu? *[Record farmers response]*

.....
Q19. “Yu laik save long risalt o ripot bilong dispela survey o nogat?” *[Circle only one option]*

- a) **Yes mi laik save**
- b) **No, mi ino laik save**

20. *[What is the gender of the farmer you are interviewing? Please circle the option below]*

- a) **Male**
- b) **Female**

THE END OF SURVEY – *[Thank the farmer and remind him or her that it will take few minutes before we can move onto the next activity]*

Sample Agronomy Quiz: English

Introduction

The second part of the survey is a short quiz. The purpose of the quiz is to assess whether the farmers know the basic knowledge about coffee rehabilitation. The farmers are provided with three options from which only one correct answer can be chosen. You are required to read each question and the options to the farmer and circle only the option which the farmer identifies as the correct answer. To maintain privacy and confidentiality of the farmer and the interviewer, code numbers will be used instead of real names. Therefore fill in the farmer, group and recorder codes, together with the other information: province, village, and date. All farmer instructions are in Tok Pidgin. The quiz should take 10 minutes.

Province: Village: Date: Recorder Code #:

Group Code #: Farmer Code #: Farmer gender: Male / Female (*circle*)

Q1. Which of this drainage spacing is recommended for coffee in water-logged or clay soil?

- a) Drainage should be closely apart and the depth and the width should be deep and wide respectively.
- b) Drainage should be far apart with shallow depth and narrow width
- c) Coffee growing in clay or waterlogged soil does not need drainage as the coffee can grow well

Q2. What type of shade level or density is recommended for a smallholder coffee garden?

- a) Very heavy shade level with about (5mx10m) spacing with 10 – 20% light penetration
- b) Light shade level with about (60m -100m) spacing with 80 -100 % light penetration
- c) Medium shade level with about (20 m x 40m) spacing with 50 – 60% light penetration.

Q3. When is the appropriate time to do weed control?

- a) Weed must be controlled routinely, every time the farmer sees weed completing with his coffee trees
- b) When the price of coffee improves, that is good time to do a massive weed control
- c) Weeds do not harm the coffee trees in any way, therefore there is no need to control weeds.

Q4. Which of these statements is correct about fertilization application in coffee?

- a) Allow the coffee trees to grow among the weeds. The trees can still give better yield without fertilizer
- b) Before applying any form of fertilizer such as animal manure, garden residues, coffee pulp, and inorganic fertilizers, firstly effectively control the weeds, maintain the drains, regulate the shade, and prune the coffee branches.
- c) So long as you are applying inorganic fertilizer, you do not need to carry out the other rehabilitation activities. The coffee tree will still respond to fertilizer applied and give better yield.

Q5. Which of the following is an indicator that your coffee requires fencing?

- a) When animals and people freely trespass your coffee garden, fencing is needed to protect your coffee
- b) When the villagers are respectful and animals are kept out of the coffee due to natural boundaries and your coffee is safe without trespass, you need fencing of your coffee garden
- c) There is no need to protect the coffee trees from animal destruction and theft. Coffee is meant to grow without fencing.

Q6. When is the correct time to do recycle pruning?

- a) The coffee trees are not meant to be pruned. Allow them to grow tall with lots of branches and canopies
- b) When the yield starts to decline over consecutive seasons as indicated by yield records and age of the trees, this is good indication that the coffee trees need recycle pruning.
- c) Coffee trees must be recycled after every season.

Q7. How many uprights should be allowed per stem after final sucker selection during recycle pruning?

- a) 4-6 uprights are recommended per stem at the smallholder level for better yield
- b) There should be as many uprights as possible as this will result in high yield
- c) The coffee tree should not be pruned as pruning will disturb its natural growth pattern.

Q8. Which of the following tools are suitable to prune coffee?

- a) Bush knives and axes
- b) Secateurs and pruning saw
- c) Any tool is suitable for coffee pruning.

Q9. What is the best approach to take when controlling pest & disease in coffee?

- a) Always apply the rehabilitation practices such as weeding, shading, pruning, drainage, fencing, nutrition application and basic farm hygiene. If the pest and disease problems persist, see your coffee specialist.
- b) Apply only the chemical method of pest & disease control because it is cheap and always effective
- c) Always follow the advice of the pesticide dealers. They know the pests and disease of coffee better.

Q10. What must the farmer do to protect himself/herself from pesticide poisoning while spraying?

- a) Carry the knapsack filled with spray chemical without any protective gears as chemicals are not harmful to man.
- b) Always the farmer must wear protective gear such as overall, hat, hand gloves, face mask, boots and goggles. Protective gear is important because chemicals are dangerous to man.
- c) The farmer after spray should not wash himself and his protective gear as there are no chemical residues present in his body or in the clothes.

END OF REHABILITATION QUIZ

Sample Agronomy Quiz: Tok Pisin

Introduction

The second part of the survey is a short quiz. The purpose of the quiz is to assess whether or not the farmers know the basic knowledge about coffee rehabilitation. The quiz is very easy as the farmers are provided with three options from which only one correct answer can be chosen. You are required to read each question and options to the farmer and circle only the option which the farmer identifies as the correct answer. To maintain privacy and confidentiality of the farmer and the interviewer, codes numbers will be used instead of real names. Therefore fill in the farmer, group and recorder codes, together with the other information such as province, village, and date. All farmer instructions are in Tok Pidgin. The quiz should take 10 minutes.

**Province: Village: Date: Recorder Code #:
Group Code #: Farmer Code #: Farmer gender: Male / Female (circle)**

“Namba tu hap bilong dispela wok panim aut em i sotpela ‘quiz’ o ‘test’ long Kopi Rehabilitation. Dispela test em ino bilong pasim o feilim ol fama, nogat. As tingting bilong dispela test em long luksave olsem skul Riabilitesen i skulim ol fama long ol impotent tingting bilong wok Riabilitesen o nogat. Dispela test em isi tru long wanem olgeta ansa we yu inap tingting na givim istap pinis long pepa na taim mi i askim ol kwesten, mi bai tokaut long tripela tingting. Yu bai tokim mi wanem bilong ol ansa i tru-pela”.

Q1. Wanem kain baret fama imas wokim long tais graun bai kopi i ken kamapim gut?

- a) Baret imas klostu, klostu, bikpela na imas igo daun long rausim planti wara long graun
- b) Baret imas longwe-longwe, liklik na i no ken igo daun tumas long graun
- c) Tais graun i no nidim baret.

Q2. Wanem kain seid level o mak em i gutpela bilong ol smolholda kopi gaden?

- a) Seid diwai imas pas-pas olsem (5 m x 10 m) bai kopi diwai i no ken kisim san lait
- b) Seid diwai imas longwe-longwe olsem (60m x 100 m) bai san lait i ken lukim gut olgeta kopi lif na han
- c) Seid diwai imas stap long gutpela mak olsem (20m x 40m) we kopi ken kisim san lait long skel.

Q3. Wanem em i gutpela taim long kontrolim o daunim grass nogut long kopi gaden?

- a) Olgeta taim fama i lukim olsem gras nogut i kamap na i resis wantaim kopi diwai, orait em imas daunim
- b) Taim prais bilong kopi i gutpela, orait klinim gut kopi na taim prais i low lusim kopi long bus
- c) Ol grass nogut ino save bagarapim kopi, olsem na nogat nid to daunim grass nogut.

Q4. Wanem bilong ol dispela tingting i makim ol gutpela wei bilong givim fetilaisa long kopi diwai?

- a) Larim kopi diwai long bikpela bus. Em yet bai kamap long laik na givim gutpela ol seri
- b) Bipo long givim fetilaiza long kopi diwai, daunim gras, stretim seid, prunim kopi, na stretim baret. Bihain put pekpek bilong animol o skin kopi o pipia bilong gaden arere long as bilong kopi diwai
- c) Putim fetilaisa long as bilong kopi diwai maski kopi istap insait long bikpela grass. Kopi bai givim yet planti seri.

Q5. Wanem bilong ol dispela pasin i sowim olsem yu nidim banis long kopi gaden?

- a) Taim yu lukim olsem pik, gout, bulmakau, o ol manmeri i nogat respect long kopi diwai na ol i brukim, stilim or wok-about insait long kopi gaden, orait wokim banis.
- b) Taim yu lukim olsem hauslain igat bikpela respect long kopi, na ol animol ino bagarapim kopi gaden bilong yu, yu ino nid long wokim banis
- c) Banis long kopi em ino impotent maski ol animol o manmeri i bagarapim. Kopi diwai em samting nating.

Q6. Wanem em i rait taim long fama i mas prunim olupela kopi diwai (recycle pruning) long gaden?

- a) Kopi diwai ino samting bilong prunim. Kopi imas kamap bikpela, olupela na mas igat planti han na kru.
- b) Taim fama i lukim olsem, insait kopi gaden, kilo bilong kopi seri igo daun olgeta yia, na diwai i luk lapun, orait dispela i sowim olsem olupela diwai kopi ino inap karim gut seri. Prunim dispela olupela kopi
- c) Bihain long olgeta kopi season, fama i ken mekim 'recycle' pruning.

Q7. Hamaspela kopi diwai fama imas larim long wanpela mama ass or mama diwai bihain long 'recycle pruning'?

- a) Wanpela mama ass i ken holim 4-6 pela diwai long givim gutpela hevi seri long winim kilo. Na sapos igat planti tumas ol han, ol kopi diwai bai resis long gris bilong giraun o san lait o wara na kopi diwai bai ino inap kamap gut.
- b) Wanpela mama ass imas igat planti kopi diwai na planti kru tu long wanem olgeta han kopi i ken karim seri na givim fama planti kilo. Dispela em i gutpela tu bilong 'quality kopi'.
- c) Kopi diwai ino samting bilong katim o prunim. Larim kopi diwai i ken kamap long laik bilong en.

Q8. Wanem bilong ol dispela tul i gutpela bilong prunim kopi?

- a) Bus naip and akis
- b) Sisis na so bilong prunim kopi diwai stret
- c) Yu ken katim o prunim kopi wantaim kainkain tul.

Q9. Long daunim sik na binatang nogut bilong kopi, wanem tingting i gutpela long bihainim?

- a) Olgeta taim lukautim gut seid, prunim kopi, klinim baret, daunim gras, banisim kopi, givim kaikai long kopi diwai na kopi gaden imas klin olgeta taim. Fama i mekim olsem tasol sik na binatang i kamap bikpela hevi yet, orait lukim saveman bilong kopi na bihainim tingting bilong en
- b) Olgeta taim yusim kemikol kontrol long wanem dispela rot no dia tumas and bai givim gutpela risalt
- c) Bihainim tingting bilong man husait i salim marasin bilong sik na binatang bilong kopi. Maski em ino klia long sik o binatang bilong kopi.

Q10. Wanem samting fama i mas mekim long lukautim em yet taim em i spreim kemikol long kopi?

- a) Karim nepsak long skin nating na spreim kopi or gras. Marasin ino inap kilim man
- b) Olgeta taim fama imas werim klos bilong spreim olsem overall, boot, han glaf, ai glass, hat na mask bilong pasim nus. Dispela bai halpim fama bai kemikol ino ken posinim em
- c) No ken waswas bihain long spreim. Kemikol ino save kilim man.

EM TASOL LONG TESTTENK YU TRU

Appendix 4: Sample Postharvest Questionnaires & Quizzes

Sample Postharvest questionnaire: English

POSTHARVEST TRAINING SURVEY QUESTIONNAIRE

Impact Assessment: Smallholder Coffee Agronomy and Postharvest Trainings in the Highlands of Papua New Guinea.

Good morning to you all. My name is Mr. Leo Aroga, and I am a Training Officer with the Coffee Industry Corporation (CIC) but currently studying at the Curtin University of Technology, Western Australia. I am pleased to see you all thank you for coming. I am told by our extension officer *[name]* that you have been informed of the purpose of this meeting. For the benefit of the few who may not be aware, let me clarify the purpose of this meeting.

I am conducting a research and it is about evaluating the Postharvest training that was conducted by the CIC through the Farmer Demand Driven Extension program. The aim of this study is to find out whether you have taken part in the training have learnt the important concepts in Postharvest. The study further aims to find out whether you are implementing the knowledge and skills, and if not, what are the obstacles preventing you.

Your group is part of the training program. Your group was chosen because you have completed the Postharvest training. Furthermore you were chosen among the other members of your group because you have volunteered to take part in this survey. I am very grateful of your decision. There has never been a study conducted by the CIC to assess the impact of the training on the coffee farmers in PNG. Therefore this study will be the first. You are special as you will share important information which the CIC will use to improve the training program.

Your identity will be strictly confidential and the information you provide will NOT be used in any way that will embarrass or bring emotional discomfort to you, your group and/or your associates. False names will be used if and when the information you provide need publication. Your involvement in this study is totally VOLUNTARY and you have the right NOT to take part in this research. Even if you are already into answering the questions but decide to change your mind not to continue, you can feel free to withdraw at any time. Furthermore, if you feel uncomfortable to answer any question, please feel free to express your concerns and request your interviewer to ignore that question and move on with the other questions. However, if you want your information to be processed and used by the CIC, you are recommended to complete the survey as incomplete surveys will not be used.

There are 3 components to this research: face-to-face interview and short quiz. Details of each component will be explained during the sessions. All the components will take approximately 3-4 hours. The extension officer will bring around copies of this paper which I have just read. If you still want to be part of this survey, please sign this paper and we can begin the survey. Farmers who participate and COMPLETE ALL of the research activities will be provide a cut lunch and a cash incentive of K10.00 each. If you want to participate, please sign below.

- c) I WANT TO take part in this research
- d) I wish to WITHDRAW from this research

Participant signature:.....Date:/...../.....

POSTHARVEST QUESTIONNAIRE – FACE-TO-FACE INTERVIEW

Instruction to the interviewer:

Each interviewer and the farmer group will be given different ID numbers. The ID numbers, the name of the province, the village name, and the date on which this survey is conducted must be completed before starting the survey. This is very important.

Each interviewer will interview about 5-6 farmers and therefore will take two hours will be required to complete the entire questionnaire. The interviewer must read and explain very carefully each question to the farmer. The interviewer must then record on the questionnaire sheet the farmer's responses for each question. Once the first farmer is completed, the next farmer must be interviewed immediately using the same procedure until all the 5-6 farmers have been completely interviewed.

*How to execute the questionnaire is self explanatory as all the instructions are given. However, the following must be noted: instructions for the interviewer are written in italic within a closed bracket []. Statements and/or questions the interviewer will be asking the farmer are written in **bold** with an open & closed exclamation mark (“”). It is very important to ask the questions very carefully without altering them. Farmer responses must be carefully recorded. The interviewer must not introduce his/her opinion while asking the questions or while recording the farmer's responses. If this is done, bias will be introduced which will affect the results.*

We will also go through the questionnaire thoroughly so that you are completely familiar with the questions and the questionnaire layout. During the interview, the farmers and/or the interviewers may raise issues that may need immediate explanation from the researcher. For this reason, the researcher will not interview the farmers but instead will closely supervise the interviewer.

There are 4 parts to this questionnaire and they are as follows:

Part A: Training Need Assessment (TNA)

This section aims to find out whether a TNA survey has been conducted. If no TNA survey had been conducted for the group, Part A will automatically be skipped and continued with Part B. If however, TNA had been conducted, the main purpose of the TNA must be explained to the farmer and proceed with asking the questions.

Part B: Actual Training Session Assessment

This section has three main areas to be assessed: (i) training aids (ii) training topics and, (iii) training methods. Training aids aims to assess how helpful the aids were in facilitating farmer learning. Questions on the training topics and the training methods aim to assess how useful the topics and the methods were in terms of helping the farmers to address their problems in coffee postharvest.

Part C: Implementation of Knowledge & Skills Assessment

This section has 3 main areas of assessment: (i) assessing whether farmers are implementing the knowledge & skills (ii) assessing factors preventing implementation of the knowledge & skills and (iii) Assessing farmers' current postharvest practices.

Part D: Farmer background information.

This section aims to collect the farmer's basic demographic information.

POSTHARVEST TRAINING SURVEY QUESTIONNAIRE.

Province:.....Place:.....Date:

Farmer ID: Group ID: Recorder ID:.....

Introduction:

[Briefly introduce yourself, parts of this survey, time required to complete the survey and the rights of the farmer in taking part in this survey].

“Good morning. My name is..... “[give your name]. “I am sure that you are aware of the purpose of this survey and also your rights to participant. Before we start, let me explain what is expected in this survey. This survey will take approximately 20 minutes. There are 4 parts to this survey:

Part A: Training Need Analysis Assessment

Part B: Training Session Assessment

Part C: Assessment of Knowledge & Skills Implementation

Part D: Farmer Background Information.

I will explain carefully the purpose of each part of the survey when we come to each section in the questionnaire”.

[Allow the farmer to ask questions if any. If you get any questions that are difficult to answer, please inform the researcher. If there are no issues to address, please proceed with the questionnaire].

“Before we begin with Part A, any questions?” [If no questions, start with Part A].

PART A: TRAINING NEED ASSESSMENT

“The first part of this survey is assessing the Training Need Assessment. Before conducting the postharvest training, your trainer may have conducted a TNA. The TNA is a survey which the CIC has asked the trainer to conduct before actually conducting the postharvest training. During the TNA, the trainer may have asked the farmers about their problems in postharvest. Postharvest training programs may also have been discussed taking into account the farmers’ social and day-to-day activities. Basing on this information, the trainer may have gone ahead with planning the training program. The answers you will be providing to the TNA questions will be based on your experiences during the TNA survey”.

“Let’s begin with our first question”.

TNA is a training tool used to identify trainees’ knowledge and skills gaps on a subject area before conducting training on it. The TNA results guide the development of training program so that the identified gaps are addressed. Likewise, your trainer was supposed to conduct a TNA on the Post-harvest before the actual training. This section aims to assess how the TNA was conducted.

Q1. Was there a TNA survey conducted for your group? (Circle ONE option)

- a) Yes..... if yes, please go to Q2
- b) I am not sure..... if not sure, please go to Q5
- c) No..... if no, please go to Q5

Q2. Did you take part in the TNA survey? (Please circle only ONE option).

- a) Yes..... if yes, please go to Q3
- b) No if no, go to Q5

Q3. The table below gives the Post-harvest TNA approaches that should have been used. On a scale of 1 – 5, where 1 is “very thorough” and 5 is “not at all used”; rate the thoroughness of the TNA approaches. (Please circle only ONE rating value for each of the approaches).

Post-harvest TNA approaches	1	2	3	4	5
How well was the aim(s) of the TNA explained?	1	2	3	4	5
How well were your initial Postharvest problems assessed?	1	2	3	4	5
How well was your previous Post-harvest knowledge assessed?	1	2	3	4	5
How well were your social commitments assessed before planning the training?	1	2	3	4	5
How well were your views sought on the type of language(s) to be used during the Post-harvest training?	1	2	3	4	5

Q4. Were other TNA approaches used apart from the ones given in Q3? (Circle only one option)

- a) No if no go to Q5
b) Yes..... If yes, briefly name the methods and rate how well they were used by circling only one value for EACH of the methods you name?

Other TNA approaches	1	2	3	4	5
	1	2	3	4	5
	1	2	3	4	5
	1	2	3	4	5

PART B: TRAINING AIDS

Training aids are materials that support training approaches which a trainer(s) normally uses during training. This sections aims to assess the usefulness of the training aids that were supposed to be used during the Post-harvest training.

Q5. The table below contains names of Post-harvest training aids that should have been used during the training. On a scale of 1 – 5, where 1 is “very helpful” and 5 is “not used”; rate how helpful the training aids were. Circle only ONE value of rating under EACH training aid. Please briefly provide reasons for your rating.

Training aids	Were the training aids used? (Circle answer)	If used, how helpful were the training aids?					Provide your reasons for the ratings
		1	2	3	4	5	
Postharvest farming notes	Yes/No	1	2	3	4		
Post-harvest video tapes (s)	Yes/No	1	2	3	4		
Processing posters	Yes/No	1	2	3	4		
Parchment posters	Yes/No	1	2	3	4		
Pulping machine	Yes/No	1	2	3	4		
Wooden fermenting box	Yes/No	1	2	3	4		
Drum (steel) fermenting box	Yes/No	1	2	3	4		
Solar drying plastics	Yes/No	1	2	3	4		
Raised drying table	Yes/No	1	2	3	4		
Samples of coffee cherries	Yes/No	1	2	3	4		
Samples of parchments	Yes/No	1	2	3	4		

Q6. Were other Post-harvest training aids used apart from those given in Q5? (Circle your answer)

- a) No if no go to Q7
b) Yes..... If yes, name the training aids and rate how useful they were. (Circle a rating value for each training aid).

Other Post-harvest training aids	1	2	3	4	5
	1	2	3	4	5
	1	2	3	4	5
	1	2	3	4	5

PART C: ACTUAL TRAINING SESSIONS

Actual Post-harvest training refers to the transfer and exchange of Post-harvest knowledge and skills that took place between the trainer and the farmers through theory and practical lessons. This section aims to assess whether or not the Post-harvest training topics and the training methods were thoroughly covered and beneficial respectively in facilitating farmer learning.

Q7. The table below contains the MOST likely TOPICS that should have been covered during the Post-harvest training. On a scale of 1–5, where 1 is “very thorough” and 5 is “not covered”; rate the thoroughness of the Post-harvest topics. Please circle only one value of rating that best suits your experience. Please briefly provide reasons for your rating.

Training Topics	Was the topic covered? (Circle your answer)	If the topic was covered, how thoroughly was it covered? Rate its thoroughness					Provide your reasons for ratings EACH topic
		1	2	3	4	5	
Harvesting: Dos & Do-nots	Yes/No	1	2	3	4	5	
Harvesting test: Basic calculations	Yes/No	1	2	3	4	5	
The Coffee pulper: Dos & Do-nots	Yes/No	1	2	3	4	5	
Fermenting methods	Yes/No	1	2	3	4	5	
Washing & soaking	Yes/No	1	2	3	4	5	
Drying methods	Yes/No	1	2	3	4	5	
Parchment classes and moisture test	Yes/No	1	2	3	4	5	
Parchment storage: Dos & do nots	Yes/No	1	2	3	4	5	
Marketing tips: useful facts & figure	Yes/No	1	2	3	4	5	

Q8. Were other Postharvest training topics covered during the training apart from the ones mentioned in Q7? (Circle your answer).

- a) No if no, go to Q9
 b) Yes..... If yes, name the training topics and rate how useful they were. (Circle a rating value for EACH training topic).

Other Post-harvest training topics covered during the training	Level of coverage. (Circle a rating value for EACH topic)				
	1	2	3	4	5
	1	2	3	4	5
	1	2	3	4	5
	1	2	3	4	5

Q9. Training METHODS are different teaching approaches used during a training session. The table below contains common training methods which are expected to be used by the Post-harvest trainer. On a scale of 1-5, where 1 is “very beneficial” and 5 is “not used”; assess how beneficial the training method was in helping you to learn. Circle only ONE value of rating that best suits your experience. Please briefly provide reasons for your rating.

Training methods & descriptions	Was this method useful? Yes/No	If the method was used, how beneficial was the method to you? Circle value.					Reasons for rating
		1	2	3	4	5	
Lecture is when the trainer explains new and/or difficult concepts to the farmers. Farmers are given time to ask questions/and or share their farming experiences.	Yes/No	1	2	3	4	5	
Small group discussion is where the farmers discuss important concepts relating to the training topic (s) in small groups. Farmers are given time to present their discussions.	Yes/No	1	2	3	4	5	
Practical demonstration is a prepared presentation to show how to perform a task. Example, repairing a pulper. Demonstration involves; show, tell, and practice through step-by-step approach.	Yes/No	1	2	3	4	5	
Field trips are a carefully arranged visit to outside of the farmer’s area to observe and study important aspects of the training such as visiting a coffee factory or a plantation.	Yes/No	1	2	3	4	5	
Farmer-centred approach is an interactive training method where farmers are given the opportunity to share their farming experiences and these experiences are respected.	Yes/No	1	2	3	4	5	
Using other experts is where experienced coffee farmers and/or specialists are brought in to explain vital coffee concepts to re-enforce what the farmers are already learning.	Yes/No	1	2	3	4	5	
Follow-up is where the trainer visits the farmer(s) after some time after the training to provide additional technical assistance.	Yes/No	1	2	3	4	5	

PART D: APPLICATION OF THE ACQUIRED KNOWLEDGE AND SKILLS.

This section aims to assess whether or not the farmers are applying the acquired Post-harvest knowledge and skills in their coffee. Furthermore, factors motivating and/or preventing application of knowledge and skills are also assessed.

Q10. The table below contains critical post-harvest quality control skills which you should have learnt during the training. Kindly assess your level of confidence in applying the skills in your coffee. Use a scale of 1 – 5 where 1 is “very confidently and 5 is “not applying at all”. Please briefly provide reasons for your rating.

Applicable Post -harvest knowledge & skills	Are you applying the skills & knowledge?	If applying the knowledge & skills, how confidently are you in applying?					Reasons for rating
		1	2	3	4	5	
Picking test: Using simple mathematical calculations to find out the percentage of green, dry, red cherries and floaters harvested.	Yes/No	1	2	3	4	5	
Pulping test: Carrying out test-run-pulping to find out how many cherries are nipped and/or un-pulped and adjusting the pulper.	Yes/No	1	2	3	4	5	
Fermentation test: Gasping handful of fermenting parchments in the palm to find out whether fermentation is completed.	Yes/No	1	2	3	4	5	
Moisture test: Using teeth and rub tests to assess whether the parchment is dried.	Yes/No	1	2	3	4	5	
Cherry-to-parchment ratio calculation: To decide whether it is profitable to sell cherry or parchment at price	Yes/No	1	2	3	4	5	

Q11. External factors are outside issues which the farmer has very little or no control over. External factors can greatly affect the farmer either positively or negatively in implementing the Post-harvest knowledge and skills. The table below contains external factors that would encourage or prevent you from applying the acquired knowledge and skills. On a scale of 1 – 5 where 1 is “very serious” and 5 is “not at all serious”, circle the value of rating which best describes the level of seriousness. Please briefly provide reasons for your rating.

Possible obstacles preventing implementation of knowledge and skills in Post-harvest	Is this an obstacle?	If this is an obstacle, how serious is it? Rate it					Reasons for your rating
		1	2	3	4	5	
Literacy problem: The post-harvest techniques were too technical.	Yes/No	1	2	3	4	5	
Poor trainer: The trainer did not deliver the concepts as expected.	Yes/No	1	2	3	4	5	
Lack of pulping machine: I do not have a pulper.	Yes/No	1	2	3	4	5	
Lack of processing equipment: There is no processing equipment such as fermenting boxes.	Yes/No	1	2	3	4	5	
Lack of clean water: Clean water to pulp coffee is not easily accessible.	Yes/No	1	2	3	4	5	
Poor road and/or lack of accessibility: Roads are very bad and/or not usable.	Yes/No	1	2	3	4	5	
Low coffee price: The local coffee price is poor	Yes/No	1	2	3	4	5	
Lack of market accessibility: There is no buyer.	Yes/No	1	2	3	4	5	
High operational cost: Transporting coffee to the market and bring inputs into the farm is expensive.	Yes/No	1	2	3	4	5	
Lack of finance: No seed money to purchase processing inputs such as a coffee pulper.	Yes/No	1	2	3	4	5	
Lack of CIC support: CIC extension services are absent.	Yes/No	1	2	3	4	5	
Lack of leadership: Weak and/or absence of strong and visionary leadership in the group.	Yes/No	1	2	3	4	5	

Q12. If you are facing other constrains apart from the ones mentioned in Q11, please briefly list and explain the constraints in the table provided below.

Names of other obstacles	How these obstacles preventing application of the techniques

Q13. Did you have any **INITIAL** coffee harvesting & processing **PROBLEMS** which you were expecting the Post-harvest training to address? (Circle your answer).

- a) Yes if yes, please go to Q14
 b) No..... if no, please go to Q 15

Q14. Please list your **MAIN** problems which you had prior to attending the training. On a scale of 1-5 where 1 is “very satisfied” and 5 is “not at all addressed”, rate your satisfactory level on how your initial problems were addressed by the training by circling only one of the rating scales provided. Finally, please explain your reasons for the rating your problems.

My initial problems	Rating scale					Reasons for rating
	1	2	3	4	5	
	1	2	3	4	5	
	1	2	3	4	5	
	1	2	3	4	5	

PART E: ASSESSING TRADITIONAL WAYS OF HARVESTING & PROCESSING COFFEE

Even after attending a coffee Post-harvest training, some farmers still value and practice their traditional postharvest techniques. Therefore this section aims to find out whether farmers are still using their old postharvest methods and if they are, why they are doing so.

Q15. The table below list major activities in coffee post-harvest. Please indicate your current practices under EACH activity mentioned. Give reasons for practicing techniques.

My current practices	Reasons for practising the techniques
My current ways of picking coffee	Reasons for the picking coffee this way
My current ways of pulping coffee	Reasons for pulping coffee my way
My current ways of fermenting coffee	Reasons for fermenting coffee my way
My current ways of washing coffee	Reasons for washing coffee my way
My current ways of drying coffee	Reasons for drying coffee my way
My ways of storing coffee	Reasons for storing coffee my way
My ways of selling coffee	Reasons for selling coffee my way

PART F: CONCLUSION

Q16. For how long have you been farming coffee? Number of years farming coffee

Q17. Kindly indicate the number of coffee trees in your (family included) coffee garden?
.....Number of coffee trees

Q18. Are you increasing and/or planning to increase the number of coffee trees in your coffee garden? (Please circle one of the options provided)

- a) Yes
- b) No

Q19. What is your highest level of formal education? If you have not been to a formal school, write in the space provided: "I have never been to school".
..... (Highest educational level)

Q20. How old are you? If you do not know your exact age, please make an estimate.

I am..... (Years) old

Q21. Please indicate your gender by circling one of the options provided below.

- a) Male
- b) Female

THE END OF SURVEY – THANKS FOR YOUR PARTICIPATION!

Sample Postharvest questionnaire: Tok Pisin

Tok igo pas

Gutpela monin tru long yupela olgeta. Nem bilong em Leo Aroga na mi Trening Ofisa bilong CIC. Tasol nau mi skul long Curtin University long Australia. Mi hamamas tru long lukim yupela olgeta. Extensen ofisa (Mr..... [Name]) i bin tok save long yupela pinis long as tingting bilong dispela bung. Mi laik kliaim gen nogut sampela ino klia.

Mi mekim wanpela wok panimaut makim wok extensen na treinin seksen bilong CIC. CIC i mekim wok extensen andinit long nuipela tingting, Fama Dimand Driven Extensen (FDDE). Wantaim halpim bilong ol sevis provaida CIC i bin skulim planti kopi fama group long kopi andinit long dispela FDDE. Yupela tu i bin go insait long dispela skul pinis na nau mipela olgeta i kam bung long panim aut hau dispela skul i halpim ol fama long kisim gut save.

Tupela eria we planti fama i bin kisim skul long en em: (i) Riabilitesen o wok bilong lukautim gut kopi diwai na (ii) 'Postharvest' o wok bilong pikim, masinim, na draim gut kopi seri na pasmen. Mi klia olsem yupela bin kisim skul long 'Postharvest'. Olsem na dispela bung i laik panim aut olsem yu lanim gut save bilong 'Postharvest' o nogat.

CIC i no bin mekim wanpela wok panimaut insait long PNG long skelim kaikai bilong fama trening andinit long FDDE olsem na dispela nau yumi laik mekim. Dispela 'survey' bilong luksave olsem ol fama i lanim gut save bilong kopi 'Postharvest' o nogat i kamap nambawan taim na yu i wanpela bilong ol dispela nambawan kopi fama long sekelim dispela FDDE fama trening. Bikpela ol as tingting bilong dispela 'survey' long Kopi 'Postharvest' skul em olsem CIC i laik luksave:

- a) Ol fama bin lanim gut save bilong kamapim 'quality' kopi insait long 'Postharvest' skul o nogat?
- b) Ol fama i bihanim o yusim ol dispela gutpela save bilong kamapim 'quality' kopi o nogat?
- c) Ol fama i panim hevi long bihanim ol save ol i bin kisim long 'Postharvest' trening o nogat?
- d) Sapos ol fama i panim hevi, wanem ol hevi i stopim ol long yusim ol save bilong 'Postharvest'?

CIC i makim yu long stap insait long dispela 'survey' long wanem:

- a) Grup bilong yu i bin kisim pinis skul long 'Postharvest'
- b) CIC save olsem yu bin stap insait long dispela 'Postharvest' trening
- c) CIC i save olsem yu igat laik long stap insait long dispela 'survey' long wanem yu bin tokim CIC ofisa olsem yu laik stap insait long dispela 'survey'.

Ol tingting yu givim long dispela 'survey' em bikpela samting, long wanem ol dispela tingting bai halpim CIC long stretim gut wok kopi extensen na trening long PNG. Olsem na taim ol ofisa i askim yu ol tingting bilong yu long 'Postharvest', yu mas tokaut stret. Lo bilong dispela 'survey' i tok klia olsem nogat wanpela man imas save long husait fama igivim ol dispela tingting. Olsem na yu i fri tru long givim olgeta tingting yu gat long Kopi 'Postharvest' Trening. Sapos yu ino laik long stap insait long dispela 'survey', yu fri tru long lusim. Tasol sapos yu laik bai CIC i ken yusim ol tingting bilong yu long stretim gut wok kopi extensen, orait yu mas pinisim olgeta wok i kamap long dispela 'survey'. Dispela projek bai givim yu belo kaikai na K10.00 long wanwan fama husait i pinisim olgeta wok bilong survey. Dispela kaikai na moni em long tok tenkyu long taim bilong yu long stap insait long 'survey'. Sapos yu laik stap long dispela 'survey', orait yumi bai pinisim tri-pela wok: 1. 'Interview', 2. 'Quiz', 3. 'Dartboard'. Mi bai kliaim as tingting bilong ol dispela wok bihain. Dispela wok 'survey' bai kisim klostu 4 -pela hauwa. Sapos yu hamamas long stap insait long dispela 'survey', orait yu mas sainim wanpela pepa we ofisa bai kisim raun: Sapos yu ino sainim, yu ino inap stap insait long dispela 'survey'.

- a) Mi laik stap insait long dispela "survey"
- b) Mi laik pulaut long dispela "survey".

Signature: Date:/...../09

POSTHARVEST QUESTIONNAIRE – FACE-TO-FACE INTERVIEW

Instruction to the interviewer:

Each interviewer and the farmer group will be given different ID numbers. The ID numbers, the name of the province, the village name, and the date on which this survey is conducted must be completed before starting the survey. This is very important.

Each interviewer will interview about 5-6 farmers. To complete the face-to-face interview with the 5-6 farmers, a total of 2 hours will be required. The interviewer must read and explain very carefully each question to the farmer. The interviewer must then record on the questionnaire sheet the farmer's responses for each question. Once the first farmer is completed, the next farmer must be interviewed immediately using the same procedure until all the 5-6 farmers have been completely interviewed.

*The questionnaire is self explanatory as all the instructions on how to use the questionnaire are given. However, the following must be noted: instructions for the interviewer are written in italic within open and close brackets []. Statements and/or questions the interviewer will be asking the farmer are written in **bold** with an open & close quotation mark (“”). It is very important to ask the questions very carefully without altering them. Farmer responses must be carefully recorded as the farmer gives them. The interviewer must not introduce his/her opinion while asking the questions or while recording the farmer's responses. If this happens, bias will be introduced which will affect the interpretation of the data.*

We will also go through the questionnaire thoroughly so that you are completely familiar with the questions and the questionnaire layout. During the interview, the farmers and/or the interviewers may raise issues that may need immediate explanation from the researcher. For this reason, the researcher will not directly interview the farmers but instead will closely supervise the interviewers so that questions or issues raised during the course of the survey are immediately addressed.

There are 4 parts to this questionnaire:

Part A: Training Need Assessment (TNA)

This section aims to find out whether a TNA survey has been conducted. If no TNA survey was conducted for the group, Part A will automatically be skipped and continued with Part B. If however, TNA was conducted, the main purpose of the TNA must be explained and proceed with the interview.

Part B: Actual Training Session Assessment

This section has three main areas to be assessed: (i) training aids, (ii) training topics, and (iii) training methods. Training aids aim to assess how helpful the aids were in facilitating farmer's learning. Questions on the training topics and the training methods aim to assess how useful the topics and the methods were in terms of helping the farmers to address their problems in coffee Postharvest.

Part C: Implementation of Knowledge & Skills Assessment

This section has 3 main areas of assessment: (i) assessing whether farmers are implementing the knowledge & skills, (ii) assessing factors preventing implementation of the knowledge & skills, and (iii) Assessing farmers' current Postharvest practices.

Part D: Farmer background information.

This section aims to collect the farmer's basic demographic or background information.

POSTHARVEST TRAINING SURVEY QUESTIONNAIRE.

Province:..... Place:..... Date:
Fama ID:..... Group ID: Recorder ID:.....

Introduction:

[Introduce yourself, parts of this survey, time required to complete the survey, and the rights of the farmer in taking part in this survey].

“Gutpela monin tru. Nem bilong mi *[Give your name]*. Man husait igo pas long dispela wok panim aut i kliaim yumi pinis long as tingting bilong dispela ‘survey’. Mi ino inap go gen long ol toktok em i bin karamapim pinis”. Dispela ‘interview’ bai kisim klostu 20 minit. Igat 4-pela hap bilong dispela ‘interview’. Bai mi askim sampela kwesten long hau treina i bin askim ol hevi bilong yu long ‘Postharvest’ o hevi insait long pikim na masinim kopi. Mi bai askim tu sampela kwesten long hau em i bin kisim ol tingting bilong yu long halpim em plenim ‘Postharvest’ trening. Bai mi askim sampela kwesten long hau treina i bin lanim yupela insait long ‘Postharvest’ skul. Bai mi askim sampela kwesten long kisim tingting bilong yu long hevi we i stopim yu long yusim ol save yu bin kisim long ‘Postharvest’ skul.

Bai yumi pinisim dispela ‘interview’ wantaim sampela ol sotpela askim long yu”.

[Allow the farmer to ask questions if any. If you get questions that are difficult to answer, please inform the researcher. If there are no issues to address, please proceed with the questionnaire].

“**Bipo long yumi stat, nogut yu gat sample askim?**” *[If no questions, start with Part A].*

PART A: TRAINING NEED ASSESSMENT

“CIC i bin askim treina bilong Kopi ‘Post harvest’ long skelim na luksave long hevi bilong ol fama bipo long Kopi ‘Postharvest’ trening. Olsem na nambawan hap bilong dispela ‘survey’ bai skelim hau treina i bin askim ol hevi bilong yu long kamapim gut ‘quality’ pasmen. Dispela seksen tu bai kisim ol tingting yu bin givim long treina long plenim Kopi ‘Postharvest’ trening”. Yumi statim ‘survey’ bilong yu.

[Ask the first question]

Q1. “Treina bilong ‘Postharvest’ i bin kam long ples na kisim hevi na skelim tingting bilong ol fama bipo long trening o nogat? Plis tokim mi wanpela bilong ol dispela ansa mi bai kolim”:

[Read the options below to the farmer, get the response, and circle only ONE option].

a) “Yes – em i bin kam”..... *[If the answer is yes, please go to Q2]*

b) “Mi no save”..... *[If the answer is **mi no save**, please go to Q3]*

c) “Nogat – em ino bin kam”..... *[If the answer is **nogat**, please go to Q3]*

Q2. Yu bin stap insait long dispela bung taim treina i kam kisim hevi na tingting bilong ol fama bipo long ronim ‘Postharvest’ trening o nogat?” *[Circle only ONE option given below and follow the instructions of the option selected].*

a) “No, mi no bin stap”..... *[If the answer is no, please go to Q3].*

b) “Yes, mi bin stap”..... *[If the answer is yes, ask the farmer the questions below].*

“Bai mi kolim nem bilong sampela wei treina inap yusim long kisim tingting na hevi bilong yu bipo long ronim ‘Postharvest’ trening. Plis tok yes sapos treina i bin yusim dispela ol pasin mi kolim o no sapos treina ino bin yusim.

“Treina i bin o nogat?” *[Complete the question with the statement provided in the table (i) below]*

- a) “No, em ino bin mekim”... [If no, circle ‘no’ in the table (ii)] [repeat the question for next approach]
- b) “Yes, em i bin mekim”.... [If yes, circle ‘yes’ in the table (ii)]....and ask the questions given below]:

“Long skel bilong 1 igo inap long 5, we 1 i makim..... [Explain the rating scale]:

1= gutpela tru, 2 = gutpela, 3 = namel, 4 = gutpela liklik, 5 = ino gutpela

“Hau treina i.....?” [Ask the question mentioned in the table (i)]

“Wanem skel yu givim long dispela pasin?” [Circle the answer given by the farmer in the table (iii)].

“Plis givim tasol wanpela rison long wanem as yu givim dispela skel o namba?” [Record farmer’s response in the table (iv)] [Repeat this procedure for all the 5 TNA approaches]

(i) The TNA approaches	(ii) Used?	(iii) Rating #	(iv) Main reason for rating
Diskasim ol hevi fama i save fesim long pikim, masin, stinim, wasim, draim na putim gut kopi seri na pasmen bipo long ronim ‘Post harvest’ trening.....	No Yes		
Panim aut ‘Post harvest’ save bilong fama wantaim liklik test o askim ol kwesten long maus o askim ol fama long tokim em wanem samting ol i laik lanim long ‘Post harvest’ trening.....	No Yes		
Askim ol fama long wanem taim ol i save mekim ol bikpela wok o holim kibung insait long hauslain bipo em i ken plenim ‘Post harvest’ trening....	No Yes		
Go insait long kopi gaden o eria bilong palpim kopi na luksave long wok fama i mekim long kopi bilong ol bipo long ‘Post harvest’ trening.....	No Yes		

PART B: ACTUAL TRAINING SESSION ASSESSMENT.

(Explain the aims and content of Part B as stated below).

“Namba tu hap bilong dispela ‘survey’ bai panim aut hau skul bilong ‘Post harvest’ i bin ron. Igat 3-pela as tingting long dispela seksen: (i) yumi bai skelim hau treina i bin yusim ol ‘training aid’ or ol samting olsem buk, pen na pepa, posta, na kopi masin. (ii) Yumi bai skelim ol het tok (o topic) insait long ‘Post harvest’ (iii) Yumi bai skelim ol pasin o wei bilong lanim ol fama treina i bin yusim insait long ‘Post harvest’ skul.

[Question 3 has two sub-questions. Read the main instruction to the farmer and ask the sub-questions. Record the responses from the farmer for each sub-question in the respective section in the table provided.

Yumi stat wantaim ol samting bilong halpim treina long skulim ol fama gut long ‘Post harvest’. Mi bai kolim nem bilong wanwan ‘training aid’ we mi bilip treina i mas yusim. Bihain mi bai askim sample kwesten. [Explain the training of training aids given in the table (i) below before asking the question]

Q3. “Treina is yusim ol o nogat?”[Name of training aid given in the table (i) below. Repeat same question for the 8 training aids]

a) “No em ino bin yusim” [If no, circle ‘no’ in the table (ii) and repeat above question for the next training aid]

b) “Yes em i bin yusim” [If yes, circle ‘yes’ in the table (ii) and ask the questions given below:

Long skel bilong 1 igo inap long 5, we 1 i makim..... [Explain the rating scale]:

1 = bikpela halpim tru, 2 = halpim, 3 = namel halpim, 4 = liklik halpim, 5 = nogat

“Hau i halpim yu save moa long wok insait long ‘Post harvest?’”
[Mention and explain the training aids given in the table (i). Record the rating value in table (iii)]

ii. **“Plis givim tasol wangepela rison long wanem as yu givim dispela skel o namba?”** *[Record farmer’s response in the table (iv)]* *[Repeat the same procedure for all the 8 training aids mentioned in the table below].*

(i) Training aids	(ii) Used	(iii) Rate #	(iv) Main reason for rating
‘Harvesting & Processing handouts’: ol pepa we treina i save givim ol fama long taim bilong trenin	No Yes		
‘Harvesting & Processing’ Posta: Piksa pepa i sowim hau long pikim, masinim, stinim, wasim, na draim kopi seri na pasmen	No Yes		
Pasmen Posta: Piksa pepa soim kainkain piksa bilong pasmen olsem nambawan pasmen, namba tu pasmen o nogut pasmen.	No Yes		
Kopi masin: Masin bilong brukim o palpim kopi seri na ol liklik hap bilong en	No Yes		
Boxis bilong stinim na wasim kopi pasmen: Ol kainkain, gutpela na nogut boxis bilong stinim kopi	No Yes		
Ol samting bilong draim kopi: Ol kain samting olsem sel, teibol antap long graun, na kain	No Yes		
Ol kainkain seri kopi olsem mau, ino mau, drai na stin	No Yes		

[Question 4 has two sub-questions. Read the instructions of the question to the farmer and then ask the sub-questions. Record the farmer’s response for each sub-question in the respective section of the table provided below].

Q4. “Treina i bin yusim ol arapela ‘training aids’ long skulim ol fama long wok bilong ‘Post harvest’ o nogat?” *[Circle farmer’s response with only one of the options given below].*

- a) **“No, em ino bin yusim”**.... *[If the answer is no, please go to Q5]*
 b) **“Yes, em i bin yusim”**.... *[If the answer is yes, ask the farmer the following questions]:*

“Plis kolim nem o kliaim ol arapela ‘training aid’ treina i bin yusim?” *[Record the farmer’s responses in the table (i)].*

i. **“Long skel bilong 1 igo inap long 5, we 1 i makim.....”** *[Explain the rating scale]:*

1 = bikpela halpim tru, 2 = halpim, 3 = namel halpim, 4 = liklik halpim, 5 = ino gat halpim

“Hau dispelai halpim yu save moa long mekim gut wok bilong ‘Post harvest?’”

[Mention name of the ‘other’ training aid described by the farmer] [Record the rating value in table (ii)]

iii. **“Plis givim tasol wangepela rison long wanem as yu givim dispela skel o namba?”** *[Record farmer’s response in the table (iii)] [Repeat same for all the other training aids named by the farmer].*

(i) Other training aids	(ii) Rating #	(iii) Main reason for rating

[This question aims to assess the training topics given in the table below. Read the main instruction of Q5 to the farmer and then ask the questions. In the appropriate sections of the table below record the farmer’s responses].

“Nau bai yumi lukluk long ol het tok o (topic) bilong ‘Post harvest’ we mi bilip treina imas skulim ol fama. Mi bai kolim nem na kliaim ol het tok na bihain long wanwan het-tok, mi bai askim

sampela kwesten". [Name and explain the training topic given in the table (i) and then ask the questions below].

Q5. "Treina i bin karamapim dispela het tok..... long 'Post harvest' trenin o nogat?"
[Name of the topic given in the table (i)] [Circle farmer's response in the table (ii)]

- a) "No, em ino karamapim" [If no, ask again the above question for the next training topic].
- b) "Yes, em i bin karamapim" [If yes, explain the rating scale and ask the questions that follow]:

i. "Long skel bilong 1 igo inap long 5, we 1 i makim..... [Explain the rating scale]:

1 = gutpela tru, 2 = gutpela, 3 = namel, 4 = gutpela liklik, 5 = ino gutpela

"Hau dispela het tok i halpim yu save moa long 'Post harvest' wok?"
[Name of training topic given in the table (i)] [Record the rating in table (iii)]

ii. "Plis givim tasol wanpela rison long wanem as yu givim dispela skel o namba? [Record farmer's response in the table (iv)]

(i) Post harvest training topics	(ii) Covered	(iii) Rating #	(iv) Main reason for rating
Pikim seri: dispela i karamapim; ol gutpela bilong pikim mau seri tasol, ol nogut bilong pikim mix seri olsem grin, drai na stin, na hau long sekim ol pikas olsem ol i pikim gut seri or nogat (picking test).	No Yes		
Kopi masin: dispela i karamapim; ol gutpela na nogut bilong yusim kopi masin, hau long stretim gut kopi masin, na hau long testim kopi masin olsem em bai katim gut kopi seri o nogat.	No Yes		
Boxis bilong stinim kopi pasmen: dispela i karamapim; ol gutpela na nogut boxis bilong stinim kopi, as bilong 'quality problem' long taim bilong stinim kopi, hau long stinim gut kopi na hau long luksave olsem kopi pasmen is sting gut	No Yes		
Wasim pasmen kopi: dispela i karamapim; gutpela bilong yusim klinpela wara long wasim pasmen, ol hevi bilong 'quality' na hau long abrusim hevi bilong 'quality' long taim bilong wasim pasmen	No Yes		
Drain pasmen: dispela i karamapim ol kainkain wei bilong drain gut pasmen, ol kainkain level bilong drain pasmen na hau long testim pasmen olsem em i nambawan pasmen o nogat	No Yes		
Kainkain pasmen level: dispela i karamapim ol kainkain level bilong pasmen, na hau long kamapim nambawan pasmen	No Yes		
Hau long putim gut pasmen: dispela i karamapim hau long putim gut drai pasmen na ol haus bilong putim pasmen bai em i no ken bagarapim 'quality'.	No Yes		

Q6. "Treina i bin yusim ol arapela het tok long skulim ol fama long 'Post harvest' o nogat?"
[Circle farmer's response with only one of the options given below].

- a) "No em ino bin yusim".... [If the answer is no, please go to Q7]
- b) "Yes em i bin yusim".... [If the answer is yes, ask the farmer the following questions]:

"Plis kolim nem o kliaim ol arapela 'het tok' treina i bin karamapim long 'Post harvest' trening?"
[Record the farmer's responses in the table (i)].

"Long skel bilong 1 igo inap long 5, we 1 i makim..... [Explain the rating scale]:

1 = gutpela tru, 2 = gutpela, 3 = namel, 4 = gutpela liklik, 5 = ino gutpela" [Mention name of other training topic given by the farmer (i)] [Record rating of topic in the table (ii)]

"Plis givim tasol wanpela rison long wanem as yu givim dispela skel o namba?"[Record farmer's response in the table (iii)] [Repeat steps b) ii and b) iii] for all the other training topics named].

[This question aims to assess the training methods (given in the table below) that may have been used by the trainer during the ‘Post harvest’ training. Carefully read and explain the main instruction to the farmer and then ask the questions. Record the farmer’s responses in the appropriate section of the table given below].

“Dispela kwesten bai lukluk long ol kainkain wei or pasin bilong skulim ol fama long ‘Post harvest’. Bai mi kolim nem na kliam sampela bilong ol dispela pasin na bihain bai mi askim sampela kwesten. [Name and explain one-at-a-time the training methods given in the table below and then ask the questions].

Q7. “Treina i bin yusim..... long skulim ol fama o nogat?” [Name of the training method (i)]. [Then circle farmer’s response in the table (ii)]

a) “Nogat em ino yusim” [If no, ask the above question for the next method given in the table (i)].

b) “Yes, em i bin yusim” [If the answer is yes, explain the rating scale & ask the questions that follow]:

“Long skel bilong 1 igo inap long 5, we 1 i makim..... [Explain the rating scale]:

1 = bikpela halpim tru, 2 = halpim, 3 = namel halpim, 4 = liklik halpim, 5 = No gat halpim

“Hau dispela..... i halpim yu save moa long ‘Post harvest’ work?” [Mention & explain the training method given in the table (i). Record farmer’s rating in table (iii)]

“Plis givim tasol wanpela rison long wanem as yu givim dispela skel o namba [Record farmer’s response in the table (iv)] [Repeat all the steps above for all the training methods]

(i) Training methods	(ii) Used?	(iii) Rating #	(iv) Main reason for rating
Lecture: Treina i mekim olgeta toktok bilong ‘Post harvest’ insait long klasrum o fil na ol fama i harim tasol. Fama bai ino putim tingting or skelim experiens bilong en long taim bilong skul	No Yes		
Grup diskasen: Ol fama i diskasim long grup save bilong ‘Post harvest’ ol i kisim long skul na experiens ol igat. Bihain ol i skelim tingting wantaim ol...	No Yes		
“Askim na save seson: Ol fama i askim kwesten long ‘Post harvest’ na treina i bekim ol askim o ol arapela fama husait i klia long ansa bilong kwesten i bekim.	No Yes		
“Han wok o prectikol seson: Tisa i tokim na i sowim ol fama long hanwok na ol fama i harim, lukim na bihanim wankain olsem treina	No Yes		
Fil trip: Treina i kisim ol fama igo aut long kopi fektri o kopi masin bilong experiens fama na ol fama lukim hau ol fama i aplaim ‘Post harvest’ save long kopi ...	No Yes		
Ges spika: Treina i askim man or meri husait igat save na experiens long wok kopi na dispela experiens man/meri i skelim save na experiens bilong ol...	No Yes		
‘Follow-up’: Treina i kam bek gen long fama bihain long trening na sekim hau fama i mekim wok long kopi. Treina i givim stia tingting na halpim long fama long wok ‘Post harvest’	No Yes		

PART C: APPLICATION OF THE AQUIRED KNOWLEDGE AND SKILLS.

[There are three areas to be evaluated in this section: Post harvest knowledge & skills application; factors preventing application of post harvest’ techniques; and farmer’s current ways of post harvest’ techniques. Evaluation of knowledge & skills application aims to assess whether or not the farmers are applying the recommended Post harvest techniques. Factors preventing implementation of knowledge and skills aims to assess constraints that may prevent farmers from applying the techniques. Evaluating farmers’ current ways of post harvest techniques aims to assess farmer’ current ways of harvesting & processing coffee and the reasons behind them applying these practices].

“Dispela seksen i laik panimaut olsem fama i aplaim ol save bilong ‘Post harvest’ long kopi o nogat. Sapos nogat, wanem ol hevi fama i gat na em ino aplaim ol save bilong en long ‘Post harvest’. Mi

bai kliaim 4-pela as tingting o save bilong sekim ‘quality’ kopi long ‘Post harvest’. Bihain mi bai askim sampela kwesten. [Explain one-at-time the ‘Post harvest’ quality control tests given in the table below and then ask the questions]:

Q8. “Yu aplaim save bilong..... o nogat?” [Name of Rehabilitation technique given in the table (i) below] [Circle farmer’s response in the table (ii)]

a) **“Mi no aplaim”** [If no, ask]... **Wanem as na yu ino.....?”**

[Name of Rehabilitation technique (i)][Record response in table (iv)]

b) **“Yes, mi aplaim”** [If the answer is yes, explain the rating scale & ask the questions that follow]:

“Long skel bilong 1 igo inap long 5, we 1 i makim.....” [Explain the rating scale]:

1= bikipela bilip tru 2= bilip 3= namel bilip 4 =liklik bilip 5= nogat bilip

Wanem kain bilip yu gat olsem yu aplaim stret save bilong.....?”

[Name of Rehabilitation technique (i)][Record response in table (iii)]

Plis givim tasol wanpela rison long wanem yu givim dispela skel o namba? [Record farmer’s response in the table (iv)] [Repeat the whole procedure for all the Post harvest techniques given in the table below]

(i) ‘Post harvest’ techniques	(ii) Applying	(iii) Rating	(iv) Main reason for rating
Luksave hau ol pikas i pikim seri gut long kopi gaden: fama imas save hau long pikim mau seri tasol, imas klia long luksave hamas pesen insait long bek igat gutpela na nogut seri na imas igat klia hau fama i pikim seri long kopi gaden bilong en.	No Yes		
Luksave olsem kopi masin i katim gut seri: Fama imas klia long sekim kopi masin bilong en na traिम long katim seri. Sapos masin ino katim gut seri, em i mas klia long stretim masin.	No Yes		
Luksave olsem kopi pasmen i stinim gut: Fama imas klia long luksave olsem pasmen i sting gut na redi long wasim o nogat.	No Yes		
Luksave long kamapim nambawan kopi: Fama imas klia na save olsem dispela pasmen em i nambawan kopi na drai gut o em ino drai gut.	No Yes		

[This question aims to assess the seriousness of assumed problems that may prevent the farmers from applying the Post harvest techniques. Explain the questions below and write the farmer’s responses in the table provided].

“Planti fama ino aplaim ol tingting o save bilong ‘Post harvest’ long wanem ol i panim planti hevi. Planti long ol dispela hevi i winim pawa o strong bilong ol fama long daunim. Bai mi kolim nem bilong sample hevi wei inap pasim yu long aplaim save bilong ‘Post harvest’. Bihain mi bai askim sampela kwesten long ol dispela hevi. [Explain one-at-a-time the problems given in the table below].

“Long skel bilong 1 igo inap 5, we 1 i makim.....” [Explain the rating scale below]

1= bikipela hevi tru 2= bikipela hevi 3= namel hevi 4 =liklik hevi 5= Nogat hevi

Q9. Wanem level bilong dispela hevi.....i stopim yu ino ken aplaim save bilong ‘Post harvest’?” [Mention the problems given in the table below][Circle farmer’s answer with the rating given in the table]

[Repeat Q9 for the rest of the problems given and circle the farmers rating in the table below]

Problems	1	2	3	4	5
“Nogat kopi masin: Mi nogat kopi masin bilong mi yet na dispela i stopim mi long katim kopi seri gut.	1	2	3	4	5
“Nogat klinpela wara: nogat klinpela wara klostu long kopi o haus na mi ino katim, o wasim kopi pasmen wantaim klinpela wara.	1	2	3	4	5
“Rot i bagarap: Rot bilong kisim kopi igo long maket i bagarap olgeta na dispela i mekim mi les long aplaim save bilong ‘Poshaviest’”.	1	2	3	4	5
Liklik kopi prais: Prais bilong kopi i daun tumas na mi save hat wok nating. Olsem na mi ino aplaim tumas save bilong ‘Post harvest’”.	1	2	3	4	5
Nogat hamamas prais long “quality” kopi: Ol baiya i baim gutpela na nogut kopi long wankain prais tasol. Dispela i save stopim mi”.	1	2	3	4	5
“Nogat moni: Mi ino gat moni long baim kopi masin o peim ol wok man long halpim mi long kopi. Dispela i save pasim mi”.	1	2	3	4	5
“Skul i hat: Treina i bin yusim hatpela toktok long skul na mi ino klia long planti samting long ‘Post harvest’”.	1	2	3	4	5

Q10. Yu fesim ol arapela hevi i pasim yu long aplaim ol save o tingting bilong ‘Post harvest’ long kopi o nogat? [Circle farmer’s response with only one of the options given below].

- a) **“No, ino gat ol arapela hevi.....”** [If the answer is no, please go to Q11]
b) **“Yes, mi fesim ol arapela hevi.....”** [If the answer is yes, ask farmer the following questions]:

- i. **“Plis tok klia long ol arapela hevi i pasim yu long aplaim save bilong ‘Post harvest’?”**
[Record the farmer’s responses in the table (i)].
- ii. **“Plis tok klia hau dispela hevi i pasim yu long aplaim Kopi Riabiltesen save long kopi?”**
[Mention the problem given by the farmer][Record farmer’s reason in the table (ii)]

Other problems (i)	Farmer’s explanation of the problem (ii)

Q11. Bipo yu igo insait long ‘Post harvest’ trening, yu bin igat sample hevi o ‘problem’ long lukautim gut kopi we yu bin laik bai dispela ‘Post harvest’ trening i ken halpim yu?” [Circle only one response given below].

- a) **“No, mi ino bin igat ol hevi”.....** [If the answer is no, please go to Q12]
b) **“Yes, mi bin igat ol sampela hevi”.....**[If the answer is yes, ask farmer the following questions]:

“Tokim mi ol hevi yu bin igat bipo long ‘Post harvest’ trening na yu bin laik bai trenin i halpim yu?” [Record farmer’s problems or responses in the table (i)]

“Long skel bilong 1 igo inap 5, we 1 i makim.....[Explain the rating scale below]

1= bikpela hamamas tru, 2= hamamas, 3= namel hamamas, 4 = liklik hamamas 5= nogat hamamas

Wanem level o mak bilong hamamas bilong yu olsem ‘Post harvest’ trening i inapim truhevi o ‘problem’ we yu bin igat bipo long trenin?”
(Mention farmer’s problem given in the table (i) below). [Record farmer’s responses in the table (ii)]

- i. **Plis givim tasol wampela rison long wanem as yu givim dispela skel o namba?**[Record farmers response in the table (iii)] [Repeat b) ii. and b) iii. for all the problems the farmer indicate]

(i) Farmers previous problems	(ii) Rating #	(iii) Main reason for rating

- ii. **“Long skel bilong 1 igo inap 5, we 1 i makim** [Explain the rating scale below]

1= bikpela hamamas tru 2= hamamas, 3= namel hamamas, 4 = liklik hamamas 5= nogat hamamas

long tokim em long kisim ‘Post harvest’ trening?” [Record farmer’s responses in the table (i)]

Plis givim tasol wanpela rison o as tingting watpo yu givim dispela skel o namba?

[Record farmer's responses in the table (ii)]

Rating (i)	Main reason (ii)

[Farmers process their coffee using methods that best work for them. Therefore this section aims to find out the farmer's CURRENT ways of processing coffee and why he or she is using these methods. Ask the farmer one-at-a-time the questions given in the table (i) below. For each question asked, write its corresponding answers in section (ii) of the table. First read Q12 and explain to the farmer. When the farmer is familiar with the type of information you are after, proceed with the other sub-questions].

Q12. “Ol fama igat we bilong ol yet long aplaim save bilong ‘Post harvest’ long kopi bilong ol long wanem ol i wok wantaim kopi long-pela taim na ol i bilip long wanem samting ol i mekim. Dispela kwesten i laik panimaut wanem ol save o tingting yu nau i aplaim long procesim kopi bilong yu. Mi bai kolim 6-pela eria bilong ‘Post harvest’ na askim wanpela kwesten long wanwan eria mi kolim. Yu mas tokim mi hau yu wok long ol dispela eria long kopi bilong yu. Long wanwan eria, plis tokim mi wanpela pasin tasol hau yu mekim wok. Ol 6-pela eria em olsem... [Go through the Post harvest areas].

(i) Rehabilitation areas	(ii) Farmer's current ways of applying the Rehabilitation techniques
“Wanem kain kopi seri yu o ol lain bilong yu save pikim olgeta taim?”	“Wanem as tingting bilong yu long pikim dispela kain seri?”
“Wanem wei yu save yusim olgeta taim long rausim skin bilong seri bilong yu?”	“Wanem as tingting bilong yu long yusim dispela wei long rausim skin bilong seri?”
“Wanem wei yu save yusim olgeta taim long stinim kopi bilong yu?”	“Wanem as tingting bilong yu long stinim pasmen kopi olsem?”
“Wanem wei yu save yusim olgeta taim long wasim kopi pasmen?”	“Wanem as tingting bilong yu long wasim kopi pasmen olsem ?”
“Wanem wei yu save usim olgeta taim long draim kopi bilong yu?”	“Wanem as tingting bilong yu long draim kopi olsem?”
“Wanem hap yu save olgeta taim putim pasmen kopi bipo long salim?”	“Wanem as tingting bilong yu long putim kopi pasmen olsem? “

PART D: FARMER BACK-GROUND INFORMATION

[This section is about collecting additional information from the farmer. Therefore it is very important that the questions are asked carefully and the answers are correctly recorded].

“Nau, yumi pinisim ‘survey bilong yumi wantaim ol sotpela kwesten”.

Q13. “Long amas krismas yu bin wok long kopi?”..... [Record farmer's response]

Q14. “Hamapela kopi diwai yu gat long kopi gaden bilong yu?” [Record farmer's response]

Q15. Long nau planim ol yangpela kopi diwai long gaden o nogat? Bai mi givim yu tingting na yu tokim mi”. [Circle only one option below as indicated by the farmer].

- a) Yes, mo wok long planim
- b) Yes mi plan long planim sampela bihain taim
- c) No, mi inap wantaim ol kopi mi gat nau

Q16. Wanem level bilong skul yu bin pinisim? Bai mi givim yu tingting na yu tokim mi *[Mention the options given below to the farmer and circle only the correct category indicated by the farmer].*

- a) Mi ino bin go long skul
- b) Mi pinisim prameri skul level (1-6)
- c) Mi pinisim hai skul level (7-10)
- d) Mi pinisim sinia hai skul level (11-12)
- e) Mi pinisim bikipela skul (Colis o univesiti)

Q17. “Wanem krismas bilong yu?”..... *[If the farmer is not sure, ask him/her to make an estimate]*

Q18. “Yu gat sampela toktok long mekim long dispela ‘Post harvest’ skul o nogat?”

- a) “No gat” ..*[If the answer is no, refer go to Q19]*
- b) “Yes mi gat sampela toktok long mekim”. *[If the answer is yes, ask]..*

Plis tokim mi wan o tupela bikipela tingting bilong yu? *[Record farmers response]*

.....

Q19. “Yu laik save long risalt o ripot bilong dispela survey o nogat?” *[Circle only one option]*

- a) Yes mi laik save
- b) No, mi ino laik save

20. *[What is the gender of the farmer you are interviewing? Please circle the option below]*

- a) Male
- b) Female

THE END OF SURVEY – *[Thank the farmer and remind him or her that it will take few minutes before we can move onto the next activity]*

Sample Postharvest Quiz: English

Introduction

The second part of the survey is a short quiz. The purpose of the quiz is to assess whether or not the farmers know the basic knowledge about coffee Postharvest. The quiz is very easy as the farmers are provided with three options from which only one correct answer can be chosen. You are required to read each question and options to the farmer and circle only the option which the farmer identifies as the correct answer. To maintain privacy and confidentiality of the farmer and the interviewer, codes will be used instead of real names and these codes will be provided by the researcher. Fill in the farmer, group, and recorder codes, together with the other information such as province, village, and date. All farmer instructions are in Tok Pidgin. The quiz should take 10 minutes.

Recorder Code #:Group Code #: Farmer Code #:

Province:..... Village: Date: Farmer gender: Male/Female (circle)

Q1. Which type of cherry is recommended to be picked in order to produce quality coffee?

- a) Unripe and green cherries
- b) Over-ripe and dry cherries
- c) Red ripe cherries only.

Q2. To minimise wear and tear on the coffee pulper, which type of cherries are recommended to be pulped?

- a) Any green or half-ripe cherries
- b) Dried and rotten cherries
- c) Red ripe cherries only.

Q3. When is the appropriate time to pulp cherries so that quality is not spoiled?

- a) On the same day as picked. If pulping is delayed for 12 – 24 hours due to some reasons, always soak the cherries in clean water and pulp them immediately
- b) Cherries do not go bad. You can pulp them at any time after, even a week later.
- c) In PNG, the cherries can be sun dried and later sell them.

Q4. In order to produce a good clean quality coffee, what type of water is needed for pulping and washing coffee?

- a) Muddy and dirty water is recommended
- b) Clean and running water is recommended
- c) Water polluted with chemical is recommended.

Q5. To produce quality coffee parchment, which type of fermenting boxes are recommended?

- a) Old rusty metal fermenting boxes are good so long as they are not broken
- b) Wooden fermenting boxes with a lot of holes are recommended
- c) Fermenting coffee by burying the parchment bags among coffee pulp is the best option.

Q6. What are the major causes of un-even fermentation in coffee?

- a) Presence of a lot of skin, un-ripe cherries and foreign matter in the fermenting box
- b) If the cherries are pulped very well and only good parchment is fermented
- c) If good wooden fermenting boxes are used, fermentation will be seriously affected.

Q7. How do you tell that fermentation is successfully completed?

- a) When fermented parchment is grasped in the hand and feels gritty or is sand-rough
- b) If the parchment feels slippery and the mucilage is still sticky around the beans
- c) There is no such thing as a fermentation test. Just wash the parchment when you think it is ready.

Q8. Which method of parchment drying is good for quality coffee?

- a) Drying on canvas beside the road where traffic is very busy
- b) Drying on a well ventilated raised table of 1 meter above the ground level and away from traffic
- c) Dry your parchment using banana leaves which can be easily blown about and the wet parchment getting contaminated with soil and dirt.

Q9. Which statement best describes the characteristics of a well dried parchment?

- a) Parchment is clean, husk comes off easily when rubbed and bean is very hard to bit with teeth
- b) The parchment is dirty, the husk is sticky and does not come off easily and bean is easily broken with teeth
- c) There is no way you can tell the difference. All the parchments are the same.

Q10. Circle the option that describes the best place to store the parchment after completing drying?

- a) Inside a house where you sleep – rest the bag(s) on the bare soil
- b) Inside a house against metal or on rusty iron sheets
- c) Inside a cool and dry, well ventilated room or building.

EM TASOL LONG TESTTENK YU TRU

Sample Postharvest Quiz: Tok Pisin

Introduction

The second part of the survey is a short quiz. The purpose of the quiz is to assess whether or not the farmers know the basic knowledge about coffee Postharvest. The quiz is very easy as the farmers are provided with three options from which only one correct answer can be chosen. You are required to read each question and options to the farmer and circle only the option which the farmer identifies as the correct answer. To maintain privacy and confidentiality of the farmer and the interviewer, codes will be used instead of real names. Therefore fill in the farmer, group, and recorder codes, together with the other information such as province, village, and date. All farmer instructions are in Tok Pidgin. The quiz should take 10 minutes.

Province:Village: Date: Recorder Code #:

Group Code #: Farmer Code #: Farmer gender: Male / Female (circle)

“Namba tu hap bilong dispela wok panim aut em i sotpela ‘quiz’ o ‘test’ long Kopi ‘Postharvest’. Dispela test em ino bilong pasim o feilim ol fama, nogat. As tingting bilong dispela test em long luksave olsem skul ‘Postharvest’ i skulim ol fama long ol impotent tingting bilong ‘Postharvest’ o nogat. Dispela test em isi tru long wanem olgeta ansa we yu inap tingting na givim istap pinis long pepa. Taim mi askim ol kwesten, mi bai tokaut long tripela tingting. Yu bai tokim mi wanem bilong ol ansa i tru-pela”. Dispela test bai kisim 10 minit.

Q1. Long kamapim gutpela ‘quality’ kopi, wanem kain seri i gutpela long pikim?

- a) Seri we em ino mau – olsem grin seri
- b) Ol drai o sting seri
- c) Seri we i mau na ret olgeta.

Q2. Long kamapim gutpela ‘quality’ kopi, wanem kain seri em i gutpela long kopi masin i ken brukim o palpim?

- a) Seri we em ino mau – olsem grin seri
- b) Ol drai o sting seri
- c) Seri we i mau na ret olgeta.

Q3. Long kamapim gutpela ‘quality’ kopi, wanem taim tru yu mas masinim kopi seri?

- a) Long sem dei yet yu pikim seri. Sapos nogat, orait putim andinit long wara na masinim hariap long narapela dei
- b) Kopi seri ino inap bagarap. Yu ken pikim seri nau na masinim bihanim long 5-pela deis.
- c) Yu ken draim kopi seri wantaim skin na bihain salim.

Q4. Long kamapim ‘quality’ kopi, wanem kain wara i gutpela long masinim na wasim kopi?

- a) Baret wara we igat graun malomalo na deiti
- b) Klinpela wara we i save ron olgeta taim
- c) Deiti wara we i pulam long marasin nogut.

Q5. Long kamapim ‘quality kopi’, wanem bilong ol dispela boxis bilong stinim kopi i gutpela?

- a) Boxis we ol i wokim long aion o ‘metal’ samting
- b) Boxis we ol i wokim long diwai na igat planti hul
- c) Putim ol kopi beg namel long ol kopi skin na karamapim ol wantaim kopi skin.

Q6. Wanem ol samting i mekim na ol pasmen ino inap sting gut long boxis?

- a) Sapos kopi pasmen i mix wantaim skin kopi, seri ino mau, lif kopi, graun na ol samting olsem
- b) Sapos kopi masin i palpim gut kopi seri, pasmen kopi ino inap sting gut long boxis
- c) Sapos fama i yusim gutpela diwai boxis long stingim kopi, kopi pasmen bai ino nap sting gut.

Q7. Wanem bilong ol dispela tingting i tok stret olsem pasmen we yu stingim insait long boxis i redi tru long wasim?

- a) Taim yu holim strong sting pasmen long han na ol pasmen ino wel tasol ol i luslus olsem wes-san. Dispela i min olsem pasmen i sting na redi long wasim.
- b) Taim yu holim strong sting pasmen long han na pasmen i wel na pas long han. Dispela i min olsem pasmen i redi long wasim
- c) Ino gat wei long sekim olsem pasmen o redi o nogat. Lukluk long ai, skelim long tingting na wasim pasmen.

Q8. Wanem wei i gutpela long draim wet pasmen nau tasol yu wasim?

- a) Draim wet kopi pasmen klostu long bikrot o rot bilong kar antap long sel.
- b) Draim pasmen longwe long bikrot or rot bilong kar na antap long teibol we igat sail o blain
- c) Draim tasol long banana lif we win inap sakim na ol pasmen i ken kapsait nabaut na deiti.

Q9. Wanem bilong ol dispela ansa i tok stret olsem pasmen i drai gut o nogat?

- a) Pasmem em i klin, skin bilong pasmen i tekawe isi tru taim yu rabim long han na grinpela kopi bin insait long pasmen i hat tru to long brukim o putim mak bilong tit long en.
- b) Pasmem i deiti, skin bilong pasmen i pas long bin and taim yu brukim bin wantaim tit, bin i bruk isi tru.
- c) Olgeta pasmen i wankain tasol, maski ol i drai gut o wet yet.

Q10. Wanem bilong ol dispela ansa i tok stret long gutpela hap bilong putim pasmen taim yu draim gut pisin na redi long salim?

- a) Insait long sem haus we yu save slip, maski haus igat planti smok. Sanapim pasmen beg long graun nating
- b) Sanapim antap long kapa aion insait long sem haus bilong slip, maski haus igat smok.
- c) Insait long gutpela kol na drai ples we igat planti gutpela win. Haus i mas no gat smok na sanapim kopi beg antap long blain o samting tasol ino antap long kapa aion.

EM TASOL LONG TESTTENK YU TRU