ACTION RESEARCH BASED CASE STUDY ON ADOPTING IT FOR SMALL AND MEDIUM ENTERPRISES

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DECLARATION

I declare that this is my own work and this thesis does not incorporate without acknowledgement any material previously submitted for a Degree or Diploma in any other University or institute of higher learning and to the best of my knowledge and belief, it does not contain any material previously published or written by another person except where the acknowledgement is made in the text.

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DEDICATION

I take this opportunity to dedicate this thesis to my late father Dr. Dias Mallikarachchi. Further I thank my mother and wife giving me courage and support for making this a success.

ACKNOWLEDGEMENT

This research may not be completed with success without the support and guidance from many people. I would like to extend my humble gratitude to the people who guided and directed me towards the completion. It may not be an easy journey with the absence of those parties.

Firstly, I would like to thank my supervisor Dr. Amal Shehan Perera who guided throughout the project timeline to achieve this research milestone. The commitment and the timely advice given by the supervisor were helpful in delivering the deliverables on time.

I would like to thank Dr. Dilum Bandara for evaluating my presentations and giving feedback on improving them.

I take this opportunity to thank the owner and manager of the Dolabodakanda estate for giving maximum support and giving the opportunity to conduct my research on their tea estate. I was very lucky to conduct the research on their difficult time. At the end of the research the owner and the manager were impressed on the research outcomes and it was a successful project at the end.

Action Research Based Case Study on Adopting IT for Small and Medium Enterprises

Abstract

Sri Lanka is a major tea supplying country to the World tea market. The Tea Small Holdings (TSHs) sector is the main green leaf provider. However, for the past five years, the national tea production is in a declining trend. Recently, researchers have attributed this decline to lack of productivity, high production costs and labour shortage while poor business practices and poor knowledge on cultivation techniques are the main reasons for lack of productivity in TSH sector. In addition, there is a lag in distributing knowledge and support from Tea Small Holdings Development Authority (TSHDA) to TSHs.

Information and Communication Technology (ICT) has been acknowledged in the agricultural sector in the form of information sharing networks for supply chain management and decision support software systems such as 'precision agriculture'. Several studies have suggested to adopt ICT to tea industry for better coordination and for better information sharing. The Kenya Tea Development Agency (KTDA) considered information technology as a facilitator for competitiveness. However, there are inhibiting factors when adopting Information Technology (IT) to tea small holdings.

This is an action research based case study that develops an IT system for a tea small holding in Sri Lanka, for its internal operations. The Design science research methods have been used for the development of the system. The adoption of the technology made use of the concept of IT therapy to overcome certain barriers such as lack of IT knowledge.

The case study revealed a successful IT system for the internal operations of TSHs. Further research is needed to find the effects of the system on the productivity of TSHs. The adoption of IT could be facilitated by giving IT therapy. The study suggested to give free IT therapy to TSHs prior to the investment on adopting IT by a government or non-government agency.

Key words; Tea Small Holdings, Adoption of IT, Action research, DSR, IT Therapy

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LIST OF ABBREVIATIONS

Abbreviation	Description
CEO	Chief Executive Officer
DSR	Design Science Research
DSS	Decision Support System
ICT	Information Communication Technology
IS	Information Systems
ISP	Internet Service Provider
IT	Information Technology
KACE	Kenya Agricultural Commodity Exchange
KTDA	Kenya Tea Development Agency
PA	Precision Agriculture
SLTB	Sri Lanka Tea Board
SMEs	Small Medium Enterprises
SSM	Site Specific Management
TRI	Tea Research Institute
TSHDA	Tea Small Holdings Development Authority
TSHs	Tea Small Holdings

LIST OF APPENDICES

Chapter 1

1. INTRODUCTION

1.1 Introduction

This chapter, gives an introduction to the research, what motivated to do the research, the problem statement, research objectives and questions, importance and benefits of the research and a brief overview of all chapters.

1.2 Introduction to Research Project

Information technology (IT) supports present business in many ways. Adoption of IT to a business results in great improvements in its productivity. However, the way that small enterprises adopt IT is different from that of large enterprises. Small enterprises are slow in adopting IT. The reason for this slowness had been acknowledged in the past literature. There are internal factors such as owner characteristics and organizational characteristics that hinder Small and Medium Enterprises (SMEs) from adopting IT. Also, there could be external factors that prevent adoption of IT to an SME.

There are stages of IT adoption. Recent studies have developed conceptual models for successful adoption of IT for SMEs. Also, studies suggest the need of external support for SMEs to adopt IT. However, most of the studies were based on survey data rather than practical experiments of adopting IT to a SME in the real world situation.

This study is an experiment of adoption of IT to an SME in the agriculture sector by providing IT therapy. IT therapy is providing with IT solutions for immediate, perceived IT needs or IT needs recognized by an IT expertise. IT therapy enhances low cost IT solutions and can be used to overcome certain barriers of adopting IT.

The study conducted as a case study and utilized Design Science Research methods to develop an IT solution for the TSH and used Action Research strategy to assess the feasibility of implementing IT solution.

The study proposed a simple, affordable system using spreadsheets and introduced useful web links. The system was iteratively evaluated for six months in a small tea estate and its feasibility was assessed based on feedback.

1.3 Background and Motivation

Sri Lanka has been a major supplier of made tea and bulk tea to the world tea market. Tea Small Holdings sub - sector has been the main green leaf provider in the Sri Lankan tea industry, accounting for 74.5% of the national tea production in 2016. However, there is a declining trend in the national tea production for the past four years. The recent literature have revealed following reasons for this continuous decline; adverse climate changes; shortage of labour, lack of land and labour productivity and high production costs (Thushara, 2015).

The Tea Research Institute (TRI), Sri Lanka Tea Board (SLTB) and Tea Small Holdings Development Authority (TSHDA) have been working for the development of tea industry. The government has been given a concession for fertilizer and financial and technical support for replanting and infilling. The TSHDA is conducting workshops and provide extension services to rural Tea Small Holdings (TSHs). Samaraweera, G. C., Ping, Q., & Yanjun, L. (2013) & Perera, (2014), show that TSHs in certain rural area are not receiving this extension service and information.

Thus, it is apparent that there is a gap or delay between provision of tea promotion activities and reception by tea growers and this gap must be eliminated and information should be passed from the top level to the grower level. Samaraweera (2013), suggested that most efficient sources of technology transfer are through Tea processing factories and individual methods (field to field method). The advances in ICT have been widely used by other industries to improve their productivity. Kenya, the main

competitor of Sri Lanka in the world tea market, has adopted IT to their tea industry to facilitate information sharing. Therefore, Sri Lanka should consider adopting IT to tea industry. Further it should mainly focus on TSHs as they play a major role in national tea production.

1.4 Problem Statement

Even though TSHDA, SLTB, and TRI have been giving various support to TSHs there is a delay in passes information from the top level to tea grower level. Therefore to eliminate this gap the tea industry can make use of IT. However, there was little evidence for adopting IT to TSHs.

1.5 Research Objective and Questions

The research objective is;
'How can we introduce ICT to TSHs to improve their productivity?'

Research Questions

Initially, it was necessary to identify the IT needs of TSHs. Therefore the research was done as a case study and a TSH was selected. The first question was formulated as;

Q1. What are the Information Technology (IT) needs of a TSH?

These needs could have already been perceived by the TSH or will have been identified by the researcher by observations. Therefore the question was again divided into two sub questions as;

Q1.1 What are the IT needs perceived by the TSH?
This can be achieved by conducting interviews with the top management of the TSHs

Q1.2 What are the IT opportunities identified by the researcher?
This can be achieved by observation.

Secondly, it was necessary to find out IT solutions to address the above needs/ opportunities. Therefore, the second question was formulated to address IT solutions.

Q2. What are the available appropriate IT solutions for above needs / opportunities?

As there were evidence of IT applications that could be used for tea industry the question was divided into three sub questions as;

Q2.1 What are the available IT solutions that can be applied for the TSH?
Available IT solutions can be identify by observing other TSHs using IT systems or referring to past literature reviews.

Q2.2 What are the innovative IT solutions for the TSH?
Need to develop suitable IT systems and test them in TSHs.

Q2.3 How to develop an innovative IT solution for the TSH?
This can be achieved by developing an IT system according to standard research methodologies. (E.g.- Design Science Research (DSR))

The next research question is to identify potential barriers in adopting IT.

Q3. What are the barriers in implementing IT for a TSHs and how to overcome them?

The barriers can be identify by conducting a literature survey and interviewing TSHs owners.

Finally, it is necessary to find if implementing IT to the TSH makes any effect on its growth. Thus the final question was formulated as;

Q4. How does implementing IT improve a TSH?

After implementing an IT solution to a TSHs, the day to day operations can be observed whether they have improved or not. Interviews with stakeholders could be conducted to get the feedback on the implemented system.

1.6 Importance and Benefits of the Study

Most of the TSHs owners record their day to day operations manually. This research attempts in developing an IT solution for a selected TSH and observing the improvement in the business operations. The system does not customize for the selected TSH. Therefore the system can be used for other TSHs. Manual recording leads to time consuming and high probability of occurring errors in employee salary calculations. The proposed system might overcome the limitations in the manual system. The proposed system is cost effective and user friendly. The TSH owner has to bear only the initial cost of purchasing a computer with the specified software. The owner can operate the system by himself and eliminate hiring an IT expert for operating. It can improve productivity by reminding optimal days for plucking. Further the TSH owner has the benefit of comparing each month's records by referring to the graphs and charts. This helps in getting a big picture on the business direction and ease of use for decision making.

1.7 Organization of the Research

The research consists of following chapters and a brief overview of each chapter is given below.

Chapter 1: Introduction

This chapter, gives a research introduction, what motivated to do the research, problem statement, research objective and questions and further describes the importance and benefits of the system.

Chapter 2: Literature Review

This chapter describes past literature on Information Technology (IT), IT adoption, IT sophistication, the benefits of IT adoption, difference between IT adoption for small and large enterprises, characteristics of SME, factors affecting adopting IT for SMEs, adoption of IT for tea industry, importance of TSH in the tea industry and adoption for IT for TSHs. Past researchers frameworks and models also been elaborated in this chapter.

Chapter 3: Background to the Research and Case Study

This chapter begins by explaining the tea industry and its position in Sri Lankan economy and the major role played by TSHs for the national tea production. It further describes functions of TSHs. Finally it gives a description on the selected TSH.

Chapter 4: Methodology

This chapter discusses the research methodologies and research strategy used by the researcher. Further the methods of data collection and data analysis have been explained.

Chapter 5: Proposed Information System

This chapter describes the proposed system for the TSHs. The chapter includes indications, the minimum hardware and software requirements, and the components which includes in the system.

Chapter 6: Result and Validation

This chapter discusses how researcher validated the system before handing over to the TSHs owner and describes post-implementation feedback results.

Chapter 7: Discussion

This chapter discusses how researcher has achieved the research objectives and how researcher has answered the research questions at the end of the study. Further

researcher has identified the barriers that came across when achieving the research objectives and came up with solutions to overcome those.

Chapter 8: Conclusions and Recommendations

This chapter describes the conclusions made by the researcher and what are the recommendations on how can ICT be introduced to TSHs. Further, discusses the future research work.

Chapter 2

2. LITERATURE REVIEW

2.1 Introduction

This chapter describes about the past literature on Information Technology (IT), IT adoption, IT sophistication, the benefits of IT adoption, difference between IT adoption for small and large enterprises, characteristics of SME, factors affecting adopting IT for SMEs, adoption of IT for tea industry, importance of TSH in the tea industry and adoption for IT for TSHs.

2.2 Information Technology (IT)

The term Information Technology (IT) had been given various definitions during the past 20 years. Earlier in 1990s, it had been defined as computer software and hardware solutions that provide support for management operations and organizational strategies (Onn, C. W., & Sorooshian, S., 2013). A recent review on definition of IT described it as systems of information, Internet, information and communication related technologies (ICT) including the software, network and hardware that process or transmit information to enhance the effectiveness of individuals and organizations (Onn, 2013).

2.3 IT adoption

IT adoption can be defined as physical utilization of IT in supporting and conducting business (Ghobakhloo, M., Sabouri, M. S., Hong, T. S., & Zulkifli, N., 2011).

2.4 IT sophistication

IT sophistication is another term used by past researchers to describe the 'Level of IT adoption'. IT sophistication is measured in three dimensions; the extent of IT usage, the intensity of IT usage and integration of Information Systems (IS) (Ghobakhloo, et

al 2011). Kapurubandara, M. (2009), used two categories in staging IT sophistication; internal and external. The term 'Internal' with regard to IT sophistication, denotes use of IT for internal purposes of the organization. External IT Sophistication implies the use of IT by an organization to communicate with the external world.

2.5 Stages of IT adoption

According to Kapurubandara (2009), the stages of internal IT sophistication range from 'No computer' to 'effective network of computers' while stages of external IT sophistication varied from 'no website' to 'effective e-commerce website' (Table 2.1).

Table 2.1: Level of IT adoption

Stage	Internal	External
1	No computers used. Operations done manually.	No website.
2	Use computers and standalone software used.	Organization has its own domain name for marketing purpose.
3	People work as teams and presence of computer networks.	Website providing two –way flow of information. Helps to answer structured queries of online ordering, order tracking.
4	Databases and information systems been interlinked. Information is shared across the enterprise.	Secure Web server to facilitate financial transactions or a link to a payment gateway to process online payments.

Source: Kapurubandara, M. (2009). A framework to e-transform SMEs in developing countries. *The Electronic Journal of Information Systems in Developing Countries*, *39*.

2.6 Why adoption of IT?

The rapid computing power, communication capacity and innovativeness of IT, drive enterprises to adopt IT into their business processes. Incorporating IT has proved to increase the productivity of a business (Ghobakhloo, 2011, Aleke, 2011).

Potential benefits of IT to SMEs (Ghobakhloo 2011, Wolcott P 2007);

1. Reduce production and labour costs
2. Improve business process and organization flexibility

3. Improvements in decision making efficiency
4. Improve customer/supplier satisfaction
5. Discovery of new business opportunities
6. Access to market information
7. Stimulate businesses to be competitive

Despite the potential benefits of IT, there were reported cases of unsuccessful or very slow adoption of IT to SMEs (Ghobakhloo, 2011, Nguyen, 2009). Forcing to implement IT to SMEs could be a major reason to fail. Therefore the redesigning process of the business must be well planned to avoid losses of adoption of IT.

2.7 Difference between SMEs and Large scale enterprises in adoption of IT

There is a significant difference between large enterprises and small enterprises in adopting IT for the business process (Ghobakhloo, 2011). Large scale enterprises invest without hesitating on adoption of IT and benefit by increasing sales and reducing costs (Ghobakhloo, 2011). Small and medium enterprises differ from that of large enterprises and adopt IT incrementally.

2.8 Characteristics of SMEs

According to the criteria published by the ministry of industry and commerce SMEs can be categorized as in Table 2.2.

Table 2.2: Characteristics of SMEs

	Medium	**Small**	**Micro**
No of Employees	300 -51	50 – 11	10>
Annual turnover Rs. Million	750 - 251	250 - 16	15>

Source: National Policy framework for small and Medium Enterprise Development (2015) *Ministry of Industry and commerce Sri Lanka*

Although, the World Bank defines SMEs as enterprises consisted of less than 99 employees.

There are a few characteristics of SMEs that account for the slowness of adoption of IT; SMEs may have limited access to marketplace, flexible structure, globalization constraint, quick decision making and lack of resources such as knowledge, skills and finance. Arendt (2008) revealed that the lag was mainly due to the lack of knowledge of owners and managers and not due to financial difficulties or deficiencies in the technology.

2.9 Factors affecting Adoption of IT to an SME

Thong et al, (1995) described 2 types of factors; individual characteristics and organization characteristics that influence on IT adoption (Table 2.3). It was reported as CEO's positive characteristics were more important than organizational characteristics in driving SMEs to adopt IT.

Table 2.3: Factors affecting Adoption of IT to an SME

Individual characteristics	Organizational Characteristics
CEO innovativeness	Business size
CEO's attitude towards adoption of IT	Competitiveness of the environment
CEO's knowledge on IT	Information intensity

Source: Thong, J. Y., & Yap, C. S. (1995). CEO characteristics, organizational characteristics and information technology adoption in small businesses. *Omega*, *23*(4), 429-442.

Many other factors can affect the IT adoption process and can be categorized into internal and external factors (Ghobakhloo, et al 2011, Kapurubandara, M 2009). If the internal or external factors are positive then it can be a driving factor in adopting IT else can be a barrier.

2.9.1 Internal Factors

Internal factors exist within the organization and can be controlled by the organization. According to Irefin et al, (2012) cost was the most influencing factor in adopting ICT by SMEs. (Irefin, I. A., Abdul-Azeez, I. A., & Tijani, A. A. 2012). Further, Irefin et al, (2012) explained lack of ICT infrastructure is the second most inhibiting factor in the adoption of ICT by SMEs. However, Arendt (2008), claims that the lack of IT knowledge was the most the powerful hindering factor. Other internal factors found from the past literature have been listed below (Table 2.4). Further, Irefin et al, (2012) stated that management support has a positive relationship to adoption of IT. If there is high level of management support, there is a high chance of adopting IT.

Table 2.4: Internal Factors

Awareness on IT
Confidence to handle IT
Trust on external IT expertise
Resistance to adopt a new technology
Environmental pressure
IT – enabled organizational improvements
Mismatch between technology and the business
Inadequate IT user skills
Troubleshooting skills
Inadequate IT development capability
IT planning ability
IT knowledge
Financial capability
Time to learn and do IT tasks
Information about grant opportunities, technology, legal services etc.

2.9.2 External Factors

External factors exist outside the organization and cannot be controlled by the organization (Table 2.5). According to Irefin et al, (2012) there should be adequate government support when adopting IT to SMEs. There is a positive relationship between receiving government support and adoption of IT for SMEs. Most of the TSHs are in rural areas and do not have the necessary infrastructure facility for adopting IT for SMEs.

Table 2.5: External Factors

Infrastructure for connectivity
Fast developing innovations in technology
Information processing capacity of a given IT
Utilitarian value of IT
Excessive symbolic value of IT
Context and culture
Competitive pressure
Poor operational procedures and IT support

2.10 Adoption of Information Technology to Agriculture

India has an agriculture related network called e-Chaupal for farmers; Thailand is using a multi-lingual internet portal called 'AIN – Agriculture Information Network' for farmers, field officers and policy makers to access information; Philippines also have several e-commerce applications to provide agriculture related information.

'Precision Agriculture (PA)' or Precision Farming or Site Specific Management (SSM) has been used for agriculture in different parts of the world for more than 25 years. PA is a management assisting programme utilizing satellite maps and colour spectrum of light to analyze yield of a crop by generating 'Yield maps' (Blackmore, 2003). It has been applied in tea industry also. The software provides a 'Yield map' indicating information about the weight of the tea plucked, the identity of the Plucker, and from

which block the tea came from. These data could be used in decision making. However PA is effective for large scale crops (Mulla, 2013; Blackmore, 2003; Bramley, 2009).

2.11 Adoption of Information Technology to Tea Industry

Past literature gives several examples for adoption of IT for the tea industry. Similar to the Precision Agriculture management system, a Decision Support System (DSS) has been developed for St. Coombes estate, a Sri Lankan state sector estate, to utilize the available land area by proper soil conversion methods along with environmental protection methods (Gunatilake, J., Shyamalie, H. W., & Wellala, N. N. K., 2012).

A study was done in Sri Lanka to find out the ICT use by corporate sector plantation managers (Samansiri, 2014) and revealed that age has a negative effect on use of IT as more elder and experienced plant managers used printed technical material to retrieve information. The study also claimed that auction tea prices, labour related information and reasons for yield decline were the 'frequently sought' types of information by plantation managers and 'mobile phones' were the easiest and frequently used communication method while 'printed technical material' were the most useful method to get tea related information as perceived by plantation managers. All plantation managers participated in that study had mobile phones and land lines while 77% had e-mail and Internet facilities.

Although Kenya has been using IT in their tea industry, Oluoch (2015), revealed 83% of the users had at least one problem in adoption of IT; the cost of IT, lack of IT fluency and training and lack of infrastructure for IT and the study has recommended a 'tea rural knowledge centre' (Oluoch, 2015).

In Sri Lankan tea industry, most of the TSHs are in the rural area and there is a delay in receiving the information from the SLTB to the growers (Perera, P 2014). The delay in information passing from the top management to the ground level growers is due to not having proper network of all TSHs.

In Kenya, the KTDA has computerized all the tea buying centres and KACE uses ICT to disseminate the information received from buying centres to the ground level workers (Oluoch, J., & Osida, J. 2015). Oluoch (2015) further stated that mobile phones been frequently used and 60% of the participants in the tea industry uses some form of ICT.

2.12 Importance of TSHs in the Tea Industry

TSHs contributed 74.5% to the tea production in the year of 2016 (Figure 3.7). This figure has been increasing for the past five years (CBSL 2016) and TSH sector has been the main green leaf supplier for the national tea production. The quality of the made tea is depends on the quality of the tea shoot. Thus the quality of the Sri Lankan tea is on the hands of TSHs.

Not only Sri Lanka, other tea producing countries such as Kenya, Vietnam, Japan also dominated by TSHs.

2.13 Adoption of Information Technology to TSHs

Most of the TSHs are in rural areas in Sri Lanka. According to past literature rural TSHs do not receive newest information from higher authorities (Samaraweera, G. C., Ping, Q., & Yanjun, L. 2013; Perera, 2014). Adoption of information technology is necessary for receiving and sharing information and to be competitive in the market. The majority of the TSH owners do their operations manually. They are not aware of the use of IT for their day to day operations. Since there is a lack of awareness on benefits of IT, adopting IT for TSH is a challenging task. According to the definition of SME, if we consider a TSH as a SME, past researchers have identified some factors why SME owners are reluctant to adopt IT for their businesses (Thong, 1995; Arendt, 2008; Kapurubandara, 2009);

- Lack of trust in the system- Have a feeling that it would not work in TSHs

- Lack of IT knowledge and unable to identify the benefits from the system
- Lack of financial capabilities to invest on the system.

The main reason identified for the above mentioned factors was the lack of sufficient IT literacy of the owner.

2.13.1 IT therapy

Wolcott stated that the inadequate IT literacy can be overcome by providing IT therapy to the owners of the TSHs. IT therapy is giving IT assistance to individuals or organizations to solve immediate, strongly perceived IT needs (Wolcott, 2008).
IT therapy attempts at producing low cost solutions and leads to the development of economy (Wolcott, 2008). Qureshi (2008), argued that by giving IT therapy can overcome the lack of awareness on IT, lack of confidence on IT, and lack of IT knowledge.

2.13.2 Action Research

An action research is a qualitative form of research strategy that brings about a change in an organization or a community while studying on the same change (Lewis, Saunders & Thornhill, 2009). Wolcott, 2008 defined action research as "the application of tools and methods from the social and behavioral sciences to practical problems with the intention both of improving the practice and of contributing to theory and knowledge in the area studied." Although originally it was used for social science research, currently the action research concepts are used in other research fields including Information Systems (IS) development. There are several forms of action research (Adelman, C. 1993) as classified in Table 2.6.

In terms of participatory action research, the researcher may participate in doing a particular action for the organization or giving consultation; the researcher understands the organization's situation and helps the client to gain necessary skills to overcome issues, a process called 'process consultation'. While the owner or a senior manager of

the organization is called the 'client or sponsor' who in turn gives the authority to change certain business processes (Adelman, C. 1993).

Table 2.6: Types of Action Research

Type of Action Research	Description
1. Diagnostic	The researcher intervenes in an already existing situation, diagnose the problem, and recommend remedial measures.
2. Participatory	The researcher must be involved in the research process from the beginning recognizes the need for a particular remedial action. This type is useful in disclosing particular and local facts
3. Empirical	Record keeping and accumulating experience in day – to – day work with a succession of similar groups. This type could be useful in clinical medicine.
4. Experimental	Uses a controlled study to test relative effectiveness of various techniques in nearly identical situations.

Source: Adelman, C. (1993). Kurt Lewin and the origins of action research. *Educational action research*, *1*(1), 7-24.

The action research is not a linear path to find the answer, rather repetitions consisting of observation, planning and action (McNiff, J. 2016). Action research framework is an iterative process which includes diagnosing, action planning, action taking, evaluating and learning (Susman, G. I. 1983) (Figure 2.1).

The action research framework can be described as either of the 3 ways; as iterative cycles (Figure 2.1), as a spiral (Figure 2.2) or as a flow chart (Figure 2.3).

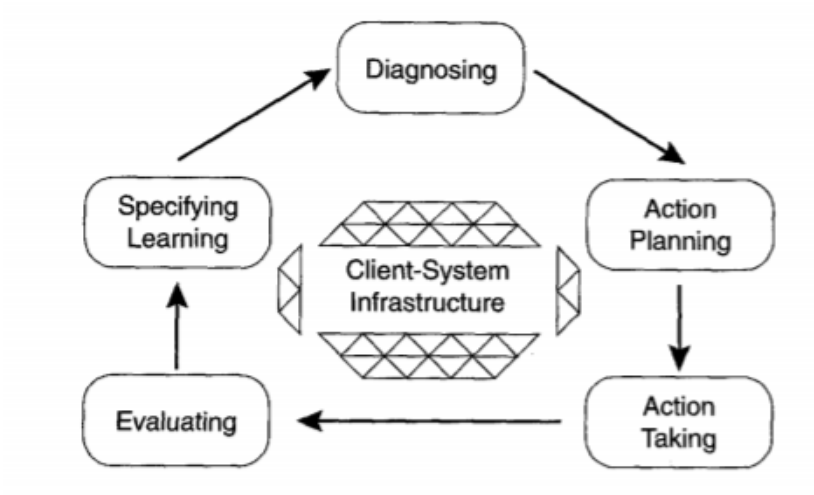


Figure 2.1: Action Research Cycle

Source: Susman, G. I. (1983). Action research: a sociotechnical systems perspective. *Beyond method: Strategies for social research*, 95-113.

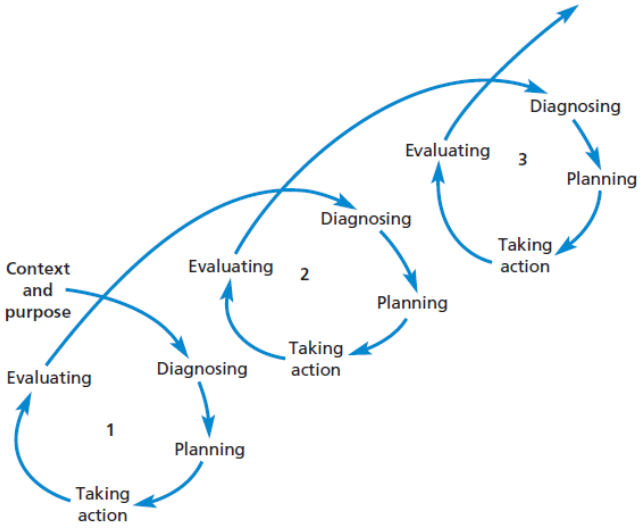


Figure 2.2 Action research spiral

Source : Saunders, M. Lewis, P. Thornhill, A. (2009) Research methods for business students 5th ed, 179

Another action research model, which is named as Systems model of action-research process was introduce by using the Kurt Lewin change theory three step model (Figure 2.3).

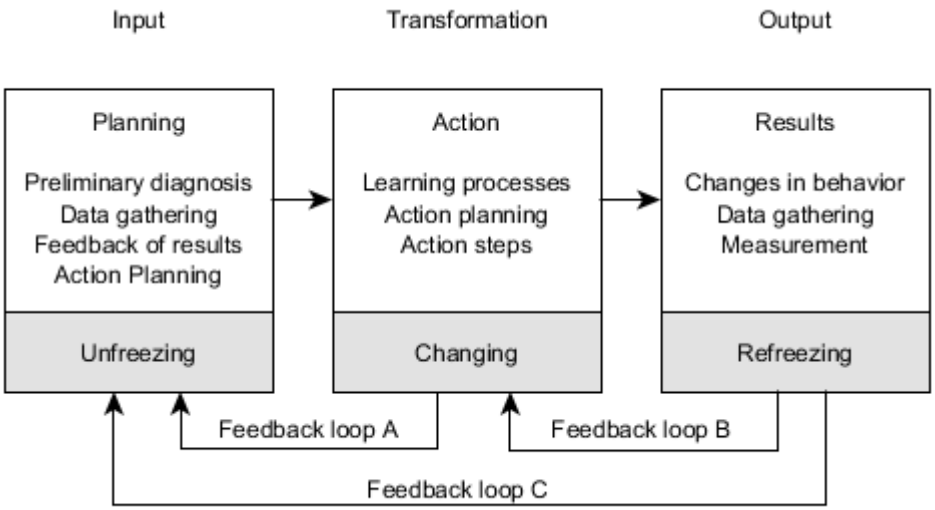


Figure 2.3: Systems model of action-research process

Source: Lewin, K. (1958). Group Decisions and Social Change'in EE Maccoby (ed.) Readings in Social Psychology. *New York: Holt, Rinehart and Winston*.

In the above model (Figure 2.3), in the unfreezing stage the IT needs must be identified by data gathering. The next step is to develop solutions to meet these IT needs. Finally, a feedback from the stake holders should be gained to assess whether the all needs are met. This is a continuous process and once the solution is finalized based on stakeholder needs, do not make any changes.

2.13.3 Design Science Research (DSR)

Design Science Research (DSR) methodology is an iterative process in developing systems. Hevnor (2007), stated that when developing a new system first need to have an environmental scanning and identify the potential IT needs. Develop a solution to meet the IT needs. Check whether the solution meets all the IT need if not examine the lessons learned from each iteration and again add the missing features to the system. This process iterates until the researcher meet all the required IT needs. DSR methods

provided the ability to re-designing and re-testing as the methodology was suitable for messy and 'wicked' problems (Hevnor, 2007) (Figure 2.4).

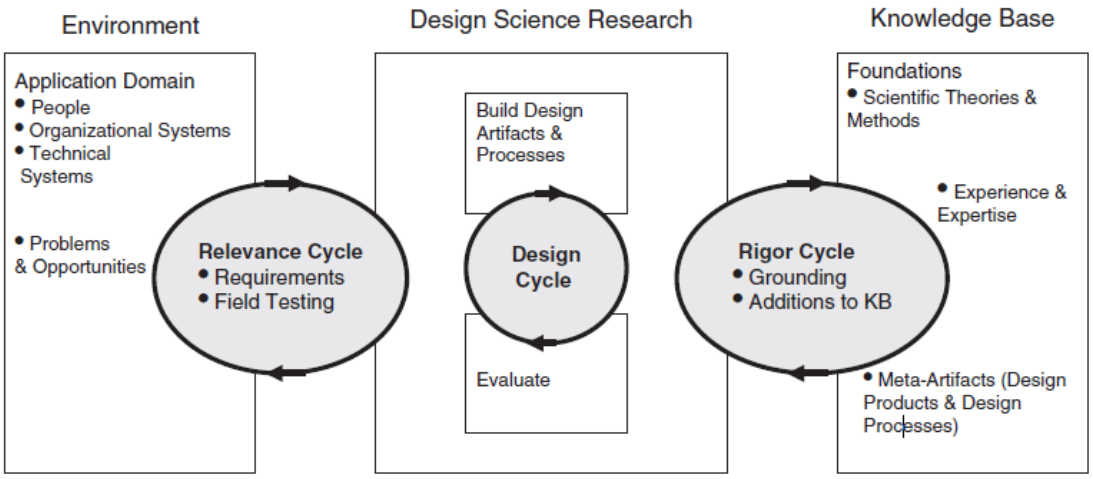


Figure 2.4: Design Science Research cycles
Source: Hevner, A. (2007). A three-cycle view of design science research, *Scandinavian Journal of Information Systems* 19 (2), pp. 87–92.

2.14 Chapter Summary

According to past literature there are many factors affecting in adopting IT for SMEs, however there is lack of evidence for adopting IT for TSHs. Various past researchers have classified those factors in several forms such as internal and external factors or individual and organizational characteristics. Further there are literatures on adopting IT for agricultural sector, adopting IT for tea industry. Action research is a research strategy that the researcher participates in the research setting and studies a change in an organization. IT therapy is a method of giving IT assistance for immediate IT needs of an organization to introduce cost effective IT solutions. DSR methodology is used for developing new systems by iterative designing and testing while contributing to the knowledge base.

Chapter 3

3. BACKGROUND TO THE RESEACH AND CASE STUDY

3.1 Introduction

This chapter begins by explaining the tea industry and its position in Sri Lankan economy and the major role played by TSHs for the national tea production. It further describes functions of TSHs. Finally it gives a description on the selected TSH.

3.2 Sri Lankan Tea Industry

Sri Lanka has been a major supplier of made tea and bulk tea to the world tea market, though there is a declining trend in the national tea production for the past four years (Figure 3.1). The place as a major supplier in the world tea market can be affected by this decline as Kenya and other competitive countries are in the process of enhancing their competitiveness in the global tea market. Therefore, recognition of the reasons behind this decline and promotion of tea industry is important.

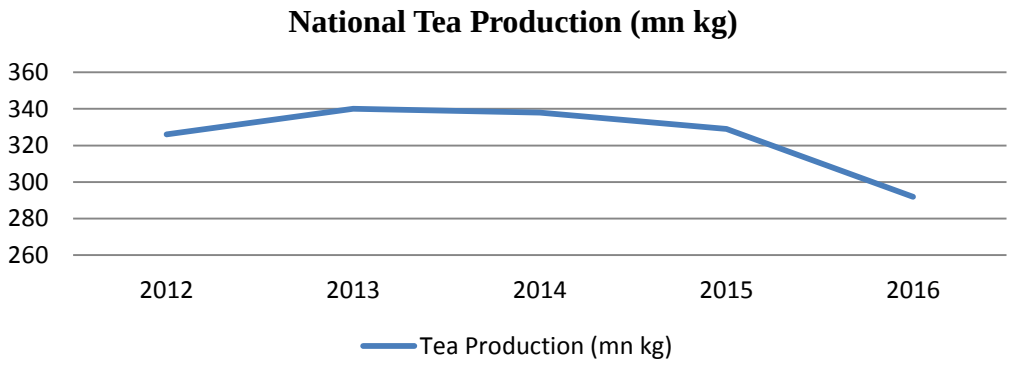


Figure 3.1: National Tea Production in million kilograms per year
Source: Annual Reports 2012 – 2016 Central Bank of Sri Lanka

3.3 Sri Lankan Economy

It was not only the tea industry, but the whole agricultural sector was facing a decline for the past 5 years and the Sri Lankan economy has been dominated by the Service sector followed by the Industrial sector (Figure 3.2).

The decline in agricultural sector is attributed to decline in growth of all major crops specially Tea and Coconut (Figure 3.3) which was mainly due to adverse climate changes during the past few years.

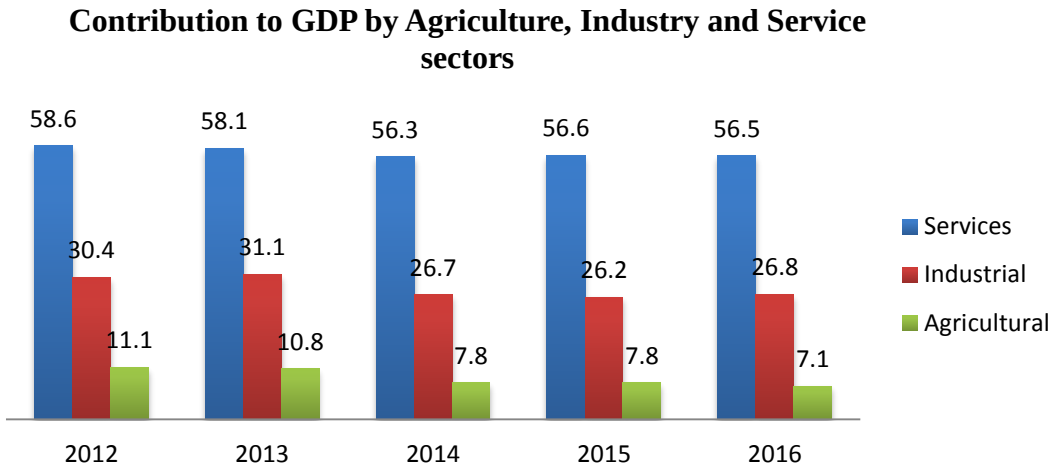


Figure 3.2: Contribution of Agriculture, Industry and Service sectors in GDP
Source: Annual Reports 2012 – 2016 Central Bank Sri Lanka

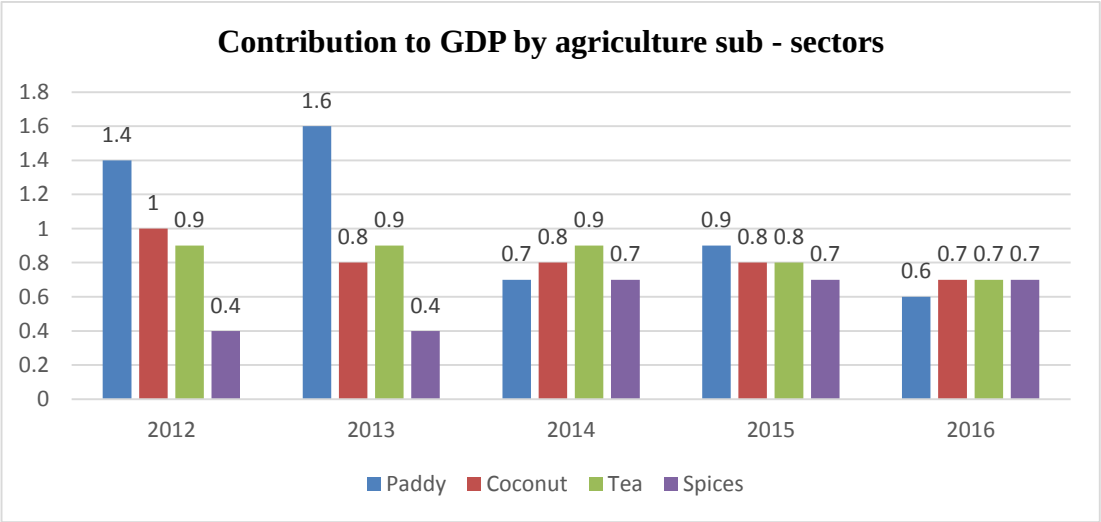


Figure 3.3: Contribution of Agriculture Sub-sectors to GDP
Source: Annual Reports 2012 – 2016 Central Bank Sri Lanka

3.4 Challenges in Tea Industry and Tea Small Holdings

However, the effect of adverse climate changes is not the sole reason for this decline in national tea production. The recent reviews in tea industry described further aspects

other than climate changes; shortage of labour, lack of land and labour productivity and high production costs (Thushara, 2015).

The Tea Research Institute (TRI), Sri Lanka Tea Board (SLTB) and Tea Small Holdings Development Authority (TSHDA) have been working for the development of tea industry. The government has been given a concession for fertilizer and financial and technical support for replanting and infilling. The TSHDA is conducting workshops and provide extension services to rural Tea Small Holdings (TSHs). Prasanna (2014), argues that TSHs in certain rural area are not receiving this extension service and information. Thus, it is apparent that there is a gap or delay between provision of tea promotions and reception by tea growers. Therefore, this gap must be eliminated and information should be passed from the top level to the grower level.

3.5 Information Technology for Tea Industry

Kenya, the main competitor of Sri Lanka, has also been experiencing the same problem, the knowledge gap, and has understood the value of Information Technology (IT); in effective supply chain management, better coordination among suppliers and buyers, information sharing from Tea Research Institute level to tea small holder level and effective and efficient internal operations within the factory/ business (Benarjee, B. 2011). The Kenya Tea Development Agency (KTDA) has computerized all tea buying centres (Benarjee, B. 2011) and Kenya Agricultural Commodity Exchange (KACE) uses Information and Communication Technology (ICT) to disseminate market information and intelligence (Oluoch, J., & Osida, J. 2015). Oluoch (2015), revealed that 60% of tea industry participants use some form of ICT, mobile phones being the most frequently used method.

Further, a United Nations Food and Agriculture conference paper raised the importance of ICT in transparency and dissemination of market information to growers especially using mobile phone applications.

Thus, adoption of IT to tea industry could be helpful in reducing this information gap between rural TSHs and development authority in Sri Lanka. This will help in growth in the tea industry.

3.6 Tea Land Distribution and TSHs

There are 14 tea growing districts in Sri Lanka; the least extent in Gampaha district and the highest extent in Nuwaraeliya district. Tea lands less than 20 ha in extent are considered as Tea Small Holdings (TSHs) and Rathnapura district has the highest number of TSHs. Most of the tea lands maintained by the government are now under the Regional Plantation Companies and TSHs. Statistics show that TSHs sector owns more tea lands than the estate sector (Table 3.1) though there is a decreasing trend in the total tea land extent (Figure 3.4).

Table 3.1: Land distribution among Estate sector and Small Holdings Sector

Sector	Estate		Tea Small Holdings
Land area in hectares		82,065	120,955
Number of estates/holdings	RPCs	286	390,346
	State estates	35	

Source: Ministry of Plantation Industries (2013) Statistical Information on Plantation Crops 2012.

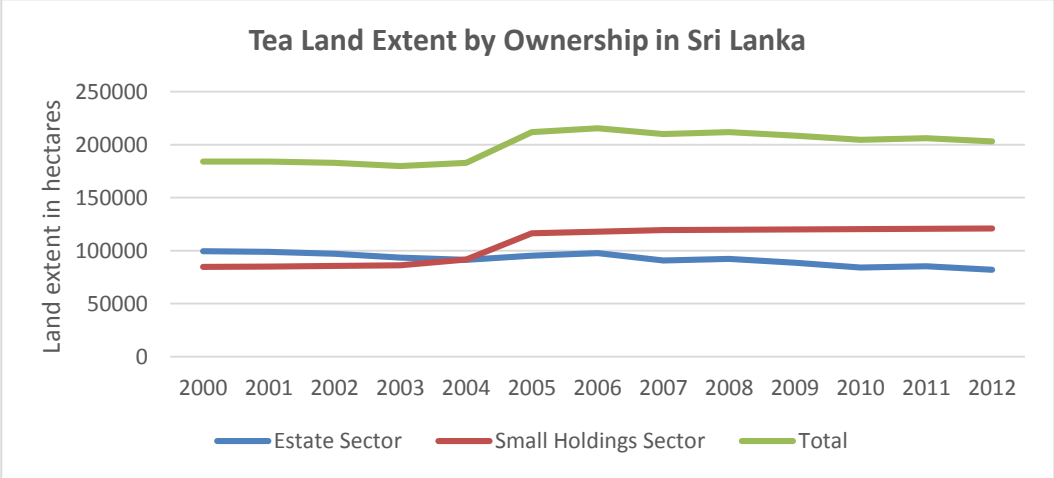


Figure 3.4: Tea Land Distribution from 2000 - 2012

Source: Ministry of Plantation Industries (2013) Statistical Information on Plantation Crops 2012.

3.7 Agro – climatic regions

The particular quality of the tea is decided by the combination of factors such as altitude, terrain and the micro-climate it has been grown on. Sri Lanka is subjected to two monsoons; the northeast and southwest and the central mountains act as a 'wind break' and 'watershed' during these monsoons. Hence the period of rainfall on either side of the central mountains differs and there are annual 'Quality seasons'. Thus, there are 7 'Districts' or 'Agro – climatic regions'; Nuwaraeliya, Udupussellawa, Dimbula, Uva, Kandy, Sabaragamuwa and Ruhuna. For a tea to bear the name of a district it should be grown within a particular agro-climatic region and should be manufactured within the same agro-climatic region (http://www.pureceylontea.com/) Figure 3.5.

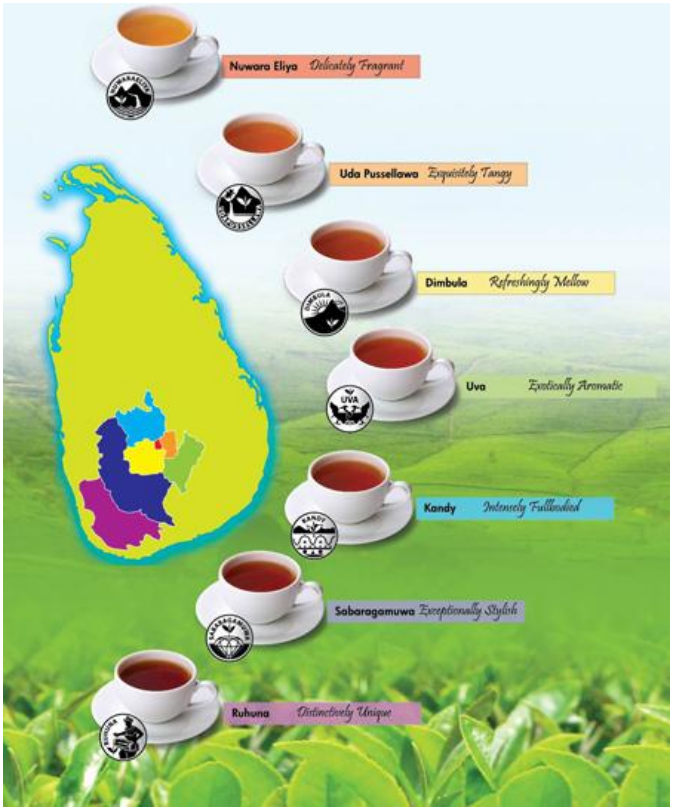
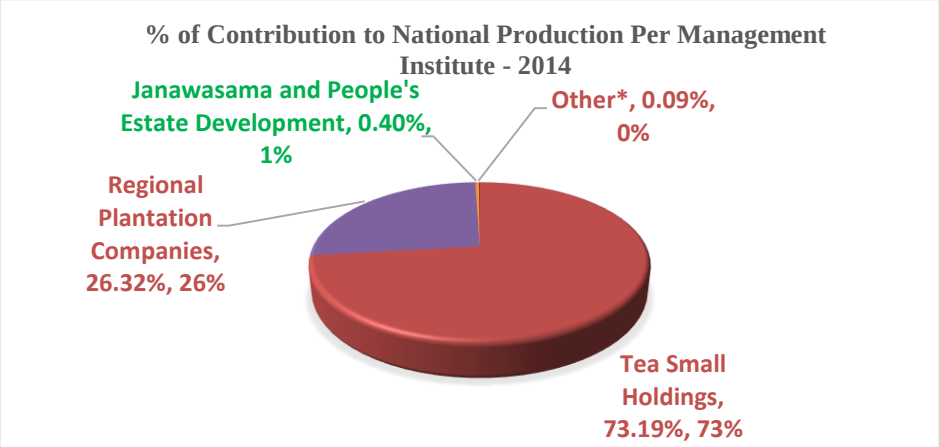


Figure 3.5: Agro-Climatic regions and types of Made Tea in Sri Lanka

Source: Sri Lanka Tea Board (SLTB)

3.8 Tea production and TSHs

Tea Small Holdings sub - sector has been the main green leaf provider (Figure 3.6) in the Sri Lankan tea industry, accounting for 74.5% of the national tea production in 2016. This is similar to the tea industry in Kenya, the main competitor of Sri Lanka in the World Tea market. The contribution to the national tea production by TSHs has been continued to increase in the past five years (Figure 3.7)



*Other – Tea Research Institute, co-operative societies, Tea Shakthi fund

Figure 3.6: The Percentage of Contribution to National Tea Production 2014

Source: Annual report – 2014, Tea Small Holdings Development Authority – Sri Lanka

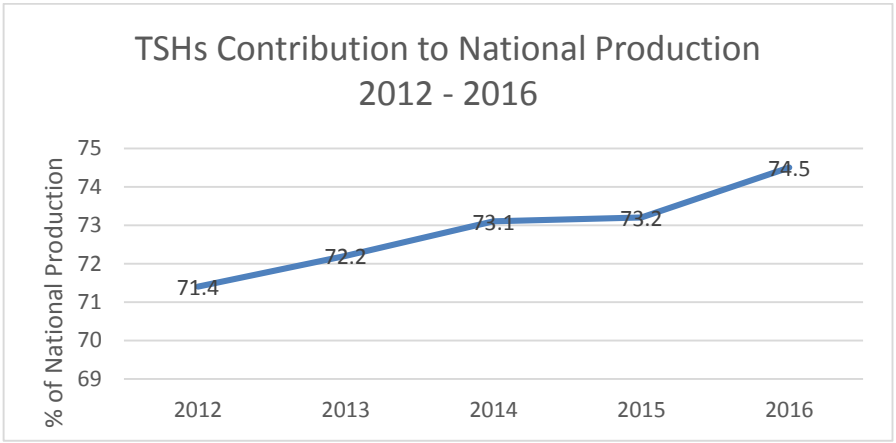


Figure 3.7: TSHs Contribution to National Tea Production 2012 – 2016

Source: Annual Report, Central Bank Sri Lanka 2016

3.9 Tea Small Holdings Development Authority (TSHDA)

The Tea Small Holdings Development Authority (TSHDA) established in 1977 to develop an economically and socially sustainable community of tea small holdings. The institute provides support for all private tea lands less than 50 acres (~20 hectares). It provides extension services to TSHs in rural areas, implement fertilizer concessions, conducts workshops for growers and provides necessary information to the Ministry for TSH policy making.

3.10 Structure of Tea Small Holdings in Sri Lanka

Typically, a tea small holding is a private tea land of few acres maintained by the land owner and his or her family members. Tea harvesting is a laborious dependent task, therefore owners may hire men/ women for plucking and maintenance. Thus, the decision making role is played by the owner of the tea land while family members and/or paid labourers involve in plucking, fertilizing, pruning, weeding, infilling etc.

3.11 Functions of a Tea Small Holding

Plucking

The quality of the made tea depends on the proportion of correct shoots it includes. The shoot should be plucked at the correct maturity; 2 – 3 leaves and a bud (Figure 3.8). For example, during rainy season, when shoots grow faster, 'fish leaf plucking' could be done (Figure 3.9), while in dry seasons where shoots grow slower, 'mother leaf plucking' is done (Figure 3.9) so that the remaining top normal leaf can provide nutrition to the next growing shoot, hence called 'mother leaf'(TeaMan, 2009).

All employees must be trained to extract the proper part when plucking. It takes around 7 – 10 days in favourable (wet) seasons, and 12 – 15 days in dry seasons, for another shoot to grow. Plucking rounds should be planned such to extract shoots in time. This will also lengthen pruning cycles, reducing pruning costs. If not, shoots will overgrow and affect the quality of the made tea. The Plucking table should be flat for efficient plucking and this can be achieved by using a 'Plucking wand'.

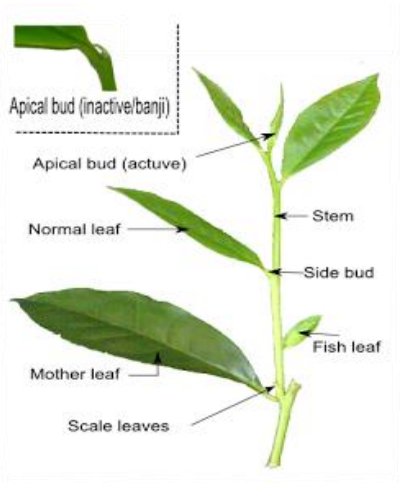


Figure 3.8: Parts of a Tea Shoot

Source: TeaMan (2009,July) Severity of plucking [Blog post].

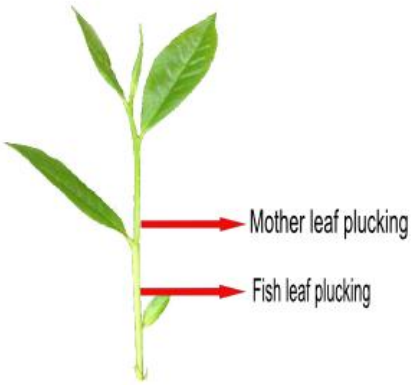


Figure 3.9: Severity of Plucking

Source: TeaMan (2009, July) Severity of plucking [Blog post].

Pruning

Pruning is done to maintain the height of the tea bush to make plucking efficient. The plucking table rises at 20cm /year or 120 -150cm in 3 – 4 years, which becomes too high for efficient plucking. Therefore pruning is done usually once in three years.

Proper instruments must be used to minimize wounds on the tea tree which can be infected and affect the productivity.

Infilling

Tea bushes affected and die due to pests or other diseases create vacant spaces in fields. This vacant space reduces the land productivity hence must be filled with new plants. Infilling is possible in the same year that pruning is done.

Weeding and pest control

Weeds among tea bushes can be removed manually, though this method can damage roots of tea. Chemical weeding is the most beneficial method, although most small holders do not use it. In case of a spreading pest, the TSHDA must be informed immediately to prevent spreading.

Fertilizing

Fertilizer should be applied at correct amount at the correct time, usually before the rain season. The recommended NPKS combination must be used. It should also be within the recommended range of Nitrogen/ hectare/ year.

Soil conservation

When there are tea lands with more than 25 degree slopes there could be soil erosion. Thus, soil conservation methods must be followed to protect the top soil layers.

3.12 Factors affecting the output of TSHs

TSHs faced several challenges; lack of awareness and training on tea cultivation techniques, poor business practices, low productivity and weak perception of sustainable agriculture (Perera, 2014). High production costs mainly due to high labour wages and labour shortage also affect the growth of TSHs (Thushara, 2015). Although the TSHDA and the government are providing support for TSHs the knowledge does not diffuse adequately to TSHs. Also the extensive coverage from the authority may

not be adequate to reach all TSHs. Lack of knowledge on cultivation techniques can lead to lack of productivity and environmental pollution. Thus the development authorities should offer training strategies.

It is fact that tea smallholders do not maintain proper records (Owuor, P. O., Kavoi, M. M., Wachira, F. N., & Ogola, S. O. 2015). Poor knowledge on business practices prevents TSHs from keeping records of basic data on production cost and sales to monitor their profit or loses (Perera, 2014).

3.13 The Case Study

The research was conducted as a case study based on following reasons; the research is about adopting IT to TSHs, a theme that has not studied thoroughly in past literature; SMEs are slow in adopting IT due to several reasons and TSHs could have the same barriers; most TSH owners do not have the IT literacy and not aware of the benefit of use of IT, TSH owners face financial problems due to high production costs hence may not have sufficient financial capability to purchase the necessary software and hardware. Further the researcher has chosen the case study based approach due to lack of time, as the total time period was around 6 months and was not sufficient to implement in other TSHs. Therefore the researcher selected a TSH, which has not implemented IT for their routine operations, to study how to implement IT for TSHs.

Since the selected tea estate has not used IT before, the researcher had to interview the two main stakeholders initially. This helped the researcher to identify the potential IT needs of the tea estate. Base on the IT needs researcher developed an IT solution. In order to verify whether the IT solution meets the IT needs, the researcher used the Design Science Research (DSR) methodology. In the DSR methodology, which have multiple iteration when implementing the system. The researcher used the action based research strategy for each iteration, which helped to identify the loopholes in each iteration.

The selected tea estate is located in the Rathnapura district at an elevation of 300 – 600 m, thus producing low country tea of Sabaragamuwa origin. It is a tea land of 20 acres with 12 fields, hence under the regulations of TSHDA. The owner lives in Colombo and used to visit in the estate twice a month to pay wages and for overall supervision. The routine functions of tea estate are done by 7 to 15 employees and under the management of a supervisor who resides in the estate premises.

Due to the shortage of employees, plucking rounds are done not on the optimal day, but after a few days. Thus the plucking table rises beyond the efficient heights, and needs frequent pruning. Maintenance task, such as weeding, pest control, fertilizing are also not done on time due to lack of labour. Thus the overall productivity of the estate has dropped.

The supervisor/ manager maintains records of all daily activities separately on books such as employee attendance, no. of kilograms plucked by each Plucker, no of hours each employee spent for each task, no of kilograms of tea leaves taken to the factory at the end of the day, payments done for employees. The calculation of salaries is done by the supervisor at the end of a salary month, which usually takes 4 -5 hours yet errors are possible.

The plucked tea shoots are being collected around 3pm – 5pm each day by a factory vehicle to the factory and the estate should pay for the transport. The roads around the estate are not well maintained hence there is a difficulty in reaching the estate. The Tea officers rarely visit the estate, except in a situation of planting new tea trees. The supervisor rarely participates in programs conducted by TSHDA.
The supervisor and the owner communicate with each other by mobile phones. The supervisor sometimes sends urgent documents via fax by going to the nearest town. They are not using any other type of Information Technology for estate functions.

3.14 SWOT Analysis for adoption of information Technology for the estate

Strengths

- Manager and the owner are willing to adopt IT for their business to enhance the productivity and to reduce costs.
- Manager and the owner are willing to provide useful information in developing the system.

Weaknesses

- Lack of IT literacy of the estate manager.
- Lack of awareness of potential benefits of IT towards the business.
- Lack of money to invest in IT.

Opportunities

- The time spent in salary preparation can be reduced and more accurate by introducing a system.
- Useful information such as production costs, plucking intervals could be extracted from available data for planning estate functions.
- Documents of calculations can be sent to the owner via smart phones frequently.
- Can get updates from TSHDA website or any other related website by using the Internet to increase the productivity.
- Able to compare past data through graphs and charts for decision making.

Threats

- Negative attitude of other TSHs, who do not use IT for their businesses, towards IT adoption.
- Currently TSHDA is not providing any support for adoption of IT.
- Owner did not provide the necessary hardware and software initially.

3.15 Chapter Summary

There is a declining trend in the tea contribution to the GDP. The national tea production has been decline since 2013. TSHs have contributed 74.5% of national tea production in 2016. And this figure has been increasing for the past 5 years. The taste of the made tea depends on the climate and the soil it has been grown. Further the quality of made tea is affected by day of the plucking cycle. Therefore plucking should be done within the optimal days of the cycle to maintain the quality of the tea shoot. TSHs in Sri Lanka have been facing several problems that can affect their productivity; poor business practices, poor cultivation techniques, high production cost and lack of information and extension services from higher authority.

Chapter 4

4. METHODOLOGY

4.1 Introduction

This chapter discusses the research methodology and research strategy used by the researcher. Further data collection and data analysis been explained.

4.2 Research Methodology and Research Strategy

In the research, as a change in an organization was being observed by changing its business process, the Action Research Strategy was selected as the research methodology.

4.2.1 Action research

As discussed in literature review chapter 2, action research defined by Wolcott, 2008 as "the application of tools and methods from the social and behavioral sciences to practical problems with the intention both of improving the practice and of contributing to theory and knowledge in the area studied." Action research is a qualitative research strategy. Action research can be in many forms as stated by Adelman, which was discussed in the literature review (Table 2.4).

.

In this case, the selected TSH must be studied closely to recognize their IT needs and opportunities to plan how to adopt IT. Therefore the appropriate research type for this study is Participatory action research. Samaraweera (2013), pointed that most effective way of technology transfer to TSHs is through individually.

There are there types of models describing action research as discussed in chapter 2. According to Susman, G. I. (1983), action research is an iterative process and shown

as action research cycles (Figure 2.1). Saunders, M. Lewis, P. Thornhill, A. (2009), pointed out that action research can be in spiral form (Figure 2.2).According to Kurt Lewin change theory, action research can be formed as systems model of action-research process (Figure 2.3). The following model figure 4.1 demonstrates how Systems model of action-research process could be adopted to the selected tea estate.

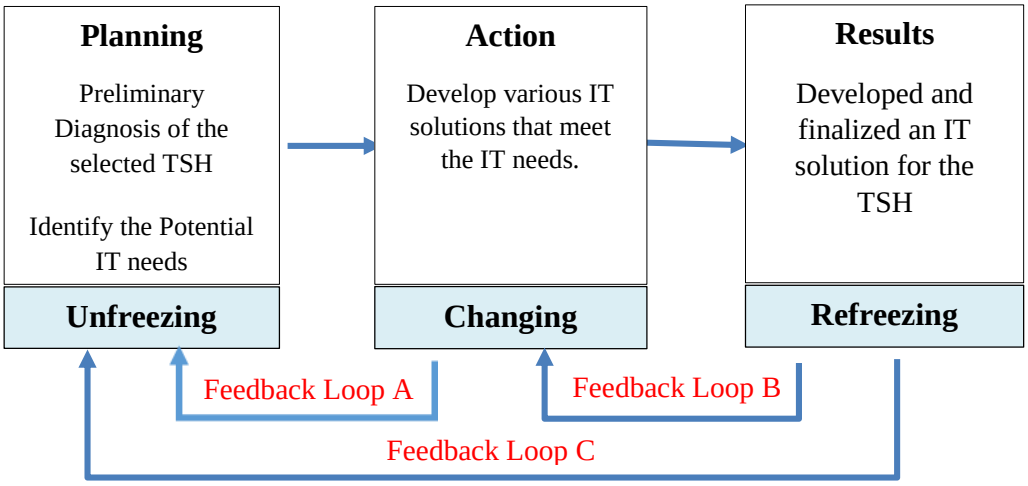


Figure 4.1: Developing an IT solution for TSH

4.2.2 Design Science Research (DSR)

There were no available IT systems for internal operations of a TSH and the IT systems mentioned in the past literature were not applicable to a TSH. Therefore a simple and affordable IT system appropriate for a TSH must be developed. The Design Science Research (DSR) is a reliable methodology of developing new systems, hence used in this research to develop an IT system for the TSH. Discussed in the literature review chapter 2 (Figure 2.4).

The DSR methodology consists of three cycles (Rittel & Webber, 1984).;

1. Relevance cycle
2. Design cycle
3. Rigor cycle

Relevance Cycle

During the relevance cycle, the assumed IT solution or the artifact is tested in the field or in this case in the TSH, for its relevance. This is done by first observing the business processes and their IT requirements and opportunities.

Design Cycle

If there are unmet requirements, the artifact must be redesigned or modified by the developer, (in this case the researcher). After each design or modification, it must undergo an evaluation process for run time errors. The evaluation of the artifact is done by using a test plan. The test plan for this case includes the following areas to be tested,

- Checking the formulas works fine or not
- Check whether excel sheets links correctly with other sheets and other workbooks
- Check the dropdowns displays properly with all dropdown options
- Check the excel sheet cell protection based on the input of another cell
- Check if unnecessary data entries are restricted

Having cleared all errors, the artifact is again taken to the relevance cycle for field testing by the manager. Again it is tested for its relevance.

Rigor cycle

Each iteration from relevance cycle to design cycle the problems experienced and solutions provided for those problems are identified. The knowledge gained from each iteration contributes to the knowledge base of the field.

4.2.3 Information Technology therapy (IT therapy)

Although the selected TSH owner is willing to adopt IT, the supervisor/ manager did not have adequate basic IT knowledge to handle the system of his own. Thus the researcher had to give IT training to the supervisor / manager.

Information Technology (IT) Therapy is giving IT assistance to individuals or organizations to solve immediate, strongly perceived IT needs. IT therapy does not aim at providing hardware or software. IT therapy attempts at producing low cost solutions and leads to the development of economy (Wolcott, 2008).

IT therapy may overcome many factors such as (Qureshi, 2008);

- Lack of awareness on IT
- Lack of confidence to handle IT
- Mismatch between technology and the business
- Inadequate IT user skills
- Poor troubleshooting skills
- Inadequate IT development capability
- Lack of IT planning ability
- Lack of IT knowledge
- Lack of money
- Lack of time to learn IT could be overcome, but it is not a complete solution.

The lack of trust on IT expertise must be overcome for a successful IT therapy result as lack of trust on the researcher prevents revealing essential business processes to the researcher and difficult to develop an optimal solution (Wolcott, 2008).

4.3 Ethical Considerations

The owner of the estate gave his written consent for face to face interviews and to carry out the research in his estate premises (Appendix D). The manager was also informed about the research process and obtained written consent for face to face interviews and

to assist in the research process (Appendix D). All consent forms were prepared in their mother language and explained to them prior to consent. The confidentiality of information gathered was assured and a copy of collected data was given to the estate.

4.4 Data collection

Qualitative type interviews were carried out to gather data relevant to the research problem. This type of data collection method was required as it was an action research, where there was a need to establish personal contact, and to check attitudes and opinions of participants as the researcher would have to work with them, where it was necessary to probe answers to get clarifications (Saunders et al, 2009). Several semi-structured one to one, face to face interviews as well as over the phone conversations were carried out with the manager to collect and clarify data on day to day operations of the estate.

4.4.1 Validity and Reliability of data

The first interviews with the owner and the manager were carried out with prior preparation for following aspects which would assure the reliability of the data gathered from the interview;

1. The researcher gathered relevant information from previous literature on challenges faced by SMEs and possible solutions
2. A date and time convenient for the owner and manager was booked for the interview in order to minimize disturbances to their day to day functions
3. Explained about the research and gained consent prior to the first interview
4. Followed an appropriate dress code acceptable to the interviewee
5. Started the first interview with open, comfortable questions, allowing the interviewee to talk
6. The questions were in simple, understandable language to the participants
7. Important but limited number of questions were asked to save time while gathering the required information

8. Neutral gestures and responses were maintained for answers given by the interviewee to reduce interviewer bias
9. Summarized information where necessary to ensure that the researcher understood it correctly
10. Recording of data done immediately after each question as well as contextual data such as time, date of interview

4.5 Data Analysis

Having designed a solution to meet estate requirements, the owner/ the manager used the final IT solution along with their manual record keeping system for a period of 3 months. At the end of the trial period the owner and the manager were interviewed face to face using open ended questions based on pre-prepared themes. All interviews were recorded with written consent of the participants. Since there were two participants the answers were manually analyzed under the pre-prepared themes. Following are the pre-pared themes.

- Time
- Error
- Complexity
- Data Sharing
- Adaptability
- Affordability
- Analyzed data
- IT assistance

The interview answers given by both participants were analyzed and the results documented.

4.6 Chapter Summary

Action research strategy has been used in this research where the researcher actively takes part in the research settings and studies a change in an organization. The

researcher adopted the Systems model of action-research process, which was developed based on Kurt Lewin change theory. DSR methodology is used for developing new systems by iterative designing and testing while contributing to the knowledge base. IT therapy is a method of giving IT assistance for immediate IT needs of an organization to introduce cost effective IT solutions. Further, this chapter describes the ethical considerations, data collection methods and finally on data analysis.

Chapter 5

5. PROPOSED INFORMATION SYSTEM

5.1 Introduction

This chapter describes the proposed system for the TSHs. The chapter includes indications, the minimum hardware and software requirements, and the components which includes in the system.

5.2 Indications

The proposed system will be useful and beneficial if the tea estate meets the following criteria. It would be a waste of money on investing on the proposed system, if the tea estate does not have the following criteria.

- TSHs willing to computerize their internal operations

  Most of the TSHs do not have the necessary financial capability to introduce IT for their day to day operations. And most tea estate owners are not aware of IT and they do not know the benefits from introducing IT. The system can be implemented to the TSHs only if, the tea estate owners have a clear understanding of the benefit of having an IT system and should have the capacity to invest.

- TSHs with more than 1 field

  This system has the capability of maintaining multiple fields, which helps in identifying the plucking rounds in each field. As discussed in the earlier chapters, the tea leaf should be plucked at the correct time frame. If not, may not able to sell them at a higher market price. Then system will be helpful for tea estates which have multiple fields.

- TSHs employing paid workers

  This system maintains each employee salary record. This helps to calculate the basic salary, gross salary, net salary, EPF, incentives and deductions for each employee. This will save the time compared to calculating the salaries manually by the tea estate manager.

5.3 Requirements

The following list gives the minimum hardware and software requirements in order to install and function the system.

- Personal computer having the windows 8 operating system with MS Excel 2013

  To operate the system, should have the minimum software requirements such as should have installed windows 8 and MS Excel 2013.

- Internet connection from an Internet service provider (ISP)

  Need an internet connection to send daily records to the tea estate owners, if the owners are living far from the tea estate. The system will helpful for the owner by having the access to the daily operations without visiting the tea estate.

- Web browser (E.g.- Chrome)

  Need a browser to navigate to the TSHDA web site for useful information. This will help to get to know the latest updates from the TSHDA. Further, it helps to email useful reports to the tea estate owner for decision making.

5.4 Components of the System

Figure 5.1 demonstrates the components of the system. The following components should be included in the "Proposed Information System" folder.

- Master file

  In the master file workbook following sheets displays.

  1. Work type (WK sheet)
  2. Plucking details (PTL sheet)
  3. Sundry details (Sundry sheet)
  4. Plucking during New Clearing (NC sheet)
  5. Plucking rounds (Plucking rounds Wet Session and Plucking rounds Dry Session)
  6. Factory details (Sales factory sheet)
  7. Expenditure (Expenditure sheet)
  8. Salary details (Salary sheet)
  9. Deductions from employees (Deduction sheet)
  10. Employee Efficiency Chart (Employee Efficiency Chart sheet)
  11. Time spent for each activity (Time spent for each activity sheet)

- Summary and Reports

  In the summary and report workbook, which has the profit and loss sheet for each month. This helps to identify the revenue and cost for each month and can control the unnecessary cost to increase profit.

  There is another sheet in the summary and report workbook which is the Report sheet. Which includes six different reports for decision making purpose. Which are tea harvest variation graph, expenditure graph, profit to sales ratio graph, factory rate variation graph and unit cost per kg graph.

- Instructions to operate Master file

  This word document includes all the instructions step by step in modifying a master file for the current month.

- Website link for TSHDA (Other useful websites can be included at the time of installation)

  This website link might be helpful for TSHs for accessing useful information and contact numbers.

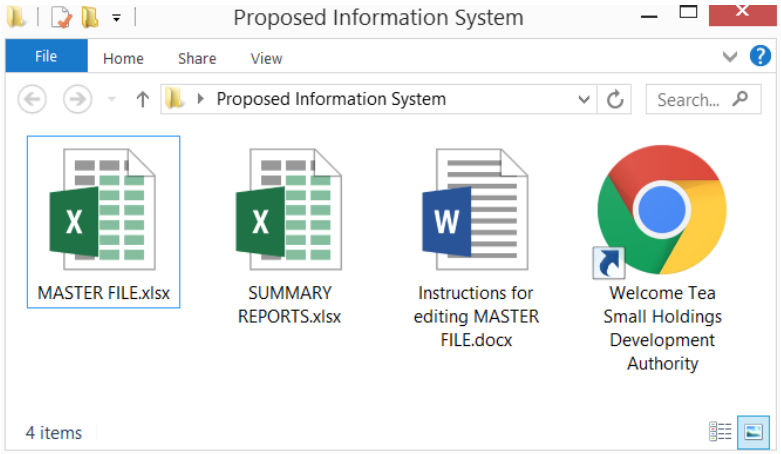


Figure 5.1: Components of the system

5.4.1 Master file and Sub-Components

Master file is a set of spreadsheets with necessary formulas for all internal operations for a month. At the beginning of a particular month the operator must make a copy of the Master file and Rename it by the month.

1. **Work Sheet (WK)**

This sheet must be filled with all employee names, their EPF / ETF numbers, and type of work done on each day. There are several types of work in a TSH and addressed in the Work sheet with suitable abbreviations (Table 5.1)

Table 5.1 Abbreviations for type of work

Abbreviation	Description
PTL	Plucking Tea Leaves
PL	Supervise Plucking by a 'Kankani'
NCW	New Clearing and Weeding
MW	Manual Weeding
CW	Chemical Weeding
MF	Mochin and Ferning
AM	Artificial Maneuvering
PR	Pruning
NC	New Clearing
LP	Lopping
CO	Coconut tree related work
RO	Rock field work
BW	Bungalow work
RD	Road related work
NU	Tea Nursery
DO	Dolomite application
CS	Cow Store
PH	Public Holiday
L	Leave

The Figure 5.2 displays the work sheet which includes the activities done by each employee for each session on a particular day. The total kilograms plucked during the month by all employees will be displayed on the top of the sheet. The total days worked and total leave days for each employee during the month will be automatically calculated. Further, the total number of sessions spent for each activity during the month by all employees will be displayed in this sheet.

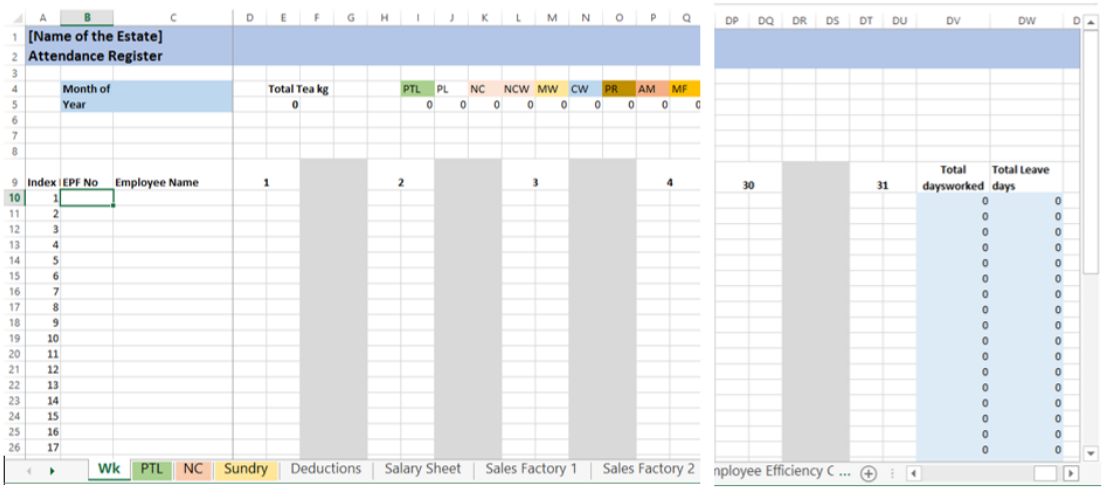


Figure 5.2: Work sheet

The Figure 5.3 shows how the dropdown list display of all type of work. The user has to select the type of work for each session done by each employee for a particular day.

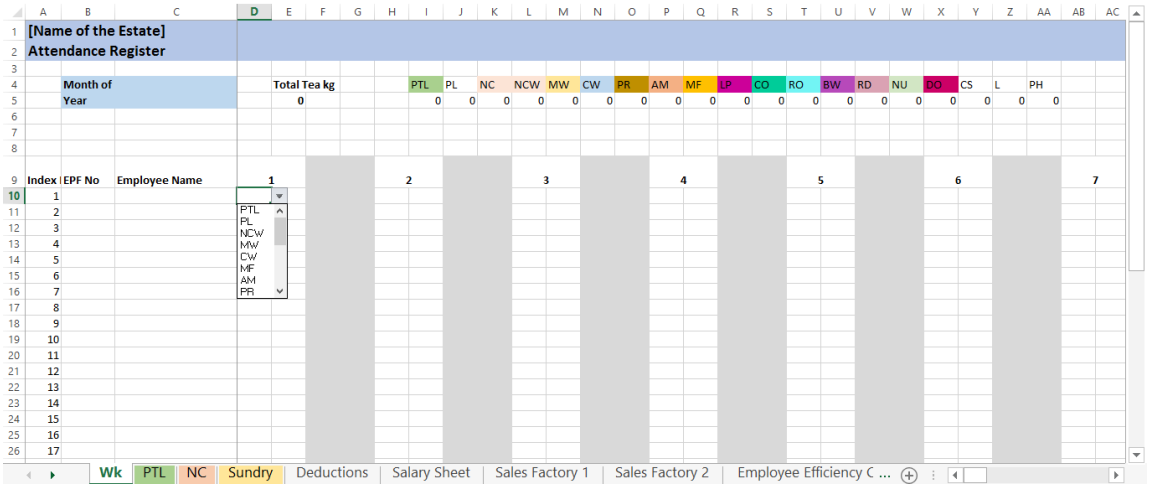


Figure 5.3: Selecting type of work

2. Plucking Tea Leaves Sheet (PTL)

The PTL sheet records the number of kilograms of tea leaves plucked by each employee on each morning and/or afternoon of ‘plucking’. The PTL sheet is shown in Figure 5.4.

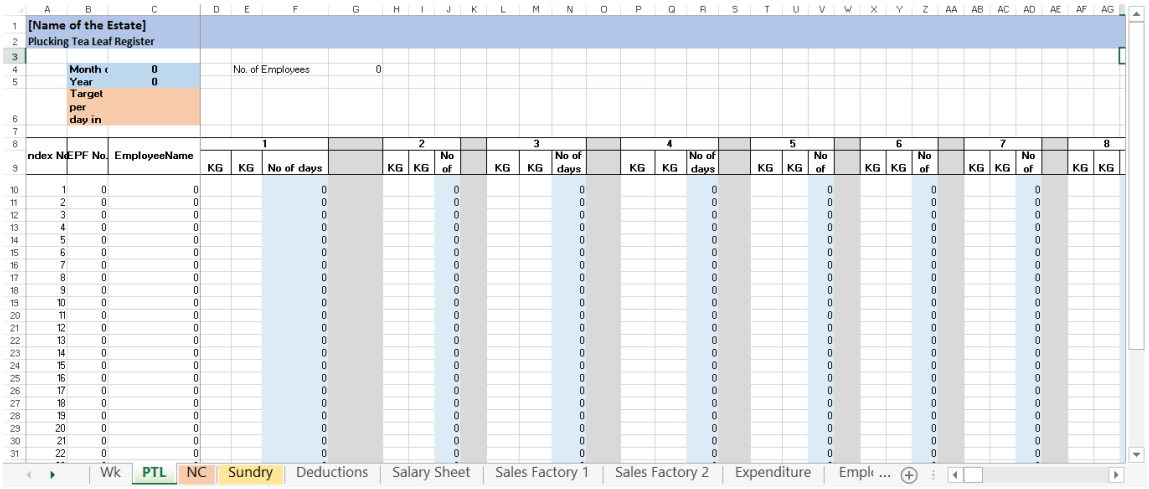


Figure 5.4: Plucking Tea Leaves Sheet (PTL)

3. New Clearing Sheet (NC)

When plucking is done for the first time in a new field, then the number of kilograms plucked is recorded on a separate sheet called ‘New Clearing (NC). The NC sheet is shown in Figure 5.5.

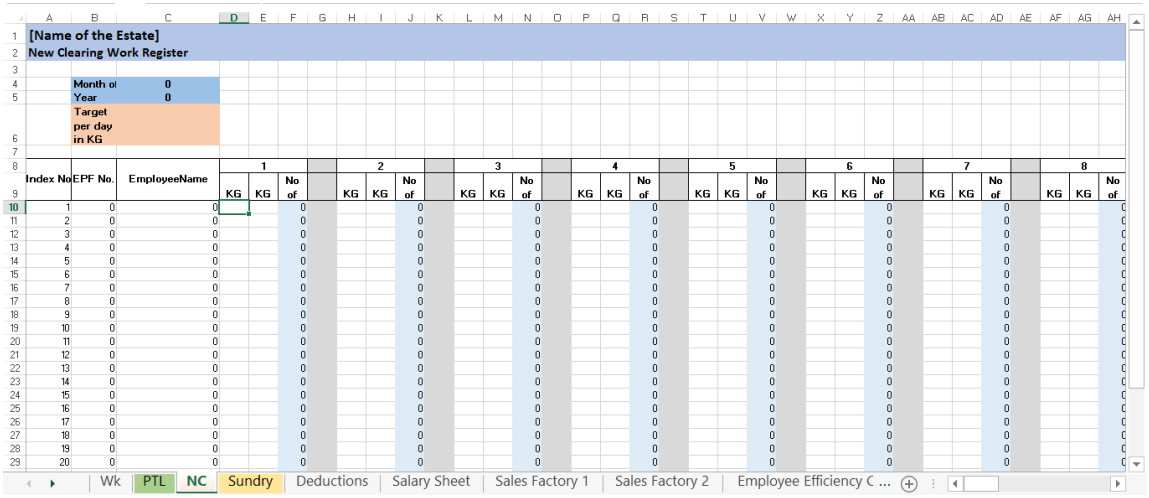


Figure 5.5: New Clearing Sheet (NC)

4. Sundry Sheet

This sheet used to record all the activities other than plucking tea leaves or plucking in a new field. These are recorded as the number of hours worked in the morning and afternoon sessions. Based on the number of hours worked by an employee for a particular day, the number of days entitled for payment will be displayed. Figure 5.6 shows the Sundry sheet.

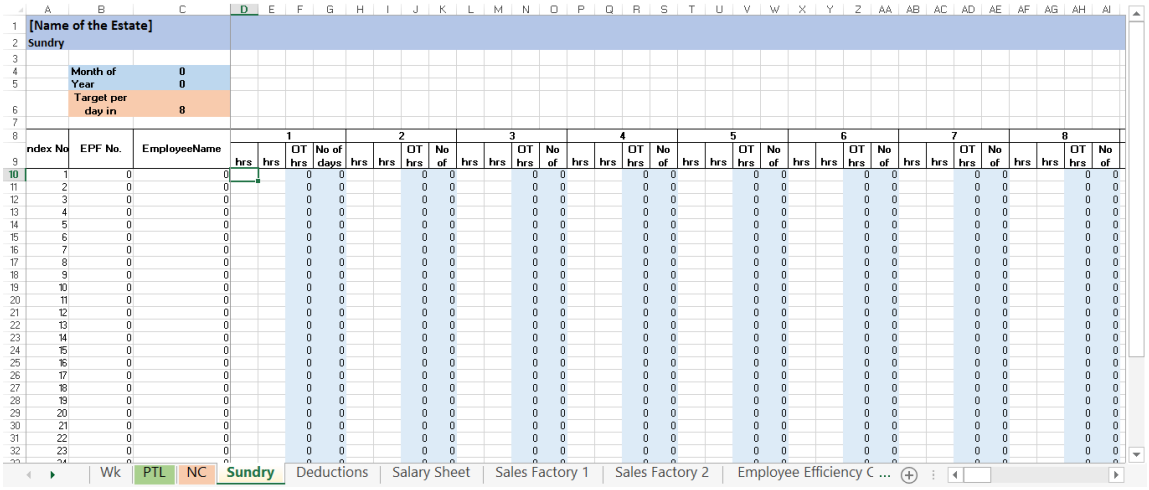


Figure 5.6: Sundry sheet

5. Deduction Sheet

In this sheet keeps records of all deductions from each employee. Figure 5.7 shows the deduction sheet.

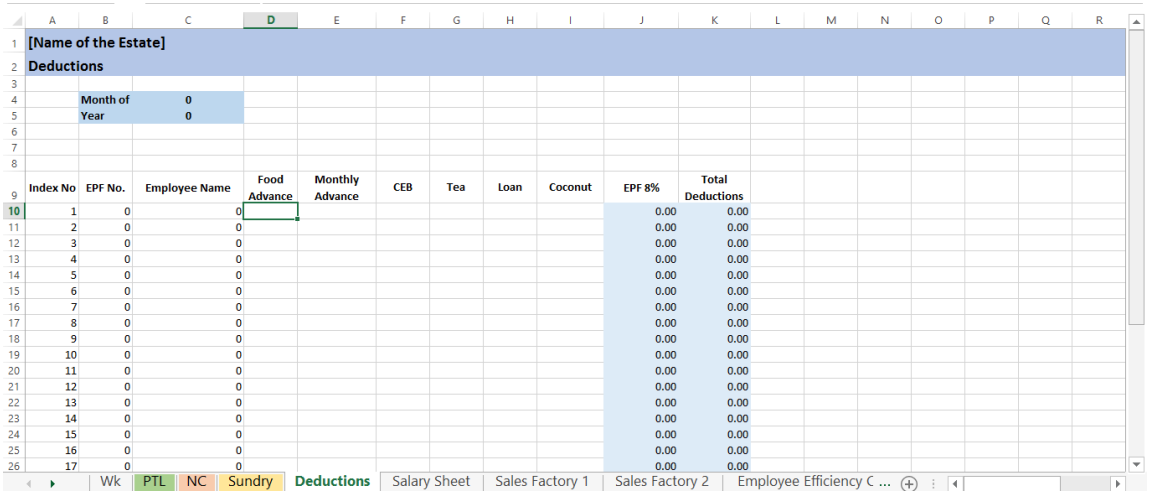


Figure 5.7: Deduction Sheet

6. Salary Sheet

This sheet is used to calculate basic salary, gross salary and net salary for each employee. Salary calculations may differ based on the salary scale selected from a dropdown list. Salary sheet is shown in Figure 5.8.

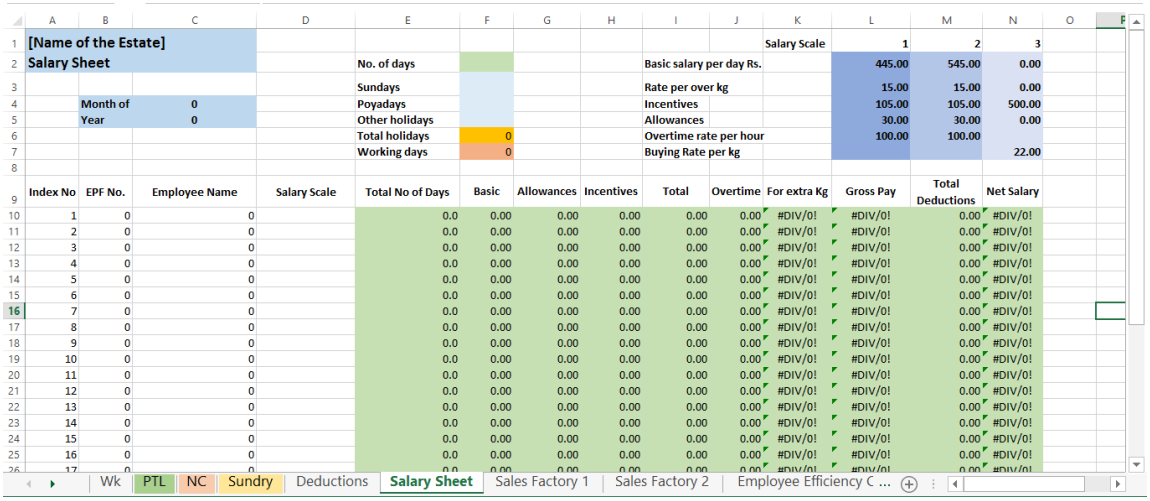


Figure 5.8: Salary Sheet

7. Factory Sheet

All transactions with the tea factory/s including factory rates, sales of tea leaves, advance taken from the factory, transportation cost, fertilizer cost, chemical and arrears are recorded on factory sheet. There can be multiple factory sheets. The Factory Sheet is shown in Figure 5.9.

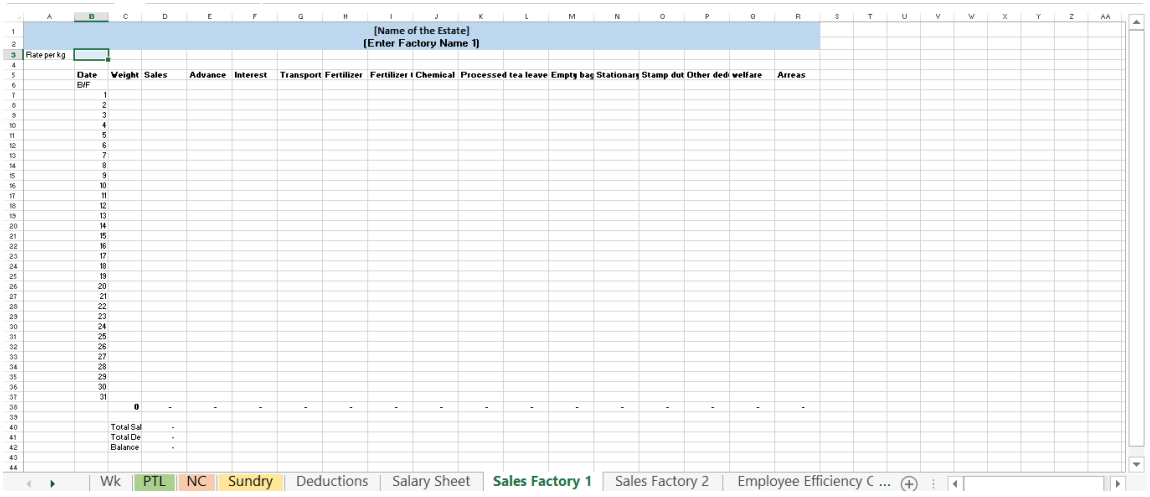


Figure 5.9: Factory Sheet

8. Expenditure sheet and graph

This graph displays all expenses and the Production cost per kilogram of tea leaves. The expenditure sheet is shown in Figure 5.10.

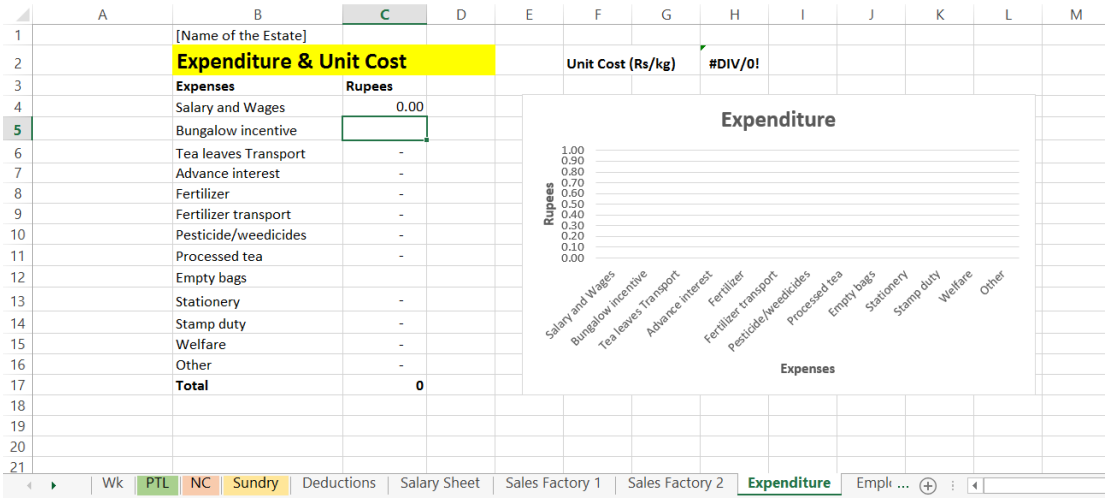


Figure 5.10: Expenditure sheet and graph

9. Plucking rounds (Wet Session)

This sheet is used to record the plucking rounds in wet sessions for each tea field. A plucking cycle begins on the day of plucking and days passed by are counted from the day of plucking. In rainy season (wet season), plucking must be done between day 7 to day 10 to get a good tea leaf. This optimal period is reminded by cells coloured in 'green'. The Plucking rounds (Wet Session) sheet is shown in Figure 5.11.

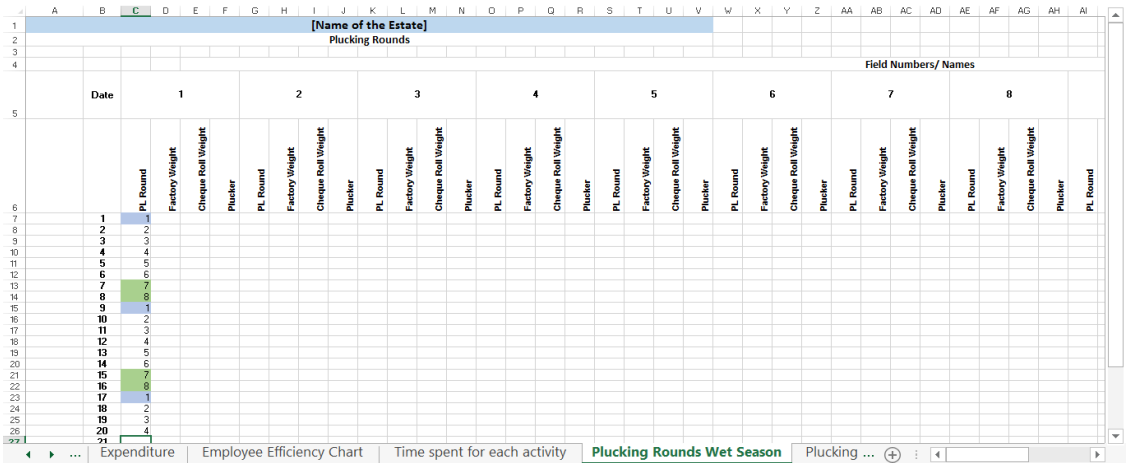


Figure 5.11: Plucking rounds (Wet Session)

10. Plucking rounds (Dry Session)

This sheet is used to record the plucking rounds in dry sessions for each tea field. During dry seasons plucking could be done between 12^{th} – 14^{th} day of the plucking cycle to get a good tea leaf. The Plucking rounds (Dry Session) sheet is shown in Figure 5.12.

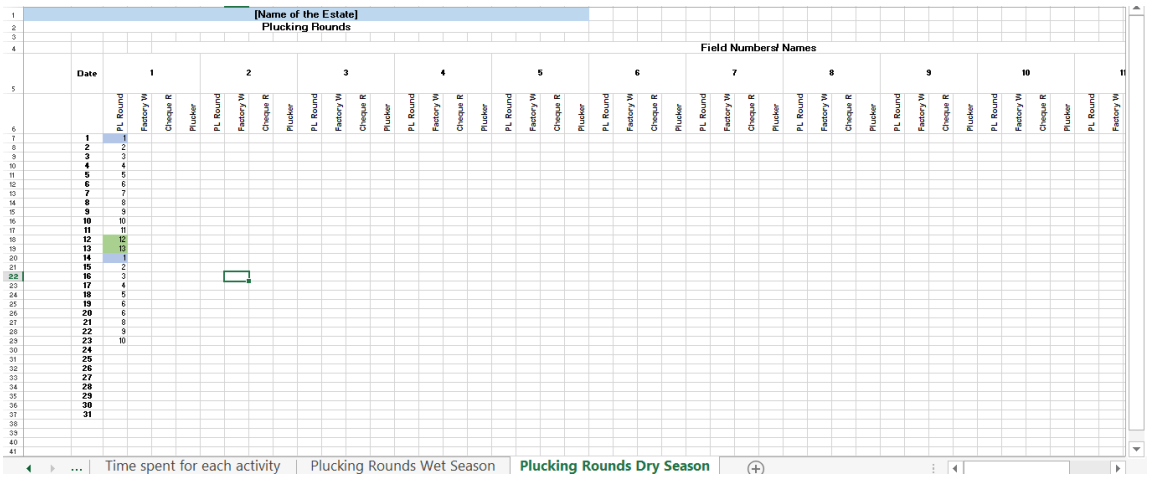


Figure 5.12: Plucking rounds (Dry Session)

11. Employee Efficiency Chart

This chart displays the tea leaves average plucking rate for each employee for a given month. The employee efficiency chart is shown in Figure 5.13.

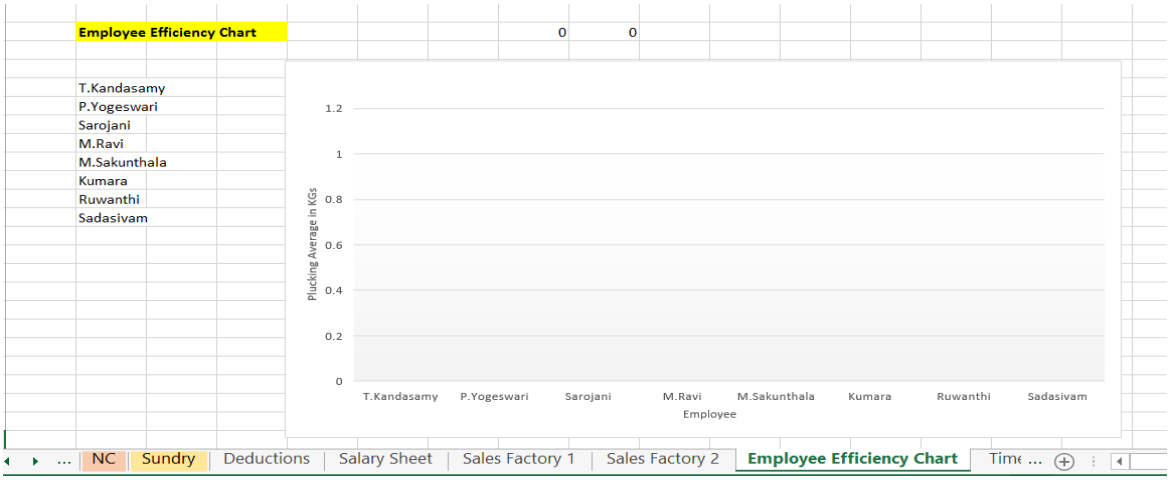


Figure 5.13: Employee Efficiency Chart

12. Time spent for each activity

This graph displays the number of sessions devoted to each activity during the month. The chart displays in Figure 5.14.

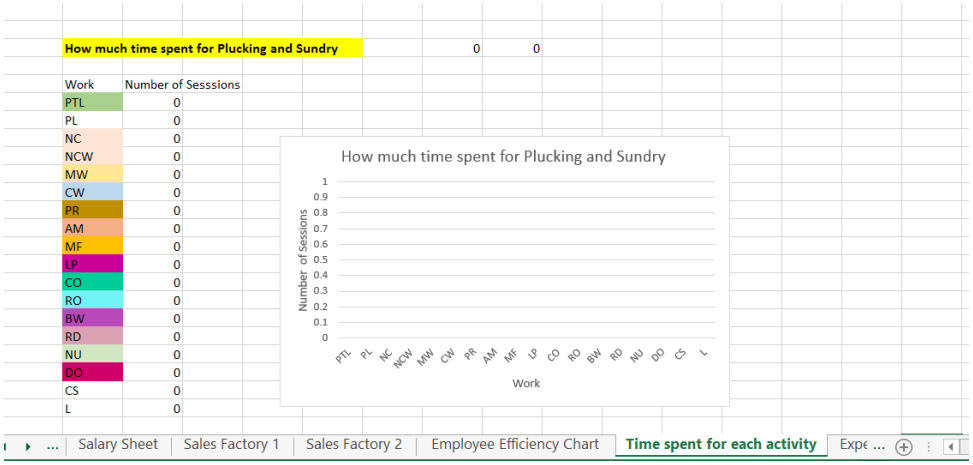


Figure 5.14: Time spent for each activity

5.4.2 Summary and Reports

This section gathers all monthly information and generates charts/ graphs to display changes in certain parameters over a period of 6 months. Profit and Loss account (Figure 5.15).

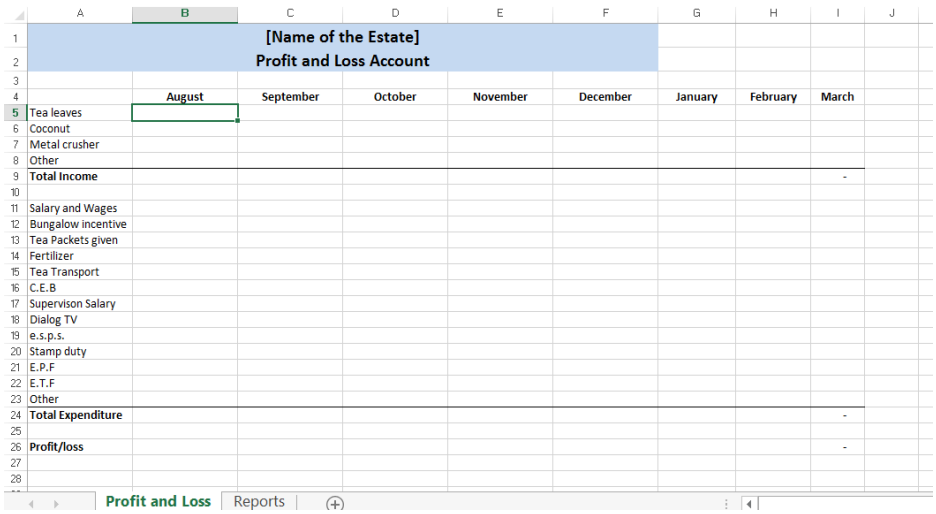


Figure 5.15: Profit and Loss Account

Also, it contains following graphs for decision making;

- Tea harvest variation
- Profit to Sales Ratio
- Expenditure
- Factory rate variations
- Production Cost variation

5.4.3 Instructions to operate Master file

There is a booklet to guide the operator on using the Master file.

5.4.4 Website link to useful websites

The TSHDA website contains useful information and updates for tea small holdings. Therefore a link to the website was included in this system. However to access this web page the operator must have a data connection.

5.5 Chapter Summary

This chapter described the indications of the proposed system, minimum hardware and software requirements to be present in order to operate the system and finally components of the proposed system.

Chapter 6

6. RESULTS AND VALIDATION

6.1 Introduction

This chapter discusses how the researcher validated the system before handing over to the TSHs owner and results of action research cycles.

Validation of the artefact was done in 2 aspects; Internal and External.

6.2 Internal Validation

The developed artefact was a combination of spread sheets as described in Chapter 5. Due to the complexity of the problem, the artefact had to be re-designed for several times. Each time before releasing it for a field trial it was thoroughly checked for bugs. The artefact was systematically checked according to Test plans in each iteration of DSR cycles (Figure 6.1).

Iteration 1
Test Plan 1

Test Objective-
Make sure all the functionalities in each sheet works as expected and should not have critical defects such as wrong calculations

Test Scope-
Test the work sheet, PTL sheet, all sundry sheets, salary sheet, and deduction sheet

Test Duration-
23/09/2016 to 30/09/2016

Test Approach-
Functional Testing- Manual Testing

Exit Criteria- Should have met the test objectives with zero defects

.

Figure: 6.1 Example of a Test Plan

Test scenario (Table 6.1) and test cases (Table 6.2) were used to test if the expected outcome could be achieved. If not, that part of the spreadsheet was adjusted to gain the expected outcome and rechecked with a new set of test data (Appendix B – Test Scenarios and Test Cases).

Table 6.1: Example of Test Scenarios for 'Work' sheet

Test scenarios for 'Work' sheet
Verify the elements in the work sheet
Verify respective worksheet cells gets enabled when enter the specific abbreviation in WORK sheet
Verify not selecting any activity in WORK sheet will restrict the user entering a figure in PTL and in all sundry sheets
Verify total work days displays correctly in WORK sheet
Verify the Total Leave days displays correctly in WORK sheet
Verify the abbreviations displays correctly in the right hand side of the 'Work' sheet

Table 6.2: Example of Test cases for the 'Work' sheet

Test case ID	**Test case Description**	**Pre-requisite**	**Steps**	**Expected outcome**	**Actual outcome**	**Results**
1	Verify the elements in the work sheet	Should have opened the 'Work' sheet in excel	Check the heading and subheading displays correctly in sheet 'Work'	Should display name of the estate as the heading and 'Attendance register' as a subheading.	Same	Pass
			Check the year and month displays correctly in WORK sheet	Current Year and month should be displayed	Same	Pass
			Check the column headings of the WORK sheet	Columns should display from left to right as index EPF No, Employee Name, Display the days for that particular month, Total days worked, Total Leave days and should display the abbreviation	Same	Pass

Having confirmed that the artefact was bug free it was released to be used in the next iteration.

6.3 External Validation

The system was evaluated by another party other than the developer, in this case it was the user/ estate manager. It was done in 2 phases;

1. Pre – implementation
2. Post – implementation

6.3.1 Pre – implementation

Having validated internally, the package was given to practice in the estate. The estate manager was given a basic training to open the package and operate spread sheets. At the same time the package was validated for its relevance to the estate functions. There were 4 iterations and problems were identified and solutions were suggested for the next iteration at the end of each iteration (Table 6.3 -6.5).

Table 6.3: 1st Iteration Results

Problems Identified	Solutions Suggested
Lack of IT literacy of manager to do basic computer tasks	• Basic training to operate the system and on demand advice. • More user friendly system
Needed to create a new spreadsheet at the beginning of a month	• Create a Master file, which can be copied for each new month
The employee may do two different tasks in a day; Ex: plucking and weeding	• Divide the day into two sessions and re-formulate calculations.
No choice for multiple salary structures	• Option to select the salary structure for non-permanent employees and for new salary rates (amendment by the budget)

At the end of the 1st iteration several problems were identified. Even though the tea estate manager was trained to operate the system at initially, he felt difficulty in opening the excel sheet to enter data. The researcher had to write the steps in a paper

on how to switch on the machine and how to navigate to the excel workbook. This helped the tea estate manager to get familiar with a computer and opening an excel sheet. Once the manager was familiar with opening the workbook, he began to enter data in the WK sheet. Initially, he felt it difficult in entering data to the WK sheet due to unfamiliarity with the keyboard. This took more time to enter data compared to the manual recording. The tea estate owner was reluctant to hire an IT expert to give IT therapy for the tea estate manager. The research had to train the estate manager to operate the system.

Initially, the WK sheet was developed to enter the activity done by each employee. After giving the system to the tea estate manager to operate, the researcher noticed that it was too complex to memories each activity abbreviations and lead to error. As a solution the researcher came up with a list of abbreviations as a dropdown list so that the tea estate manager able to select an activity from the drop down list.

When tea estate manager was selecting activities for each employee for each day, he felt that cannot select multiple activities for a particular day. There can be situations where an employee can do two activities for a particular day. The research came up with a solution by modifying the WK sheet by having two separate columns for each day. This helps to select one activity in the morning session and another activity in the afternoon session.

There were altogether 15 employees working at the estate and only 2 employees were permanent and the rest was on a contract basis. At the initial stage there were only one salary scaled maintained and it was applicable to all employees. This was not correct when calculating EPF for permanent employees. As a result the researcher had to maintain two salary scales for permanent and contract employees.

At the 1st iteration there were no master file maintained. The need of a master file came when moving to a new month and the number of days gets changed, number of Sundays, holidays and working days get change. To avoid this separate master file was created. Once the month finishers, the tea estate manager able to modify the master file for the next month.

Table 6.4: 2nd Iteration Results

Problems Identified	Solutions Suggested
Factory transactions were not addressed	• Add a separate sheet to record transactions with each factory ex: sales, loans
Income, expenditure and profit and loss are not addressed	• Creation of separate sheets for income and expenditure and profit and loss
Maintaining separate spreadsheets for each sundry work was too complex and spent more time to enter data	• Maintain all sundry type work in one sheet

After the 2nd iteration, problems were identified in the system. For each sundry activity separate sheet was maintained. The tea estate manager found that it was too complex and take more time to record data in each specific sheet. The researcher created a separate sheet to record all sundry activities and able to remove all the sheets which was related to each sundry activities. This resulted the workbook to be user friendly.

There were no profit and loss sheet to record each month's income, expenses and profit/loss. As per the owner's request separate workbook was maintained for profit and loss sheet which included all the months' data. This was very useful for the owner for decision making.

The tea leaves plucked was sold to two different factories. The tea estate manager was maintaining two separate books were each factory. The tea estate manager faced difficulty in comparing the benefit received from each factory. Therefore "sales factory" sheet was added to the master file. Separate factory sheets were maintained for each factory. This helped in identifying which factory paid the maximum price per kg, which factory gives more advance, which factory gives transportation allowances and which factory provide fertilizer at a lower cost. Tea estate manager can take

decisions to sell more kilograms for the beneficial tea factory in order to maximize the profit.

Table 6.5: 3rd Iteration Results

Problems Identified	Solutions Suggested
Lack of data analysis for decision making	• Add graphs for tea harvest variation, employee efficiency etc.
Internet access was not considered	• Addition of Web page links for easy references.
Did not have 'Instructions' for editing the Master file for a new month	• Add an Instruction document, including all the instructions step by step.

After the 3rd iteration, tea estate manager was facing some difficulty in editing the master file. The researcher created a separate word document with all the instructions on editing a master file. This helped the researcher to create the new excel sheet according to the month without any guidance from the researcher.

There were no internet connection and the researcher requested for internet connection. The owner was able to provide the internet and it helped the tea estate manager to navigate to TSHDA website when needed. Further, the internet connection was helpful for the tea estate manager to send daily sheets and reports to the tea estate owner who was living in a remote location.

Tea estate owner requested for graphs in order to take decisions. The researcher able to create several graphs such as employee efficiency chart, time spend for each activity graph, plucking round charts, unit cost per Kg chart, tea harvest variation chart, factory rate chart, profit to sales ratio chart and expenditure chart. The owner can examine the charts and able to get a high level picture of the operations in the tea estate.

After the 4th iteration the estate manager/ supervisor became satisfied with the system.

6.3.2 Post – implementation

After 3 months since implementing, the package was again validated for its Relevance and usefulness to the business by obtaining a feedback from the stakeholders (the owner and the manager of the estate). The feedback results are summarized in Table 6.6.

Table 6.6: Post-Implementation Feedback Results

Theme	Feedback Results
Time	Both agreed that the new system saves time.
Errors	Both agreed that the new system is more accurate than manual.
Complexity	Both agreed that the new system is not too complex to understand.
Data sharing	Both agreed that they could send and share spreadsheets via mobile applications.
Adaptability	Both agreed that the new system could be applied to other estates (not plantations).
Affordability	The owner agreed that it was worth to buy a computer to implement the system. The manager commented that any tea holder with 10 or more tea acres had enough income to buy a computer.
Analyzed data	Both agreed that graphs such as Unit cost (Figure 6.2), plucking rounds (Figure 6.3) helped in decision making.
	The manager stated that graphs could be used to motivate employees by showing the growth in tea harvest (Figure 6.5) and profit, their plucking efficiency (Figure 6.4) among others etc.
IT assistance	Both agreed that the manager should be given an adequate training to handle the system/ errors.

Figure 6.2 displays the expenditure chart which includes list of expenses for a month. Further it displays the cost incurred in producing one kilogram of tea leaves. This chart is very useful for the tea estate owner to identify what are the expenses and what can be reduced to minimize the cost per tea kilogram.

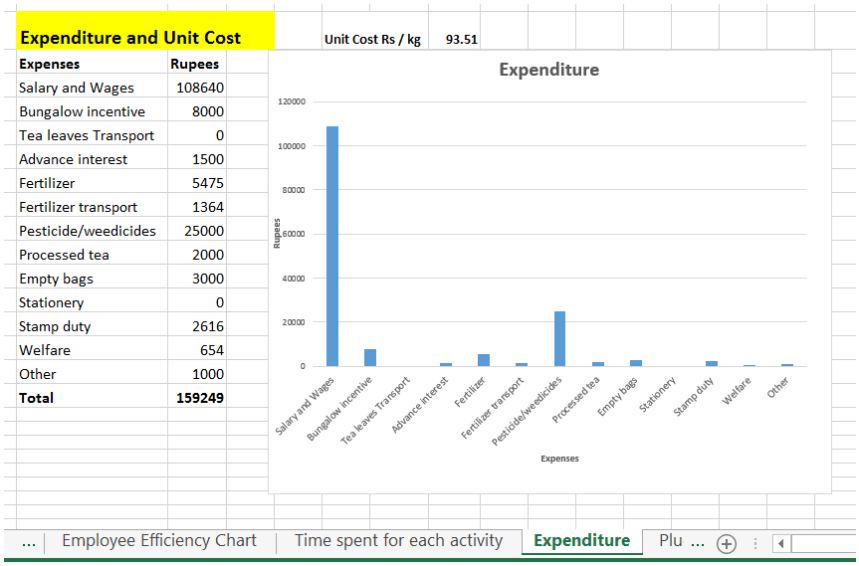
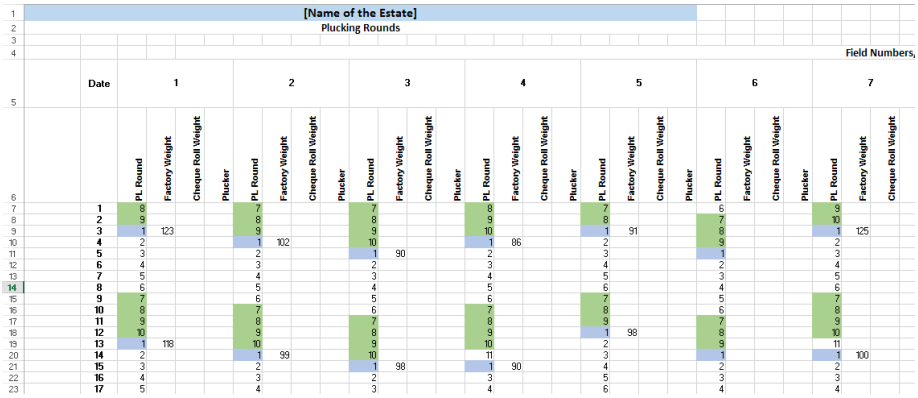


Figure 6.2: Expenditure and Unit Cost during the month

Figure 6.3 displays the plucking round chart. There are two separate plucking charts for wet season (rainy season) and for dry season. The growth rate of the tea shoot depends on the climate, for example, during rainy months it grows fast. Thus, in wet season plucking can be done once in every 7 days and for dry season need to wait till 12^{th} day for a quality shoot.

Based on the climate effects on a given month, the estate manager selects the appropriate sheet to record plucking round for each field. The plucking cycle of a particular field begins from the plucked date and the user must enter '1' for the plucked day and should continue to count till the next plucking. The first day of a cycle will get displayed in 'blue' and the optimal date for next plucking for that field will get displayed in 'green' and reminds the user to arrange plucking.



[Name of the Estate]

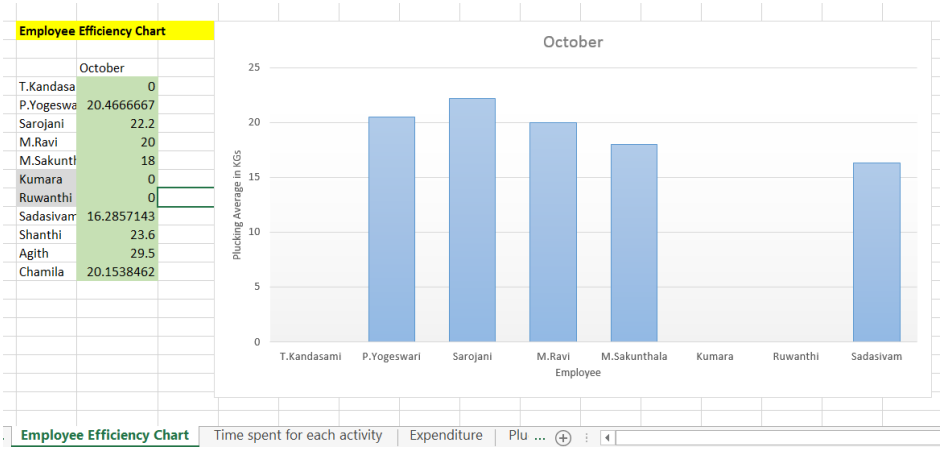
Plucking Rounds

Field Numbers,

Date	1				2				3				4				5				6				7			
	PL Round	Factory Weight	Cheque Roll Weight	Plucker	PL Round	Factory Weight	Cheque Roll Weight	Plucker	PL Round	Factory Weight	Cheque Roll Weight	Plucker	PL Round	Factory Weight	Cheque Roll Weight	Plucker	PL Round	Factory Weight	Cheque Roll Weight	Plucker	PL Round	Factory Weight	Cheque Roll Weight	Plucker	PL Round	Factory Weight	Cheque Roll Weight	Plucker
1	8				7				7				8				7				6				8			
2	9				8				8				9				8				7				10			
3	1	123			9				9				10				1	91			8				1	125		
4	2				1	102			10				1	86			2				9				2			
5	3				2				1	90			2				3				1				3			
6	4				3				2				3				4				2				4			
7	5				4				3				4				5				3				5			
8	6				5				4				5				6				4				6			
9	7				6				5				6				7				5				7			
10	8				7				6				7				8				6				8			
11	9				8				7				8				9				7				9			
12	10				9				8				9				1	98			8				10			
13	1	118			10				9				10				2				9				11			
14	2				1	99			10				11				3				1				1	100		
15	3				2				1	98			1	90			4				2				2			
16	4				3				2				3				5				3				3			
17	5				4				3				4				6				4				4			

Figure 6.3: Plucking Rounds

Figure 6.4 displays the employee efficiency chart for each month. This chart helps to identify the efficient employees and inefficient employees. The owner can provide training to inefficient employees on plucking techniques to improve the efficacy. Further, this chart is helpful for the top management to motivate employees and for conducting performance appraisals, and to take decisions on whether to permanent a temporary employee or not.



Employee Efficiency Chart

	October
T.Kandasa	0
P.Yogeswa	20.4666667
Sarojani	22.2
M.Ravi	20
M.Sakunth	18
Kumara	0
Ruwanthi	0
Sadasivam	16.2857143
Shanthi	23.6
Agith	29.5
Chamila	20.1538462

Figure 6.4: Employee Average plucking rate for during a month

At the same time, business performance was measured in terms of Profit, Sales, and Expenditure. The graphs generated by the system are shown in Figure 6.5 to 6.8.

6.4 Business performance from August 2016 to February 2017

Figure 6.5 represents a graphical view of the trends in tea harvest. According to the graph the highest tea production resulted in the month of November, 2016 while the lowest in the month of August, 2016.

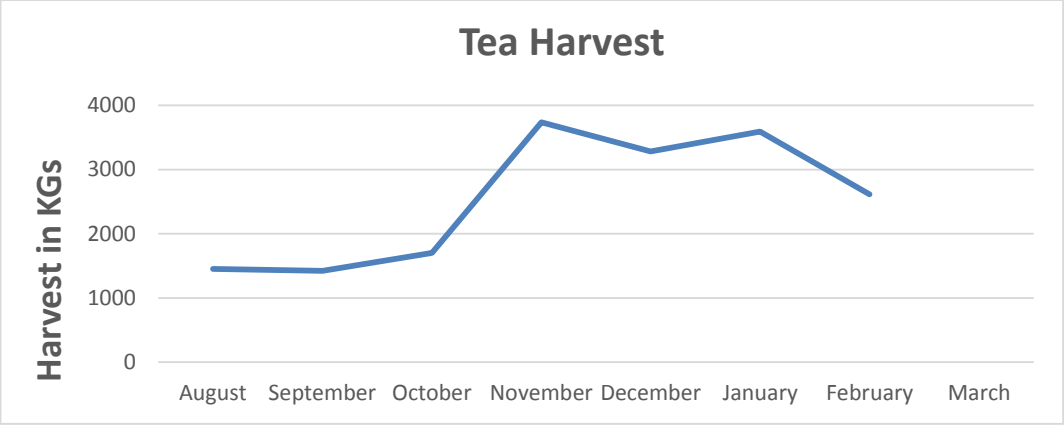


Figure 6.5: Tea Harvest Variation

Figure 6.6 displays the expenditure chart. This demonstrates how expenses have been distributed among various activities. Salaries and wages were the main determinant of expenditure, hence the total expenditure and salary/wages graphs have a similar pattern.

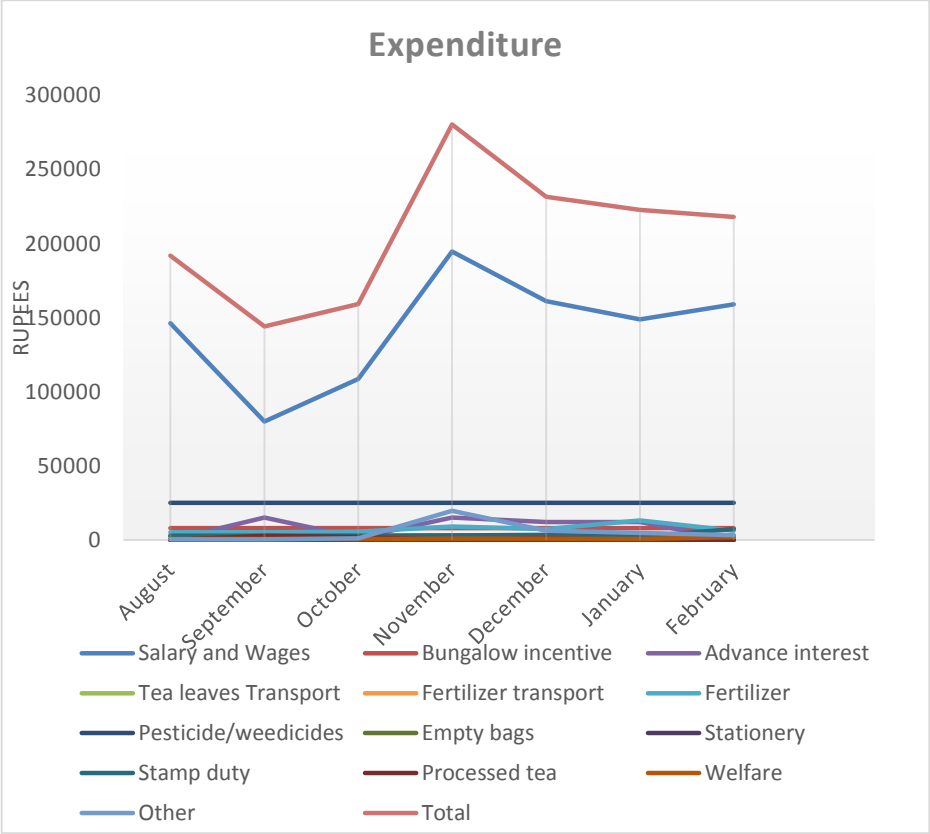


Figure 6.6: Expenditure Fluctuations

Figure 6.7 displays how the cost of production per kilogram changed during the period of 7 months.

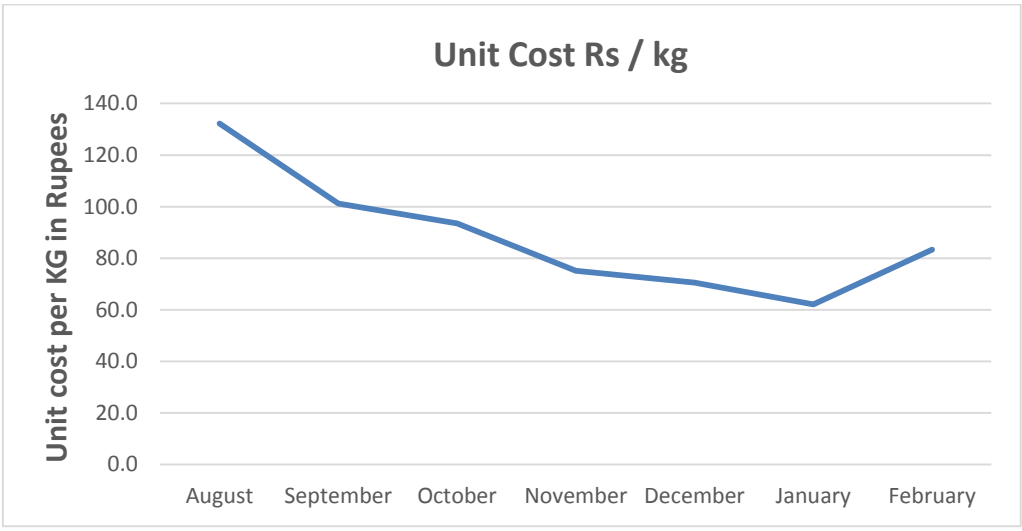


Figure 6.7: Production Cost per kg

Figure 6.8 displays the profit to sale ratio during the past 7 months. In August there was a loss, but in the last few months it has been an increased. The proposed system was introduced in the month of August. The researcher cannot conclude that the increase in profit was due to the implementation of the system. To justify that the increase in profit is due to the adoption of the system, at least past data from August 2015 to February 2016 must be considered. Due to the unavailability of the data, the researcher cannot conclude that the increase in profit is due to the adoption of the new system.

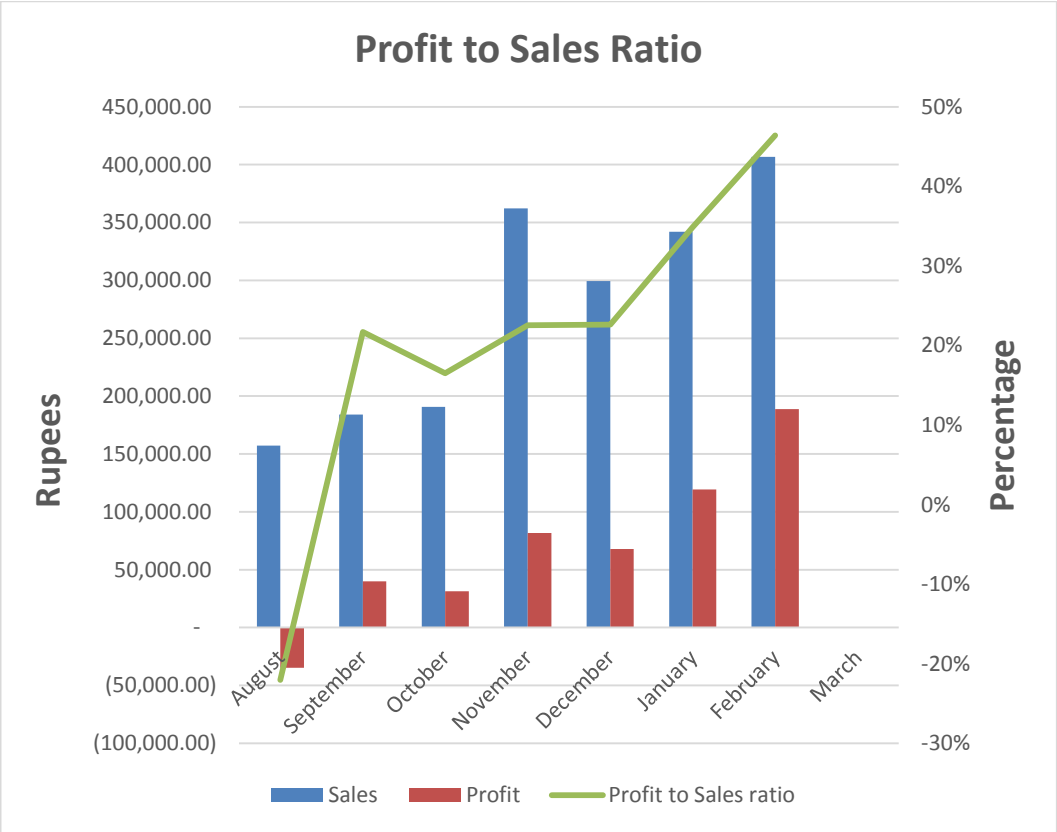


Figure 6.8: Profit to Sales Ratio

6.5 Chapter Summary

The proposed system was validated internally as well as externally in all DSR iteration cycles. The system was validated internally by creating test plan document, creating test scenarios, and creating test cases. The system was validated externally by pre implementation and post implementation techniques. The pre implementations were done by identifying the problems faced in each iteration and solutions were developed to overcome the problems. The post implementation feedback was gained by interviewing the owner and the manager after using the system for 3 months. The feedback was analyzed by pre-defined themes. Further, a graphical representation of business performances has been shown from August 2016 to February 2017.

Chapter 7

7. DISCUSSION

7.1 Introduction

This chapter discusses how researcher has achieved the research objective and how researcher has answered the research questions at the end of the study. Further researcher has identified the barriers that came across when achieving the research objective and came up with solutions to overcome those.

The objective of this research was;
'How can we introduce ICT to TSHs to improve their productivity?'

To achieve the research objectives several questions were formulated as,

Q1. What are the Information Technology (IT) needs of a TSH?
Q2. What are the available appropriate IT solutions for above needs / opportunities?
Q3. What are the barriers in implementing IT for a TSHs?
Q4. How does implementing IT improve a TSH?

7.2 Q1. What are the Information Technology (IT) needs of a TSH?

The answers to the first questions were gathered from observations done at the TSH and by non-formal interviews with the stakeholders.

Q1.1 What are the IT needs perceived by the TSH?

The TSH had several IT needs as perceived by them;

1. They needed a better method for salary preparation as the manual method was time consuming and error prone with the number of employees increase.

In the manual system, the researcher found several salary calculation errors when developing the proposed system. Which was a lost to the organization by paying more to the employees.

Further, tea estate manager pointed out that it takes around 4 to 5 hours when calculating salaries currently. He stated that if the number of employees grows in the organization it will resulted in more.

2. The owner wanted to monitor the estate functions more frequently than once in every two weeks.

   Since the owner is living far away from the estate, it was difficult to monitor the operations. The owner had to visit the estate to monitor the operations. The tea estate manager sends the excel sheets daily to the owner. This helps the estate owner to go through the daily operations at his own residence.

Q1.2 What are the IT opportunities identified by the researcher?

In addition to these perceived needs, the researcher could observe more IT opportunities such as;

1. Storing and processing data to assist in decision making

   Researcher identified by implementing an IT solution, it will helps to retrieve the past months data in to a single sheet where owner able to compare each months figures for decision making. Further researcher added more features to the system by adding useful graphs and charts. Thereby owner may able to forecast the performance of the estate for the future months.

2. Receiving tea industry related updates from TSHDA

By having a web link to the TSHDA site, the manager was up to date on the things going in the tea industry. Further, able to communicate with the tea industry authorities when needed. The manager had the ability to communicate through forums in the website.

7.3 Q2. What are the available appropriate IT solutions for above needs / opportunities?

Q2.1 What are the available IT solutions that can be applied for the TSH?

Thus, having had identified these immediate IT needs and opportunities, the next step was to seek any available IT system to match above requirements. As the needs were related to the internal operations of the TSH, the systems designed for yield mapping (Blackmore, 2003) or systems using global positioning systems (Gunatilake, 2012) were excluded. Any system that could be used with smart phones were to be taken into consideration as both owner and the manager were having smart phones and mobile phones were available to almost all plantation managers and were the easiest method of communication as perceived by them (Samansiri 2014).

Q2.2 What are the innovative IT solutions for the TSH?

The aim was to find a low cost solution that will meet the IT needs. Spreadsheet based solutions can be used for routine calculations and for generating graphs for decision making. In this research, the researcher used Excel 2013 which supported all calculations. Free and open source software's were not considered due to not supporting some required functionality and lack of reliability. When considering

the estate managers literacy level and maintainability excel was the most appropriate solution. Since excel was user friendly and easy to operate. Further, by using excel able to do the modification to the calculations when the calculation method gets changed.

Q2.3 How to develop an innovative IT solution for the TSH?

Thus, there was a need to develop an IT solution. It was advantageous if the solution could be shared via smart phones. According to their salary preparation needs, a basic spreadsheet application was designed with necessary formula, internally validated for errors by the developer. This internal validation was done as for any other newly designed software, using test plans, test scenarios, and test cases (Appendix – B). After each internal validation, it was released for external validation by the operator/ manager of the estate.

Results of the 1st Iteration

Although the owner of the TSH was willing to adopt IT, he could not provide necessary hardware and software on time. Therefore the researcher had to provide a computer with the necessary software to run the system. This inability of the owner could be due to several reasons mentioned in past literature (Kapurubandara, 2009, Thong, 1995);

- Lack of trust in the system that it would not work for the TSH
- Lack of IT knowledge that he could not understand the potential benefits of the system – Initially owner was not aware of the benefits from the system.
- Lack of money at the time of implementation - The system was implemented in August 2016 which had a loss in that particular month

Although provision of hardware and software is not an objective of IT therapy, in this study, the researcher had to provide both IT consultations as well as hardware and software for study purpose (Wolcott, 2008). The primary design did not have a master file, the operator had to make a few changes to the existing file to use it for the next month. However, another barrier in past literature 'lack of adequate IT knowledge' (Arendt, 2008, Kapurubandara, 2009) was confirmed as the IT literacy of the operator was not adequate.

There were complex operations such as the working day of the TSH was divided into morning and afternoon sessions and the solution had to be redesigned to accommodate that option. The DSR methods provided the ability to re-designing and re-testing as the methodology was suitable for messy and 'wicked' problems (Hevnor, 2007).

Results of the 2nd Iteration

During this cycle the manager gave fine details on methods of calculations to improve the system. Also, he gave suggestions for some additions, although he could have provided these details initially. This was an additional burden for the researcher to redesign the system. The tea estate manager didn't disclose all the information to the researcher at the initial stage may due to several reasons.

- Lack of IT knowledge and practice
- Lack of understanding of the system – estate manager may not know the complexity, when adding features to the system once developed.
- Lack of interest in the system- since estate manager does not have IT literacy, he might not have the interest to learn the system.
- Lack of trust on the researcher as mentioned in past literature.

However, at the end of the 2nd iteration, he was enthusiastically involved in developing the system by asking questions, giving suggestions, sharing documents with the researcher. This could

provide an example that IT therapy can overcome above barriers of IT adoption (Wolcott, 2008).

Results of the 3rd Iteration

Initially the manager did not know how to open a spreadsheet file. But at the end of 3rd iteration, the manager showed a significant improvement, from 'can't operate at all' stage to 'able to enter data and save' stage without relying on the researcher. This fact recommend that a training and on demand help would be needed for a successful IT adoption. The researcher should have provided sufficient IT therapy to the estate manager to operate the system. The manager confirmed that he needs more training in order to operate the system. This was revealed in his final feedback.

At the end of the 4th iteration the manager satisfied with the system.

7.4 Q3. What are the barriers in implementing IT for a TSHs?

What are the barriers?

Barrier 1:

Tea estate manager didn't have adequate IT literacy at the initial stage. Further estate manager had lack of trust, lack of confidence on the system.

Overcoming the Barrier 1:

The researcher had to provide IT assistance frequently. This was done by giving IT therapy to the tea estate manager. In this case, the researcher participated in providing IT therapy for the tea estate since the tea estate owner was reluctant to hire an additional IT expert. This solution may not be a concrete solution when trying to apply for other tea estates and the giving IT therapy by the researcher won't be practical when adopting the system to a sample of tea estates. If the owner is reluctant to hire an IT expert, there must be a way of gaining necessary IT knowledge to operate the system.

Barrier 2:

The tea estate owner was reluctant to invest on the necessary hardware and software at the initial stage. This was due to several reasons as discussed above. The main reason was lack of awareness of the perceived benefits of the system.

Overcoming the Barrier 2:

After giving IT therapy to the estate manager and allowing the system to use for the past 6 months, owner realized the benefits of the system and agreed to invest on the necessary hardware and software. When adopting IT for other selected TSHs, where most of the owners do not have adequate IT literacy and do not know the importance and benefits of an IT system. One solution would be to give the system to use in the real business environment and get the owners feedback as it was done in this research. The other would be to encourage the TSH owners on adopting IT for their businesses by the government or authorized bodies of Tea industry. This can be achieved by giving education on how TSHs in developed countries do their day to day operations by the use of IT and what are the benefits gained in the long run.

Further, government or the TSHDA can provide interest free loans for TSHs on purchasing the necessary hardware and software or can have installment plans for easy payments.

The researcher can get the system approved by the TSHDA. This will change the mindset of the TSHs owners on use of this system for their day to day operations.

7.5 Q4. How does implementing IT improve a TSH?

The final system was given to the TSH and after a period of 3 months, feedbacks were obtained from all stakeholders (the owner and the manager) by means of interviews. Interviews were carried out individually, but using the same questions (Appendix C). All stakeholders agreed that the proposed system was sparing time, more accurate, not complex, and applicable to other TSHs (Table 6.6).

Regarding the affordability the owner stated that though it was difficult to afford, it would be a long term investment, and the manager noted that hardware could be bought for an installment plan. If this is the same situation with other TSHs, public or any other organization would have to provide financial/ material support for TSHs. Past literature provides evidence for such funding agencies that promote IT for development (Qureshi 2008).

Regarding data sharing, the manager was able to send spreadsheets to the owner via mobile phone applications (Viber) which could reduce the need for fax.

Both agreed that graphs and charts were useful. The owner and the manager both stated expenditure and cost graph indicated an increase in cost, necessary actions can be taken to control the expenditure of the month. The plucking round chart helps in planning plucking days, utilizing available employees optimally to get good quality leaves. Thus, it ultimately aided in improving productivity. The manager also stated that graphs such as plucking averages, the tea harvest could be used to motivate employees.

Regarding IT assistance, the manager clearly stated that he needed a prior training to operate the system as well as on demand assistance for at least 3 months, while the owner mentioned that giving a training to the estate manager/ operator was cost effective than hiring an IT expert.

Ghobakhloo (2012), mentioned that if there is an IT-enabled business performance, then it becomes a driving factor for adoption of IT. The proposed system could change the traditional way of operations in the TSH and drive it towards adoption of IT. There was also a clear improvement in managers' IT literacy, thence an improvement in the information processing capability for better decision making to raise the productivity.

7.6 Chapter Summary

How the research objective and questions have been achieved by the researcher is described in this chapter.

Chapter 8

8. CONCLUSIONS AND RECOMMENDATIONS

8.1 Introduction

This chapter describes the conclusions made by the researcher and recommendations on how ICT can be introduced to TSHs. Further, discusses the future research work.

8.2 Conclusions and Recommendations

The results of this action research based case study clearly concluded that, if the CEO/ top management has knowledge on, IT and its benefits, and a positive attitude towards IT, then IT can be adopted successfully. Even though there are many TSHs, who do not have financial capabilities to invest in an IT system at the initial stage, this can be overcome by having a positive attitude toward implementing IT.

It could also conclude that IT therapy can overcome the barriers such as lack of knowledge on IT, lack of trust on IT, lack of confidence on handling IT, lack of money as IT therapy gives low cost solutions. Based on the past literature reviews and based on the feedback given by the manager and the owner, it was confirmed that giving IT therapy is essential at the initial stage which would help towards adapting IT for TSHs.

The improvements in business performances cannot merely be attributed to the adoption of IT to the TSH as the study has not excluded other positive factors such good climate changes, having efficient and skilled employees in the period where system was used. However, it can be concluded that having an IT system in a TSHs would improve its productivity based on the positive feedback given by both manager and owner after using the system for 6 months. Initially, owner was reluctant to invest on the proposed system. This was due to lack of awareness of the perceived benefits from the system. After using the system for 6 months, owner decided to invest.

This system was not developed for this particular TSH. Based on the feedback given by the owner after using the system, he stated that the system can be adapted by other TSHs since they have the same functions.

As per the owner's feedback on the proposed system, the system was very useful in analyzing past month's data and able to get predictions on the future of the estate. Since the owner is living in a remote location he need not visit frequently to the estate to take important decisions. He can go through the excel sheets, reports and charts while staying at his residence.

This research was conducted as a case study and the action research strategy was used in implementing ICT for the selected estate. Since the new system was developed through multiple iterations, the DSR technique was helpful.

IT therapy plays a vital role when adopting IT for TSHs, as TSHs stakeholders lack IT literacy. They may not be willing to take the risk. Therefore, it can be proposed to give initial IT therapy free of charge by a funding agency (government or non-government) as this is important in adoption of IT. The study also suggests either to establish or make use of available IT centres in provision of knowledge on IT to TSHs.

After giving initial IT therapy, the TSHs can invest on hardware and software. This can be facilitated by providing a grant by a public authority or a non-government agency, for those TSHs who need financial support to adopt IT. Further, the owner stated that if some TSH is facing financial issues they can purchase the required hardware and software in an installment basis. This may not affect the cash flow of that particular month. This will gain long term benefits when the productivity gets improved.

8.3 Future Research Work

This research was conducted as case study on a selected TSH. The researcher has not interviewed other TSHs owners on implementation of this system for their tea estates. Since the system has been developed for the general activities of a typical TSH, it can be adopted for other TSHs. The study could be improved by further research by testing the proposed IT system in a representative sample of TSHs. Researcher can conduct more interviews with other TSHs owners and give the proposed system to use for their day to day activities. Thereby the researcher can get an understanding on the importance and usefulness of the system.

In this research, the researcher was unable to compare the variation in tea production after using the system, with the past years tea production. This was due to unavailability of past years data. Therefore researcher was unable to justify the increase in tea production was due to the implementation of the system. The researcher needs to have data for at least 2 years after implementing the system, since the tea production varies due to the weather and cannot compare the production monthly for a particular year. Thereby the researcher can compare the seasonal change before coming to a conclusion on the effects of the system on the increases in productivity.

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Appendix A: Instructions for editing the Master file

Steps

1. Take a copy of the MASTER FILE workbook and rename it to the relevant YEAR MONTH.xlsx
2. Open the new month workbook.
3. In the WK sheet, enter the estate name, month and year (Figure1)

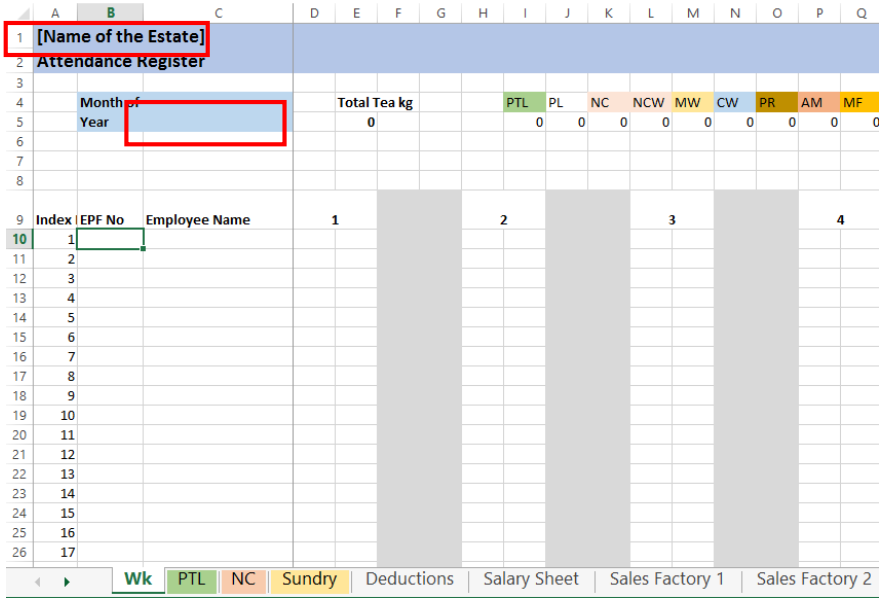


Figure 1

4. If a new employee joins the estate, then add the name and EPF number list. If another joins then add the second name below the first (Figure 2).

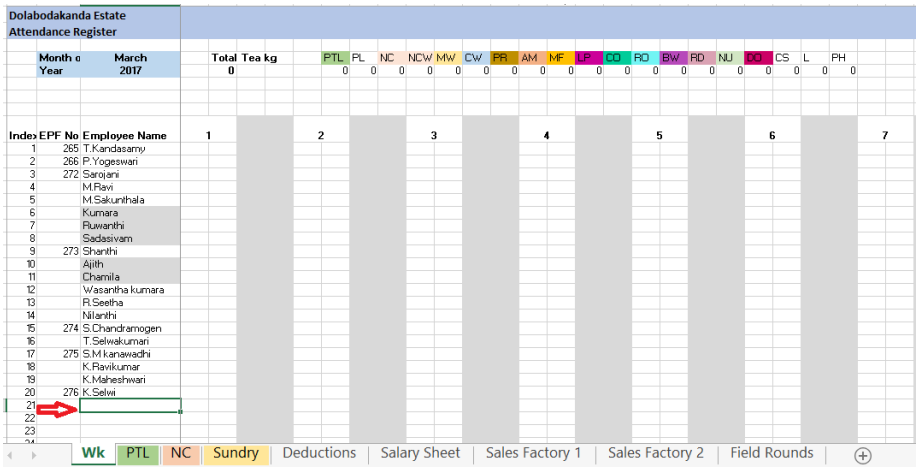


Figure 2

5. In Salary Sheet, enter the Number of days in the month, number of Sundays, number of Poya days and other holidays. Total leave days and work days will be calculated automatically (Figure 3)

Dolabodakanda Estate			Salary Scale	1	2	3
Salary Sheet	No. of days	31	Basic salary per day Rs.	445.00	545.00	0.00
	Sundays	4	Rate per over kg	15.00	15.00	0.00
Month of March	Poyadays	1	Incentives	105.00	105.00	500.00
Year 2017	Other holidays	0	Allowances	30.00	30.00	0.00
	Total holidays	5	Overtime rate per hour	100.00	100.00	
	Working days	26	Buying Rate per kg			22.00

Index No	EPF No.	Employee Name	Salary Scale	Total No of Days	Basic	Allowances	Incentives	Total	Overtime	For extra Kg	Gross Pay	Total Deductions	Net Salary
1	265	T.Kandasamy		0.0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
2	266	P.Yogeswari		0.0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
3	272	Sarojani		0.0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
4	0	M.Ravi		0.0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
5	0	M.Sakunthala		0.0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
6	0	Kumara											
7	0	Ruwanthi											
8	0	Sadasivam											
9	273	Shanthi		0.0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
10	0	Ajith											
11	0	Chamila											
12	0	Wasantha kumara		0.0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
13	0	R.Seetha		0.0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
14	0	Nilanthi		0.0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
15	274	S.Chandramogen		0.0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00

Wk | PTL | NC | Sundry | Deductions | Salary Sheet | Sales Factory 1 | Sales Factory 2 | Field Rounds

Figure 3

6. Enter the norm (expected plucking weight per person) per day in the PTL sheet (Figure 4).

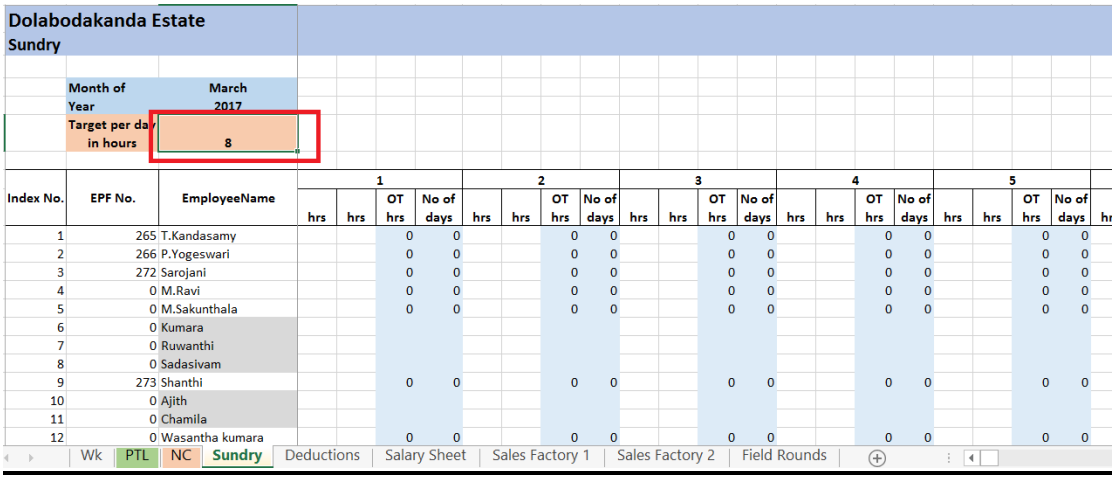
Dolabodakanda Estate	
Plucking Tea Leaf Register	
Month of	March
Year	2017
Target per day in kg	22

Index No	EPF No.	EmployeeName	1 KG	KG	No of days	2 KG	KG	No of days	3 KG	KG	No of days	4 KG	KG	No of days	5 KG	KG	No of days
1	265	T.Kandasamy			0			0			0			0			0
2	266	P.Yogeswari			0			0			0			0			0
3	272	Sarojani			0			0			0			0			0
4	0	M.Ravi			0			0			0			0			0
5	0	M.Sakunthala			0			0			0			0			0
6	0	Kumara															
7	0	Ruwanthi															
8	0	Sadasivam															
9	273	Shanthi			0			0			0			0			0
10	0	Ajith															
11	0	Chamila															
12	0	Wasantha kumara			0			0			0			0			0
13	0	R.Seetha			0			0			0			0			0
14	0	Nilanthi			0			0			0			0			0

Wk | PTL | NC | Sundry | Deductions | Salary Sheet | Sales Factory 1 | Sales Factory 2 | Field Rounds

Figure 4

7. Enter the number of hours an employee should work for a particular day in Sundry sheet (Figure 5).



Dolabodakanda Estate
Sundry

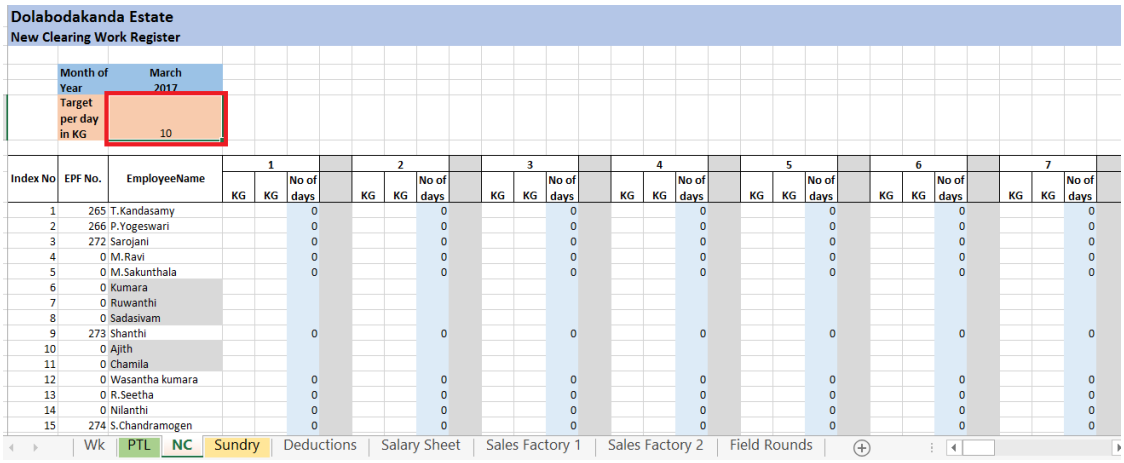
Month of Year	March 2017
Target per day in hours	8

Index No.	EPF No.	EmployeeName	1				2				3				4				5			
			hrs	hrs	OT hrs	No of days	hrs	hrs	OT hrs	No of days	hrs	hrs	OT hrs	No of days	hrs	hrs	OT hrs	No of days	hrs	hrs	OT hrs	No of days
1	265	T.Kandasamy			0	0			0	0			0	0			0	0			0	0
2	266	P.Yogeswari			0	0			0	0			0	0			0	0			0	0
3	272	Sarojani			0	0			0	0			0	0			0	0			0	0
4	0	M.Ravi			0	0			0	0			0	0			0	0			0	0
5	0	M.Sakunthala			0	0			0	0			0	0			0	0			0	0
6	0	Kumara																				
7	0	Ruwanthi																				
8	0	Sadasivam																				
9	273	Shanthi			0	0			0	0			0	0			0	0			0	0
10	0	Ajith																				
11	0	Chamila																				
12	0	Wasantha kumara			0	0			0	0			0	0			0	0			0	0

Wk | PTL | NC | Sundry | Deductions | Salary Sheet | Sales Factory 1 | Sales Factory 2 | Field Rounds

Figure 5

8. Enter the number of KGs per day in the New Clearing sheet (Figure 6).



Dolabodakanda Estate
New Clearing Work Register

Month of Year	March 2017
Target per day in KG	10

Index No	EPF No.	EmployeeName	1			2			3			4			5			6			7		
			KG	KG	No of days	KG	KG	No of days	KG	KG	No of days	KG	KG	No of days	KG	KG	No of days	KG	KG	No of days	KG	KG	No of days
1	265	T.Kandasamy			0			0			0			0			0			0			0
2	266	P.Yogeswari			0			0			0			0			0			0			0
3	272	Sarojani			0			0			0			0			0			0			0
4	0	M.Ravi			0			0			0			0			0			0			0
5	0	M.Sakunthala			0			0			0			0			0			0			0
6	0	Kumara																					
7	0	Ruwanthi																					
8	0	Sadasivam																					
9	273	Shanthi			0			0			0			0			0			0			0
10	0	Ajith																					
11	0	Chamila																					
12	0	Wasantha kumara			0			0			0			0			0			0			0
13	0	R.Seetha			0			0			0			0			0			0			0
14	0	Nilanthi			0			0			0			0			0			0			0
15	274	S.Chandramogen			0			0			0			0			0			0			0

Wk | PTL | NC | Sundry | Deductions | Salary Sheet | Sales Factory 1 | Sales Factory 2 | Field Rounds

Figure 6

9. Select the work done from the dropdown list in sheet ‘Work’. The first column is for the first half of the day while the second column is for the second half of the day. Need to fill both columns for that particular day (Figure 7).

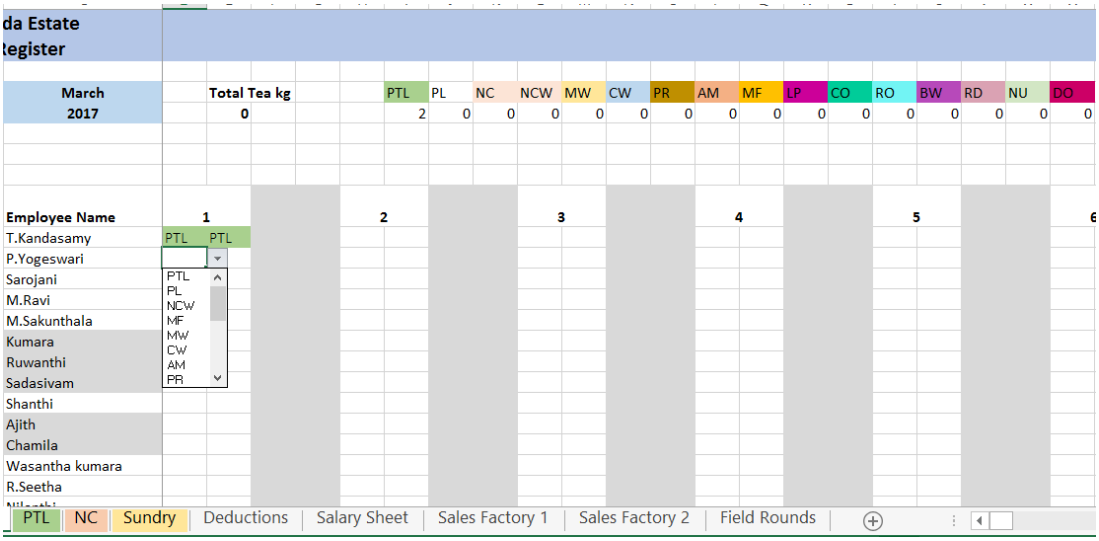


Figure 7

Example:

If 'PTL' is selected for both sessions in day 1 for 'T.Kandasamy', in PTL sheet the cell for the day 1 for T.Kandasamy gets activated to enter the number of KGs plucked. User should enter the number of KGs plucked in both sessions to call it a day. If you only enter the KGs for one session it will show as half day work. Please see the Figure 8 below.

Scenario 1:

When select PTL for morning session and did not select anything for afternoon session (Figure 8).

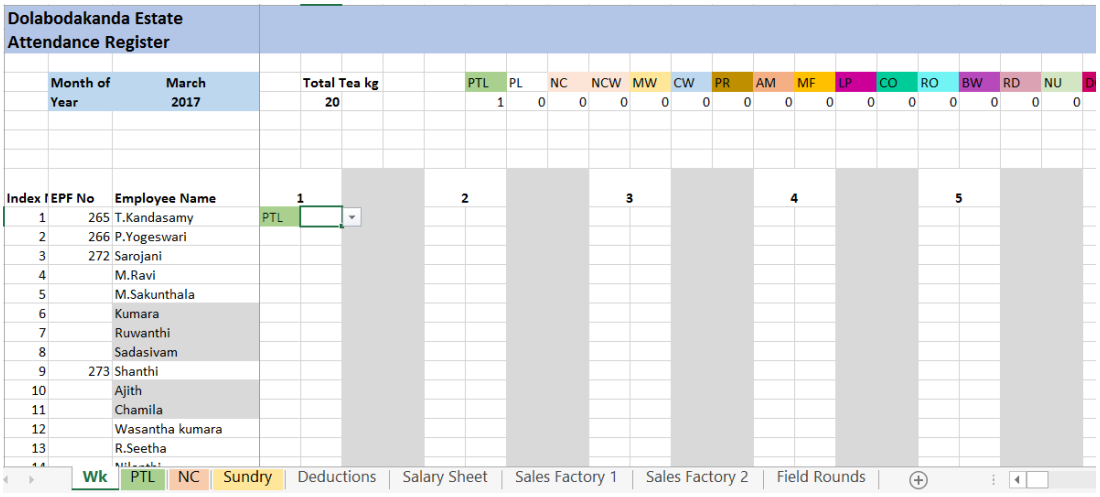


Figure 8

In the PTL sheet, user is restricted from entering a value for afternoon session (Figure 9).

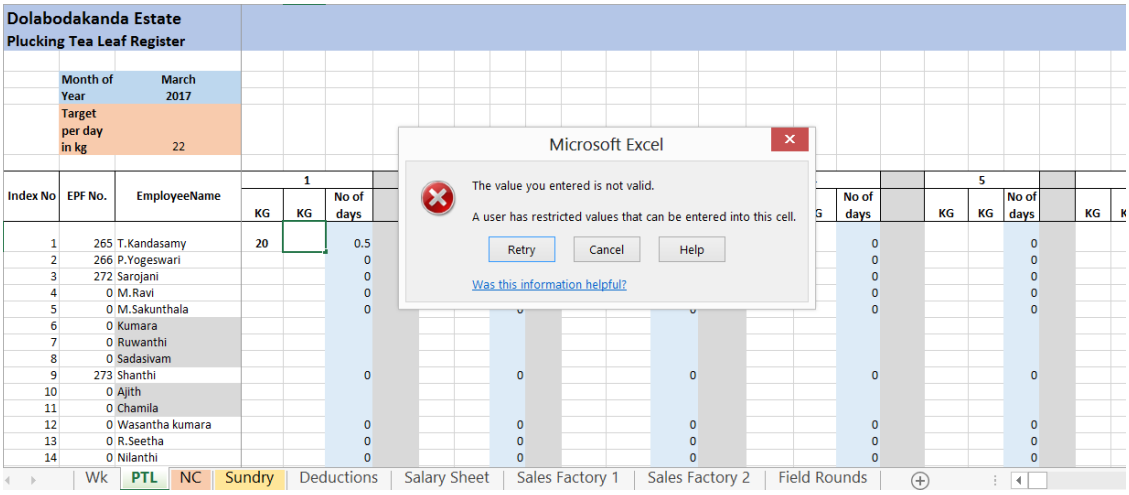


Figure 9

Scenario 2:

Selecting 'PTL' for both sessions (Figure 10).

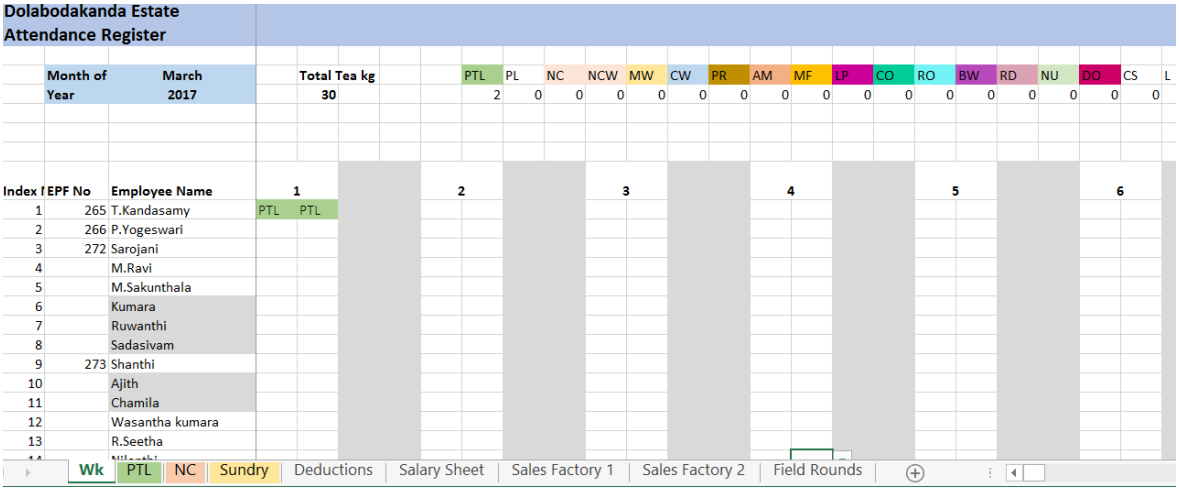


Figure 10

In PTL sheet, enter number of KGs in both the sessions (Figure 11).

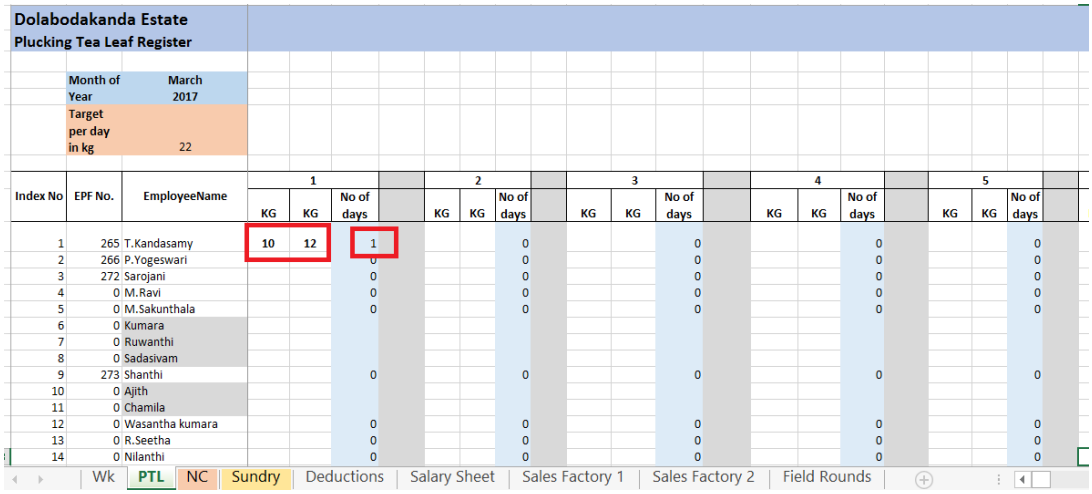


Figure 11

Scenario 3:

In WK sheet, select PTL in the morning session and select a sundry work in the afternoon session (Figure 12).

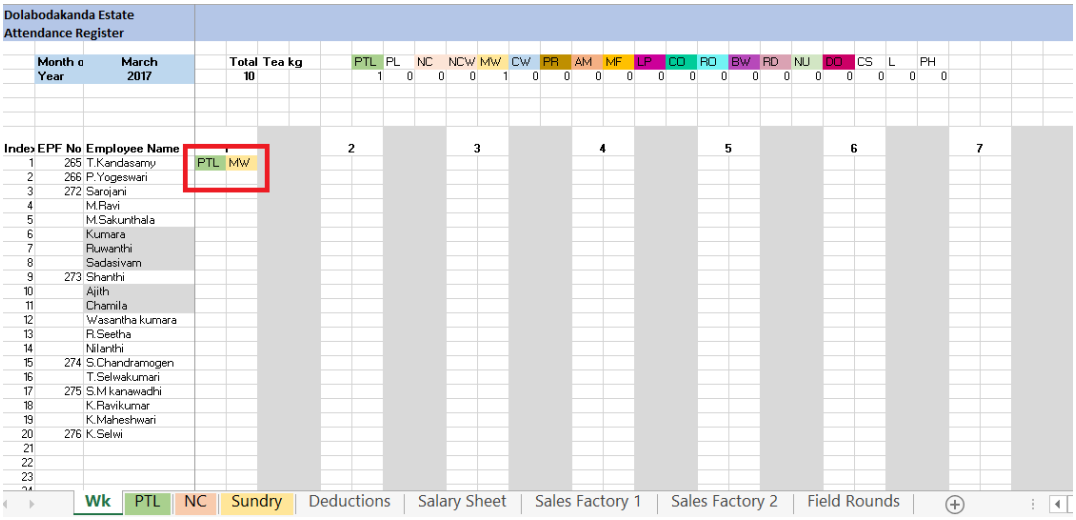
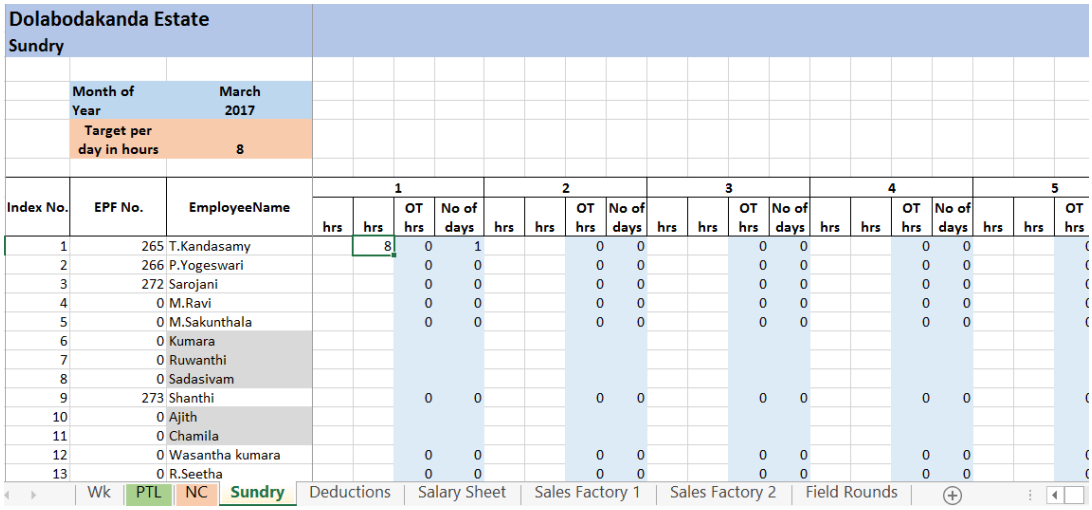


Figure 12

In PTL sheet, in the afternoon session, user is restricted from entering a value. In sundry sheet, for T. Kandasamy, for day 1, only the afternoon session can include a value.



Dolabodakanda Estate
Sundry

Month of Year	March 2017
Target per day in hours	8

Index No.	EPF No.	EmployeeName	1				2				3				4				5		
			hrs	hrs	OT hrs	No of days	hrs	hrs	OT hrs	No of days	hrs	hrs	OT hrs	No of days	hrs	hrs	OT hrs	No of days	hrs	hrs	OT hrs
1	265	T.Kandasamy		8	0	1			0	0			0	0			0	0			0
2	266	P.Yogeswari			0	0			0	0			0	0			0	0			0
3	272	Sarojani			0	0			0	0			0	0			0	0			0
4	0	M.Ravi			0	0			0	0			0	0			0	0			0
5	0	M.Sakunthala			0	0			0	0			0	0			0	0			0
6	0	Kumara																			
7	0	Ruwanthi																			
8	0	Sadasivam																			
9	273	Shanthi			0	0			0	0			0	0			0	0			0
10	0	Ajith																			
11	0	Chamila																			
12	0	Wasantha kumara			0	0			0	0			0	0			0	0			0
13	0	R.Seetha			0	0			0	0			0	0			0	0			0

Wk | PTL | NC | Sundry | Deductions | Salary Sheet | Sales Factory 1 | Sales Factory 2 | Field Rounds

Figure 13

User restricted entering a value for the morning session of the day 1 for T. Kandasamy, since user has not selected a sundry work in the WK sheet. (Excluding PTL, NC and L all other types of work belong to Sundry work) (Figure 14).

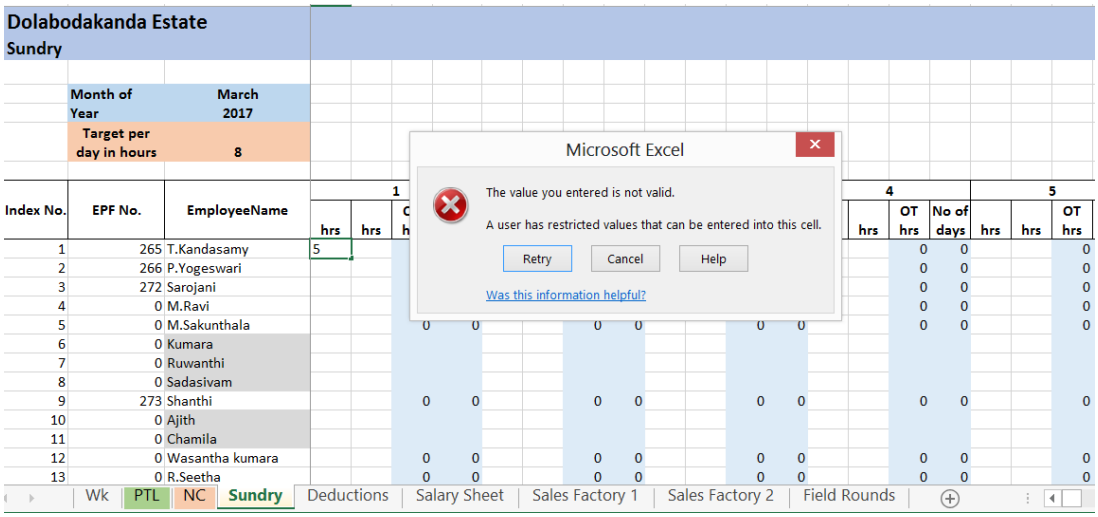
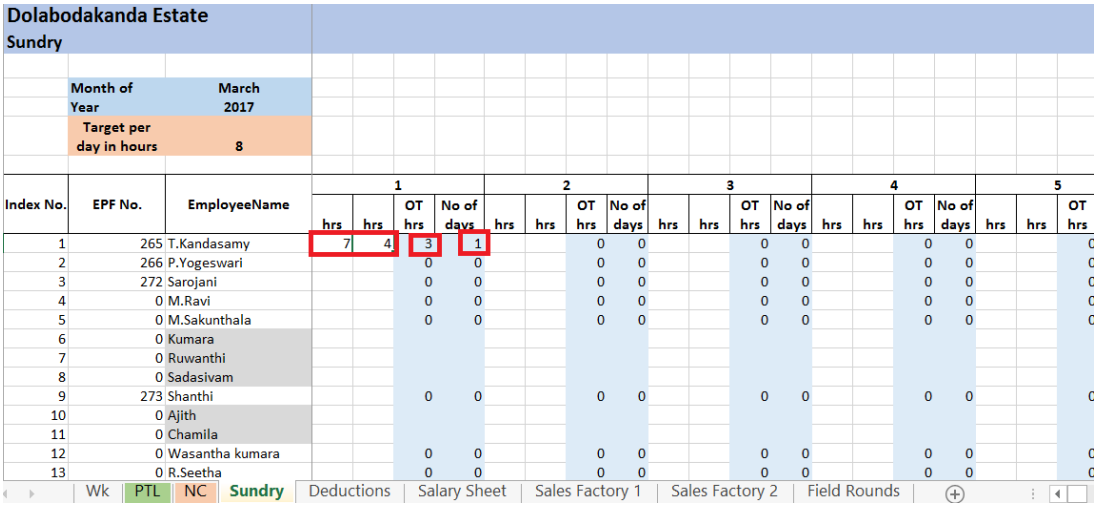


Figure 14

Scenario 4:

If the total number of hours for both the sessions is greater than 8 then the number of OverTime hours will be displayed as per the calculation ‘total hours-8’ (Figure 15).



Dolabodakanda Estate
Sundry

Month of	March
Year	2017
Target per day in hours	8

Index No.	EPF No.	EmployeeName	1				2				3				4				5		
			hrs	hrs	OT hrs	No of days	hrs	hrs	OT hrs	No of days	hrs	hrs	OT hrs	No of days	hrs	hrs	OT hrs	No of days	hrs	hrs	OT hrs
1	265	T.Kandasamy	7	4	3	1			0	0			0	0			0	0			0
2	266	P.Yogeswari			0	0			0	0			0	0			0	0			0
3	272	Sarojani			0	0			0	0			0	0			0	0			0
4	0	M.Ravi			0	0			0	0			0	0			0	0			0
5	0	M.Sakunthala			0	0			0	0			0	0			0	0			0
6	0	Kumara																			
7	0	Ruwanthi																			
8	0	Sadasivam																			
9	273	Shanthi			0	0			0	0			0	0			0	0			0
10	0	Ajith																			
11	0	Chamila																			
12	0	Wasantha kumara			0	0			0	0			0	0			0	0			0
13	0	R.Seetha			0	0			0	0			0	0			0	0			0

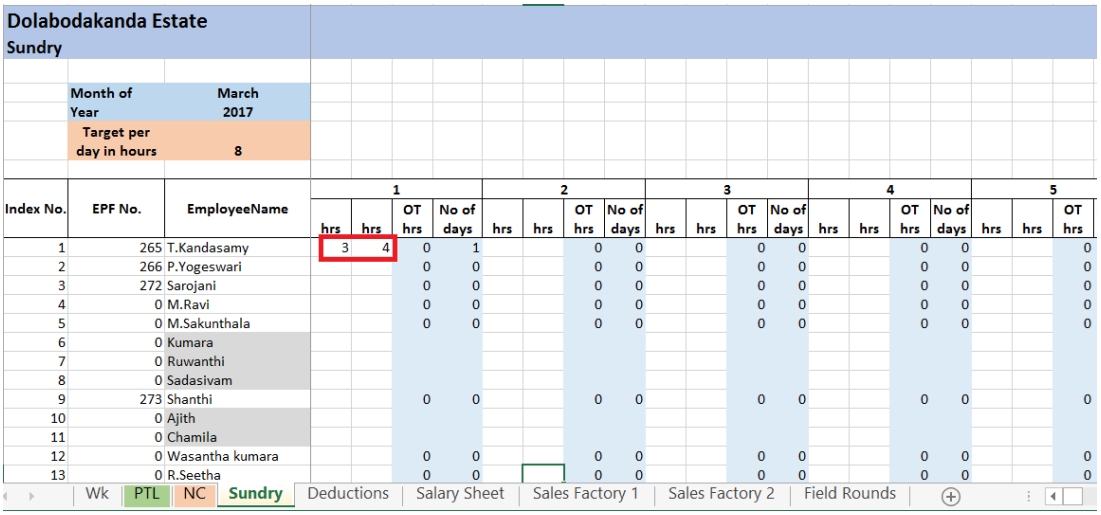
Wk | PTL | NC | Sundry | Deductions | Salary Sheet | Sales Factory 1 | Sales Factory 2 | Field Rounds

Figure 15

Scenario 5:

When the total number of hours for the both sessions is 7 or 8 then the OT hours is zero and the number of days worked will be displayed as 1.

When total hours is 7 (Figure 16),



Dolabodakanda Estate
Sundry

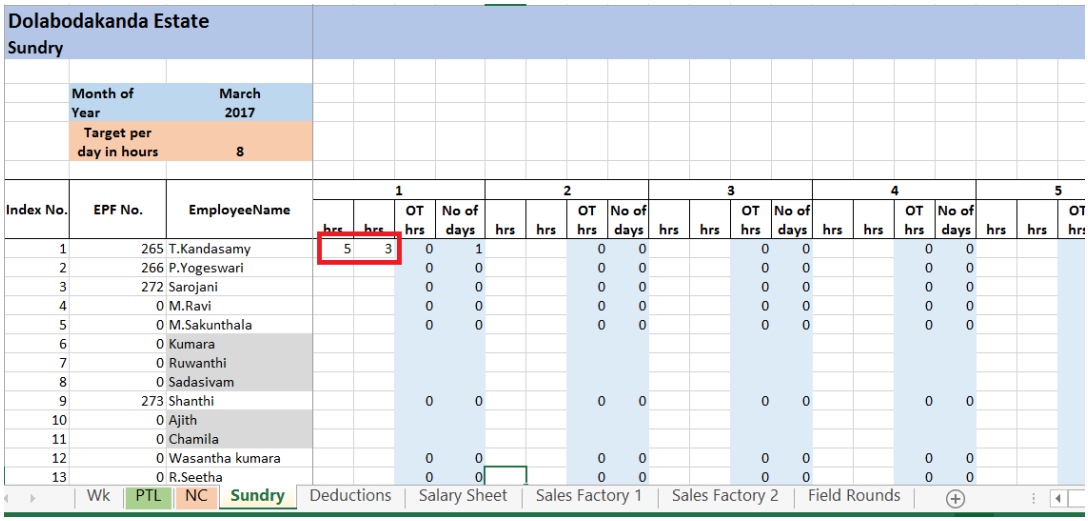
Month of	March
Year	2017
Target per day in hours	8

Index No.	EPF No.	EmployeeName	1				2				3				4				5		
			hrs	hrs	OT hrs	No of days	hrs	hrs	OT hrs	No of days	hrs	hrs	OT hrs	No of days	hrs	hrs	OT hrs	No of days	hrs	hrs	OT hrs
1	265	T.Kandasamy	3	4	0	1			0	0			0	0			0	0			0
2	266	P.Yogeswari			0	0			0	0			0	0			0	0			0
3	272	Sarojani			0	0			0	0			0	0			0	0			0
4	0	M.Ravi			0	0			0	0			0	0			0	0			0
5	0	M.Sakunthala			0	0			0	0			0	0			0	0			0
6	0	Kumara																			
7	0	Ruwanthi																			
8	0	Sadasivam																			
9	273	Shanthi			0	0			0	0			0	0			0	0			0
10	0	Ajith																			
11	0	Chamila																			
12	0	Wasantha kumara			0	0			0	0			0	0			0	0			0
13	0	R.Seetha			0	0			0	0			0	0			0	0			0

Wk | PTL | NC | Sundry | Deductions | Salary Sheet | Sales Factory 1 | Sales Factory 2 | Field Rounds

Figure 16

When total hours is 8 (Figure 17),



Dolabodakanda Estate
Sundry

Month of Year	March 2017
Target per day in hours	8

Index No.	EPF No.	EmployeeName	1				2				3				4				5		
			hrs	hrs	OT hrs	No of days	hrs	hrs	OT hrs	No of days	hrs	hrs	OT hrs	No of days	hrs	hrs	OT hrs	No of days	hrs	hrs	OT hrs
1	265	T.Kandasamy	5	3	0	1			0	0			0	0			0	0			
2	266	P.Yogeswari			0	0			0	0			0	0			0	0			
3	272	Sarojani			0	0			0	0			0	0			0	0			
4	0	M.Ravi			0	0			0	0			0	0			0	0			
5	0	M.Sakunthala			0	0			0	0			0	0			0	0			
6	0	Kumara																			
7	0	Ruwanthi																			
8	0	Sadasivam																			
9	273	Shanthi			0	0			0	0			0	0			0	0			
10	0	Ajith																			
11	0	Chamila																			
12	0	Wasantha kumara			0	0			0	0			0	0			0	0			
13	0	R.Seetha			0	0			0	0			0	0			0	0			

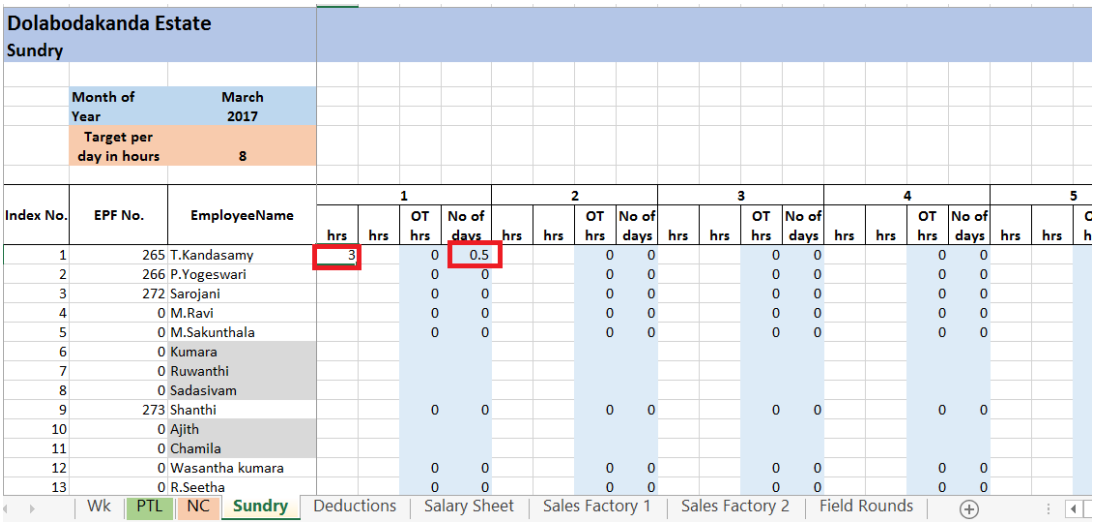
Wk | PTL | NC | Sundry | Deductions | Salary Sheet | Sales Factory 1 | Sales Factory 2 | Field Rounds

Figure 17

Scenario 6:

When the total number of hours for the both sessions is more than 2 and less than 7, the number of days display as 0.5 (Figure 18).

When total hours is 3,



Dolabodakanda Estate
Sundry

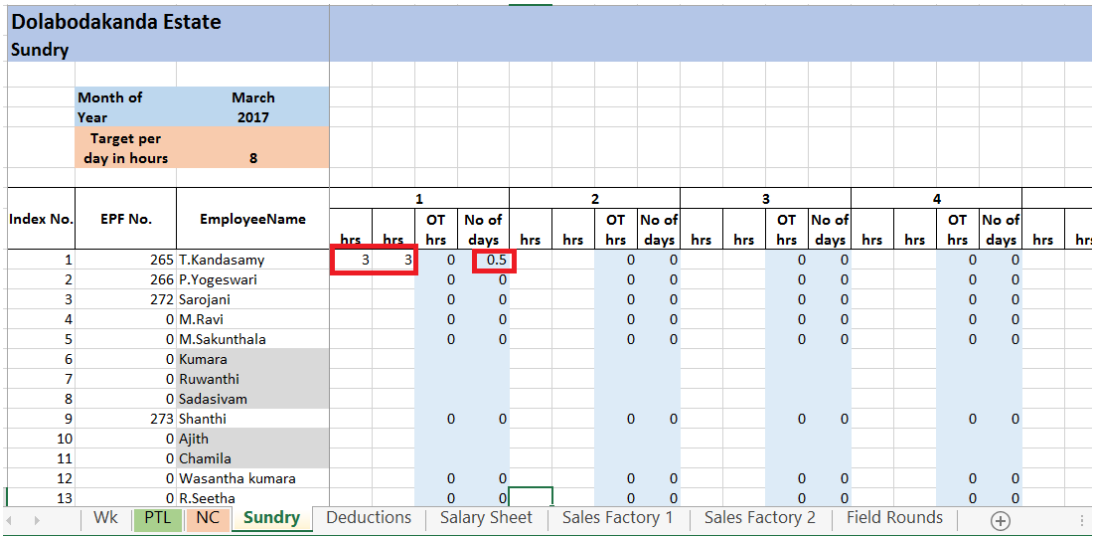
Month of Year	March 2017
Target per day in hours	8

Index No.	EPF No.	EmployeeName	1				2				3				4				5		
			hrs	hrs	OT hrs	No of days	hrs	hrs	OT hrs	No of days	hrs	hrs	OT hrs	No of days	hrs	hrs	OT hrs	No of days	hrs	hrs	OT hrs
1	265	T.Kandasamy	3		0	0.5			0	0			0	0			0	0			
2	266	P.Yogeswari			0	0			0	0			0	0			0	0			
3	272	Sarojani			0	0			0	0			0	0			0	0			
4	0	M.Ravi			0	0			0	0			0	0			0	0			
5	0	M.Sakunthala			0	0			0	0			0	0			0	0			
6	0	Kumara																			
7	0	Ruwanthi																			
8	0	Sadasivam																			
9	273	Shanthi			0	0			0	0			0	0			0	0			
10	0	Ajith																			
11	0	Chamila																			
12	0	Wasantha kumara			0	0			0	0			0	0			0	0			
13	0	R.Seetha			0	0			0	0			0	0			0	0			

Wk | PTL | NC | Sundry | Deductions | Salary Sheet | Sales Factory 1 | Sales Factory 2 | Field Rounds

Figure 18

When total hours is 6 (Figure19)



Dolabodakanda Estate
Sundry

Month of	March
Year	2017
Target per day in hours	8

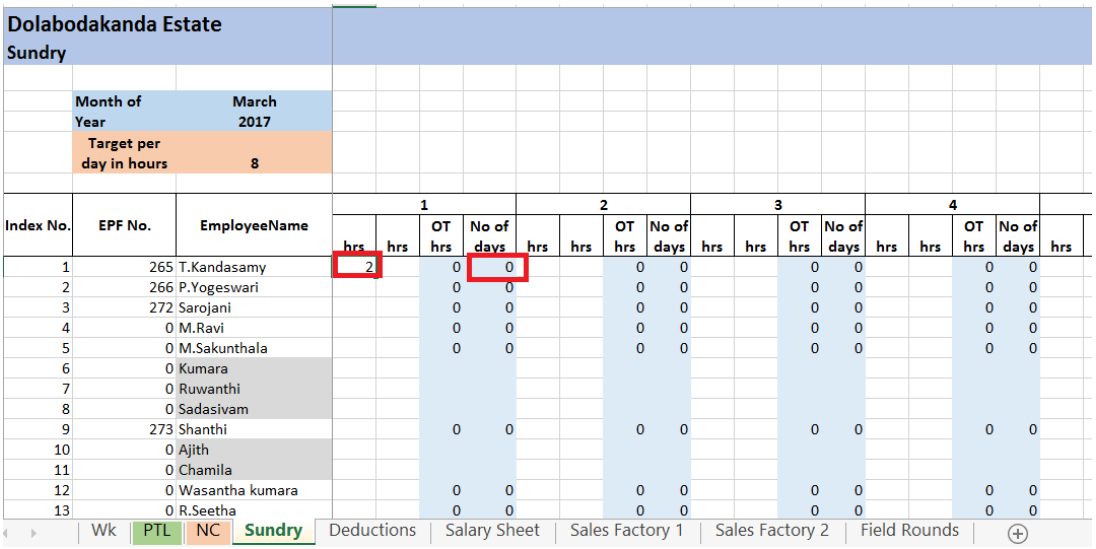
Index No.	EPF No.	EmployeeName	1				2				3				4					
			hrs	hrs	OT hrs	No of days	hrs	hrs	OT hrs	No of days	hrs	hrs	OT hrs	No of days	hrs	hrs	OT hrs	No of days	hrs	hrs
1	265	T.Kandasamy	3	3	0	0.5			0	0			0	0			0	0		
2	266	P.Yogeswari			0	0			0	0			0	0			0	0		
3	272	Sarojani			0	0			0	0			0	0			0	0		
4	0	M.Ravi			0	0			0	0			0	0			0	0		
5	0	M.Sakunthala			0	0			0	0			0	0			0	0		
6	0	Kumara																		
7	0	Ruwanthi																		
8	0	Sadasivam																		
9	273	Shanthi			0	0			0	0			0	0			0	0		
10	0	Ajith																		
11	0	Chamila																		
12	0	Wasantha kumara			0	0			0	0			0	0			0	0		
13	0	R.Seetha			0	0			0	0			0	0			0	0		

Wk | PTL | NC | Sundry | Deductions | Salary Sheet | Sales Factory 1 | Sales Factory 2 | Field Rounds

Figure 19

Scenario 7:

When the total number of hours for the both sessions is 2 or less than 2 then the number of days will be displayed as 0 (Figure 20).



Dolabodakanda Estate
Sundry

Month of	March
Year	2017
Target per day in hours	8

Index No.	EPF No.	EmployeeName	1				2				3				4					
			hrs	hrs	OT hrs	No of days	hrs	hrs	OT hrs	No of days	hrs	hrs	OT hrs	No of days	hrs	hrs	OT hrs	No of days	hrs	hrs
1	265	T.Kandasamy	2		0	0			0	0			0	0			0	0		
2	266	P.Yogeswari			0	0			0	0			0	0			0	0		
3	272	Sarojani			0	0			0	0			0	0			0	0		
4	0	M.Ravi			0	0			0	0			0	0			0	0		
5	0	M.Sakunthala			0	0			0	0			0	0			0	0		
6	0	Kumara																		
7	0	Ruwanthi																		
8	0	Sadasivam																		
9	273	Shanthi			0	0			0	0			0	0			0	0		
10	0	Ajith																		
11	0	Chamila																		
12	0	Wasantha kumara			0	0			0	0			0	0			0	0		
13	0	R.Seetha			0	0			0	0			0	0			0	0		

Wk | PTL | NC | Sundry | Deductions | Salary Sheet | Sales Factory 1 | Sales Factory 2 | Field Rounds

Figure 20

WK Sheet

Total days worked = No of days per month in salary sheet – Total leaves for that user (Figure 21)

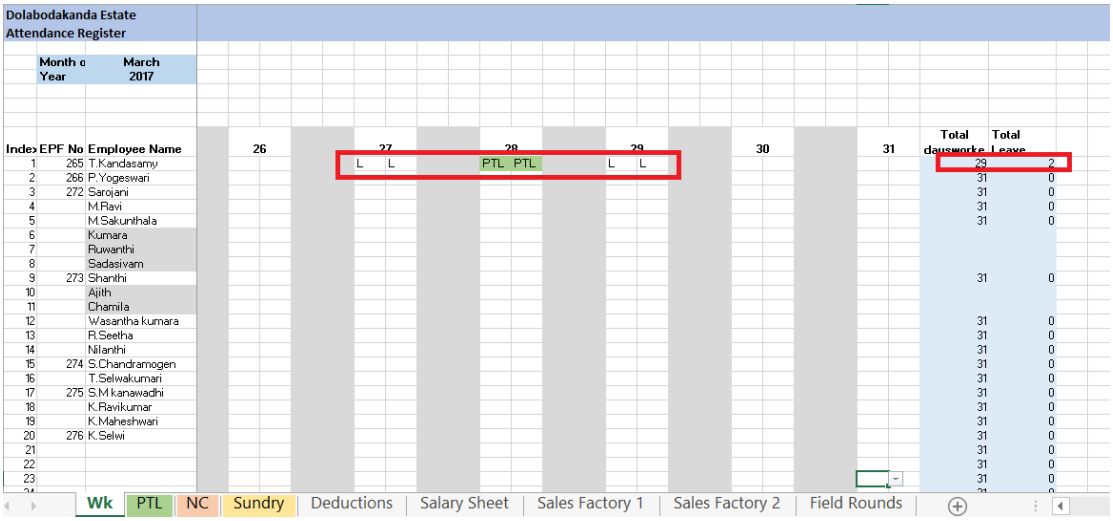


Figure 21

Number of session count gets display on the top of the sheet (Figure 22)

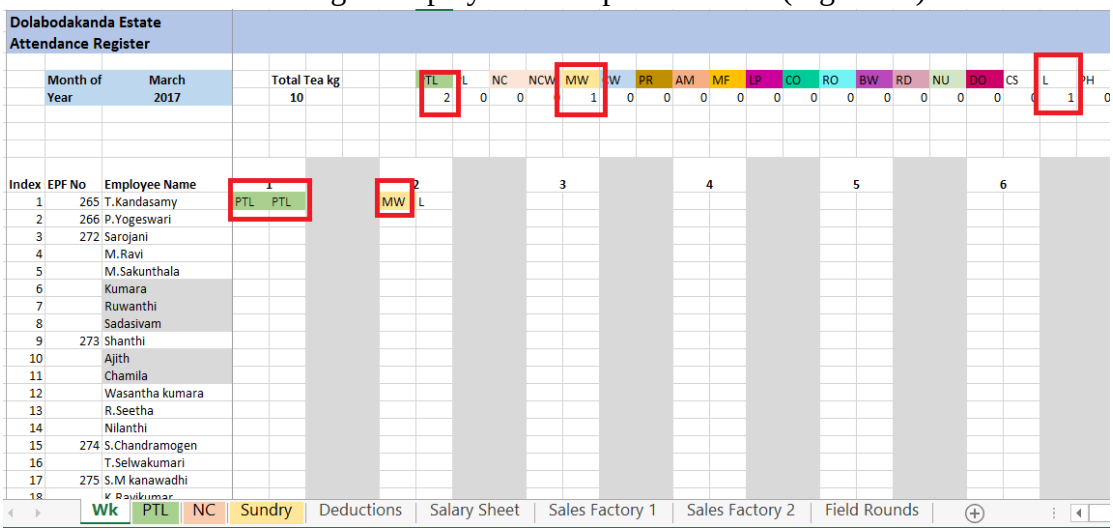
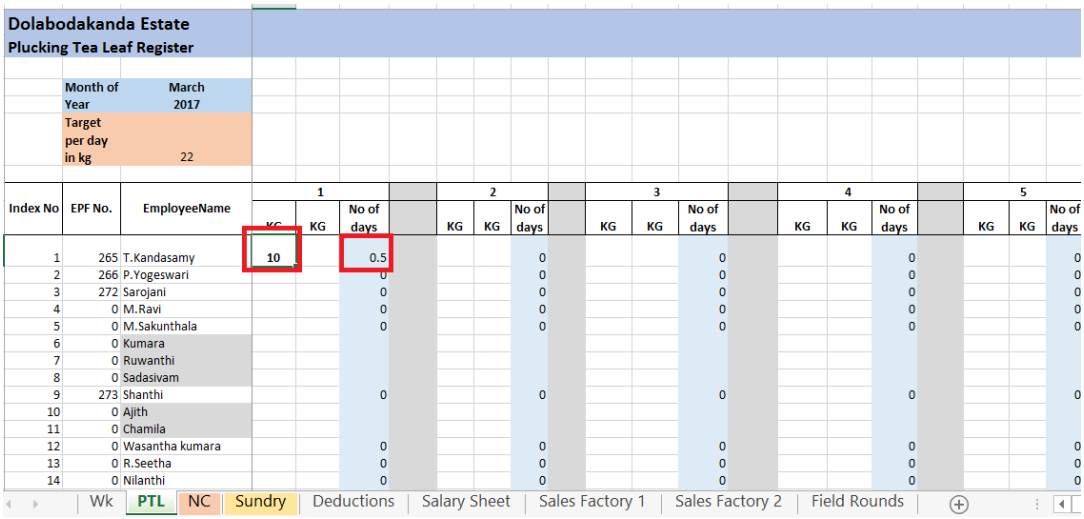


Figure 22

PTL Sheet

If the number of KGs plucked is entered to one column, then the number of days will be displayed as 0.5 (Figure 23).



Dolabodakanda Estate
Plucking Tea Leaf Register

Month of Year	March 2017
Target per day in kg	22

Index No	EPF No.	EmployeeName	1			2			3			4			5		
			KG	KG	No of days	KG	KG	No of days	KG	KG	No of days	KG	KG	No of days	KG	KG	No of days
1	265	T.Kandasamy	10		0.5			0			0			0			0
2	266	P.Yogeswari			0			0			0			0			0
3	272	Sarojani			0			0			0			0			0
4	0	M.Ravi			0			0			0			0			0
5	0	M.Sakunthala			0			0			0			0			0
6	0	Kumara															
7	0	Ruwanthi															
8	0	Sadasivam															
9	273	Shanthi			0			0			0			0			0
10	0	Ajith															
11	0	Chamila															
12	0	Wasantha kumara			0			0			0			0			0
13	0	R.Seetha			0			0			0			0			0
14	0	Nilanthi			0			0			0			0			0

Wk | PTL | NC | Sundry | Deductions | Salary Sheet | Sales Factory 1 | Sales Factory 2 | Field Rounds

Figure 23

Total worked KG= Number of KGs plucked

Actual Number of days = Total of all days worked for a particular user

Target = Target per day in KGs * No of days entitle for payment

Excess= Total work KG – Target

No of days worked =< to target = Total work KG/ Target per day in kg

Plucking Average = Total work KG/ Actual No. of Days

No. of Days entitled for payment= Total KGs plucked for the month/ Target KG per

NC sheet

Fraction= Total work KG/ Target

Excess=If Total work KG> Target then Total work KG- Target

Target=No. of Days* Target per day in KG

No. of Days entitled for payment= Total KGs plucked for the month/ Target KG per day

Sundry Sheet

Total work hrs= Total hours worked in both sessions

No. of Days= Total of No. of Days

Target =No. of Days* Target per day in hours

Excess= Total of Overtime hours

Fraction= If target is >0, Total work hrs/Target

No. of Days entitled for payment= If fraction>=75%, then No. of Days, else (Fraction * No. of Days)

Deduction Sheet

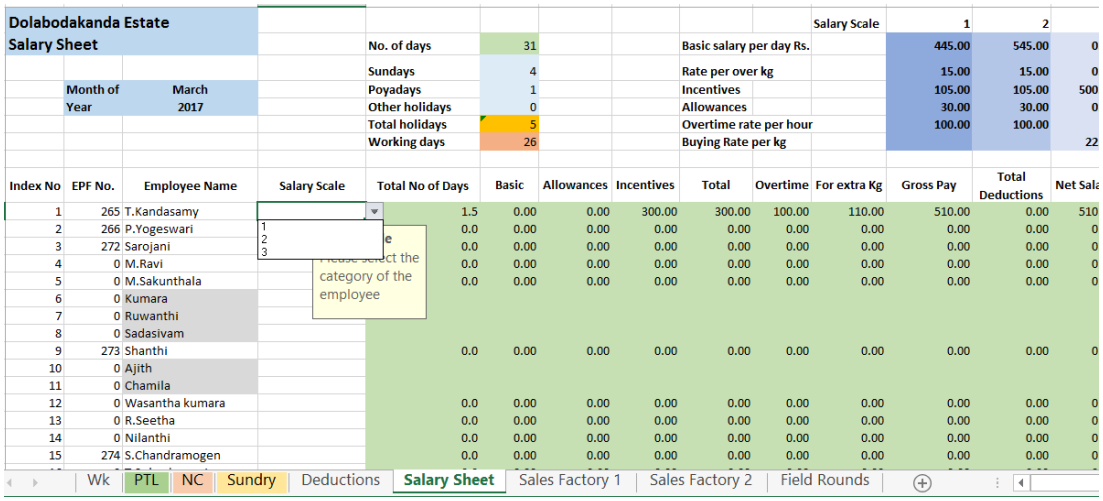
User should able to enter the following deductions Food advance, Monthly advance, CEB, Tea, Loan and Coconut.

The EPF and Total Deductions gets calculated automatically

EPF calculation happens for the employees who have EPF numbers. And 8% gets calculated for the basic salary which is in the salary sheet.

Salary Sheet

Need to select the salary scale from the dropdown (Figure 24).



Dolabodakanda Estate										Salary Scale	1	2	
Salary Sheet				No. of days	31			Basic salary per day Rs.			445.00	545.00	0
				Sundays	4			Rate per over kg			15.00	15.00	0
	Month of	March		Poyadays	1			Incentives			105.00	105.00	500
	Year	2017		Other holidays	0			Allowances			30.00	30.00	0
				Total holidays	5			Overtime rate per hour			100.00	100.00	
				Working days	26			Buying Rate per kg					22

Index No	EPF No.	Employee Name	Salary Scale	Total No of Days	Basic	Allowances	Incentives	Total	Overtime	For extra Kg	Gross Pay	Total Deductions	Net Sala
1	265	T.Kandasamy		1.5	0.00	0.00	300.00	300.00	100.00	110.00	510.00	0.00	510
2	266	P.Yogeswari		0.0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0
3	272	Sarojani		0.0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0
4	0	M.Ravi		0.0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0
5	0	M.Sakunthala		0.0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0
6	0	Kumara											
7	0	Ruwanthi											
8	0	Sadasivam											
9	273	Shanthi		0.0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0
10	0	Ajith											
11	0	Chamila											
12	0	Wasantha kumara		0.0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0
13	0	R.Seetha		0.0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0
14	0	Nilanthi		0.0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0
15	274	S.Chandramogen		0.0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0

1
2
3

category of the employee

Wk | PTL | NC | Sundry | Deductions | Salary Sheet | Sales Factory 1 | Sales Factory 2 | Field Rounds

Figure 24

Total No of Days =

If Scale 1:Take the No. of Days entitled for payment of PTL,NC and Sundry

If Scale 2: Take the No. of Days entitled for payment of PTL,NC and Sundry

If Scale 3: Take the Actual No. of Days in PTL sheet and No. of Days in NC and Sundry sheet.

Basic =Total No of Days * Basic rate of that relevant salary scale

Allowances= Total No of Days * Allowances of that relevant salary scale

Incentive= If no of days entitled for payment is >= 75% of the total working days

Total = Basic + Allowances + Incentive

Overtime= Excess in Sundry Sheet * Overtime rate per hour

For extra Kg= Total KGs plucked for month – Target KG for month

Gross Pay = Total+ Overtime+ For extra Kg

Total Deductions= Comes from the deduction sheet

Net Salary= Gross Pay- Total Deductions

Sales Factory Sheet

Enter the factory rate per KG (Figure 25)

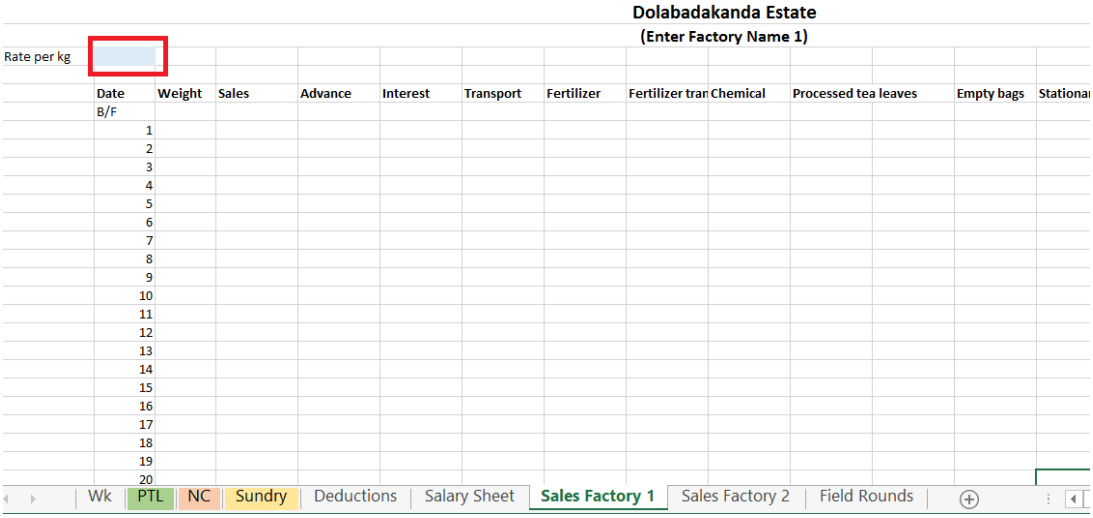


Figure 25

User enter the weight, sales, advance, interest, transport, fertilizer, fertilizer transport, chemical, processed tea leaves, empty bags, stationary, stamp duties, other deduction, welfare, and arrears.

Total sales, Total deductions and Balance C/F gets automatically displayed.

Plucking Rounds Sheet

- Plucking cycle starts by plucking tea leaves. ‘1’ should be put on the day of plucking in the corresponding field. The cell will get ‘blue’ in colour.
- Thereafter on each day pass by is counted.
- When the cycle reach day 7 (as in wet season) or day 12 (as in dry season) the cell will get ‘green’ in colour indicating time for next plucking (green arrow).
- On the day of plucking the plucked weight must be entered in the corresponding cell of the weight column (Figure 26).

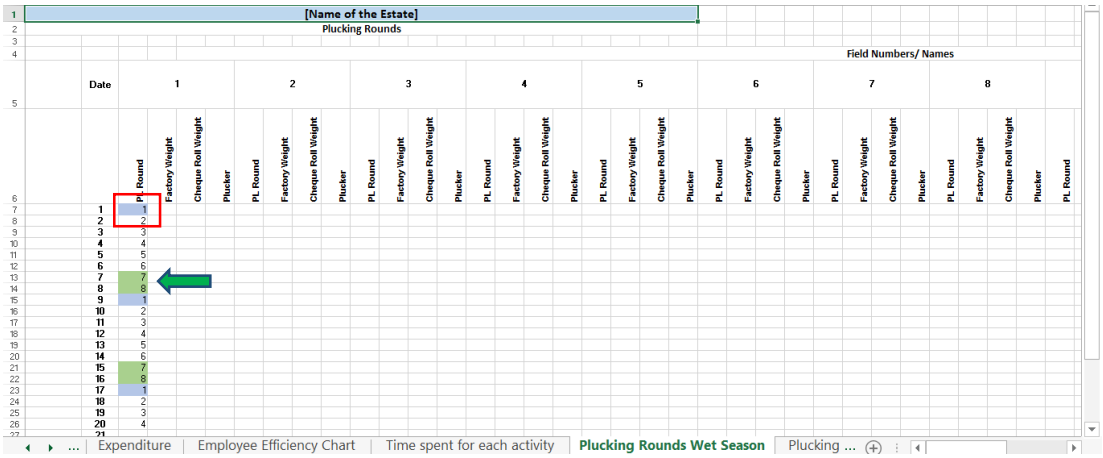


Figure 26

Appendix B: Test Scenario and Test Cases

Iteration 1

Test scenarios for 'Work' sheet
Verify the elements in the work sheet
Verify respective work sheet cells gets enable when enter the specific abbreviation in WORK sheet
Verify not selecting any activity in WORK sheet will restrict user entering a figure in PTL and in all sundry sheets
Verify total work days displays correctly in WORK sheet
Verify the Total Leave days displays correctly in WORK sheet
Verify the abbreviations displays correctly in the right hand side of the 'Work' sheet

Test cases for 'Work' sheet

Test case ID	Test case Description	Pre-requisite	Steps	Expected outcome	Actual outcome	Results
1	Verify the elements in the work sheet	Should have open the WORK sheet in excel	Check the heading and sub heading displays correctly in sheet 'Work'	Should display name of the estate as the heading and 'Attendance register' as sub heading as	same	Pass
			Check the year and month displays correctly in WORK sheet	Current Year and month should be display	same	Pass
			Check the column headings of the WORK sheet	Columns should display from left to right as index EPF No, Employee Name, Display the days for that particular month, Total days worked, Total Leave days and should display the abbreviation	same	Pass
2	Verify respective work sheet cells gets enable when enter the	*Should have open the WORK sheet in excel	Select PTL from the dropdown in WORK sheet	PTL gets selected	same	Pass

	specific abbreviation in WORK sheet	*Should have entered an Index umber and Employee name				
			Verify in PTL Sheet, 1st day for that particular employee gets enabled to enter the number of KGs	User able to enter the number of KGs in the PTL sheet for that particular user for the 1st day.	same	Pass
			Clear the amount in the PTL	Amount gets cleared	same	Pass
			Change PTL to MW in the WORK sheet for that particular employee for 1st day	Gets changed to MW	same	Pass
			In the PTL sheet for that particular employee enter an amount	User should restrict entering an amount	same	Pass
			Verify user able to enter a value in the MW sheet	User able to enter a value in the MW sheet	same	Pass
3	Verify not selecting any activity in WORK sheet will restrict user entering a figure in PTL and in all sundry sheets	Should have open the WORK sheet in excel	Do not select any activity from the dropdown for a particular employee for a particular day	Should not have any selected any activity in WORK sheet	same	Pass

			Verify user able to enter a figure in the PTL sheet for that particular employee for that particular date	User should not able to enter a figure for that particular employee for that particular date	same	Pass
			Verify user able to enter a figure in all sundry sheet for that particular employee for that particular date	User should not able to enter a figure for that particular employee for that particular date	same	Pass
4	Verify total work days displays correctly in WORK sheet	*Should have open the WORK sheet in excel * Should have enter the No of days for the month in Salary sheet * Should have PTL, Sundry activities and leaves for a particular employee	Verify the Total days worked for the selected employee	Total worked days should be (No of days for the month – No of leaves) or (No of PTL + No of all the sundry activities)	same	Pass
			Verify when change a PTL to Leave day or change a Sundry activity to a Leave day will reduce the Total days worked by 1.	Total days worked reduce by one and Total Leave days increased by 1	same	Pass

5	Verify the Total Leave days displays correctly in WORK sheet	*Should have open the WORK sheet in excel * Should have enter the No of days for the month in Salary sheet * Should have PTL, Sundry activities and leaves for a particular employee	Verify the Total Leave days	The count of the total number of leaves for the particular month	same	Pass
			Verify when change a Leave day to a PTL or a sundry activity, the leave count gets reduced	Leave count gets reduced by one and the Total days worked increased by 1.	same	Pass
6	Verify the abbreviations displays correctly in the right hand side of the WORK sheet	Should have open the WORK sheet in excel	Verify all the abbreviation displays correctly	Abbreviation should display as follows.  PTL Plucking Tea Leaves PL Plucking Kankani NCW New Clearing Weading AM Manual Weeding PR Chemical Weeding MF Mochin and Ferning MW Artificial Manuaring CW Pruning NC New Clearing LP Lopping CO Coconut RO Rock BW Banglow RD Road NU Nursary DO Dolamite CS Cow Store PH Public Holiday L Leave	same	Pass

Test scenarios for PTL sheet
Verify the index number, EPF No, employee names get auto populated in the PTL sheet once entered in the Work sheet
Verify the correct month and year gets displays which entered in WORK sheet
Verify user able to enter “Target per day in kg”
Verify when select PTL from dropdown in WORK sheet for a particular employee for a particular day, the particular cell in PTL sheet gets enables to enter the number of KGs plucked
Verify when select a sundry activity from dropdown in WORK sheet for a particular employee for a particular day, the particular cell in particular sundry sheet gets enables to enter the value
Verify when not select any activity in WORK sheet will not able to enter any value for that particular cell in PTL Sheet and in all sundry sheets
Verify when enter an activity in WORK sheet and enter a value in specific sheet will display the number of days as 1.
Verify the Total Work KG displays correctly
Verify the Actual No. of Days displays correctly
Verify the target displays correctly
Verify the excess amount displays correctly
Verify No of days worked =< to target displays correctly
Verify No. of Days entitled for payment displays correctly
Verify plucking average displays correctly

Test cases for PTL sheet

Test case ID	Test case Description	Pre-requisite	Steps	Expected outcome	Actual outcome	Results
1	Verify the index number, EPF No, employee names get auto populated in the PTL sheet once entered in the Work sheet	*Should have enter the employee names in the WORK sheet * Open the PTL sheet	Check the index number, EPF No and employee names entered in WORK sheet displays correctly in PTL sheet	Should display all the index number, EPF No and employee names correctly in PTL sheet	same	Pass
2	Verify the correct month and year gets displays which entered in WORK sheet	*Should have enter the month and year in WORK sheet * Open the PTL sheet	Verify the correct month and year gets display in the PTL sheet	Correct month and year should get display in the PTL sheet	same	Pass
3	Verify user able to enter "Target per day in kg"	* Open the PTL sheet	Verify user able to enter the target KGs per day	User should able to type the target KGs per day	same	Pass
4	Verify when select PTL from dropdown in WORK sheet for a particular employee for a particular day, the particular cell in PTL sheet gets	*User should have Select "PTL" in WORK sheet for a particular employee for a particular day * Open the PTL sheet	Verify user able to enter the number of KGs plucked for the particular cell in PTL sheet	User should able to type the number of KGs plucked	same	Pass

	enables to enter the number of KGs plucked					
			Verify user able to enter the value for any sundry sheet for that particular cell	User should restricted entering values for that particular cell in all sundry sheets	same	Pass
5	Verify when select a sundry activity from dropdown in WORK sheet for a particular employee for a particular day, the particular cell in particular sundry sheet gets enables to enter the value	*User should have Select a sundry activity in WORK sheet for a particular employee for a particular day	Open the relevant sundry sheet and verify user able to enter the value for the specified sundry sheet for that particular cell	User should able to enter a value for that particular cell in the specified sundry sheet	same	Pass
			Open the another sundry sheet and verify user able to enter the value for another sundry sheet for that particular cell	User should not be able to enter a value and should be restricted	same	Pass
			Open PTL sheet and verify user able to enter	User should not be able to enter a value and should be restricted	same	Pass

			a value in PTL sheet for that particular cell			
6	Verify when not select any activity in WORK sheet will not able to enter any value for that particular cell in PTL Sheet and in all sundry sheets	*User should not have Select any activity in WORK sheet for a particular employee for a particular day	Open PTL sheet and verify user able to enter a value in PTL sheet for that particular cell	User should not be able to enter a value and should be restricted	same	Pass
			Open all sundry sheets and verify user able to enter the value for the specified sundry sheet for that particular cell	User should not be able to enter a value and should be restricted	same	Pass
7	Verify when enter an activity in WORK sheet and enter a value in specific sheet will display the number of days as 1.	*User should have Select any activity in WORK sheet for a particular employee for a particular day	If user selected PTL in WORK sheet, then open the PTL sheet and enter a value for that particular cell	The No of days change from 0 to 1	same	Pass

8	Verify the Total Work KG displays correctly	*User should have enter the number of KGs plucked for morning and afternoon sessions	Check the total plucked KGs at the end of a month for a particular employee.	Total number of KGs should display correctly	same	Pass
9	Verify the Actual No. of Days displays correctly	*User should have enter the number of KGs plucked for morning and afternoon sessions	Check the actual No of day's displays correctly at the end of a month for a particular employee.	Total number of days should display correctly	same	Pass
10	Verify the target displays correctly	*Should have entered the target per day in KGs * Should have the Actual No. of Days for a particular employee	Verify the target displays correctly for that particular employee	Actual No. of Days * Target per day in kg	same	Pass
11	Verify the excess amount displays correctly	*Should have entered the Total work KG and the Target for a particular employee(Total work KG should be > Target)	Verify the excess amount displays correctly	=(Total work KG – Target)	same	Pass
12	Verify No of days worked =< to target displays correctly	*Should have entered the Total work KG and Target per day in kg	Verify the No of days worked by dividing the total KGs plucked to Target per day in kg	=(Total work KGs/Target per day in KGs)	same	Pass

13	Verify No. of Days entitled for payment displays correctly	*Should have entered the "Total work KG" ,"Target per day in kg", "Actual No. of Days" and "No of days worked =< to target"	Check the "**No. of Days entitled for payment**" correctly calculated	<u>First Condition</u> ("Actual No. of Days" is LESS than "No of days worked =< to target" then take the "Actual No. of Days" as the "**No. of Days entitled for payment**" <u>If first condition not meet</u> Take the remainder of "Total work KG" and the "Target per day in kg" and divide it by "Target per day in kg", <u>Scenario 1</u> If the answer is less than 0.4 the take the integer value of "Total work KG"/ Target per day in kg as "**No. of Days entitled for payment**" <u>Scenario 2</u> If the answer is 0.4 or between 0.4 and 0.9 then take the integer value of "Total work KG"/ Target per day in kg and add 0.5 to get the "**No. of Days entitled for payment**" <u>Scenario 3</u> If the answer is 0.9 or more than 0.9 then take the integer value of "Total work KG"/ Target per day in	same	Pass

				kg and add 1 to get the "**No. of Days entitled for payment**"		
14	Verify plucking average displays correctly	*Should have enter "Total work KG" and "Actual No. of Days"	Check the Actual No. of Days is equal to zero	If its zero then the Plucking Average displays zero	same	Pass
			Actual No. of Days not equal to zero	Then (Total work KG/ Actual No. of Days)	same	Pass

Test scenarios for Manual Weeding sheet(Sundry activity)
Verify the index number, EPF No, employee names get auto populated in the MW sheet once entered in the Work sheet
Verify the correct month and year gets displays which entered in WORK sheet
Verify user able to enter "Number of Square feet" covered for the particular day
Verify when select MW from dropdown in WORK sheet for a particular employee for a particular day, the particular cell in MW sheet gets enables to enter the Number of Square feet
Verify when select PTL from dropdown in WORK sheet for a particular employee for a particular day, the particular cell in particular PTL sheet gets enables to enter the value
Verify when not select any activity in WORK sheet will not able to enter any value for that particular cell in MW Sheet , in all sundry sheets and in PTL sheet
Verify when enter an activity in WORK sheet and enter a value in specific sheet will display the number of days as 1.
Verify the Total Work Square feet displays correctly
Verify the Actual No. of Days displays correctly
Verify the target displays correctly
Verify the excess amount displays correctly
Verify fraction display correctly
Verify No. of Days entitled for payment displays correctly

Test case for Manual Weeding sundry sheet

Test case ID	Test case Description	Pre-requisite	Steps	Expected outcome	Actual outcome	Results
1	Verify the index number, EPF No, employee names get auto populated in the MW sheet once entered in the Work sheet	*Should have enter the employee names in the WORK sheet * Open the MW sheet	Check the index number, EPF No and employee names entered in WORK sheet displays correctly in MW sheet	Should display all the index number, EPF No and employee names correctly in MW sheet	same	Pass
2	Verify the correct month and year gets displays which entered in WORK sheet	*Should have enter the month and year in WORK sheet * Open the MW sheet	Verify the correct month and year gets display in the MW sheet	Correct month and year should get display in the MW sheet	same	Pass
3	Verify user able to enter "Number of Square feet" covered for the particular day	* Open the MW sheet	Verify user able to enter the Number of Square feet per day	User should able to type the Number of Square feet per day	same	Pass
4	Verify when select MW from dropdown in WORK sheet for a particular employee for a particular day, the	*User should have Select "MW" in WORK sheet for a particular employee for a particular day * Open the MW sheet	Verify user able to enter the Number of Square feet per day for the particular cell in MW sheet	User should able to type the Number of Square feet per day	same	Pass

	particular cell in MW sheet gets enables to enter the Number of Square feet					
			Verify user able to enter the value for any sundry activity sheet(RO) for that particular cell	User should restricted entering values for RO sheet for that particular cell.	same	Pass
5	Verify when select PTL from dropdown in WORK sheet for a particular employee for a particular day, the particular cell in particular PTL sheet gets enables to enter the value	*User should have Select PTL in WORK sheet for a particular employee for a particular day	Open the MW sheet and verify user able to enter the value for the MW sheet for that particular cell	User should restrict entering a value for MW sheet that particular cell	same	Pass
			Open the another sundry sheet (RO) and verify user able to enter the value for RO sheet for that particular cell	User should not be able to enter a value and should be restricted	same	Pass

			Open PTL sheet and verify user able to enter a value in PTL sheet for that particular cell	User should able to enter a value in PTL sheet and should not restricted	same	Pass
6	Verify when not select any activity in WORK sheet will not able to enter any value for that particular cell in MW Sheet , in all sundry sheets and in PTL sheet	*User should not have Select any activity in WORK sheet for a particular employee for a particular day	Open MW sheet and verify user able to enter a value in MW sheet for that particular cell	User should not be able to enter a value and should be restricted	same	Pass
			Open all sundry sheets and verify user able to enter the value for other sundry sheets for that particular cell	User should not be able to enter a value and should be restricted	same	Pass
			Open PTL sheet and verify user able to enter the value for PTL sheet	User should not be able to enter a value and should be restricted	same	Pass
7	Verify when enter an activity	*User should have Select any activity in	If user selected MW in WORK	The No of days change from 0 to 1	same	Pass

	in WORK sheet and enter a value in specific sheet will display the number of days as 1.	WORK sheet for a particular employee for a particular day	sheet, then open the MW sheet and enter a value for that particular cell			
8	Verify the Total Work Square feet displays correctly	*User should have enter the number of square feet weeded for morning and afternoon sessions	Check the total weeded square feet at the end of a month for a particular employee.	Total number of square feet should display correctly	same	Pass
9	Verify the Actual No. of Days displays correctly	*User should have enter the number of square feet weeded for morning and afternoon sessions	Check the actual No of day's displays correctly at the end of a month for a particular employee.	Total number of days should display correctly	same	Pass
10	Verify the target displays correctly	*Should have entered the target per day in square feet * Should have the Actual No. of Days for a particular employee	Verify the target displays correctly for that particular employee	Actual No. of Days * Target per day in square feet	same	Pass
11	Verify the excess amount displays correctly	*Should have entered the Total work square feet and the Target for a particular employee(Total work square feet should be > Target)	Verify the excess amount displays correctly	=(Total work square feet – Target)	same	Pass
12	Verify fraction display correctly	*Should have entered Total work square feet and target	Verify the fraction by dividing total worked	= Total worked square feet/Target	same	Pass

			square feet dividing by target			
13	Verify No. of Days entitled for payment displays correctly	*Should have entered the "Actual no of days" and "Fraction"	Check the "**No. of Days entitled for payment**" correctly calculated	First Condition Check "fraction" is >= to 0.75. If it satisfied then display the actual number of days If condition not meet =Fraction * Actual number of days	same	Pass

Test scenarios for Deduction sheet
Verify the index number, EPF No, employee names get auto populated in the Deduction sheet once entered in the Work sheet
Verify the correct month and year gets displays which entered in WORK sheet
Verify user able to enter food advance, monthly advance, CEB, Tea, Loan, Coconut
Verify EPF amount gets calculated correctly
Verify the total deduction amount displays correctly

Test case for Deduction sheet

Test case ID	Test case Description	Pre-requisite	Steps	Expected outcome	Actual outcome	Results
1	Verify the index number, EPF No, employee names get auto populated in the Deduction sheet once entered in the Work sheet	*Should have enter the employee names in the WORK sheet * Open the deduction sheet	Check the index number, EPF No and employee names entered in WORK sheet displays correctly in deduction sheet	Should display all the index number, EPF No and employee names correctly in deduction sheet	same	Pass
2	Verify the correct month and year gets displays which entered in WORK sheet	*Should have enter the month and year in WORK sheet * Open the Deduction sheet	Verify the correct month and year gets display in the Deduction sheet	Correct month and year should get display in the Deduction sheet	same	Pass
3	Verify user able to enter food advance, monthly advance, CEB, Tea, Loan, Coconut	User navigate to deduction sheet	Enter amounts to food advance, monthly advance, CEB, Tea, Loan, Coconut	User should able to enter amounts to food advance, monthly advance, CEB, Tea, Loan, Coconut	same	Pass

4	Verify EPF amount gets calculated correctly	*User navigate to deduction sheet *Should have employees with EPF numbers	*Enter the basic salary for the EPF number employees. *Navigate to deduction sheet	Check whether the calculation displays correctly. = Basic salary*8/100	same	Pass
5	Verify the total deduction amount displays correctly	*User navigate to deduction sheet *Should have employees with EPF numbers	Verify the sum of all the deductions (Food advance, CEB, Tea, Loan, Coconut and EPF)	The sum of all deductions should display correctly	same	Pass

Test scenarios for Salary sheet
Verify the index number, EPF No, employee names get auto populated in the Salary sheet once entered in the Work sheet
Verify the correct month and year gets displays which entered in WORK sheet
Verify user able to enter number of days for that particular month, sundays, poya day and Other holidays
Verify the total days displays correctly
Verify the working days displays correctly
Verify user able to enter the basic salary per day, Rate per over Kg, Incentives, allowance and over time rate per hour for salary scale
Verify the total number of days displays correctly
Verify the basic salary gets calculated correctly
Verify allowance calculated correctly
Verify incentives calculated correctly
Verify total calculates correctly
Verify Overtime calculates correctly
Verify For extra KGs calculate correctly
Verify the gross pay calculated correctly
Verify the deduction amount displays correctly
Verify the net salary amount displays correctly

Test case for Salary sheet

Test case ID	Test case Description	Pre-requisite	Steps	Expected outcome	Actual outcome	Results
1	Verify the index number, EPF No, employee names get auto populated in the Salary sheet once entered in the Work sheet	*Should have enter the employee names in the WORK sheet * Open the salary sheet	Check the index number, EPF No and employee names entered in WORK sheet displays correctly in salary sheet	Should display all the index number, EPF No and employee names correctly in salary sheet	same	Pass
2	Verify the correct month and year gets displays which entered in WORK sheet	*Should have enter the month and year in WORK sheet * Open the Salary sheet	Verify the correct month and year gets display in the Salary sheet	Correct month and year should get display in the Salary sheet	same	Pass
3	Verify user able to enter number of days for that particular month, sundays, poya day and Other holidays	User navigate to salary sheet	Enter amounts in number of days for that particular month, sundays, poya day and Other holidays	User should able to enter amounts in number of days, sundays, poya day and Other holidays cells	same	Pass
4	Verify the total days displays correctly	*User navigate to salary sheet *Should have entered number of days	*Check the total display correctly	Total should be, Total= Sundays+ poya day + Other holidays	same	Pass

		for that particular month, sundays, poya day and Other holidays				
5	Verify the working days displays correctly	*User navigate to salary sheet *Should have entered number of days for that particular month, sundays, poya day and Other holidays	Check the working days displays correctly	The working days should be, Working days= No of days - total	same	Pass
6	Verify user able to enter the basic salary per day, Rate per over Kg, Incentives, allowance and over time rate per hour for salary scale	*User navigate to salary sheet	User enter amounts for basic salary per day, Rate per over Kg, Incentives, allowance and over time rate per hour for salary scale	User should able to enter amounts for basic salary per day, Rate per over Kg, Incentives, allowance and over time rate per hour for salary scale	same	Pass
7	Verify the total number of days displays correctly	*User navigate to salary sheet * Should have enter data in PTL,NC or in sundry sheet	Check the total number of days gets displays correctly	(number of days entitled for payment in PTL sheet+ number of days entitled for payment in NC sheet + number of days entitled for payment in Sundry sheet)	same	Pass

8	Verify the basic salary gets calculated correctly	*User navigate to salary sheet * Should have enter the basic salary per day for salary scale and should have the total number of days	Check the basic salary calculates correctly	(total number of days * basic salary per day)	same	Pass
9	Verify allowance calculated correctly	*User navigate to salary sheet * Should have enter allowance for salary scale and should have the total number of days	Check the allowance calculates correctly	(total number of days * allowance)	same	Pass
10	Verify incentives calculated correctly	*User navigate to salary sheet * Should have enter incentives for salary scale and should have the total number of days	Check the incentives calculates correctly	Check the Total No of Days is greater than or equal to 75%, if so the Total No of days * incentives- scale 1 , else zero	same	Pass
11	Verify total calculates correctly	*User navigate to salary sheet * Should have enter basic,	Check the total amount displays correctly	Total should be, Total= basic+ allowance+ incentive	same	Pass

		allowance and incentives				
12	Verify Overtime calculates correctly	*User navigate to salary sheet * Should have enter Overtime rate per hour for salary scale * Should have excess hours in sundry sheet	Check the overtime amount displays correctly	Sundry excess hours * Overtime rate per hour	same	Pass
13	Verify For extra KGs calculate correctly	*User navigate to salary sheet * Should have enter rate per over Kgs for salary scale * Should have excess KGs in PTL sheet	Check the overtime amount displays correctly	PTL excess KGs * Rate per over kg	same	Pass
14	Verify the gross pay calculated correctly	*User navigate to salary sheet * Should have Total/ Overtime / For extra KG	Verify the Gross pay amount display correctly	Gross pay amount should be, Gross pay = Total+ Overtime+ For extra KG	same	Pass
15	Verify the deduction amount displays correctly	*User navigate to salary sheet * Should have fill	Verify the deduction amount displays correctly	Deduction amount should be the total deduction from the deduction sheet	same	Pass

		all the deductions in the deduction sheet				
16	Verify the net salary amount displays correctly	*User navigate to salary sheet * Should have fill the gross pay and the total deduction	Verify the net salary displays correctly	Net salary amount should be, Net salary= Gross pay- Total Deductions	same	Pass

Iteration 2

Test scenarios for PTL sheet

Test scenarios for PTL sheet
Verify when enter PTL for morning session and afternoon sessions for a particular employee in WORK sheet will able to enter the number of KGs plucked for both sessions in PTL sheet
Verify when enter the PTL for morning session in WORK sheet will able to enter the number of KGs plucked only for the morning session in PTL sheet
Verify when enter the PTL for afternoon session in WORK sheet will able to enter the number of KGs plucked only for the afternoon session in PTL sheet
Verify an employee worked in both sessions PTL in WORK sheet, will display “No of days” as 1 in PTL Sheet
Verify an employee worked only one session PTL in WORK sheet will display “No of days” as 0.5 in PTL sheet

Test cases for PTL sheet

Test case ID	Test case Description	Pre-requisite	Steps	Expected outcome	Actual outcome	Results
1	Verify when enter PTL for morning session and afternoon sessions for a particular employee in WORK sheet will able to enter the number of KGs plucked for both sessions in PTL sheet	*User should have Select “PTL” for both morning and afternoon session in WORK sheet for a particular employee for a particular day * Open the PTL sheet	Verify user able to enter the number of KGs plucked for morning and afternoon session	User should able to type the number of KGs plucked in both sessions	same	Pass
2	Verify when enter the PTL for morning	*User should have Select “PTL”	Verify user able to enter the number of KGs plucked	User should able to enter the number of KGs plucked for the morning session	same	Pass

	session in WORK sheet will able to enter the number of KGs plucked only for the morning session in PTL sheet	for morning Session only in WORK sheet for a particular employee for a particular day * Open the PTL sheet	for morning session			
			Verify user able to enter the number of KGs plucked for afternoon session	User should restrict entering the number of KGs plucked for the afternoon session	same	Pass
3	Verify when enter the PTL for afternoon session in WORK sheet will able to enter the number of KGs plucked only for the afternoon session in PTL sheet	*User should have Select "PTL" for afternoon Session only in WORK sheet for a particular employee for a particular day * Open the PTL sheet	Verify user able to enter the number of KGs plucked for afternoon session	User should able to enter the number of KGs plucked for the afternoon session	same	Pass
			Verify user able to enter the number of KGs plucked for morning session	User should restrict entering the number of KGs plucked for the morning session	same	Pass

4	Verify an employee worked in both sessions PTL in WORK sheet, will display "No of days" as 1 in PTL Sheet	*User should have Select "PTL" for both sessions in WORK sheet for a particular employee for a particular day * Open the PTL sheet	Enter the value for both sessions for that particular employee, particular cell	The no of days change from 0 to 1	same	Pass
5	Verify an employee worked only one session PTL in WORK sheet will display "No of days" as 0.5 in PTL sheet	*User should have Select "PTL" for only one sessions in WORK sheet for a particular employee for a particular day * Open the PTL sheet	If user have select PTL for morning session in Work sheet, then enter a value for morning session in PTL sheet	The No of days change from 0 to 0.5	same	Pass
			If user have select PTL for afternoon session in Work sheet, then enter a value for afternoon session in PTL sheet	The No of days change from 0 to 0.5	same	Pass

Test scenarios for MW sheet

Test scenarios for MW sheet
Verify when enter MW for morning session and afternoon sessions for a particular employee in WORK sheet will able to enter the number of Square feet weeded for both sessions in MW sheet
Verify when enter the MW for morning session in WORK sheet will able to enter the number of Square feet weeded for the morning session in MW sheet
Verify when enter the MW for afternoon session in WORK sheet will able to enter the number of Square feet weeded only for the afternoon session in MW sheet
Verify an employee worked in both sessions MW in WORK sheet, will display "No of days" as 1 in MW Sheet
Verify an employee worked only one session MW in WORK sheet will display "No of days" as 0.5 in MW sheet

Test cases for PTL sheet

Test case ID	Test case Description	Pre-requisite	Steps	Expected outcome	Actual outcome	Results
1	Verify when enter MW for morning session and afternoon sessions for a particular employee in WORK sheet will able to enter the number of Square feet weeded for both sessions in MW sheet	*User should have Select "MW" for both morning and afternoon session in WORK sheet for a particular employee for a particular day * Open the MW sheet	Verify user able to enter the number of Square feet weeded for morning and afternoon session	User should able to type the number of Square feet weeded in both sessions	same	Pass
2	Verify when enter the MW for morning session in WORK	*User should have Select "MW" for morning	Verify user able to enter the number of Square feet weeded for morning session	User should able to enter the number of Square feet weeded for the morning session	same	Pass

	sheet will able to enter the number of Square feet weeded only for the morning session in MW sheet	Session only in WORK sheet for a particular employee for a particular day *Open the MW sheet				
			Verify user able to enter the number of Square feet weeded for afternoon session	User should restrict entering the number of Square feet weeded for the afternoon session	same	Pass
3	Verify when enter the MW for afternoon session in WORK sheet will able to enter the number of Square feet weeded only for the afternoon session in MW sheet	*User should have Select "MW" for afternoon Session only in WORK sheet for a particular employee for a particular day * Open the MW sheet	Verify user able to enter the number of Square feet weeded for afternoon session	User should able to enter the number of Square feet weeded for the afternoon session	same	Pass
			Verify user able to enter the number of Square feet weeded for morning session	User should restrict entering the number of Square feet weeded for the morning session	same	Pass

4	Verify an employee worked in both sessions MW in WORK sheet, will display "No of days" as 1 in MW Sheet	*User should have Select "MW" for both sessions in WORK sheet for a particular employee for a particular day * Open the MW sheet	Enter the value for both sessions for that particular employee, particular cell	The no of days change from 0 to 1	same	Pass
5	Verify an employee worked only one session MW in WORK sheet will display "No of days" as 0.5 in MW sheet	*User should have Select "MW" for only one sessions in WORK sheet for a particular employee for a particular day * Open the MW sheet	If user have select MW for morning session in Work sheet, then enter a value for morning session in MW sheet	The No of days change from 0 to 0.5	same	Pass
			If user have select MW for afternoon session in Work sheet, then enter a value for afternoon session in MW sheet	The No of days change from 0 to 0.5	same	Pass

Test scenarios for Salary sheet
Verify user able to enter the basic salary per day, Rate per over Kg, Incentives, allowance, over time rate per hour and buying rate per Kg for each salary scale
Verify user able to select the salary scale from the dropdown
Verify the total number of days displays correctly
Verify the basic salary gets calculated correctly
Verify allowance calculated correctly
Verify incentives calculated correctly
Verify Overtime calculates correctly
Verify For extra KGs calculate correctly

Test cases for Salary sheet

Test case ID	Test case Description	Pre-requisite	Steps	Expected outcome	Actual outcome	Results
1	Verify user able to enter the basic salary per day, Rate per over Kg, Incentives, allowance, over time rate per hour and buying rate per Kg for each salary scale	*User navigate to salary sheet	User enter amounts for basic salary per day, Rate per over Kg, Incentives, allowance, over time rate per hour and buying rate per Kg for each salary scale	User should able to enter amounts for basic salary per day, Rate per over Kg, Incentives, allowance, over time rate per hour and buying rate per Kg for each salary scale	same	Pass
2	Verify user able to select the salary scale from the dropdown	*User navigate to salary sheet	Click on the salary scale dropdown and select a salary scale option	User able to select a salary scale from the drop down	same	Pass
3	Verify the total number of days	*User navigate to salary sheet * Should have	Check the total number of days gets displays correctly	If select salary scale 1- (number of days entitled for payment in PTL sheet+ number of days	same	Pass

	displays correctly	enter data in PTL,NC or in sundry sheet		entitled for payment in NC sheet + number of days entitled for payment in Sundry sheet) If select salary scale 2- (number of days entitled for payment in PTL sheet+ number of days entitled for payment in NC sheet + number of days entitled for payment in Sundry sheet) If select salary scale 3- (Actual No. of Days in PTL sheet+ No. of Days in NC sheet+ No. of Days in Sundry sheet)		
4	Verify the basic salary gets calculated correctly	*User navigate to salary sheet * Should have enter the basic salary per day for scale 1 and scale 2 and should have the total number of days	Check the basic salary calculates correctly	If select scale 1, (total number of days * basic salary per day for scale 1) If select scale 2, (total number of days * basic salary per day for scale 2) If select scale 3, no basic salary should be calculated	same	Pass
5	Verify allowance calculated correctly	*User navigate to salary sheet * Should have enter	Check the allowance calculates correctly	If select scale 1, (total number of days * allowance for scale 1) If select scale 2, (total number of days * allowance for scale 2)	same	Pass

		allowance for scale 1 and scale 2 and should have the total number of days		If select scale 3, no allowance should be calculated		
6	Verify incentives calculated correctly	*User navigate to salary sheet * Should have enter incentives for scale 1,2,3 and should have the total number of days	Check the incentives calculates correctly	If select scale 1, (check the Total No of Days is greater than or equal to 75%, if so the Total No of days * incentives- scale 1 , else zero) If select scale 2, (check the Total No of Days is greater than or equal to 75%, if so the Total No of days * incentives of scale 2, else zero) If select scale 3, (check the Total No of Days is greater than or equal to 75%, if so in sundry sheet no of days * incentives of scale 3, else sundry sheet no of days * incentives of scale 3*60%)	same	Pass

7	Verify Overtime calculates correctly	*User navigate to salary sheet * Should have enter Overtime rate per hour for scale 1 and scale 2 * Should have excess hours in sundry sheet	Check the overtime amount displays correctly when change the salary scale	If select salary scale 1, Sundry excess hours * Overtime rate per hour Of salary scale 1 If select salary scale 2, Sundry excess hours * Overtime rate per hour Of salary scale 2 If select salary scale 3, No overtime amount	same	Pass
8	Verify For extra KGs calculate correctly	*User navigate to salary sheet * Should have enter rate per over Kgs for scale 1 and scale 2 * Should have excess KGs in PTL sheet	Check the overtime amount displays correctly when change the salary scale	If select salary scale 1, PTL excess KGs * Rate per over kg Of salary scale 1 If select salary scale 2, PTL excess KGs * Rate per over kg Of salary scale 2 If select salary scale 3, PTL excess KGs * Buying Rate per kg of salary scale 3	same	Pass

Iteration 3

Test scenarios for Factory sheet
Verify user able to enter the rate per KG
Verify user able to enter the weight, sales, advance, interest, transport, fertilizer, chemical, processed tea leaves, empty bags, stationary, stamp duty, other deduction, welfare and arrears
Verify the total sum of each column displays correctly
Verify the total sales, total deduction and balance c/d displays correctly

Test cases for Factory sheet

Test case ID	Test case Description	Pre-requisite	Steps	Expected outcome	Actual outcome	Results
1	Verify user able to enter the rate per KG	User navigate to sales factory sheet	Enter the rate per Kg	User able to enter the rate per Kg	Same	Pass
2	Verify user able to enter the weight, sales, advance, interest, transport, fertilizer, chemical, processed tea leaves, empty bags, stationary, stamp duty, other deduction, welfare and arrears	User navigate to sales factory sheet	Enter amounts for weight, sales, advance, interest, transport, fertilizer, chemical, processed tea leaves, empty bags, stationary, stamp duty, other deduction, welfare and arrears for each day in the month	User able to enter amounts for each day in all columns	Same	Pass
3	Verify the total sum of each column displays correctly	*User navigate to sales factory sheet	Verify the total sum of each column	The sum of each column should display correctly	Same	Pass

		*Should have enter amounts for each columns				
4	Verify the total sales, total deduction and balance c/d displays correctly	*User navigate to sales factory sheet *Should have enter amounts for each columns	Verify the total sales displays correctly	The total sales should be the sum of sales column	Same	pass
			Verify the total deductions displays correctly	The total deduction should be the total of all the columns except sales	Same	pass
			Verify the balance c/d displays correctly	The balance c/d should be Total sales-Total deductions	Same	pass

Test scenarios for Sundry sheet
Verify user able to enter number of hours worked in morning and afternoon sessions
Verify the excess hours gets calculated correctly

Test cases for Sundry sheet

Test case ID	Test case Description	Pre-requisite	Steps	Expected outcome	Actual outcome	Results
1	Verify user able to enter number of hours worked in morning and afternoon sessions	Should have open the sundry sheet	For a particular employee enter the number of hours worked in morning and afternoon sessions.	User able to enter the number of hours for morning and afternoon sessions	Same	Pass
2	Verify the excess hours gets calculated correctly	*Should have open the sundry sheet * Should have enter the hours more than 8	Check the OT hours displays correctly	OT hours should be, OT hours= number of hours worked - 8	Same	Pass

Test scenarios for Profit and Loss sheet
Verify user able to enter amounts for income and expenses for each months
Verify the sum of total income and sum of total expenses displays correctly

Test cases for Profit and Loss sheet

Test case ID	Test case Description	Pre-requisite	Steps	Expected outcome	Actual outcome	Results
1	Verify user able to enter amounts for income and expenses for each months	*Open the summary report sheet in the IT package *User navigate to profit and loss sheet	Enter amounts for all income and expenses for each months	User able to enter amounts for all income and expenses	Same	Pass
2	Verify the sum of total income and sum of total expenses displays correctly	*Open the summary report sheet in the IT package *User navigate to profit and loss sheet *Should have enter values for income and expenses	Verify the sum of total income and total expenses displays correctly	The sum of total income and total expenses should correctly displays	Same	Pass

Iteration 4

Test scenarios for Plucking Rounds Wet Season sheet
Verify cell gets blue color when enter 1 in PL Round for each field
Verify cell gets green color when enter 7, 8, 9, 10 in PL Round for each field
Verify user able to enter the KGs for Factory Weight for each field
Verify user able to enter the KGs for Cheque Roll Weight for each field
Verify user able to enter the plucker's name for each field

Test cases for Plucking Rounds Wet Season sheet

Test case ID	Test case Description	Pre-requisite	Steps	Expected outcome	Actual outcome	Results
1	Verify cell gets blue color when enter 1 in PL Round for each field	User open the monthly sheet and navigate to Plucking Rounds Wet Season sheet	Enter 1 in PL Round column for a particular field	The cell should display in blue color	same	pass
2	Verify cell gets green color when enter 7, 8, 9, 10 in PL Round for each field	User open the monthly sheet and navigate to Plucking Rounds Wet Season sheet	Enter 7,8,9,10 in PL Round column for a particular field	The cell should display in green color	same	pass
3	Verify user able to enter the KGs for Factory Weight for each field	User open the monthly sheet and navigate to Plucking Rounds Wet Season sheet	User enter the KGs for Factory Weight for each field	User should able to enter the KGs for factory weight	same	pass

4	Verify user able to enter the KGs for Cheque Roll Weight for each field	User open the monthly sheet and navigate to Plucking Rounds Wet Season sheet	User enter the KGs for Cheque Roll weight for each field	User should able to enter the KGs for Cheque Roll weight	same	pass
5	Verify user able to enter the plucker's name for each field	User open the monthly sheet and navigate to Plucking Rounds Wet Season sheet	User enter the plucker's name for plucker column for each field	User should able to enter the plucker's name	same	pass

Test scenarios for Plucking Rounds Dry Season sheet
Verify cell gets blue color when enter 1 in PL Round
Verify cell gets green color when enter 12, 13,14,15
Verify user able to enter the KGs for Factory Weight for each field
Verify user able to enter the KGs for Cheque Roll Weight for each field
Verify user able to enter the plucker's name for each field

Test cases for Plucking Rounds Dry Season sheet

Test case ID	Test case Description	Pre-requisite	Steps	Expected outcome	Actual outcome	Results
1	Verify cell gets blue color when enter 1 in PL Round	User open the monthly sheet and navigate to Plucking Rounds Dry Season sheet	Enter 1 in PL Round column for a particular field	The cell should display in blue color	same	pass
2	Verify cell gets green color when enter 12, 13,14,15	User open the monthly sheet and navigate to Plucking Rounds Dry Season sheet	Enter 12,13,14,15 in PL Round column for a particular field	The cell should display in green color	same	pass
3	Verify user able to enter the KGs for Factory Weight for each field	User open the monthly sheet and navigate to Plucking Rounds Dry Season sheet	User enter the KGs for Factory Weight for each field	User should able to enter the KGs for factory weight	same	pass
4	Verify user able to enter the KGs for Cheque Roll Weight for each field	User open the monthly sheet and navigate to Plucking Rounds Dry Season sheet	User enter the KGs for Cheque Roll weight for each field	User should able to enter the KGs for Cheque Roll weight	same	pass

5	Verify user able to enter the plucker's name for each field	User open the monthly sheet and navigate to Plucking Rounds Dry Season sheet	User enter the plucker's name for plucker column for each field	User should able to enter the plucker's name	same	pass

Having confirmed that the artefact was bug free it was released to be used in the next iteration.

Appendix C: Post – Implementation Interview Questions

1. Which system, manual recording or computerized system, was faster in recording data?

2. Which system, manual recording or computerized system, is more accurate?

3. Which system, manual recording or computerized system, is more complex?

4. How did you communicate with the owner/manager for the past 3 months?

5. Which system is more suitable for TSHs?

6. Will be able to invest on the computerized system?

7. Which system helps more in decision making?

8. What kind of assistance you need to use a computerized system?

Appendix D: Consent Form