PhD Civil Engineering

Approaches for the monetisation of social benefits accruing from rural road projects

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March 2023

ABSTRACT

People in remote areas in developing countries suffer without road access. Rural road infrastructure is a strategy to improve those people's lives for the better. To achieve a road policy, the monetary value of social benefits needs to be included in road appraisal to help evaluate if road investment can contribute to the improvement of societal activities and the economy. However, social benefits can be considered as non-monetary value and may not be able to facilitate the appraisal directly. Therefore, there is a need to monetise the social benefits arising from rural road projects to apply for such an appraisal.

This study developed the social benefits framework for road appraisal and linked social impact assessment to economic measurement, economic valuation techniques and economic appraisal. Farmers' revenue and better health were the social benefits that rural road projects were selected to monetise. The novel in-depth insight was that these social benefits were monetised for each type of road improvement. It was found that different types of standards of upgrades and maintenance can yield varying monetary social benefits, implying that monetary social benefits are valid for the appraisal by which the most appropriate road alternative can be justified. Moreover, monetary social benefits, when they were added to the appraisal, resulted in positive returns, implying that road infrastructure can maintain social activities in the long run.

ACKNOWLEDGEMENTS

My wife Wanwipa Pothinamtong is the first person I must thank. She has had to sacrifice her time and energy to take care of our daughter in my home country while I was in the UK pursuing my dream to become a PhD.

I would also like to say a special thanks to Dr. Michael Burrow, my leading supervisor, who not only supervised my work academically but also provided me with help and guidance on life in the UK. He is a real expert in my opinion.

Finally, I would like to say thanks to Dr. Mehran Eskandari Torbaghan. He came in at the last minute to help me finish my PhD thesis.

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CHAPTER 1 INTRODUCTION

1.1 Background

Well-being is foundational, and it is defined as 'the combination of feeling good and functioning well; the experience of positive emotions such as happiness and contentment as well as the development of one's potential, having some control over one's life, having a sense of purpose, and experiencing positive relationships' (Ruggeri K et al., 2020). Transport plays a very important role in realising several components of well-being (Street and Swan, 2020). For example at the national level, transport can be regarded as facilitating well-being by being a means for stimulating foreign and local investment, decreasing the cost of production and reducing the working capital of firms (Popova, 2017). As a component of transport, road infrastructure is fundamental to the resilience of health and well-being of communities (ITF-OECD, 2018; John et al., 2018; Daniel and Pasquire, 2019). It is a basic need for connecting people and linking new or upgraded infrastructure to public spaces can contribute to well-being (Smyth and Briggs, 2021). Accordingly, the provision of road infrastructure is a key strategy applied in several countries to improve the livelihood of people (Hine et al., 2019).

In developing countries, safe, affordable and reliable (i.e. good) rural road infrastructure has been shown to improve the quality of life (Burrow et al., 2016a). The infrastructure could yield well-being, such as boosting household incomes, employment opportunities, agricultural production and sales, improving health and increasing school attendance (Hine et al., 2019; Bopoto et al., 2019; Iimi et al., 2015; Bell et al., 2012). The social benefits rising from rural roads were therefore often considered as improved access to rural facilities (Turner, J. et al., 2004). For example, a World Bank study in Ethiopia, found that linking road infrastructure to remote increased household consumption by 16% compared to villages without roads (Nakamura et al., 2019). When rural roads are in good condition, people can also access hospitals faster and with greater comfort in times of emergencies (Bell, 2012), and they can help farmers increase crop productivity (Tamene and Megento, 2017).

Demand for integrating social impacts into investment decisions to improve well-being has risen in several countries (Fujiwara and Campbell, 2011; Karoly, 2018). In the UK, the Public Services (Social Value) Act was introduced in 2012 (Fujiwara and Dass, 2020). Moreover, the European Commission (2014) and the UK's Office of Best Practice Regulation (2020) published guidelines to consider social value. Because of budget constraints and the need therefore to have transparent means of justifying expenditure, such countries aim to measure social well-being in monetary terms using cost–benefit analyses that enable more informed policy decisions which are based on sound economic principles. Nevertheless, well-being or social value can be considered as a non-monetary value that can be challenging to quantify in monetary terms (Odoki et al., 2013).

Difficulties in the valuation for well-being are a key factor impeding such policy decision (Plant et al., 2012; Zerbe and Bellas, 2015). It poses two main problems (Vardakoulias, 2013). One of an ethical nature and another of a technical nature. The ethical question mark over whether well-being impacts should be expressed in market (monetary) terms in the first place—by doing so, there may be a risk in merchandising well-being by creating the illusion that it can be substituted for money, since in the cost–benefit framework, any well-being cost can potentially be outweighed by financial or economic benefits. On the other hand, for the technical nature, there are a wide range or economic valuation techniques to monetise well-being and social value. In these techniques, consumer satisfaction is converted to social value in monetary terms (Pearce, 2002). These techniques are acknowledged as stated and revealed preference techniques (Fujiwara and Campbell, 2011; Clark, 2013; Karoly, 2018; Fujiwara and Dass, 2020). As pointed out by Wu and Huang (2001), these techniques could yield varying results since each technique was based on different concept to monetise.

Cost–benefit analysis (CBA) is the predominant tool used in welfare economics to justify investment policies and it is often used to appraise strategic road projects (Korytárová and Papežíková, 2015; Karoly, 2018). CBA could show ways that businesses are managed to deliver the maximum social impact (National Center for Environmental Economics Office of Policy, 2010). It provides powerful and transparent evidence that investigating is good value for money. It can also help to promote the understanding of the importance of stakeholder involvement and helps to ensure that what matters to all stakeholders affected by an intervention are considered and that their voices are recognised and reflected in decision-making (Plant et al., 2012).

Incorporating social-benefits within a CBA requires social and environmental impacts to be translated into monetary terms so that they can be compared on a common scale with economic impacts (Clark, 2013). Putting a monetary tag on non-market goods may be challenging, but it is important to recognise that social impacts themselves are subjective (LSE, 2009). A loss of employment, for example, can be expressed in simple monetary terms as a reduction in income and tax revenue (BIO Intelligence Service, 2011). However, it can also be expressed in terms of a loss of well-being, such as reduced self-esteem, optimism and personal or community resilience (Mann et al., 2004; Collins, 2007; Sawai et al., 2011). The intention of CBA is to ensure that relevant costs and benefits – economic, social and environmental – are assigned an approximate and evidence-based value.

In a standard road economic appraisal, CBA is used to compare the economic benefit of savings in road user cost (RUC), vehicle operation cost, time cost and accident cost with construction and maintenance costs in order to select appropriate road alternatives (Miller et al., 2015; Kerali, 2003). Such an appraisal, however, does not identify whether road infrastructure can deliver social well-being to communities; that is, the monetary value of social benefits has little been used in the appraisal. Moreover, considering only RUC savings can sometimes result in a negative return on investment for rural road projects since traffic volume, which was associated with the RUC estimate, can be very tiny for remote context (Kerali, 2003; Soparat et al., 2019).

With the above in mind, a new and more suitable approach to rural road appraisal is necessary if remote communities are to have good rural road access that encourages and maintains social activities and the economy. However, social CBA will not be sufficient on its own. It will need to be supported by economic valuation approaches to quantify the monetary value of the social benefits. Moreover, the rationale for monetising social benefits is now being questioned whether the social benefits can be useful for road investment appraisal in the alleviation of suffering in remote communities and the enhancement of remote communities' productivity, or not.

In order to address the above issues: firstly, the consideration of the social benefits for road appraisal by CBA; secondly, economic valuation approaches that are appropriate for the appraisal; finally, the effectiveness of the social benefits when they come to the appraisal, this doctoral research focuses on the framework of the social benefits for the appraisal; economic valuation techniques to monetise the social benefits to remote communities accruing from rural roads; the appraisal with the monetised social benefits as a means to incorporating these benefits within a traditional CBA.

1.2 Aim and objectives

This study aims to apply the social benefits rising from rural roads for economic appraisal. Further it investigates social dimensions including economic valuation approaches can be used within a traditional CBA. To achieve this, the research has the following method statements:

1. To review the possible benefits and costs of good (safe, affordable and reliable) rural access.
2. To identify the approaches (Economic measure) used to monetise social benefits in other disciplines, such as the social sciences.
3. To identify the economic valuation techniques for quantifying the social benefits of rural roads, with a focus on those that can be used to relate accrued benefits to road condition changes.
4. To develop the theoretical social benefit framework to select social benefits that could be used for CBA.
5. To develop econometric models and mathematical equations which can be used to monetise the selected indicators of social benefits.
6. To trial the developed approaches in the context of selected rural areas in Thailand with a focus on investigating the relationship between social benefits derived from rural road investment and changes in road condition.

6.1 To discuss the relative merits of the developed approaches in the context of their use in Thailand.

6.2 To draw conclusions on whether the monetisation of social benefits is useful in supporting rural road investment appraisal.

1.3 Novelty

This research represents a shift from the current standard road investment appraisal methodology that considers only changes in the road user cost result from investment, Rather the approach developed herein includes the monetary value of social benefits arising from rural road projects. This makes four contributions to the body of knowledge:

1. The research develops a social benefit framework for appraisal by which to select appropriate economic measures and valuation techniques for a given social indicator. There are several economic measures and allied valuation techniques that might be adopted for monetising indicators of social benefit. For a given indicator, the select economic tools may yield different results and therefore guidance is required on how best to select the appropriate tools, particularly where the results of monetisation are to be used within a cost benefit analysis.
2. It examines the relationship between social benefits and varying road interventions using the theory of consumer satisfaction—the utility function. Road treatment interventions of pavement surfacing types and conditions that could generate varying social values; that is, each road intervention should associate with each social benefits to identify within CBA the appropriate interventions for rural road network in remote areas.
3. It examines how the monetary value of social benefits determined can be influenced by CBA and how the ambiguity of the benefits determined can be reduced.

1.4 Benefits of the research

The methods and techniques proposed in this research provides a more transparent, informed and therefore robust methodology to appraise rural roads investment. By so doing the research can assist road agencies make fair and transparent investment decisions, thereby providing them with a means by which they can equitably prioritise interventions.

1. At the strategic level of road management, by considering the social benefits of rural roads within appraisal methodologies, a road agency's strategies and policies on road investment are improved, and when considered in the wider context of investing in the road network, this could enable rural road networks to receive a more equitable share of the overall road budget. This could in turn promote decentralisation—an increasingly important budgetary issue for local authorities.
2. At the tactical level of road management, the methodology provided by the research can help the asset manager to identify economically justifiable road construction and maintenance standards and prioritise sections of road for improvement. For example, a CBA including social benefit might demonstrate that a less expensive treatment, such as a Cape seal, can provide a sufficiently safe, affordable, and reliable road that meets a remote community's needs compared to a more durable, but expensive asphalt concrete road.
3. The resulting appraisal was presented to the road agency in Thailand. These confirmed that the appraisal with the monetary social benefits could be helpful to selecting road alternatives and project prioritisation.

1.5 Thesis structure

This thesis contains eight chapters. A summary of each chapter is outlined below.

Chapter 2 reviews the literature on traditional approaches used for road appraisal, and the concept of economic valuation and approaches available in the literature. By so doing the chapter identifies the research gap that necessitates a study such as that proposed (Objective 1, 2 and 3).

Chapter 3 describes the research methodology in detail, including the survey methods (namely the questionnaire, interviews, and observations), model development, how the results will be compared within an economic appraisal. It also utilises the findings from the preceding chapter to develop a framework for identifying suitable economic valuation techniques for particular indicators of social benefit and demonstrates how this framework has been used for the indicators of social benefit selected for the research (Objective 4).

Chapter 4 focuses on the case studies which demonstrate how the selected indicators of social benefit can be monetised. Using field data collected from two remote regions in Thailand, the social benefits of improved rural infrastructure on access to health facilities and on agricultural transport, the chapter shows how the accruing benefits can be monetised in terms of the value of statistical life (VSL) and the additional income from reduced transport cost, respectively. It also demonstrates how the VSL, and the income are a function of improved road conditions (Objective 6.1).

Chapter 5 shows how the VSL and income from Chapter 4 can be used within a traditional road economic appraisal methodology. By means of structured discussions with relevant experts in the local rural road authority, the chapter appraises the usefulness of the approach for supporting budgetary planning (Objective 6.2).

Chapter 6 discusses the respective merits of the approaches developed in the research. It also addresses whether the research objectives have been met and outlines the limitations for the research as well as potential fruitful areas of further research (Objective 6.2).

Chapter 7 draws findings and associated conclusions from the research and suggests recommendations for future research.

CHAPTER 2 LITERATURE REVIEW

2.1 Introduction

As mentioned in the Introduction, most rural communities in developing countries need affordable, safe and reliable transport for their socio-economic development. However, the benefits from investment in rural road infrastructure are not as tangible as for strategic roads, but still significant. One of the main reasons for this is the lack of a suitable means of motivating a strong case arguing for funds for rural investment where social benefits are significant (Burrow et al., 2016b).

This research aims to address this by investigating the monetisation of rural road benefits. First, the benefits, and indicators of rural road investment are described and discussed in Section 2.2. Section 2.3 provides a critical review of the literature related to economic appraisal. Section 2.4 identifies the monetary value of social benefits in the transport sector. Section 2.5 introduces several economic valuation techniques that might be used for monetising the social benefits of rural roads. Several techniques which could be potentially used are initially identified and appraised in order to identify suitable ones for this research.

2.2 What is social?

Social means the interactions and activities among individuals within a group, community or society (Cambridge Business English Dictionary, 2002). Social impacts can affect people and communities by changing the existing interactions among individuals. This can include actions, inactions, activities, projects, programmes and policies (Goodfinance, 2015). Impacts that positively contribute to communities and provide advantages are considered social benefits (Studysmarter, 2002). The

Organisation for Economic Co-operation and Development (OECD) defines social benefits as subsidies received by households intended to provide for certain needs or circumstances, such as sickness, unemployment, retirement, housing, education or family circumstances (OECD, 2001).

On a global scale, the United Nations (UN) and the World Bank considered social inclusion as a result of their investment. Social inclusion is the process of improving the terms on which individuals and groups take part in society – improving the abilities, opportunities and dignities of those disadvantaged based on their identity (Kenyon, 2003). The UN measures social inclusion as a contribution to an individual's well-being (Atkinson and Marlier, 2010). Its findings helped develop the monitoring framework of indicators used to measure the growth rate of gross domestic product (GDP), the net enrolment ratio in primary education and the share of women in wage employment in the non-agriculture sector.

Similarly, the World Bank considered social sustainability and inclusion in its attempt to place people in development processes. It promotes the social inclusion of lower socioeconomic and vulnerable persons through empowerment, the development of cohesive and resilient societies, and the promotion of accessible and accountable institutions (Karten, 2017). It highlights that inclusion can be created when people have access to health, education, jobs, fair wages and financial markets. Moreover, it considers the impact that climate change has on inequality in the social dimension. As the effects of climate change become more prevalent, millions of vulnerable people face disproportionate challenges, such as overcoming extreme events, health issues, food security, employment barriers, clean water accessibility, and cultural identity.

All three organisations agree that the term ‘social’ means activities within society and that social inclusion uses social activities and investment projects to empower people. As a result of social inclusion, society could receive benefits and other positive changes. Therefore, this research needs to identify social activities that could rise from rural road projects.

Next Section 2.2 identifies the social benefits rising from rural road projects.

2.3 Social benefits of rural roads

In previous Section 2.2 mentioned about social in general and initiated some idea for this research to identify social benefits, the purpose of this section is to focus on the evidence provided by published studies of the social benefits that typically arise from rural road projects, and their associated dimensions and indicators.

In the context of rural road appraisal, the following useful definition is provided by Rolt et al. (2005) for the social benefits of rural roads: ‘*benefits resulting from an investment that improve the quality of life of the population, or parts of the population, but which may not be quantifiable in economic or monetary terms’*.

Following the above definition, the considered social benefits are related to impacts on individuals (e.g. changes in their quality of life) by investments in rural road infrastructure that improve access. These benefits are often non-monetary, hence; it is challenging to quantify them in terms of economic value. For example, it can be challenging to estimate the monetary value of the quality of life.

The literature reports empirical studies demonstrating several benefits of investing in rural road infrastructure, and these are typically associated with improved access to facilities, goods, services and people having better access produces a wide range of benefits. Determined by Oversea road note 22 (ORN 22), basically, social benefits of rural road project can be categorised into five groups namely; 1) health, 2) education, 3) employment, 4) transport and 5) social capital (Turner, J. et al., 2004).

Seventeen studies were identified in the literature, and these are summarised in Table 2-1. Table 2-1 shows the category (or dimension) associated with a benefit and means by which the dimension is typically measured. For example, improved rural access can increase healthcare provision, via better access to hospitals and clinics, and this is most often quantified in terms of a reduction in the number of days of sickness or a reduction in the death rate (e.g. number of deaths per year). From Table 2-1 summarises the social benefits of used to measure rural road projects. It summarises six social dimensions and sixteen social indicators.

Table 2-2 present the frequency of these social benefits. From Figure 2-2, of those studies identified, improved marketing was the most often studied. (n=12). The frequently assessed indicators were an increase in revenue (n=5) and employment opportunity (n= 4)— the percentage of people getting employed and the second most frequent was the crop volume increased (also under access to agriculture; n=4). For education, most of the literature reviewed considered increased school attendance (n=4).

Table 2-1. List of social benefits associated with rural road projects.

Social dimension	Social indicator	Measurement type	Source
Healthcare	Days of sickness	Non-monetised	(Iimi et al., 2015)
	Number of deaths	Non-monetised	(Bell et al., 2012)
	Number of sick members	Non-monetised	(Bell et al., 2012)
Education	School attendance	Non-monetised	(Khandker et al., 2006; Iimi et al., 2015; Aggarwal, 2018; Bopoto et al., 2019)
	Number of new schools	Non-monetised	(Singru, 2009)
Marketplaces	Employment opportunity	Non-monetised	(Khandker et al., 2006; Tarefder, 2015; Wang and Sun, 2016; Nakamura et al., 2019)
	Number of businesses along roads	Non-monetised	(Bopoto et al., 2019)
	Revenue	Monetised	(Singru, 2009; Wang and Sun, 2016; Nakamura et al., 2019)
	Expenditure		(Ohe, 2010; Asomani-Boateng et al., 2015)
Agriculture	Crop volumes	Non-monetised	(Singru, 2009; Wang and Sun, 2016; Aggarwal, 2018; Nakamura et al., 2019)
	Crop prices	Non-monetised	
	Crop damage	Non-monetised	(Bradbury et al., 2017; Bopoto et al., 2019)
Transport and mobility	New modes of transport	Non-monetised	(Iimi et al., 2015; Asher and Novosad, 2018; Bopoto et al., 2019).
	Traffic volume	Non-monetised	(Asomani-Boateng et al., 2015; Ahmed and Nahiduzzaman, 2016; Bopoto et al., 2019)
	Waiting time/travel time	Non-monetised	(Bopoto et al., 2019)
Social capital	Frequency of trips to i.e. recreational site	Non-monetised	(Gray et al., 2006; Iimi et al., 2015; Bradbury et al., 2017; Bopoto et al., 2019)

Table 2-2. Frequency of social indicators for assessment.

Social Indicators	Bopoto et al. (2019)	Iimi et al. (2015)	Nakamura et al (2019)	Bell and Wan (2012)	Aggarwal (2018)	Ahmed and Nahi~ (2016)	Bell and Wan (2018)	Nguyen (2017)	Singru (2009)	Wang and Sun (2016)	Yuan et al. (2019)	Asomani et al. (2015)	Tarefder (2015)	Asher and Novosad (2018)	Gray (2006)	Bradbury (2006)	Bradbury et al. (2017)	**Count**
Education																		
Number of new school									X									**1**
School attendance	X	X		X	X													**4**
Health																		
Number of sick member		X																**1**
Number of death by sickness				X														**1**
Days of sickness							X											**1**
Market																		
Expenditure, purchase									X			X						**2**
Revenue			X						X	X	X	X						**5**
Employment opportunity		X	X					X					X					**4**
Number of business along road	X																	**1**
Agriculture																		
Crop price increased				X														**1**
Crop volume increased			X		X			X		X								**4**
Crop damage																	X	**1**
Transport service																		
New mode of transport (Bus)	X	X												X				**3**
Traffic volume	X					X												**2**
Waitng time	X																	**1**
Social Capital																		
Frequency of trip to recreational site	X	X													X	X		**4**

The dimensions and their indicators are described more fully in the following subsections.

2.3.1 Access to healthcare facilities

Empirical studies (Bell et al., 2012; Iimi et al., 2015) have shown that improved accessibility may result in improved health of villagers in remote areas in developing countries. Iimi et al. (2015) measured the number of sick household members before and after rural road improvements of the upgrade to paved rural road in rural regions in Brazil. It analysed a decade's worth of data using a difference in differences (DID) econometric model, which was an experimental research design using observational study data, by studying the differential effect of a treatment on a 'treatment group' versus a 'control group' in a natural experiment. Such a model requires data from a treatment group (i.e.

villages with road projects) and a control group (villages without projects). The results showed that the sickness member fell from 0.3–0.4 to about 0.15–0.2 per household across the region due to the improvement. However, the results, statistically, were found to be insignificant, since most of the surveyed participants did not experience particular difficulties journeying to a hospital or health centre and they in general preferred to travel a longer distance to a better hospital. Bell et al. (2012) used the morbidity and mortality rates from 2006 to 2009 to measure the health impact due to new rural roads in India. The improvements were associated with all-whether rural roads. In their study, the morbidity rate was defined as the average number of days of household sickness, while the mortality rate was the number of deaths per household. The study found that 455 households benefitting from improved access had on average 5.77 days of sickness per year, and the 837 households without a road project had an average of 5.63 days of sickness per year. It might be thought that this signal absence of any difference was due to a failure to control for other factors, such as age, sex, infrastructure, and the ability to recognize the importance of treatment and the capacity to pay for travel. Moreover, some reductions in mortality were found, but these were not significant. However, focus group suggested that the local communities believed that the new roads had reduced mortality; the average estimate was a reduction of about 2.5 deaths per year in each village.

2.3.2 Access to education facilities

Rural road improvement can have a positive impact on education since it can affect the school attendance of students and teachers. This argument has been supported by several studies (Singru, 2009; Bell, 2012; Iimi et al., 2015; Aggarwal, 2018; Bopoto et al., 2019) . In Liberia, student attendance in junior high schools was assessed as an outcome of road intervention. The number of students before and after a new road was opened increased by 30% (Bopoto et al., 2019). In Vietnam (Bell, 2012), the study showed that road projects were linked to an increase of 15–25% in school attendance. However, Iimi et al. (2015) argued that school attendance could be found for the future. Instead, shortened distances and reduced travel time that result from improved rural access should be measured, as these are the short-run effects that encourage school attendance. Singru (2009) found, in Lao, there was a new school building after a new road open.

2.3.3 Access to markets

The impact of better rural road access on marketplaces is generally considered in terms of changes in employment opportunity, the ultimate goal being to improve household income.

Employment in this context refers to the creation of jobs in the non-agricultural sector, mobility of labour and choice of occupation (Hine et al., 2019). In Liberia, for example, Bopoto et al., (2019) examined the number of shops along roads before and after a road improvement between 2018 and 2019. For villages with nearby (within 24 km) recently improved roads, the number of shops increased by 21% compared to the villages without road projects. In India, Aggarwal (2018) revealed that improved road access for local community yielded 25% increased by women to start working. Wang and Sun (2016) looked at household incomes in rural China as a function of rural road infrastructure investment (primarily associated with rural road network extension) using longitudinal data from 1978 to 2008, they used an econometric model consisting of crop yield, income and road length to determine relationships between net income per household and road infrastructure. They found that household income increased by 0.14% for every 1% increase in improved rural road network length. In Ethiopia, Nakamura et al. (2019) revealed that improved rural road access could increase the share of household members with waged jobs by 2.8%. In Laos, Singru (2009) found people found increased purchase goods and service after a new road open.

2.3.4 Agriculture output

Improved road access to farms can affect agriculture outcomes in terms of agricultural productivity and crop transportation costs. For instance, farmers can produce more crops by 32.2% through easier access to fertilisers (Nakamura et al., 2019). Thus, a surge in agricultural production has frequently been recorded following rural road improvement schemes (Wang and Sun, 2016; Asher and Novosad, 2018). Wang and Sun (2016) found that an increase of 1% in road network length increased crop production performance by 0.19% in rural China. Similarly, in India, 1.6% higher agriculture yield per village was found due to a new road (Asher and Novosad, 2018). In addition, the condition of rural roads can affect freight transportation and crop damage. For example, tomato, bell pepper and hot pepper loss during transport for 28% 15% and 10%, respectively (Bopoto et al., 2019; Bradbury et al., 2017). However, In Vietnam, Nguyen et al. (2017) found that improved road project could lead a 30% reduction in cultivated land. Such reduction forced people in villages with road projects were more likely to find jobs in the industrial sector and less likely to work in the agriculture sector.

2.3.5 Mobility and transport services

Improved rural roads can lead to better rural transport services, such as more frequent and cheaper bus services (Iimi et al., 2015; Das et al., 2009). Certain studies (Bopoto et al., 2019; Iimi et al., 2015; Asher and Novosad, 2018) have tried to associate new modes of public transport to rural road improvements. Moreover, better road conditions can increase the number of trips people in rural areas take, both on public and private transport; in other words, greater traffic volume can be generated (Iimi et al., 2015).

A study by Asher and Novosad (2018) in India showed a new road was found to cause a statistically significant 12.8% increase in the availability of public bus services. The impact on private buses was nearly as large but was measured with less precision. The use of taxis and vans, which are more expensive forms of transportation, were not shown to experience significant growth. The availability of auto- rickshaws, the least expensive private form of motorized transport, was found to increase by 7.8%. Moreover, rural roads could increase traffic volume for moterised and non-moterised by 140% and 75%. However, this finding was not based on any statistic experiments (Ahmed and Nahiduzzaman, 2016)

2.3.6 Social capital

Social capital in the context of rural road investment refers to the ability of people to maintain connections with family members, recreational site and worships outside their rural areas (Turner, et al., 2004). Such connections allow for greater social interactions. Certain studies have explored the concept of social capital by investigating the increased frequency of trips to visit family members outside their village (Bradbury, 2006; Gray et al., 2006).

In Kenya, Bradbury (2006) measured on social trip making (e.g. sport activities, place of worship, funerals and weddings. The study also considered the relationship between social trip purpose and trip distance. In the UK, Gray et al. (2006) measured the relationship between mobility and social exclusion, which found that those people without access to car did affect the exclusion, which reduced their trips of travel to doctor, market, picking up kids from school and social service and communities. Moreover, Social capital could be consequent upon improved access to certain facilities such as worship and recreational site, which could measure the increased trip numbers (Turner,

J. et al., 2004). Anderson (2009) counted the number of trips to ice-climbing site in Hyalite canyon in Montana the USA, which found an increase in the trip after improving access road.

2.3.7 Social cost of rural road projects

In addition to positive benefits, rural road projects may develop negative impacts. These potential adverse effects include an increase in road accidents resulting from more traffic, an increase in crime rates due to a surge in tourism and an increase in prostitution and sexually transmitted diseases (Hine et al., 2016).

Two studies (Smith et al., 1999; Ruijs et al., 2004) identified several negative effects of rural road development in African countries. In Nigeria (Ruijs et al., 2004), providing partial improvements to the road network may have the unintended negative consequence of disproportionate goods availability leading to higher prices in regions of shortages and less competitive positioning in regions of surplus. The study found that if transport costs decrease by 25%, consumer grain prices will reduce by 0.4% and producer grain prices will rise by 3.3%. In Uganda (Smith et al., 1999), it was reported that the incidence of HIV in the communities of intermediate trading villages and trading centres established on main roads was respectively 1.9 and 3.3 times higher than in rural agricultural villages with fewer or no road connections. However, this research was from an older study and the country may have developed a strategy to control HIV transmission.

It should be considered that the negative impacts of road projects were often mentioned in urban areas. Urban road projects in developed countries, such as the UK, can produce negative impacts including carbon dioxide emission and noise pollution (Sloman et al., 2017).

2.3.8 The scale of social benefits

Several studies focusing on rural road projects were funded by the Department of National Development in the UK. Hine et al. (2014) examined the studies to determine the range and scale of the social impacts (agriculture, education and economics) on society due to road intervention. In these studies, the theory of change was used to describe the process of moving from initial rural road investment to the final impact on the livelihood of rural populations. However, due to the heterogeneity of the studies and data, it was not possible to establish the range and scale of outcomes and impacts.

On a national scale (OECD, 2022), developed countries such as Japan, the UK and other EU nations measured social benefits as a percentage of GDP. The GDP can be estimated by dividing household social benefits into two distinct categories: social transfers in kind and social benefits other than social transfers in kind. Transfers in kind relate to the provision of certain goods or services (e.g. health care and education) and are provided to households for specific purposes; social benefits other than social transfers in kind generally consist of cash and allow households to use the cash indistinguishably from other income. Social benefits other than social transfers in kind may be further broken down into two key components: pension benefits and non-pension benefits. The latter consists of cash transfers made by the government or by non-profit institutions serving households (NPISHs) to households to meet their financial needs and incidental events, such as sickness, unemployment, housing, education or family circumstances.

The reviews of literature in this section help understand the aspect of social impact rising from rural road projects. Most of these impacts were measured in term of non-monetary.

However, these impacts will help scope benefits that should be monetised. The next section 2.4 introduced the theory of the valuation of these social benefits.

2.4 Economic appraisal

Economic appraisal studies the allocation of scarce resources in a society as a means of satisfying public needs (Zerbe and Bellas, 2015). It considers the constraint of resources and provides useful tools that can support investment decision-making to enhance goods and services, productivity and the distribution of income within a society (Turner et al., 2004).A common economic appraisal methodology is Cost Benefit Analysis (CBA) which provides a rational and systematic framework for appraising alternative management and policy options (Clark, 2013). CBA entails the identification and economic valuation of all positive and negative effects of alternative options (Agarwal et al., 2017). This involves the translation of all benefits and costs into monetary terms, including, whenever possible, non-marketed goods and services, i.e. goods and services that are consumed by people but are not traded in markets, such as the value of a recreational visit and its environmental, social and other impacts (Zerbe and Bellas, 2015). This is based on the underlying assumption that individual preferences should determine the allocation of resources among competing uses in society.

Several economic indicators are used to test the viability of an investment, these include Net present value (NPV), Internal rate of return (IRR) and benefit-cost ratio (BCR). The most economically efficient option is that with the highest present value of the net benefit, i.e. net present value (NPV). Economic efficiency requires the selection of the alternative with maximum NPV. Alternatives are economically viable only when the NPV they generate is positive, which means that their associated benefits, including the ones for the society and the environment, are higher than their costs (Sasidharan et al., 2020).

Concerning road investment, road economic appraisal refers to the study of the appropriateness of a road project by considering its economic viability as well as a wide range of impacts on society and the environment (Van de Walle, 2002). Its objectives include examining the costs and benefits of the road project (essentially, the investment costs, i.e. construction and maintenance, and the economic benefits, i.e. road user benefits), initialising road geometry (including structural design standards as appropriate to the budgetary allocation to maintain road users' benefits) and prioritising projects in case of budget constraints (Odoki et al., 2013). To capture the costs and benefits associated with a road project, road investment appraisals can also seek to assess the impacts of road investment on society and the environment (e.g. on education and health) resulting from access improvement (Kerali, 2003).

Standard road economic appraisal using CBA is based on the concept of minimised total transport cost, which consists of road user cost (RUC), time value, vehicle operation cost, accident cost and road agency cost (Figure 2-1). The appraisal is used to select the appropriate type(s) of road work to upgrade or maintain a road, i.e. a road standard, based on its current condition. In such a concept, and with reference to Figure 2-1, the RUC for a road section are relatively high if the roads are constructed with low standards and / or are maintained in poor condition. Conversely, RUC reduce when roads are maintained to a higher standard. An optimal standard (Figure 2.1) is that where the total transport cost, given by the RUC plus road agency costs, are at a minimum (Harvey, 2012; Kerali, 2003).

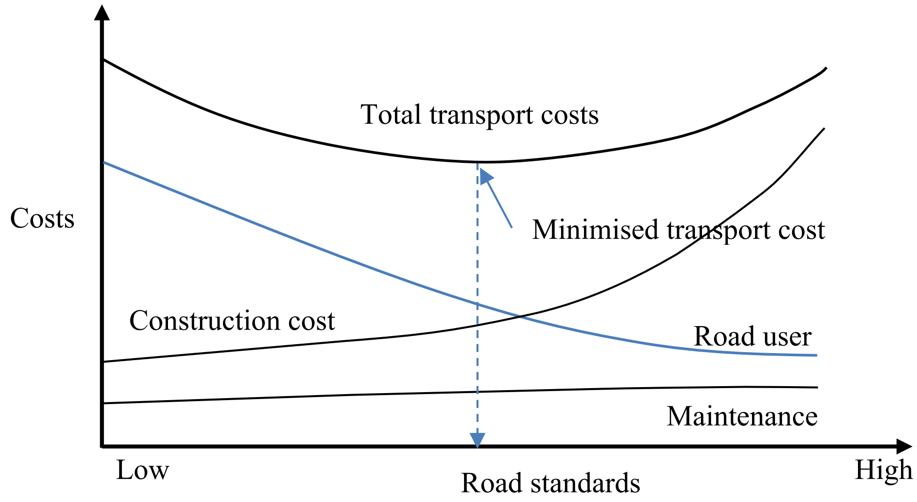

Figure 2-1. Total transport cost (Kerali, 2003).

Several studies (Carruthers and Nogales, 2013; Soparat et al., 2019; Al-Kaisy et al., 2017; Babcock and Alakshendra, 2012; Ojukwu, 2006) have also shown that standard appraisal that considers only the RUC may not always fully capture the benefits of rural roads, in particular those that have low traffic volumes, yielding a negative return on investment. For example, Soparat et al. (2019) describe a CBA carried out by the Department of Rural Roads in Thailand, which sought to appraise the upgrade of a gravel road to an asphaltic concrete road with two lanes and a 6-m width carriageway with a length of 5.4 km and an anticipated traffic volume of 811 AADT (annual average daily traffic volume). The cost of construction and maintenance was estimated at £1.5 million over the 20 years period of the analysis with resulting savings in RUC reduction of £100,000 per year. The project appraisal showed a negative return on the investment. The B/C ratio, which is the overall relationship between costs and benefits, was 0.07. Another example of an appraisal carried out by the Department of Rural Roads in Thailand reported by Soparat et al. (2019) was the upgrade of a 13km section of paved road from two lanes to four lanes. The traffic volume was 5,409 AADT. Similarly, it was found that the project had a negative yield for the investment. The road agency costs were predicted to be £3.8 million, whilst the savings in RUC were estimated to be £1.8 million per year, resulting in a B/C ratio of 0.47.

Carruthers and Nogales (2013), appraised the upgrade of gravel roads to paved ones in countries i.e. Ethiopia, Kenya and Tanzania by means of a standard CBA. Two different standards of road works were considered, namely double surface treatment (DST) with an agency cost of £167,000/km and single surface treatment (SST) with an agency cost of £157,000/km. Where the standards were applied to a low-volume road with lower than 100 AADT, a negative NPV resulted. As a result, the study recommended that road projects with low-volume traffic any CBA should consider wider benefits other than just savings in RUC.

These studies show that whilst standard CBA that seek to minimize total transport costs might be appropriate for high volume roads where RUC are significant, the approach could be lacking for low-volume roads where traffic levels may be low.

Several guides and practices published by road agencies in several countries, however, strongly recommend including monetised social benefits within a CBA (Parkman et al., 2012; Carruthers and Nogales, 2013; New Zealand Treasury, 2015; Fujiwara and Dass, 2020). A more appropriate approach of CBA when social benefits are included would therefore be that illustrated in Figure 2-2 below.

An analogous concept to that described in Figure 2-1 is that of determining the ideal road maintenance standard where there are no social benefits. On the other hand, the maximised net social benefit concept is shown in Figure 2-2. Figure 2-2 the upper (solid line) curve shows the net social benefit accruing from a new road as a function of the condition or type of road. The lower (dash line) line shows the road agency costs of achieving a given road standard. The ideal road standard occurs when the difference between the social benefit and road agency costs are maximised, this is shown by point Q in the figure As net benefits are still positive beyond the ideal road standard (point Q), there may be some occasions in which better road standards, albeit with diminishing returns, are chosen by the road agency, as they still provide a positive NPV and also greater monetary social benefits, albeit it higher agency costs.

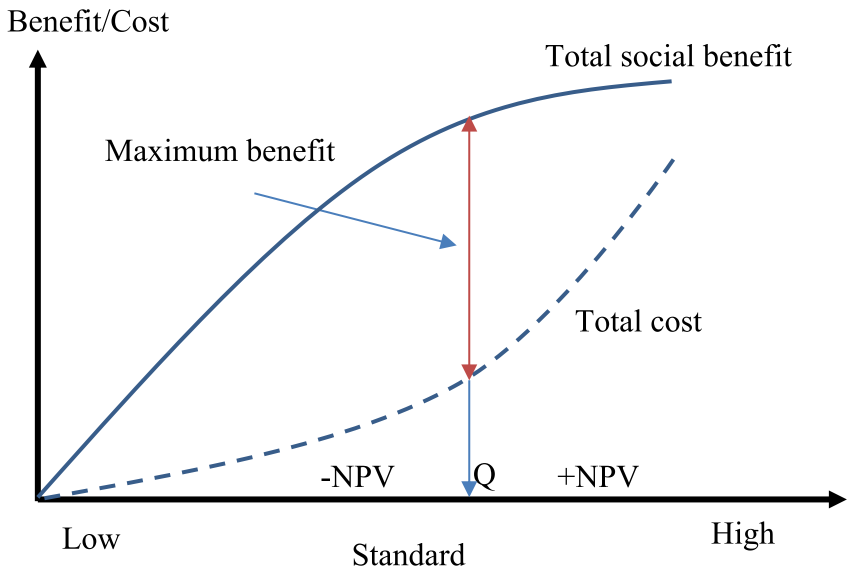

Figure 2-2. Maximised net social benefits for rural roads (National Center for Environmental Economics Office of Policy, 2010).

However, the social aspects of rural road investment can be considered within a CBA are further discussed in the following.

2.5 Valuing social benefits arising from rural roads

Section 2.2 described the types of social benefit which may arise from improved rural access provision. Section 2.3 described the concept of CBA and how CBA is used within traditional road investment appraisal methodologies. It was found that in the context of rural roads, it is important to consider social benefits, but this rarely the case, resulting in potentially misinformed analyses. This section reviews the general approaches which can be used to determine measures of social value, namely the consumer surplus (CS).

- **Consumer surplus**

Consumer Surplus (CS) is an economic concept that considers the difference between the actual price that individuals pay for goods and the price they are willing to pay (WTP), reflecting the fact that individuals may be happy if the price they pay is less than their expectation (Pearce, 2002). The WTP is the maximum price an individual is willing to pay for goods and services (Stobierski, 2020). There are several economic valuation techniques which can be used to elicit WTP. Pertinent techniques to this research are described in Section 2.5.

CS is used in traditional road economic investment models such as the World Bank's Road Economic Decision Model (RED) and its World Bank's Highway Design Maintenance Standards Model as a means of determining the benefit of road improvements to traffic generated by the improvement , (Archondo-callao, 2018; Agosta and Agosta, 2014). The former has been developed for the assessment of low volume road investment. For road economic appraisal, an inverse demand curve is used to determine the CS (Figure 2-3) in which the user transport cost is associated with travel demand. In the Inverse demand curve method, the RUC decreases with improved road condition, resulting in an increase in travel demand. The CS1 for normal travel demand, i.e. exiting demand (existing road user), and the CS2 from a decrease in transport cost that leads to an increase in travel demand (increased road users), are known as the economic benefits for road users (Archondo Callao, 2008). As shown in Figure 2-3, when the user transport cost (COST1) for normal average daily traffic (ADT1) is reduced to COST2 by improving the road condition, leading to higher demand, i.e. ADT2 (Archondo-callao, 2018).

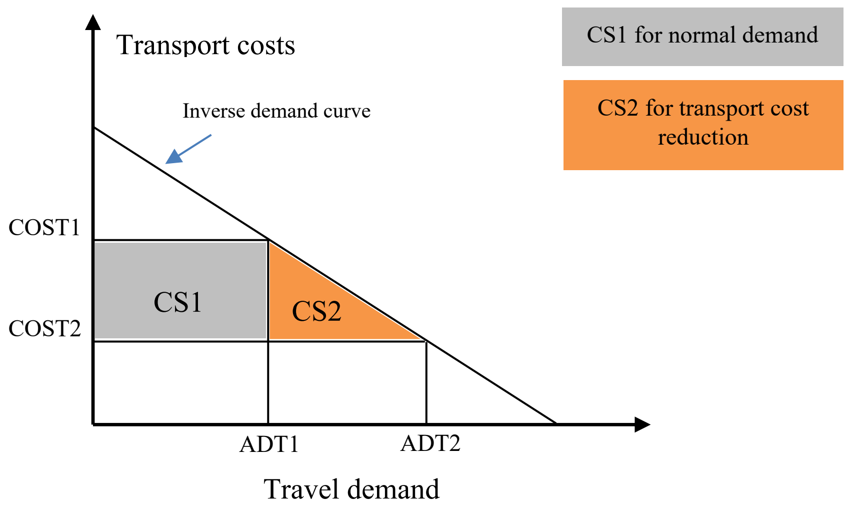

Figure 2-3. Consumer surplus (CS) for road users.

Moreover, the CS can be used to determine the benefits for local businesses due to local road improvements. Figure 2-4 illustrates the CS for local business development through a hypothetical example. In the example, a new road project results in higher travel demand (Archondo-callao, 2018). As seen in Figure 2-4, travel demand shifted from DEMAND1 to DEMAND2. The demand can shift if a road improvement in access increases products. For example, if improving a road section reduces the travel time of workers to a factory, this can lead to additional working hours and marginal productivity gains.

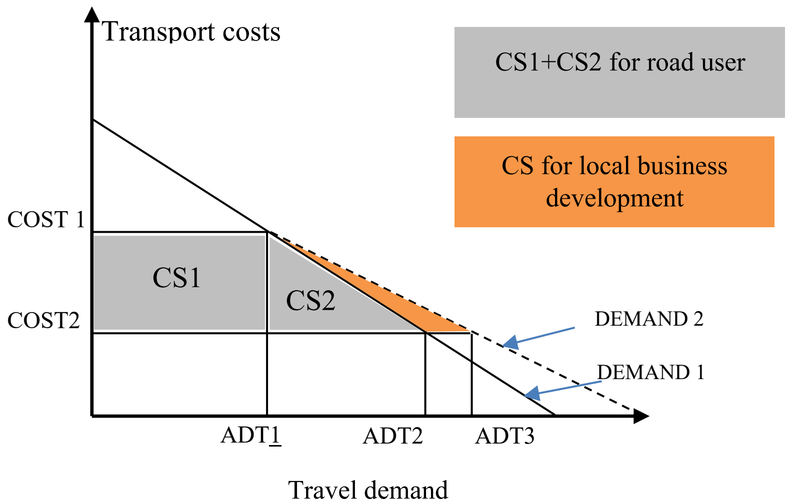

Figure 2-4. CS for Local business development

As mentioned in Figure 2.4, demand curve can shift from DEMAND1 to DEMAND2 when road improvement could increase benefit for local business sector. The CS for local business in Figure 2-4 can be acknowledged as wider impact economics or external benefit.

Figure 2-5 shows a representation of wider economic benefits that is acknowledged as the impact of road infrastructure on other market sectors/external benefits such as local business development. For example, a government can provide a road that is creating a positive externality of production; that is, local businesses can increase the supply of the good production at Q* and the unit cost of production will decrease from Pe to P*. The business will maximise its profits where the marginal revenue is equal to the unit production cost (at point O). At this point (O) consumers' willingness to pay (Marginal benefit—P_e) exceeds the unit production cost (Point O), implying that output (Q_e) in this market is below the output that is socially optimal (Q*).

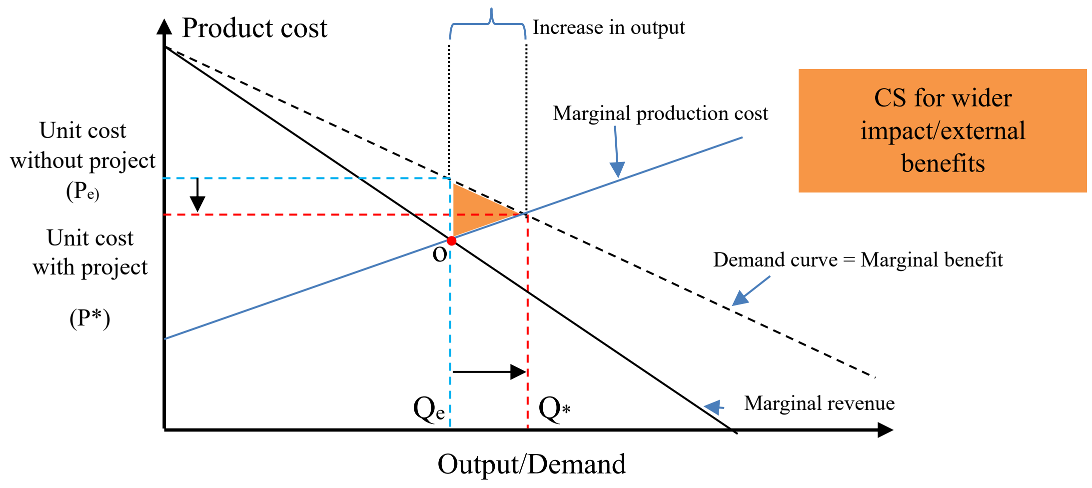

Figure 2-5. Wider economic impacts from transport (Kernohan and Rognlien, 2011).

To evaluate some of the social benefits of rural roads a similar approach could be used to the aforementioned wider economic impact concept, since the social benefits from road improvements in a remote community include increased productivity in various sectors. Some examples of where the approach has been used to assess the types of social benefit this research is trying to monetise include education, agriculture productivity, increased job opportunities and income boosting (Odoki et al., 2008, 2013; Iimi et al., 2015; Hine et al., 2019; Bopoto et al., 2019).

Indeed, WTP has been used to measure various social benefits; for instance, to determine the economic value of death risk by considering the marginal change in deaths – the marginal change in this context is the WTP that could reduce one death (Hensher et al., 2011). The WTP has also been used to refer the economic value of comfortable riding in rural areas (Satishkumar et al., 2018) and the availability of emergency services (Delgado-Lindeman et al., 2019). These WTPs associate with the utility or preference from individuals for goods and services. The utility described in the next section.

- **The concept of consumer satisfaction (Utility function)**

Utility is a measure of satisfaction an individual obtains from the consumption of the commodities. Total utility (TU) is the sum of the total satisfaction from the consumption of specific goods or services. It increases as more goods are consumed. Marginal utility (MU) is the additional satisfaction gained from each extra unit of consumption. By law of diminishing marginal utility (Berkman et al., 2016), MU decreases with each additional increase in the consumption of a good. In Figure 2-6, when the TU is low, the MU increase sharply; WTP can be less when the TU is high; WTP is zero when the TU is maximum at point O.

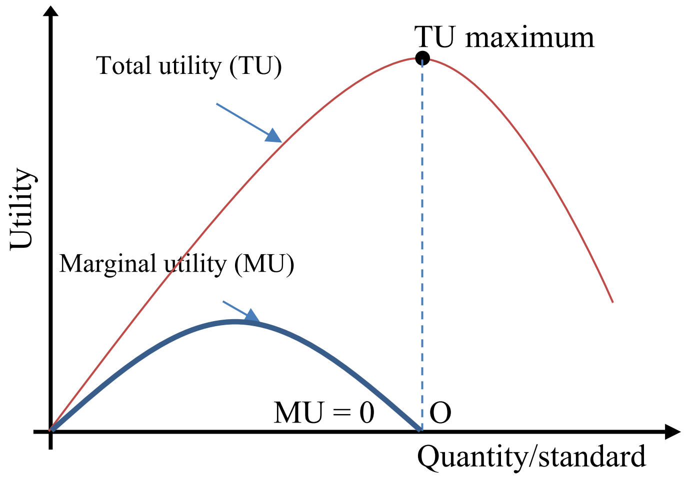

Figure 2-6 Utility maximisation curve

A marginal benefit is a maximum amount a consumer is willing to pay (WTP) for an additional good or service. It is also the additional satisfaction or utility that a consumer receives when the additional good or service is purchased. In the business world, the marginal benefit for producers is often referred to as marginal revenue (Kenton, 2020). Accordingly, the MU can be referred to marginal WTP and marginal revenue in the inverted demand curve in Figure 2-4 and 2.5.

- **Stated and Revealed Preference**

The economic valuation theories of stated and revealed preference have been often used to determine the WTP. They are particularly useful methods that can be used to help to determine the economic measures of VSL, consumer surplus and net income. Stated preference (SP) techniques are a family of tools that allow how consumers value different product/service attributes to be determined. In brief, the SP techniques attempt to quantify people's willingness to pay by asking them directly how much they value a certain good or service. Revealed preference RP) techniques on the other hand are based on the concept that a consumer's preferences can be revealed by what they purchase under different circumstances, particularly under different income and price circumstances (Pearce, 2002).

In the transport sector, SP and RP techniques have been used to monetise intangible values, such as travel time (Li et al., 2020; Shams et al., 2017; Fezzi et al., 2014) and accident cost to life (Hensher et al., 2011; Niroomand and Jenkins, 2016), and wider economic benefits from transport, such as changes to labour supply and agriculture productivity (Kernohan and Rognlien, 2011; Legaspi et al., 2015; Thiessen et al., 2017; Workman et al., 2018; Qiao et al., 2019; Graham and Gibbons, 2019) the effect of transport on the environment and ecosystem (Deisenroth et al., 2009; Samdin et al., 2013). Pertinent approaches provided in rural roads studies are described further in Section 2.5.

2.6 A review of studies used to value social benefits of rural roads

Section 2.3 described a wide range of benefits and associated indicators which can arise from improved rural access, whilst Section 2.4 described the concept of consumer surplus as social benefit rising from road projects. In order for the benefits which arise from improved rural access to be included within a CBA they need to be monetised i.e., the indicators need to be related to economic measures of their monetary values.

The purpose of this section is to identify potential economic valuation techniques and associated monetised models, for the task in hand, which have been used to quantify economic measures of social value in studies reported in the literature to set the context for the methods developed in the thesis. A scoping review approach was used to analyse the existing literature on economic valuation in the field of transport and other sectors. This type of review is designed to capture the breadth and depth of available evidence on a given topic by mapping, examining and summarising the relevant information.

The following questions were developed to guide the review process: Which approach of economic value can refer social benefits? and which techniques should be used to monetise such values? The search strategy focused on investigating journal articles, reports, books and conference papers. Three main steps were involved. The first step consisted of defining the key search terms. These were defined according to three different layers associated with economic valuation — transport/infrastructure and road impact on society.

Thereafter, the search terms were searched in Scopus, the World Bank's research database, the Web of Science, ASCE, DFID, Sega, and other sites. Studies published before 2000 were excluded from the database search so that only recent literature would be used. The search obtained a total of 1,171 studies, and the distribution of studies per database in relation to each keyword is provided in Table 2-3.

Finally, an assessment of relevance was undertaken to filter and identify the most relevant studies for the review. The process consisted of firstly removing duplicates and excluding studies not written in the English language. Finally, the studies were analysed by title, abstract and text. Studies that did not relate to monetisation were excluded. Following the above process, twenty-one empirical studies were identified for further narrative synthesis.

Twenty-one studies which used economic valuation techniques to determine social benefit were identified and reviewed. To inform the selection of appropriate techniques for the task in hand, the advantages and disadvantages of the techniques described in the studies, in relation to their use in the rural road context, are discussed in Section 2-5 (Table 2-4). Pertinent aspects of the review are summarised in Table 2-4. Table 2-5 summarises the applications of each technique for monetising social benefits.

Table 2-3. Search strategy.

Concept	Search Term
Economic valuation	Economic valu* OR monetise OR monetisation OR Welfare OR wellbeing OR Risk reduc* OR state preference OR reveal preference OR non market* OR intangib* OR social benefit OR non use* OR direct use* Or surplus OR wiliness to pay OR contingent OR Discrete choice OR Averting OR replacement OR production function
Transport/infrastructure	AND Transport OR road accident OR time value OR road OR infrastructur* OR rural road OR Highway OR demand OR freight
Social indicator	AND Death OR life OR health OR Education OR school OR Agriculture OR social capital OR employment OR job OR Social capital

- **Summary of identified studies**

The twenty-one studies evaluated four different social dimensions of benefit, namely health, education, market, transport, social capital and agriculture. This is in comparison to the six different types of social benefit that could arise from rural roads, as identified from the wider literature review described in Section 2.2 (see Table 2-1). To quantify these benefits, the studies used seven different types of economic evaluation technique to determine three measures of economic benefit. These statistics are summarised in Figures 2-7 to 2-10 below.

Figure 2-7 illustrates the economic measure used for each to value the social dimensions identified in Section 2-2. From the figure, the VSL was the most often used measure in the identified studies (n=7) and was used exclusively to measure the impact of health-related transport. In agriculture related transport, the CS (n=2) and the income (n=4) was used to determine benefits. Only the CS (n=4) was often used to measure the benefit from transport (i.e., toll and fare, walking time). However, this research did not find the economic measures for education and market (employment opportunity).

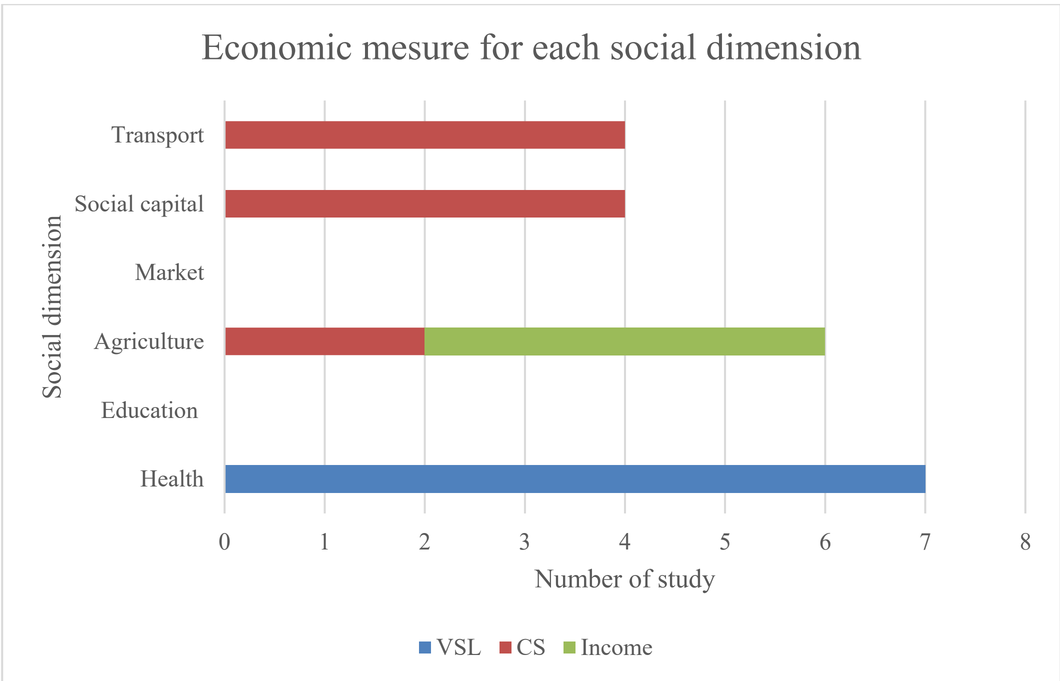

Figure 2-7. Economic measure used for each social dimension.

This Figure 2-7 identifies that each social dimension can be referred by varying types of social values (economic measures). Focusing on agriculture, both income and CS can be referred to, which depending on social indicators (i.e., the indicator of crop volume should associate with the economic measure of income; the indictor of freight cost should consider the CS). See detail in 2.5.1 to 2.5.7.

The techniques identified from the studies that were to determine the economic measures of social benefit as summarised in Figure 2-8. From Figure 2-8, as far as estimating VSL, the contingent valuation (n = 1) and discrete choice experiment (n= 4) were the stated preference techniques used, whilst averting behaviour (n= 2) where the revealed preference techniques were used. The elasticity of price (n= 2) and production (n= 2) were used to estimate the marginal change of additional income. The CS was determined in 10 studies from the WTP from the travel cost method (n= 3), contingent valuation (n= 3), and Demand function (n= 3).

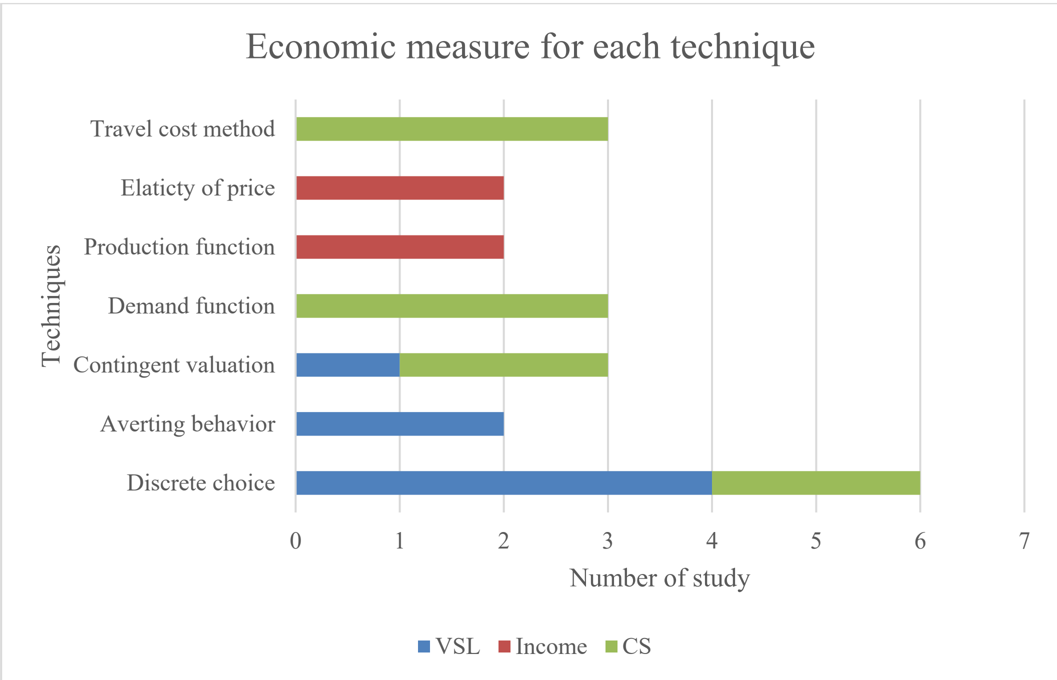

Figure 2-8. Economic measure for each technique.

This figure 2-8 identifies that not all techniques are suitable to examine all economic measures (social benefits). i.e., the elasticity of price will never be used to examine the VSL.

Figure 2-9 shows the number of studies using a particular technique. Figure 2-9 summarises the number of studies which used a particular technique to evaluate a particular economic metrics. Transport cost method considers transport cost as economic metric. Contingent valuation can measure tax payment and transport cost. Averting behaviour can observe purchasing of goods that can help individuals reduced health risk. Production function considered investment capital as an input. This figure 2-9 is crucial to model development for each technique to capture a right economic market for a social benefit.

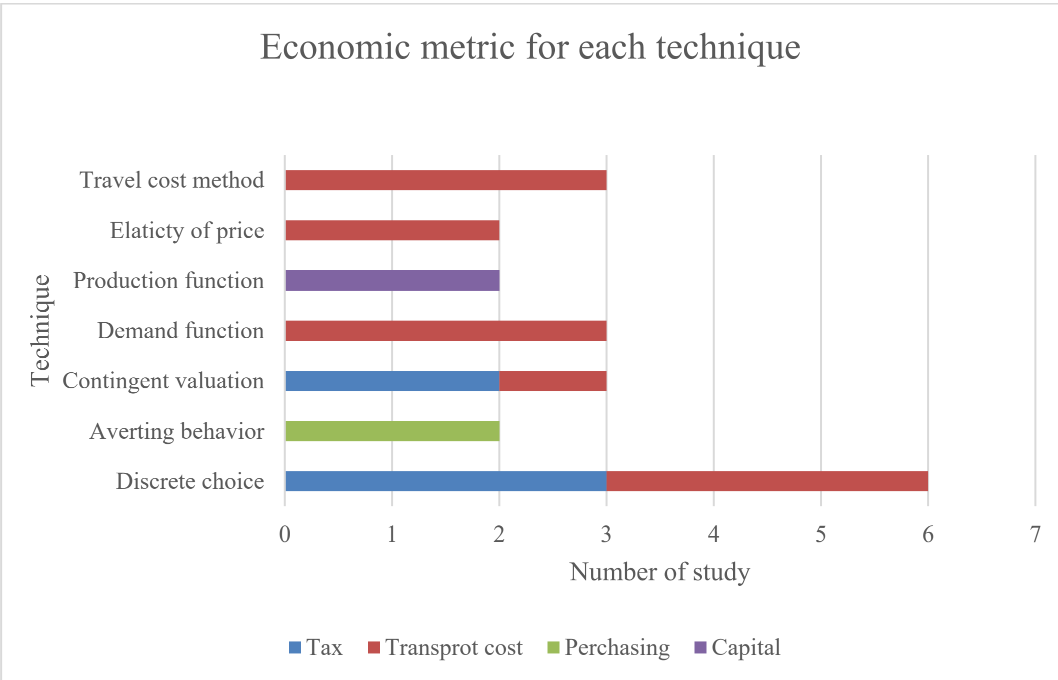

Figure 2-9 Economic metric for each technique

Figure 2-10 shows economic metric (payment types of WTP) for each economic measure. The economic metric is crucial to capture a right economic market for a social benefit. From Figure 2-10, transport cost can be used to estimate the VSL (n=8), CS (n=3) and income (n=2). tax can be used to estimate the VSL, and CS. Capital and purchasing can be used to estimate the CS and income, but the VSL. The capital was often used in the context that the government funded for road projects and examined GDP (Gross domestic product) to be return (Gebeyehu, 2010). The purchasing was used to observe the behavior of people buying things to avoid themselves from risk (Blomquist, 2004 and Um et al., 2002). Transport cost, such as fuel and transport fare, was often used in social benefits-related transport (Niroomand and Jenkins, 2016). And tax was used in the context that people would prefer to pay for public projects (Vanwechel and Vachal, 2006).

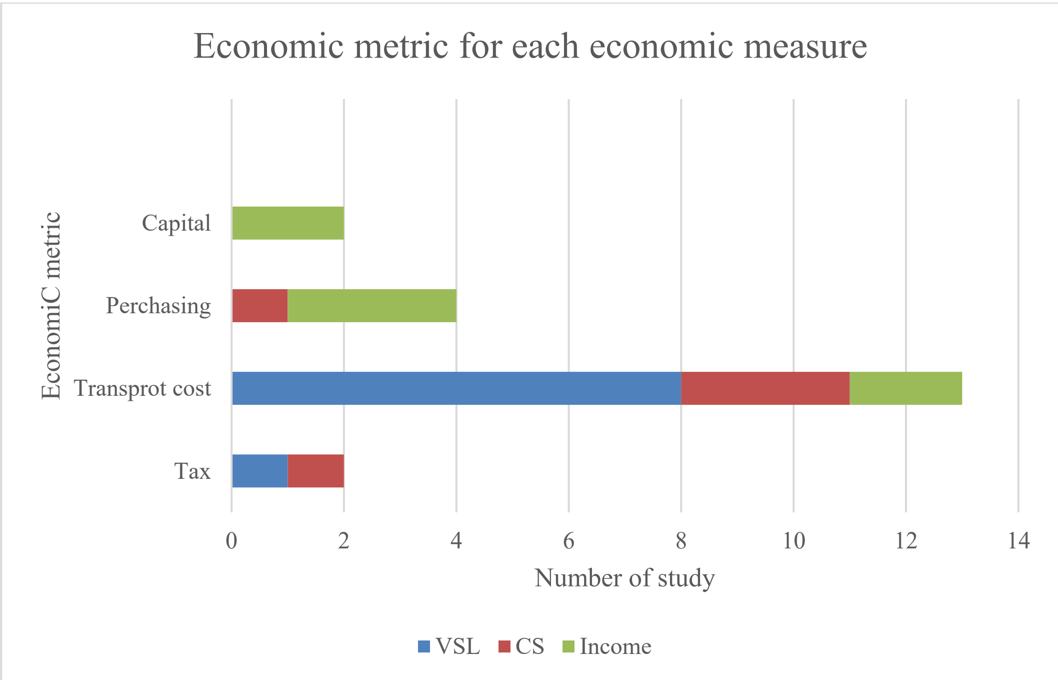

Figure 2-10. Economic metric for each economic measure.

2.6.1 Contingent valuation method

Three studies are reviewed (Vanwechel and Vachal, 2006; Andersson, 2007; Londero Brandli et al., 2014). Contingent valuation (CV), a stated preference approach, utilises information collected from surveys that are designed to ask individuals directly about their WTP for a product, or service, in a hypothetical market (Pearce, 2002). Vanwechel and Vachal (2006) used the approach to estimate the economic value of upgrading gravel roads to paved roads for the transport of agricultural produce in rural areas in North Dakota in the US. The questionnaire they developed was given to farmers and was designed to elicit their WTP for the upgraded roads in terms of the amount of additional tax they would be willing to pay. The results of their study showed that the respondents WTP for an upgrade was up to $293.25 per year. In Sweden, Andersson (2007) estimated the value of statistical life (VSL), the VSL is the monetary value that happens to reduce certain deaths, for road safety for varying Swedish demographics such as income, traffic risk and health status. The VSL for Swedish was about 108 million SEK (1 million USD), which was observed by the purchasing of the safety device. Londero Brandli et al. (2014) used contingent valuation to estimate an urban park in Brazil. Tax was a payment for observing WTP.As a result, economic value of the park was about 1.4 million USD.

To adopt the contingent valuation approach for monetising the social benefits of upgrading a road, it would be necessary to construct road scenarios that are associated and associate these with hypothetical payments. For example, the WTP for the upgrade of earth road to asphaltic road. Moreover, when it comes to quantifying the impact of rural access on health, contingent valuation can ask WTP for such upgrade associated with a certain death exposure (i.e. 1 death per 10,000 population).

2.6.2 Discrete choice experiment

A discrete choice experiment (DCE), a stated preference approach, was developed to indirectly assess WTP (Pearce, 2002). DCE questionnaires are based on statistical experiments whereby individuals must choose a series of attributes to reveal their preferences (Mandy et al., 2012). A DCE typically uses a logistic regression model to determine the WTP. In this model, the dependent variables can be dichotomous or multiple choices, and the independent variables require at least one monetary attribute, that is used to monetise other independent variables that are non–monetary attributes (Mandy et al., 2012).

Six studies were reviewed. In relation to road accidents, a DCE has often been used to determine the WTP to minimise the risk of death and time value. For such purposes, the model consists of a series of independent variables that are non-monetary attributes, such as the number of fatalities and injuries and travel time, and a monetary attribute, such as paying for road safety improvement (Niroomand and Jenkins, 2016; Hensher et al., 2011). For example, Hensher et al. (2011) utilised the approach to monetise the VSL for roads with pedestrian crossings in a community in New south Wales, Austria. To achieve this, participants stated their WTP for different alternatives, such as the number of lanes, crossing types, walking times, speed limits, as well as their WTP for the number of fatalities and injuries. Hensher et al. (2011) for that the WTP for the reductions of death risk and major injuries were \$15.52 and £3.23 per month, respectively.

Table 2-4 present the attributes used in DCE for these six studies. The DCE requires at least one monetary value that could be payment method to monetise intangible benefits. For monetising the VSL, the payment could be either council tax (Hensher et al., 2011), or transport cost (Niroomand and Jenkins, 2016).

For this research, it would seem that the DCE questionnaire could be used to quantify the VSL for various types of rural road alternatives serving a community (e.g. gravel roads, cape seal roads and asphaltic concrete), as one of the attributes associated with the death rate for a remote community.

Table 2-4 A summary of attributes and levels

Reference	Study aim	Attribute [Levels]
(Phanikumar and Maitra, 2007)	Rural bus service	Discomfort [status quo (seating), (partly standing), (standing comfortably), (stand in crowd)] Headway (min) [status quo (15), (30), (45), (60)] Travel speed (km/hr.) [status quo (30), (35), (40), (45)] *Travel cost (bus fare, Paisa/km) [status quo (35), (40), (45), (50)]
(Das et al., 2009)	Rural feeder service (bus)	*Fare per km. (Rs.) [status quo (1), (1.5), (2), (2.5)] Seating discomfort [status quo (comfortable seating), (congested seating)] Access walking distance (km.) [status quo (0-0.5), (0.5-1), (1-1.5), (1.5-2)] Time deviation (min) [status quo (0-15), (15-30), (30-45), (45-60)] Waiting discomfort [status quo (Anxious waiting at stop), (Relaxed waiting at stop), (Relaxed waiting at home)]
(Majumdar et al., 2017)	Bicycle factor	Road width [status quo (road with = 3.5 m shared with bicyclist), (1.5 m. bicycle lane), (2.0 m.)] Bicycle journey time min/km. [status quo (6), (5), (4)] *Bicycle operating cost (Paisa) [status quo (35), (40), (45)] Level of risk [status quo (highest), (moderate), (lower), (least)] Route visibility [status quo (no streetlight), (street light, but illuminated), (street light, illuminated)]
(Majumdar and Mitra, 2019)	VSL	Road width [status quo (road with = 3.5 m shared with bicyclist), (1.5 m. bicycle lane), (2.0 m.)] Bicycle journey time min/km. [status quo (6), (5), (4)] *Bicycle operating cost (Paisa) [status quo (35), (40), (45)] Level of risk [status quo (highest), (moderate), (lower), (least)] Route visibility [status quo (no streetlight), (streetlight, but illuminated), (streetlight, illuminated)]
(Niroomand and Jenkins, 2016)	Estimates of the value of statistic life and injury and travel time saving	Average speed limits per km/hr. [status quo (60), (80), (90), (100)] No. of speed cameras per lane [status quo (1), (2)] Travel time [status quo (less than 60), (more than 60)] No. of injury per year (car accident) [status quo (less than 20), (more than 20)] No. of fatality per year (car accident) [status quo (less than 10), (more than 10)] *Percentage change monthly cost [status quo (5% higher than now), (10%), (15%), (20%)]
(Hensher et al., 2011)	Value of risk reduction for pedestrian	No. of lane [status quo (1), (2), (3)] Speed limit [status quo (60), (80), (90), (100), (110)] Crossing type [status quo (none), (zebra crossing), (traffic lights), (Pedestrian overpass)] Walking time [status quo (10), (15), (20), (25), (30), (35), (40)] *Council rate [status quo $(0), (25), (50), (75), (100)] No. of deaths per year [status quo $(0), (25), (50), (75), (100)] No. severe permanent injuries per year [status quo (1), (2), (3), (4), (5), (6), (7), (8), (9)] No. of injuries requiring hospitalization per year [status quo (1), …, (19)] No. of minor injuries per year[status quo (1), … , (29)]

* means monetary attribute

2.6.3 Averting behaviour

Averting behaviour is a revealed-preference approach that can measure individuals' behaviours to avoid hazards that can affect life (Bolt et al., 2005). In approach, the averting expenditure – elicited by observation – is the cost that an individual would pay for a particular behaviour that would avoid such risks. Typically, this approach utilises a probit model, which was a type of regression where the dependent variable can take only two values based on their predicted probabilities, for example married or not married and is a type of binary classification model, for estimating the observed WTP.

Two studies by (Blomquist, 2004 and Um et al., 2002) respectively utilised this approach to estimate the economic value of improved polluted water supply in South Korea. The studies assumed that individuals would behave differently to avoid health risks due to the polluted water supply. For example, they would boil the water, purchase bottled water and draw spring water. The averting expenditures were travel time cost, purchasing cost and transport.

2.6.4 Demand function

Three studies were reviewed. The demand function approach is often used in transport studies to evaluate the CS for road users (Archondo-callao, 2018). The approach utilises the relationship between transport demand and the associated price(Otaki et al., 2017; Klophaus, 2009). As for agricultural freight transport in rural areas, Stifel et al. (2016) estimated the CS derived from the upgrade of an earth road to a gravel road, in Ethiopia, using the demand function that was the relationship between the agricultural transport cost of renting a donkey and the demand for crops to be transported. By means of revealed preference, 5,180 farmers' households were interviewed to obtain the WTP for renting a donkey. Stifel et al. (2016) found that reduction in the cost of renting a donkey for transportation from £1.18 to £0.59 per 100 kg led to an increase in crop demand from transporting 500 to 750kg. The associated WTP averaged about £53 per household per year, and that yielded a CS of over £200,000 per year for community. The appraisal with the inclusion of CS justified the upgrading project for 7 km as worth investing in, yielding an IRR of 35%.

2.6.5 Production function method

Two studies were reviewed. The production function approach is based on the Cobb–Douglas production function in which the economic value of non-market input factors – calculated as equivalent to marginal productivity – is multiplied by the output market price to examine the economic value of water supply (Grammatikopoulou et al., 2020).

For use in the road sector, road infrastructure quality could be assessed as an input that affects agricultural produce productivity. Gebeyehu (2010) attempted to identify the relationship between upgrading a road network from gravel to asphaltic concrete and gross domestic product (GDP) for Ethiopia. The study used the Cobb–Douglas production function to identify the relationship, together with empirical data from 1971 to 2009. The GDP growth was associated with such an improvement.

2.6.6 Price elasticity

Two studies were reviewed. The elasticity of price is often used to integrate the effect of transport into other market sectors (Workman et al., 2018; Graham and Gibbons, 2019), particularly to obtain wider economic benefits of transport (Kernohan and Rognlien, 2011). The price elasticity is the ratio between productivity changes in other sectors due to a 1% change in transport cost; that is, the marginal transport cost that can change productivity by 1 unit (Melo et al., 2013).

Workman et al. (2018) used elasticity of price to quantify the impact of a road project on farmers' income distribution. In the study, conducted in Kenya and Tanzania, the collected data were divided into two categories: one associated with farmers data, e.g. agriculture output and revenue, and the other related to transport, e.g. distance and fuel cost. These were used to calculate the price elasticity in terms of the percentage changes in transport cost before and after a road project. Similarly, the percentage change in net income, i.e., total revenue minus transport cost and other relevant costs, was calculated. The elasticity was then given by the income change divided by the cost change. Workman et al. (2018) found that the resulting elasticity was about 4.6, implying that a change in freight cost can significantly alleviate the income issue. When Workman et al. (2018) utilised the results within an investment appraisal, it was shown that upgrading the road from earth road to asphaltic road would be justified, yielding IRR, NPV and B/C ratio of 47%, £1 million per year and 2.65, respectively.

From the above, the price elasticity approach might be appropriate for determining the benefit of rural roads on farmers' revenue.

2.6.7 Travel cost method

Three studies were reviewed. The travel cost method is for describing the demand for the natural resource services and recreational sites. People visit such sites from diverse distance or point of origin. This observed travel behaviour is then used to evaluate the willingness to pay to visit the site. Essentially, the different travel costs from these diverse points of origin serve as proxies for willingness to pay to visit the site. Typically, in the context of transport, WTP considers such as fuel costs and ticket prices.

Three studies (Anderson, 2009; Gillespie et al., 2017; Hanauer and Reid, 2017) identified this method as preferable for recreation-related research. The studies found that improving recreation sites aesthetically increased travel demand. The consumer surplus (mentioned in Section 2.5) can be used as the monetary value for social benefits. For example, Anderson (2009) estimated the economic value of ice climbing as the surplus due to improved winter road conditions in Montana, Canada. His results showed WTP per person per trip was range between \$76 to \$135 an increased number of climbers, the collected data for whom were travel origination and travel cost.

2.6.8 Discussion

Based on the review of the twenty-one identified studies, the advantages and disadvantages of each technique have been summarised in Table 2–5. This information was used to inform the selection of the techniques and develop the monetised models for the task at hand, presented in Section 3.2.1. Chapter 3.

To set the context for the methods developed in the thesis, the social benefits arising from rural road projects would first need to be identified using certain indicators in Table 2–1 to monetise and include in CBA. It is important to consider the social benefits that primarily reflect remote communities and conduct a social assessment for monetisation.

Additionally, it is important to assign economic measures (i.e. the monetary value of social benefits) for each social indicator. Figure 2–7 shows a wide range of economic measures (e.g. the CS and VSL) appropriate for each social dimension. Moreover, it should consider economic metrics (e.g. payment types) for these measures, as shown in Figure 2–10. Payment types, including tax and purchasing, are important to the monetisation process as it measures what people need to pay to improve their life.

Economic valuation techniques should also be considered for survey methods and monetised models. Stated preference techniques, such as contingent valuation (Section 2.6.1) and discrete choice experiment (Section 2.6.2), should be used to elicit WTP if real payment cannot be observed. These techniques are based on questionnaire surveys and are found to be economical. However, the revealed preference techniques, such as averting behaviour (Section 2.6.3) and price elasticity (Section 2.6.6), should be selected if monetisation needs the explicit value of WTP.

Finally, it should select monetised models that are appropriate for road economic appraisals, such as the econometrics or mathematics model. It should be noted that the appraisals require social values for each associated road treatment option. Econometric models (e.g. logistic regression) and techniques (e.g. discrete choice experiment and averting behaviour) (Section 2.6.2 and 2.6.3) can be examined to determine the relationship between social value and road treatment options. However, the mathematical models used in contingent valuation (2.6.1) and travel cost method (2.6.7) need to develop a few scenarios to compare social values. Moreover, Sections 2.6.1 to 2.6.7 show that models used to monetise social benefits must consist of social demographics (e.g. income and household numbers) and payment types.

Studies show there are several techniques, economic measures and economic metrics (e.g. payment methods) that can be used to monetise varying social dimensions. However, these techniques cannot monetise all social benefits. Therefore, a framework that links these metrics to appropriately identify means to monetise social benefits rising from rural road projects is needed.

Table 2-5 The advantage and disadvantage for each technique in the context of rural roads

	Approach	Advantages	Disadvantages
Stated preference	Contingent valuation (CV)	The CV method is based on hypothetical cost, and therefore it has advantageous when actual data cannot be obtained. Consequently, it has widely been used in the literature to determine the value of transport infrastructure for varying purposes such as health-related transport.	CV does not require actual data that can overestimate social benefits. It considers a whole monetary benefit, not its component value.
	Discrete choice experiment (DCE)	The DCE method is based on hypothetical cost, and therefore it has advantageous when actual data cannot be obtained. Consequently, it has widely been used in the literature to determine the value of transport infrastructure for varying purposes such as health-related transport. Moreover, it bases on logit regression model that can examine the WTP/social benefits for each type of road works.	CV does not require actual data that can overestimate or underestimate social benefits. It can be difficult to interpret the WTP.
Revealed preference	Averting behaviour (AV)	The AV method put a value to ways people protect themselves from the impact of road infrastructure. For example, in healthcare access, remote people might buy their own vehicle (motorcycle) to travel to hospital, which vehicle price can be considered as averting cost to avoid health risk as there is no emergency service available.	It should observe the ways people avoid the impact of road condition access.
	Demand function (DF)	The DF method is based on actual transport cost, transport demand and other actual costs and therefore it has advantageous in terms of explicit benefits. Consequently, it has widely been used in the literature to determine the value of transport infrastructure for varying purposes. It could therefore potentially be used in the rural road context to quantify the benefits to society focusing on transport demand.	It has to observe transport cost that affect transport demand.
	Production function (PF)	The PF method is based on actual data for agriculture production/volume and their unit of sale price and therefore it has advantageous in terms of explicit benefits. Consequently, it has widely been used in the literature to determine the value of transport infrastructure for agriculture purposes. It could therefore potentially	It is data-intensive, and data on changes in services and the impact on production are often difficult to obtain.

	Approach	Advantages	Disadvantages
		be used in the rural road context to quantify the benefits to society focusing on agriculture productivity.	
	Elasticity of price (EP)	The EP method is based on actual transport cost change that could affect income changes and therefore it has advantageous in terms of explicit benefits. Consequently, it has widely been used in the literature to determine the relationship between transport infrastructure projects and income change. It could therefore potentially be used in the rural road context to quantify the benefits to society focusing revenue, income and expenditure.	It can be difficult to collect actual data that could estimate gross revenue.
	Travel cost method (TC)	The TC method is based on actual cost, transport demand and other actual data and therefore it has advantageous in terms of explicit benefits. Consequently, it has widely been used in the literature to determine the value of transport infrastructure for recreational purposes. It could therefore potentially be used in the rural road context to quantify the benefits to society of improving access to leisure facilities, places of worship and for visiting friends and relatives, for example.	Rural roads in remote areas have never been measured for the benefits from recreation.

2.7 Research gaps and direction of the research

The gap in current knowledge identified from the reviewed literature is highlighted in this section and summarised in Table 2.6. Gaps pertinent to this research are described below.

The literature review in Section 2.1 revealed a wide range of social dimensions and indicators and Section 2.4 found that there are several economic measures and allied valuation techniques that might be adopted for monetising these social indicators. However, there is no agreed framework which be used to select appropriate economic measures and valuation techniques for a given social indicator. Such a framework needs to be developed to resolve the following issues.

1) Economic measurements

The literature review has shown that there are several economic measurements, such as the VSL, Income and CS, that can be used to obtain the monetary value of the social benefits accruing from improved rural access. However, it is necessary to select the appropriate measurements for each perceived benefit since they have differences in the how they are determined and the results they produce.

2) Economic valuation techniques

Certain economic measurements, such as the VSL, can be quantified by different techniques, such as contingent valuation and discrete choice experiment approaches (see Section 2.4.1 and 2.4.2). These techniques are based on different concepts of monetisation and can therefore yield different results. It is also not possible to use a single economic valuation approach to quantify all types of social benefit. And as many researchers (Wu and Huang, 2001; Smith and Olaru, 2011; Fujiwara and Campbell, 2011) have revealed, using different economic valuation approaches to monetise an intangible can generate widely varying WTPs. However, there is a paucity of research that considers whether the ambiguity is because of the rural context, and on how the ambiguity may be addressed. In addition to the need for the suggested framework, the following gaps in current knowledge will be addressed in this research.

3) Maintenance standards

Table 2-6 illustrates that several identified studies have used economic valuation techniques to monetise social benefits arising from rural roads as a function of the type of road. For example, the social benefits arising from an upgrade of a gravel road to an asphaltic road (Workman et al., 2018). However, none of them focused on investigating monetary social benefits as a function of road condition / standard (or types of road) for a particular community. Such information could allow the optimum road standard / road surface type to be chosen for a particular location (cf. Figure 2-5). Note that as described in Section 2.2, Ashington et al. (2008) showed that different types of road standards yield varying social benefits and this can be used to help prioritise and select alternatives, however the study was conducted using MCA.

Table 2-6. Economic valuation techniques relating to rural road social benefits.

Approach	Model description	Sector	Economic approach	Transport modes	CBA	Type of road work	Study
Demand function	Uses inverse demand function to identify the relation between transport cost and demand	Agriculture-related transport	WTP for cost of renting donkey (CS)	Non-motorised (donkey)	Yes	Upgrade gravel road to paved road	(Stifel et al., 2016)
			WTP for cost of oxcart and handloading (CS)	Non-motorised (oxcart)	No	A hypothetical road project	(Jacoby and Minten, 2008)
Production function	Empirical study, Cobb–Douglas production function	Agriculture-related transport	GDP	Motorised	No	Gravel road to asphaltic road	(Gebeyehu, 2010)
Elasticity of price	Uses price elasticity, the correlation between income changes and freight cost change	Agriculture-related transport	Net income	Motorised	Yes	Upgrade earth road to asphaltic road	(Workman et al., 2018)
Contingent valuation	Average WTP	Agriculture-related transport	WTP for council tax	Motorised	No	Upgrade gravel road to paved road	(Vanwechel and Vachal, 2006)
Discrete choice experiment	Uses econometrics to develop model	Health-related transport	VSL	Motorised	No	Road facilities, e.g. number of lanes and speed limit	(Hensher et al., 2011; Niroomand and Jenkins, 2016)

4) Utility theory

According to the reviewed literature in Section 2.5, economic valuation techniques are typically based on the economic concept of consumer satisfaction (i.e., utility theory). Utility theory suggests that perceived social benefits would increase, non-linearly with improvements in rural road standards and that an optimal road standard, or level of investment, could be achieved (Figures 2-6). The relationship between perceived social benefits and road condition is non-liner in theory, since it would be expected that marginal social benefits will decrease as the condition of the road reaches a level at which the community judges are sufficient for its needs. i.e., individuals will be willing to pay more when they perceive that further improved road quality will provide greater benefit to them, but their marginal willingness to pay will decrease when further improved road condition they believe will not to yield further benefits. However, there is a paucity of research (Table 2-6) investigating whether this is so.

5) Rural road investment appraisal

As mentioned in Section 2.3 (Figure 2-2), the monetary social benefits, together with road agency costs could be used to select appropriate economically justifiable rural road standards. This concept, however, has never been demonstrated as reasonable for road agencies to select road alternatives for remote communities. The magnitude of the monetary social benefits is important to justify the appropriateness of a road project, i.e. they should be greater than road agency costs. However, since the monetary values of the accruing social benefits are determined by utility theory (and often WTP methods) it is important to consider whether benefits so determined provide a reasonable estimation of the true monetary value. For example, Stifel et al., (2016) found that the monetary social benefits, when derived from the WTP approach can be lower for remote villagers who have a lower income than more prosperous adjacent villagers. In other words, poor and small communities in remote areas can yield a lower WTP that may result in the magnitude of social benefits to be lower than expected. This may result in an economic appraisal that suggests that a proposed road scheme is not justifiable.

How these aspects have been considered in this research and the methods used to carry out the research are described in the following chapters.

2.8 Summary

This chapter has reviewed the literature with respect to the following. Firstly, it identified indicators of social benefit that might be monetised to reveal the benefit of investment in rural road infrastructure in Section 2.3. Section 2.4 reviewed traditional road appraisal methodologies that consider only the RUC as the economic benefit of appraising road projects. Section 2.5 reviews the valuing social benefit from road infrastructure. An analogous theory for rural roads was identified, which makes use of monetised benefits, namely the theory of maximised social benefits, could be appropriate for rural roads. Section 2.6 focused on the concepts of economic valuation techniques, broadly classified as stated and revealed preference, which might be suitable for monetising the social benefits of rural roads.

Based on a review of existing research in Section 2.6, Section 2.7 identified potential research gaps and suggested that there is a need to develop a framework which can be used to help identify suitable economic tools to monetise social benefits for road economic appraisal. The section also highlighted the need to investigate the impact of road condition on social benefits, how the income of a surveyed village may affect the perceived value of a particular social benefit and how monetary values of social benefit are considered within an appraisal. The following chapter describes the research methodology adopted to address the above, and it outlines the proposed framework.

CHAPTER 3 METHODOLOGY

3.1 Introduction

The gap in knowledge described in Section 2.7 identified that there is a paucity of studies investigating the monetisation of social benefits for rural road investment appraisals. A major limitation of the research to date, relating to road investment appraisal, is how social benefits vary by types of maintenance interventions. Such research is important, as it provides a rationale and transparent means to help justify expenditures on rural road maintenance and provides asset managers with a means to identify, on a rational basis, appropriate and economic road standards for rural road networks.

Moreover, there is a limitation to valuing social benefits in monetary terms. The research on monetising rural road benefits is concerned with robust economic valuation techniques to generate explicit social value. For instance, a wide range of stated and revealed preference techniques can yield varying monetised results that cannot be identified appropriate values. However, the literature review revealed that none of research can identify techniques that are the most appropriate for rural road appraisal context.

Furthermore, there is a variety of economic measures in welfare economics, such as the VSL, net income and CS, that can be referred to the monetary value of social benefits and are used in a cost–benefit analysis to appraise rural road investments. These economic measures have yet to be assigned into the social benefits rising from rural road projects. For example, it wonders if the CS can be a monetary value that could refer the impact of road improvement on society, regarding health, employment, and education. Thus, these measures should be identified and the data that the measures require to be obtained.

This chapter presents the research methodology that was developed to address these shortcomings of the research into quantifying rural road benefits. The chapter consists of three discrete parts:

(1) Research methodology (Section 3.2) describes the methodology used to conduct the research.

(2) Model development (Section 3.3) explains the theories and factors considered to develop a model for monetisation.

(3) Model demonstration (Section 3.4) describes how a case study (presented fully in Chapters 4 and 5) was used to demonstrate how the model can be used.

3.2 Research methodology

An overview of the research methodology is shown in Figure 3-1. Figure 3-1 also maps the adopted methodology with the research objectives identified in Section 1.2.

3.2.1 Literature review

A comprehensive literature review was carried out to understand (1) the need to consider social benefits in road investment appraisals, (2) the major elements that can be considered to contribute to social benefits and select the appropriate ones for the rural road context and (3) the economic valuation approaches for monetising the benefits. These are further discussed in the following:

3.2.1.1 Identifying the social benefits of rural roads

Relevant literature on the assessment of social benefits associated with the provision of rural roads in remote societies in developing countries was reviewed in Section 2.3. This was carried out to understand the different types of social benefits that can occur from the provision of rural roads.

3.2.1.2 Identifying social benefits in road appraisals

Relevant literature was reviewed in Section 2.4 to identify the importance of the social benefits of rural roads and to understand the factors contributing to the magnitude of social benefits achieved by any type of intervention. The review found that the social benefits provided by a rural road are a significant part of the overall benefit provided by the road but are often difficult to determine and that these benefits are a function of the road surfacing type (e.g. gravel road vs sealed road) and road condition. Because of the difficulty in quantifying such benefits, many are often overlooked in the cost–benefit analysis of a rural road investment appraisal, thus potentially skewing the conclusions of such analyses.

3.2.1.3 Identifying the most appropriate economic valuation approach

Relevant literature on economic valuation techniques suitable for the social benefit analysis was reviewed in Section 2.5. Several measures of social benefits that may be appropriate for use in a cost–benefit analysis for a rural road investment appraisal were identified; they included CS, VSL and net income. The information required by these techniques can be obtained using a variety of approaches. Two approaches that seemed to be particularly promising for this research were the stated and revealed preference techniques, which required the use of interview techniques.

3.2.1.4 Model development

Based on the findings from the literature in Section 2.6, a theoretical framework for rural road investment appraisal that included social benefits was proposed. It is summarised in

Figure 3-3. This framework can be used to select the most appropriate indicators, measurements and techniques for the appraisal. The selected techniques are modelled to monetise the selected social benefits. These techniques identified and trialled the application described in this thesis (i.e. rural roads in a developing country). They are shown in Figure 3-3 and described in Sections 3.3.1 to 3.3.3.

3.2.1.5 Model demonstration

To demonstrate the developed theoretical framework, data associated with two roads in rural Thailand were collected. The monetary benefits obtained from the monetisation were used in a CBA to assess various investment alternatives. Feedback from the relevant road agencies in Thailand, i.e. the local road authority that managed the road projects and the road agency for the central government that conducted budget allocation planning for the road projects, on the usefulness of the approach and the validity of the answers provided was obtained (Chapters 4 and 5).

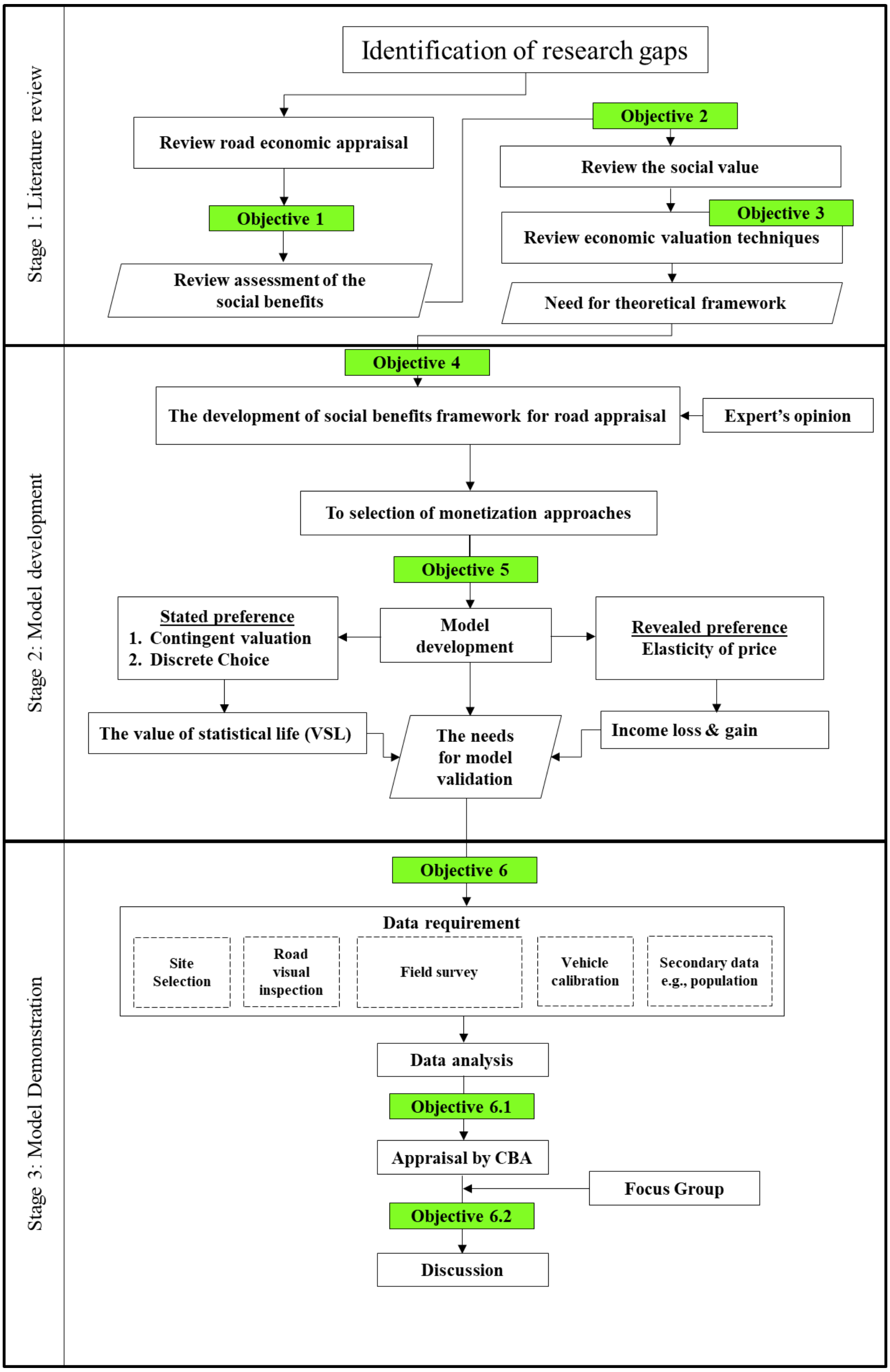

Figure 3-1. Research methodology.

3.2.2 Expert's opinion and focus group

As suggested by several studies (Street et al., 2005; Mandy et al., 2012; Abiiro et al., 2014; Karyani et al., 2018), developing a model with economic valuation techniques should be derived from at least one of the following robust methods:

1. literature review
2. expert's opinion
3. focus group

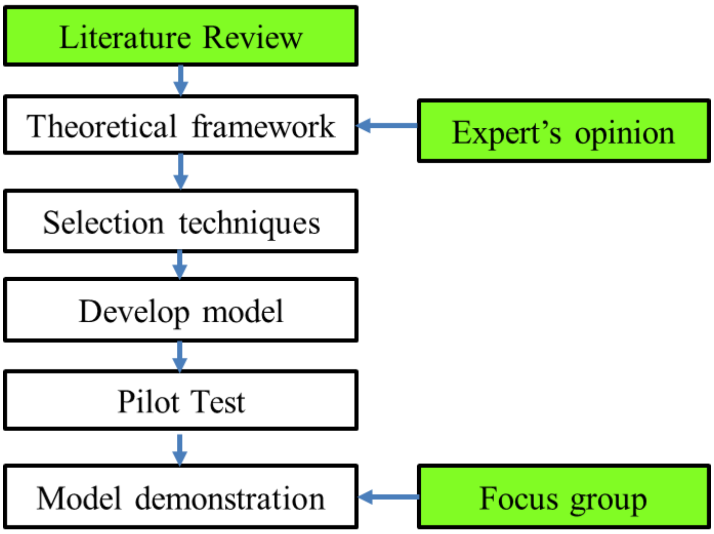

Figure 3-2. The procedure for model development.

Figure 3-2 illustrates the procedures used to develop the model. An expert's opinion was obtained from an economist, Professor David Maddison of the Department of Economics at the University of Birmingham, who helped identify the social benefits framework for road appraisals, select social indicators, assign economic measures, and develop a model for each economic valuation technique. Finally, feedback from the Department of Rural Roads (DRR), Thailand and relevant local rural road authorities was used to refine and verify the model and to identify whether the proposed approach was suitable and rational and could be helpful for them in selecting rural areas that might benefit from a road project, the appropriate type of intervention and to help prioritise identified projects.

3.2.3 The theoretical social benefits framework for road economic appraisal

This section 3.2.3 describes the developed theoretical framework that can be used to determine the appropriate economic measures and associated valuation techniques that should be used in rural road investment appraisal (Figure 3-3). Note that the developed framework considered the benefits of rural road projects in remote areas, where a rural road agency is primarily concerned with identifying and prioritising road projects that will contribute to the villagers' better quality of life. The social cost related to the road projects, i.e. disease transmission (HIV), was not included in the framework. However, this aspect will be discussed in Chapter 6.

The developed framework consists of four stages:

1. Stage 1: identifying the social impact accrued from the investment, including the category of social benefit and indicators that are associated with the impact of road access on remote society.
2. Stage 2: identifying the categories of economic measures appropriate for each social indicator and that can be referred to in monetary terms.
3. Stage 3: identifying economic valuation techniques to quantify the social benefit indicators in monetary terms (economic measures) according to the economic measure identified in stage 2 of the framework.
4. Stage 4: carrying out economic appraisal, that includes quantifying the social benefits accruing from the investment as identified in stage 1, economic benefits of savings and agency costs that should be included in an economic appraisal of a rural road investment

Figure 3-3 illustrates the developed social benefits framework. In the social impact stage, the relevant social indicators are selected. These indicators could be in monetary and non-monetary terms. However, even those which are already in monetary terms may not be used directly within a rural road appraisal. The second stage assigns an appropriate economic measure to each social indicator. The third stage considers appropriate economic valuation techniques that can quantify these economic measures, for each identified social indicator. The fourth stage consists of an economic appraisal that identifies the relevant benefits and costs to be appraised.

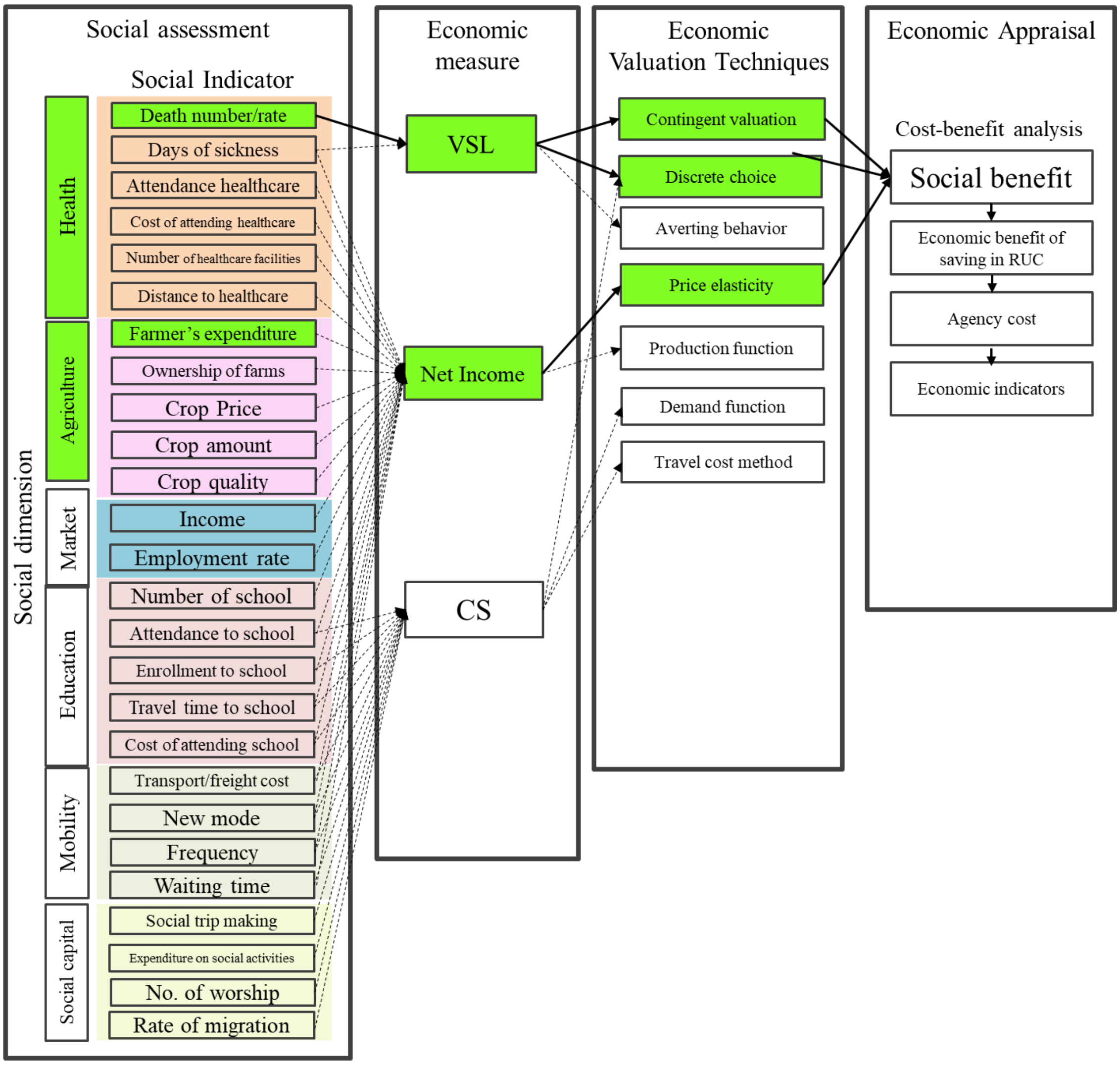

Figure 3-3 The social benefit framework

3.2.3.1 Social assessment

The first stage of the framework classifies the type of impact expected from the investment. The stage helps road authorities to identify and select the appropriate benefits to include in a rural road investment appraisal. It consists of the general category or indicator of the possible benefits (e.g. access to healthcare) and the metrics that were suggested in the literature as being valid measures of the indicator (e.g. the number of deaths is considered a reasonable indicator of healthcare). Note that a rural road project is unlikely to affect all possible social dimensions. For instance, a road that serves industry and logistics may not affect the educational aspect but could affect labour supply and productivity. The selection should therefore be based on the local context. For the case study of the remote area in Thailand:

1. The social dimensions were selected by considering the main impact of road conditions on remote society. This was obtained by asking local authorities (healthcare staff and village heads) who knew the situations of the villagers in the study areas well. The main concern was death, as they were not able to access healthcare facilities or mobile emergency treatment in time.
2. The social indicators were selected by the association of social dimensions with the means of frequency, as shown in Table 2-2. The death number metric was the most relevant to the health aspect, and farmer's revenue was selected, as it had the highest count.

3.2.3.2 Economic measures

This component of the framework was associated with choosing suitable economic measures for each social dimension and indicator that were previously identified by the literature as being potentially suitable for each social indicator. Figure 2-7 shows that the economic measures most appropriate for rural road appraisals are the VSL, CS and net income. These economic measures are assigned to social indicators by considering the attributes of an economic measure in relation to a social indicator. For example, the VSL required the number of deaths per population to match the estimate with the social indicator of the number of deaths. For agriculture-related transport, the net income was selected as an economic measure of the social benefit of farmer's revenue since the revenue was deducted from transport costs.

3.2.3.3 Economic valuation techniques

This part of the framework is used to select economic analysis techniques that are suitable for obtaining the monetary values of the social indicators identified in stage 1 of the framework (Section 3.2.1.1) in accordance with the economic measures identified in stage 2 of the framework (Section 3.2.1.2). The literature describes many economic analysis techniques (Section 2.4), but not all of these are suitable for all the measures. For example, the production function method is not suitable for obtaining monetised values of the VSL, but it is suitable for estimating income. Therefore, when selecting the techniques, it was necessary to consider whether they could logically be used to obtain a monetary value of a social benefit indicator in accordance with the identified economic measure.

The following criteria were considered when choosing the economic measures and valuation techniques for the case study:

1. The theoretical use of each economic valuation technique to quantify the economic measures (monetary value). For example, the travel cost method can be used for quantifying the CS but not for quantifying the VSL (Figure 2-8).

2. Techniques identified that have been used in other disciplines to value the social dimensions (Figure 2-9).
3. For this research specifically, the available data, including the payment method to capture the economic market. In this criterion, if the real payment could not be observed, the stated preference technique was immediately chosen to state the WTP instead of revealed preference (observed actual payment).

3.2.3.4 Economic appraisal

This part of the framework described the identification of the components of benefits and costs that should be used in the CBA. The details are given in Chapter 5.

3.2.4 Pilot test

A pilot test was conducted twice in June 2020 during the Covid-19 crisis. The first test helped select social benefits to be monetised. The village leaders were interviewed about the social impacts of the existing road projects. As a result, the leaders suggested that poor road conditions hindered necessary events such as emergency travel to the hospital and transportation accessibility between farms and markets. According to the first pilot test, the framework developed in Figure 3–3 was used to identify social dimensions and indicators. Figure 3–3 shows the first module (social assessment), the relevant indicators of numbers of deaths (health benefit) and the farm-gate access vehicle (agriculture benefit), respectively. In the second module (economic measure), the relevant measures were the VSL and income. In the third module (economic valuation technique), contingent valuation and discrete choice experiments were selected to monetise the VSL using linear and logistic regression models; the elasticity of price, which was a mathematics model, was selected to examine the net income.

The second pilot test conducted the preliminary survey to develop the associated questionnaire and the monetised models for the VSL and income. Further details of the models developed for contingent valuation, discrete choice and price elasticity are provided in Sections 3.3.1 to 3.3.3 below and include how they were specifically used for the case studies in rural Thailand as described in Chapter 4.

3.3 Model development

The following section demonstrates the development of the model for each economic valuation technique selected:

1. contingent valuation (Section 3.3.1)
2. discrete choice experiment (Section 3.3.2)
3. the elasticity of price (Section 3.3.3)

3.3.1 Contingent valuation

The contingent valuation used an open-ended questionnaire to allow the participants to state directly their WTP for council tax to improve road projects. The VSL for the community was then calculated from the WTP divided by the probability of death risk reduction (ΔP), as suggested by Hensher et al. (2011) and shown in Eq. 3-1.

$$\mathrm{VSL} = \frac{\mathrm{WTP}}{\Delta\mathrm{P}} \qquad \text{Eq. 3-1}$$

In Eq. 3-1, the WTP can be elicited directly and associated with a certain amount of risk reduction (ΔP), which is 1/10,000. This number is derived from the average number of deaths per annual flow of emergency medical trips throughout Thailand, as provided by the National Institute for Emergency Medicine (NIEM). In 2019, there were 10,927 deaths per 1,680,789 trips with an average distance of 21 km. Thus, the baseline probability can be calculated as 0.0003 [10,927 ÷ (1,680,789 × 21)]. In other words, there were three deaths per 10,000 vehicle kilometres travelled (VKT). Accordingly, 1 per 10,000 VKT was used as the probability of death risk reduction (ΔP).

Council tax was considered as the hypothetical economic market to refer to the WTP. Table 2-11 shows that certain studies also considered tax payments as the WTP for infrastructure projects associated with the VSL (Vanwechel and Vachal, 2006; Niroomand and Jenkins, 2016; Londero Brandli et al., 2014; Hensher et al., 2011). This was the same as the expert's opinion that recommended tax payment (economic metric) for road infrastructure. Moreover, in this pilot test, remote villagers in Thailand could understand tax payment, as they paid tax for other utilities, e.g. land tax.

However, it should be noted that the WTP is obtained in term of Thai Baht (THB) per year per project (5 km) for an individual, while the probability is in term of death per 10,000 VKT. To estimate the VSL, the WTP should be converted to the term as THB/VKT. To convert, the number of trips an individual travel to hospital for a year is utilised. The community VSL can be given by the individual VSL multiplied by population.

For the detail and model demonstration, see the case study in Section 4.3.1.

3.3.2 Discrete choice model

The data for the discrete choice model were obtained through a discrete choice experiment in which individuals were asked to choose their preferred road improvement in hypothetical alternative scenarios, goods and services. The preferred choice referred to the random utility model. The generic term for the utility model is shown in Eq. 3-2. According to Mandy et al. (2012), utility of coefficient variables can be observed by a conditional logit model, as shown in Eq. 3-3.

$$U_{ij} = V_{ij} + \varepsilon_{ij} \qquad \text{Eq. 3-2}$$

U_{ij} is the utility for an individual i choosing alternative j.

V_{ij} is the deterministic function of an attribute (Eq. 3-3).

ε_{ij} is the function of unobserved job attributes and individual-level variations in tastes.

$$V_{ij} = \alpha_1 + \beta_1 X_{1j} + \beta_2 X_{2j} + \cdots + \beta_c X_{cj} + \varepsilon_{ij} \qquad \text{Eq. 3-3}$$

β and X are coefficients, and the values X_1, X_2,…,X_c are attributes and values for alternative j. A conditional logit model was used to observe the probability of individual i choosing alternative j (Mandy et al., 2012), as shown in Eq. 3-4.

$$\text{Prob[choice j]} = \text{Prob}\left(\text{U}_\text{j} > \text{U}_\text{m}\right) \forall_{\text{m} \neq \text{j}} \qquad \text{Eq. 3-4}$$

$$\text{Prob[choice j]} = \text{Prob}\left(\varepsilon_{\text{ij}} - \varepsilon_{\text{im}} > \text{V}_{\text{ij}} - \text{V}_{\text{im}}\right) \forall_{\text{m} \neq \text{j}} \qquad \text{Eq. 3-5}$$

$$P_i(j) = \frac{\exp\left(V_{ij}\right)}{\sum_{m\,=\,0}^{J} \exp(V_{im})}; j = 0, \ldots, m, J \qquad \text{Eq. 3-6}$$

To estimate Eq.3-3, it is assumed that the term ε is a normal distribution. P_{ij} is the probability of individual i choosing alternative j, which can be calculated with Eq. 3-6.

The log likelihood function is used to examine the coefficient (βs) in Eq.3-7.

$$\log L(\beta) = \sum_{j\,=\,1}^{J} \sum_{m\,=\,1}^{m} Y_{ij} \log \frac{\exp\,(V_{ij})}{\sum_{m\,=\,1}^{J} \exp\,(V_{mj})} \qquad \text{Eq. 3-7}$$

The coefficients (βs) generated from the logit model of Eq.3-6 can be used for two main purposes:

1. to determine whether the attributes are important (statistically significant, as shown by the significance level of β) and to indicate the direction of importance

(shown by the sign of the estimated β) and relative importance (size of the estimated parameter) and

2. to check the theoretical/internal validity of the DCE model provided by the direction of the coefficient signs; that is, whether the coefficients move as the economic theory or a priori expectation predicts. For example, the economic theory predicts that the salary attribute will have a positive sign, i.e. the higher salary, the more desirable the post.

To measure the goodness of fit for the conditional logit models, McFadden R^2, a likelihood ratio index, was used. LogL(0) is the log-likelihood function that determines β equal to 0, as shown in Eq. 3-8.

$$McFadden\ R^2 = 1 - \frac{LogL(\beta)}{LogL(0)} \qquad \text{Eq. 3-8}$$

From Eq. 3-2, this research developed a utility model to identify an individual i choosing alternatives 1, 2 and 3 to avoid the health impact, as seen in Eq.3-9. The coefficient β (attributes) and value X were described in Section 3.3.2.1.

$$\begin{aligned} \mathrm{U(alternative\ 1,2,3)} &= \beta_{Death}\mathrm{X}_{Death} \\ &+ \beta_{\mathrm{Time}}\mathrm{X}_{\mathrm{Time}} + \beta_{\mathrm{Death*Type}}\mathrm{X}_{\mathrm{Death*Type}} \\ &+ \beta_{\mathrm{Tax}}\mathrm{X}_{\mathrm{Tax}} \end{aligned} \qquad \text{Eq. 3-9}$$

U	Utility
β	Coefficient of variable X
X	Independent variable
B_{Death}, X_{Death}	Coefficient of death risk and variable

β_{Time}, X_{Time}	Coefficient of travel time and variable
β_{Type}, X_{Type}	Coefficient of road type and variable (dummy variable), e.g. asphaltic concrete road and cape seal road
$B_{Death*Type}$, $X_{Death*Type}$	Coefficient of interaction between death risk and road type
β_{Tax}, X_{Tax}	Coefficient of council tax and variable

As seen in Eq. 3-1, since the VSL is the marginal substitution between the WTP for the tax and death reduction, by using an econometric model, the WTP to avoid death risk for each road intervention can be considered as the ratio between the coefficient of death risk and the coefficient of tax, Eq. 3-10. Note that the WTP obtained from Eq. 3-10 is in term of THB per year per project (5 km) for an individual and should be converted to the term of THB per VKT to estimate the VSL. Therefore, the individual VSL is given by Eq. 3-11. The community VSL can be given by the individual VSL multiplied by population.

$$\mathrm{MU}_{\mathrm{Type}} = \text{average } \mathrm{WTP}_{\mathrm{Type}} = -\frac{\beta_{\mathrm{Death*Type}} - \beta_{\mathrm{Death}}}{\beta_{\mathrm{Tax}}} \qquad \text{Eq. 3-10}$$

$$\text{Individual } \mathrm{VSL}_{\mathrm{Type}} = -\frac{\beta_{\mathrm{Death*Type}} - \beta_{\mathrm{Death}}}{\beta_{\mathrm{Tax}}} \times 10{,}000 \text{ VKT} \qquad \text{Eq. 3-11}$$

With regard to the discrete choice experiment, these parameters for the utility model followed these three steps (Mandy et al. (2012):

1. determining the attributes and levels
2. orthogonal design (statistical experiment)
3. developing the discrete choice

The first step was used to determine the relevant parameters (attributes) and values (levels) provided by the literature review and the expert’s opinion. The second and third steps were used to develop the DCE questionnaire.

3.3.2.1 Determine the attributes and levels

The *attributes and levels* were determined by either the literature review (section 2.5.2) or the expert's opinion (Mandy et al., 2012). To estimate the VSL, the utility model had to consist of attributes for deaths and at least one monetary attribute (Section 2.5.2). The summary of attributes and levels is in Table 3-1. See the case study in Section 4.3.2 for further details of how the model was applied.

Table 3-1 Attributes and levels for road maintenance types.

	Level / Attributes	**0**	**1**	**2**	**3**
1	**Death risk (Death number/10,000)**	0	1	2	3
2	**Travel time (minute)**	30	60	90	120
3.1	**Types of road maintenance (R1S1, R2S1)**	Very poor road (i.e. unmaintained)	Poor condition	Fair condition	Good condition
3.2	**Types of road upgrades (R1S2, R2S2)**	Earth road	Gravel road	Cape seal	Asphaltic
4	**Tax payment (THB)**	0 (did not pay)	50	100	200

Following the approach described in Section 2.5.2, four attributes were identified for this research. An attribute should be influential in real decision-making and uncorrelated with other relevant attributes. These attributes were:

1. Death risk

To estimate the VSL by means of the DCE, the death risk must be assigned as the required attribute (Section 2.4.2). To estimate the level of the death risk (ΔP), it was referred to the baseline value of three deaths per 10,000 VKT, as calculated in Section 3.2.3. Accordingly, the researcher determined the levels of deaths gradually as 0, 1, 2 and 3 per 10,000 VKT.

2. Travel time

The attribute of travel time can be used to estimate the value of time. The levels for the travel time attribute were determined as the time spent driving from Sak Nga Village (road project 1 in Section 2) on very poor road conditions to the district hospital that was about 120 minutes away at a 10-km distance. The travel time from Rom Klao Village was 30 minutes (road project 1 in Section 1), which was the shortest time among the four villages to the district hospital.

3. Types of road improvements

The attribute for types of road improvement was assigned to examine the value of a health-related road project, as shown in Eq. 3-4. Note that each road project had two sections; the first section was a paved road, and the second section was an earth road. Thus, the types of road conditions (very poor, poor, fair and good road) were for the first section. The types of road surfacing standards (earth, gravel, cape seal and asphaltic road) were for the second section.

Four levels of road conditions and surfacing were used by the road agency for evaluating and planning. Table 3-2 illustrates the differences among each type by considering price, comfort, travel time and health impact. These factors affected the respondents' stated WTP. Moreover, it also considers ambulance travel of time and speed reaching to these villages.

Table 3-2. The attributes for types of road conditions.

Road conditions	**Road surfacing types**	**Price**	**Riding comfort**	**Travel time/ speed**	**Health Impact**
Good road 	Asphaltic road 	The highest standard and cost of construction and maintenance	The most rising comfort, very smooth ride	Driver can drive at high speed and less travel time	No death from not being able to healthcar e access
Fair road 	Cape seal road 	Moderate standard and cost of construction and maintenance	Moderately comfort	Limit speed and vehicle loading	1 death
Poor road 	Gravel road 	Relatively low cost of construction and maintenance	Uncomfortabl e	With obstacle, travel to low speed	2 deaths
Fair road 	Earth road 	The lowest cost of construction and maintenance	Very uncomfortable ride all year	Lowest speed and the highest travel time	3 deaths (highest impact)

4. Tax payment

The council tax was used as the monetary attribute. It was the hypothetical economic value constructed to refer to the economic value of the road projects. The level of the tax was determined by a pilot test of contingent valuation, which found that the villagers' state WTP for council tax ranged from 0 up to 200 THB per year per project for 20 years. A discrete choice model used this range to develop the level of the tax so that contingent valuation and discrete choice experiment could compare the VSL fairly. The types of payments were selected using the literature review and the expert's opinion.

3.3.2.2 Orthogonal design

An orthogonal design is a statistical design of an experiment that studies multiple independent variables in which each level of a variable can be combined with each level of every other variable, and the entire set of experiment results can be affected by an equal or proportional number of observations (Mandy et al., 2012). The orthogonal design process aims to reduce the number of possible combinations of independent variables and levels, thus greatly simplifying the data collection and analysis processes. As there were four attributes and four levels, the result was 4 x 4 x 4 x 4 = 256 possible combinations. For the purposes of the research, the SPSS software package was used to generate the orthogonal design for the DCE. Further information about SPSS and how it can be used to generate an orthogonal design for a DCE can be found in Street et al. (2005).

Table 3-3 and 3.4 illustrate the results generated by the SPSS software for the four types of road maintenance and upgrade alternatives. The tables show that there were 16 combinations of associated independent variables and their levels, and they were the first choices in the DCE questionnaire.

Table 3-3 Orthogonal Design for the DCE (road maintenance)

Card ID	Death risk (No./10,000)	Travel time (Minute)	Types of road alternatives	Tax (payment)
1	3	120	Very poor	0
2	3	60	Poor	100
3	3	30	Fair	200
4	3	90	Good	50
5	2	30	Good	0
6	1	60	Fair	0
7	0	90	Poor	0
8	0	30	Very poor	100
9	0	120	Fair	50

Card ID	Death risk (No./10,000)	Travel time (Minute)	Types of road alternatives	Tax (payment)
10	2	60	Very poor	50
11	0	60	good	200
12	1	120	good	100
13	2	120	poor	200
14	1	30	poor	50
15	2	90	Fair	100
16	1	90	Very poor	200

Table 3-4. Orthogonal design for the DCE (road upgrade).

Card ID	Death risk (No./10,000)	Travel time (Minute)	Types of road alternatives	Tax (Payment)
1	3	30	Earth road	0
2	2	90	Earth road	100
3	0	120	Earth road	200
4	1	60	Earth road	50
5	1	120	Cape seal	0
6	0	90	Gravel road	0
7	2	60	Asphaltic	0
8	3	120	Asphaltic	100
9	0	30	Asphaltic	50
10	3	90	Cape seal	50
11	1	90	Asphaltic	200
12	1	30	Gravel road	100
13	2	30	Cape seal	200
14	2	120	Gravel road	50
15	0	60	Cape seal	100
16	3	60	Gravel road	200

3.3.2.3 Develop DCE choice

Note that the DCE model was based on the logit regression model to measure the utility of choice (0 or 1). To generate the first and second-choice options, the card list in Table 3-3 and 3-4 had to have a dummy value (0, 1, 2 or 3). The second-choice option was obtained by adding the generator, which was equal to 1, to each row of the first-choice option. Next, to generate the second-choice option, the concept of role modulo, which was a way to determine the remainder of a division operation and instead of returning the result of the division, the modulo operation returned the whole number remainder, was used: any addition greater than the level value (0 to 3) began at the zero level to convert the new level's value (Street et al., 2005). Table 3-5 and 3-6 illustrate the first and the second-choice options. Moreover, the DCE model can have an opt-out option, implying the current stage of the situation wherein there is no council tax to pay. Finally, the respondents were given 16 sets of choices, and each set had three options.

Table 3-5. First-choice and second-choice options (road maintenance).

	First-choice option				Second-choice option			
Card	Death	Time	Types	Tax	Death	Time	Types	Tax
1	3	0	0	0	0	1	1	1
2	3	2	2	2	0	3	3	3
3	3	3	3	3	0	0	0	0
4	3	1	1	1	0	2	2	2
5	2	3	1	0	3	0	2	1
6	1	2	3	0	2	3	0	1
7	0	1	2	0	1	2	3	1
8	0	3	0	2	1	0	1	3
9	0	0	3	1	1	1	0	2
10	2	2	0	1	3	3	1	2
11	0	2	1	3	1	3	2	0
12	1	0	1	2	2	1	2	3
13	2	0	2	3	3	1	3	0
14	1	3	2	1	2	0	3	2
15	2	1	3	2	3	2	0	3
16	1	1	0	3	2	2	1	0

Table 3-6 First-choice and second-choice options (road upgrade)

	First-choice option				**Second-choice option**			
Card	Death	Time	Types	Tax	Death	Time	Types	Tax
1	3	3	0	0	0	0	1	1
2	2	1	0	2	3	2	1	3
3	0	0	0	3	1	1	1	0
4	1	2	0	1	2	3	1	2
5	1	0	2	0	2	1	3	1
6	0	1	1	0	1	2	2	1
7	2	2	3	0	3	3	0	1
8	3	0	3	2	0	1	0	3
9	0	3	3	1	1	0	0	2
10	3	1	2	1	0	2	3	2
11	1	1	3	3	2	2	0	0
12	1	3	1	2	2	0	2	3
13	2	3	2	3	3	0	3	0
14	2	0	1	1	3	1	2	2
15	0	2	2	2	1	3	3	3
16	3	2	1	3	0	3	2	0

Choice sets were formed by pairing the first and second options. The number of choice sets was equal to the number of rows in the orthogonal design, which was 16 choice sets.

An opt-out option was added to the questionnaire for respondents who preferred not to select any choice. This option was designed to represent the current situation or status quo. When a respondent selected this choice, it implied that they preferred the current situation to the other options provided. An example of the questionnaire is shown in Section 3.4.3.1.

The uses of the results obtained from the DCE of the case study of rural Thailand are provided in Section 4.3.2.

3.3.3 The model for the elasticity of price

The elasticity is a measure of a variable's sensitivity to change in another variable. Elasticity refers the degree to which consumers or producers change their demand in response to price or income changes. This technique can be expressed as the proportionate change in net incomes divided by a proportionate change in transport charges (Workman et al., 2018) , as seen in Eq. 3-12.

$$\varepsilon = \frac{\Delta\text{Income\%}}{\Delta\text{Freight cost\%}} \times \frac{\text{Freight cost}_{\text{Based case}}}{\text{Income}_{\text{Based case}}} \qquad \text{Eq. 3-12}$$

Elasticities can be divided into three broad categories: elastic($\varepsilon > 1$), inelastic ($\varepsilon < 1$) and unitary ($\varepsilon = 1$) (Greenlaw and Shapiro, 2018). Elasticity indicates that the net income had high responsiveness to changes in freight cost. Inelasticity indicates that the net income was less responsive to changes in freight cost. Unitary elasticity indicates proportional responsiveness of either the net income or freight cost (Workman et al., 2018). For the data on the elasticity of price, see Section 3.3.4.2.

Note that this research examines the elasticity for each road treatment (i.e. cape seal and asphaltic road. Table 3-7 shows the scenario used to estimate the elasticity. The different between the revenue for each alternative and the based case can be the additional income that will be used in the appraisal.

Table 3-7 Scenarios for the elasticity of price method

Alternatives	R1S1 and R2S1	R1S2 and R2S2
Based case (IRI = 9)	Very poor road	Earth road
Alternative 1 (IRI = 7)	Poor road	Gravel road
Alternative 2 (IRI = 5)	Fair road	Cape seal road
Alternative 3 (IRI = 3)	Good road	Asphaltic road

The case study of rural Thailand are provided in Section 4.3.3.

3.4 Model demonstration

The demonstration process showed how the developed models could be used to monetise the social benefit of rural roads and how the results of this process could be used for road investment appraisals. The use and applicability of the developed models were demonstrated by using data collected from two rural areas in Thailand. This involved

1. the use of the selected stated preference approaches, i.e. contingent valuation and discrete choice experiment, to quantify and compare the VSL accruing from potential rural road projects in the two rural areas
2. the use of the revealed preference approach, namely price elasticity, to quantify the net income from possible rural road projects in the two study areas
3. demonstrating the appraisals with and without the inclusion of social benefits in economic evaluations using CBA
4. a discussion of the results produced by the models to be better informed about their applicability

The following subsections identify the means of collecting relevant data for this research.

3.4.1 Site selection

The researcher identified possible areas of study through television news that reported the impacts of rural road access on remote societies. Then, the researcher surveyed the areas. During the survey, the researcher interviewed village heads (local authorities) about the impacts. The researcher took the obtained information and consulted with the relevant road authority to select road projects in the focus group. In order to adequately demonstrate and assess the models chosen, it was necessary to select at least two study areas for comparison.

Two villages in remote regions were chosen: Sak Nga Village in Petchabun Province (road project 1) and Rom Klao Village in Phitsanulok Province (road project 2).

Access to Sak Nga and Rom Klao from the main road network both were via a paved road 5 km long and thereafter a single earth road in very poor condition (see Figures 3-3 and 3-4).

Figure 3-4. Condition of the road serving Sak Nga Village (source: Chiangmainews, 2019).

Figure 3-5. Road serving Rom Klao Village (source: Nationtv, 2018).

This study selected two roads serving villages in the provinces of Phetchabun and Phitsanulok in northern Thailand to quantify the social benefits of rural road projects (Figure 3-6).

Figure 3-6. Phetchabun and Phitsanulok provinces.

Figure 3-7 illustrates the Sila and Chompu subdistricts. The Sila subdistrict is in Phetchabun; Chompu is in Phitsanulok. Road project 1 (R1) is in the Sila subdistrict, and it serves the villagers of Hin Ngon and Sak Nga. Its distance from the subdistrict is about 10 km. There is a high school in the district of Lom Klao, which is about 60 km from Sak Nga Village. The business area is in the province of Phetchabun, which is over 150 km away from Sak Nga Village.

Road project 2 (R2) is in the Chompu subdistrict, and it serves Pao Thai and Rom Klao. Its distance from the subdistrict is about 10 km. There is a high school in the Noen Mapranga district, which is about 40 km away from Rom Klao. The business area is in the province of Phitsanulok, which is over 100 km away from Rom Klao.

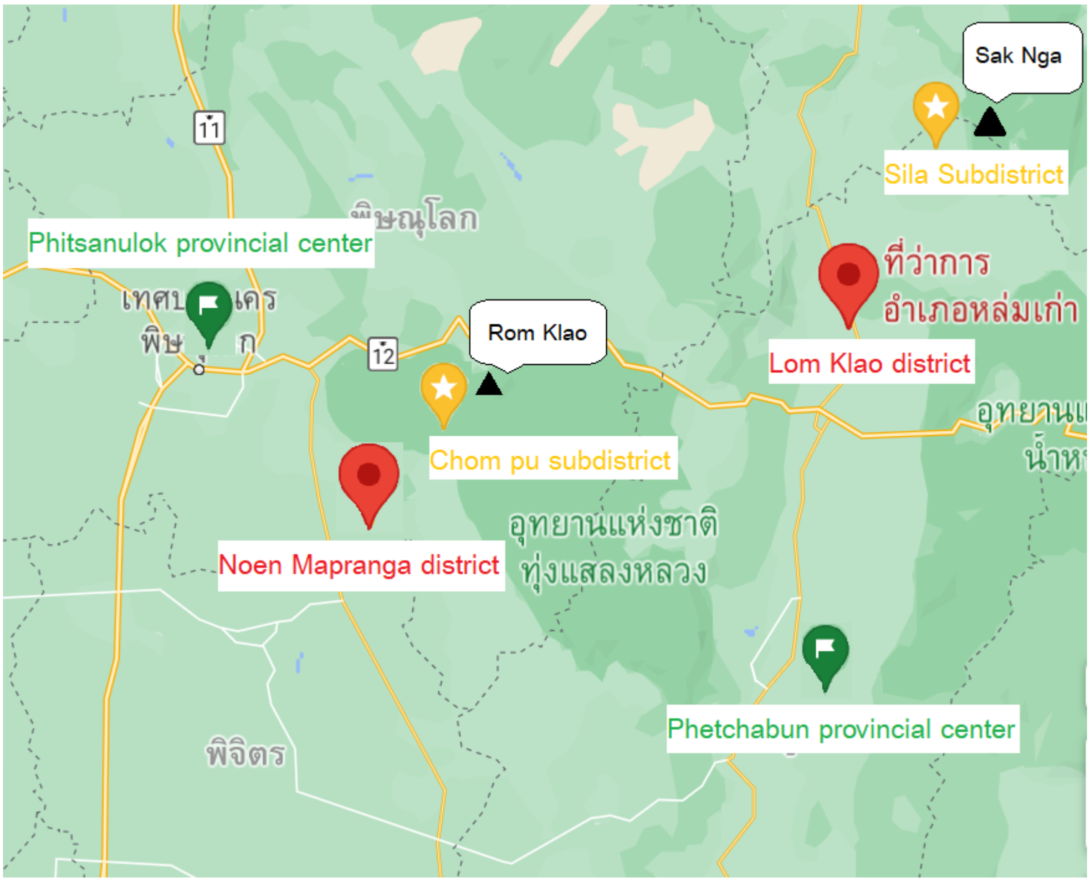

Figure 3-7. Sila and Chompu subdistricts.

3.4.2 Participants

The people living along the two road projects (their homes were in the villages) were asked to participate in the research. The number of samples was divided between the stated and the revealed preference techniques.

Regarding the stated preference technique, Mandy et al. (2012) in ‘How to Conduct a Discrete Choice Experiment for Health Workforce Recruitment and Retention in Remote and Rural Areas’ recommended a minimum number of at least 30 respondents in a sample for a questionnaire. Therefore, this research recruited 30 respondents from each village, for a total of 120 respondents. The respondents had to be over 18 years old.

For revealed preference to measure the impact on agriculture-related transport, Talpur et al. (2015) assessed the impact of transport accessibility in rural Pakistan and considered 10% of the population. In the areas of this study, the highest number of farmers was 98, so 10% of 98 was about 10 respondents from each village. Therefore, this research considered 20 participants from each village for a total of about 80 farmers.

3.4.3 Survey methods

Bolt et al. (2005) provided a helpful summary of survey methods for the stated and revealed preference techniques to collect the data required by the identified techniques. Based on Bolt et al.'s (2005) recommendations, for the stated preference techniques, CV and DCE, data were collected by survey questionnaires to elicit the WTP. For the revealed preference technique, which required collecting actual data (i.e. bill payments), an observation survey was conducted to elicit the actual WTP.

3.4.3.1 The survey for contingent valuation and discrete choice experiment

The questionnaire was separated into three parts. The first part was an introduction of the research in general, containing the research's benefit, while the second part and the main body of the questionnaire were designed to collect data for contingent valuation and the discrete choice experiment. The final part of the questionnaire was designed to collect the respondent's household demographics. The complete questionnaire is shown in Appendix A. This researcher conducted home interviews, which means that the researcher met the participants in their homes. Figure 3-8 illustrates the questionnaire procedures.

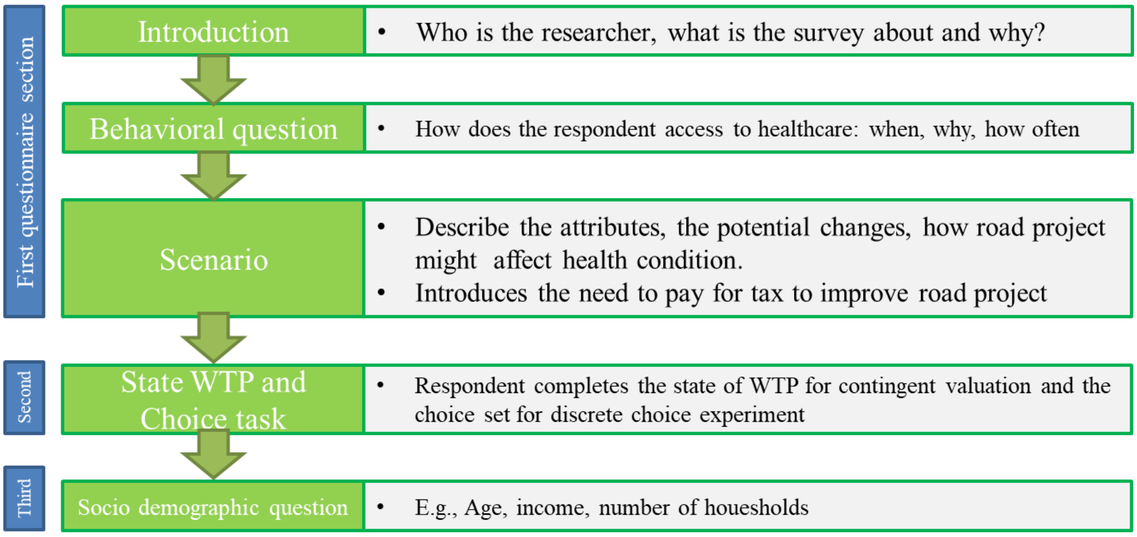

Figure 3-8. Survey procedure for the stated preference techniques.

For the first section of the questionnaire, the researcher introduced himself, explained the details of the study and invited the participants to participate. The interviewer informed the respondents that their names and surnames would not be released and that they were protected. In addition, they could stop at any time during the interview. After they agreed, the research asked them about the impact of rural road access on healthcare in general. The researcher described how road conditions affect the health conditions of villagers and convinced the participants to pay the council tax for road projects annually.

In the second section of the questionnaire, the questions for contingent valuation were open-ended. The CV scenarios were presented and explained to the respondents in terms of the impact of the rural road condition on the death risk (Tables 3-8 and 3-9). Death risk was defined as not being able to access a health centre in time to prevent death. The participants were asked how much annual council tax they would be willing to pay for each type of road improvement. The third section collected the respondents' demographics.

Table 3-8. An example of the CV questionnaire for the first section (paved road).

	Alternative (Road standard)	WTP to reduce 1 death (Thai Baht/ year)
Leaving Left very poor road		Did not pay
Left poor road		0
Keeping fair road		30
Keeping good road		100

Table 3-9. An example of the CV questionnaire for the second road section (unpaved road).

	Alternative (Road standard)	WTP to reduce 1 death (Thai Baht/ year)
No project Left Earth road		Did not pay
Improved ‘earth road’ to ‘Gravel road’		50
Improved ‘earth road’ to ‘cape seal road’		70

	Alternative (Road standard)	WTP to reduce 1 death (Thai Baht/ year)
Improved ‘earth road’ to ‘asphaltic road’		100

For the DCE questionnaire, the respondents were presented with three choices (first, second and opt out) for the 16 choice sets shown in Appendix A. The respondents were asked to imagine that they had a life-threatening illness and that if the road serving their village was not improved, then they were likely to die due to being unable to access the hospital in time. The participants were asked to choose one of the three alternatives shown in Tables 3-10 and 3-11.

Table 3-10. An example of the DCE questionnaire for the first section (paved road).

Attribute	The first choice	The second choice	Opt-out
N0. Death	1/10,000	0/10,000 No death	3/10,000
Travel time (min)	120	90	90
Alternative (Road maintenance regime)	Leaving very poor 	Keeping good road 	Leaving very poor 
Tax (Thai Baht)	0	50	0
Preferred choice	☐	☐	☐

Table 3-11. An example of the DCE questionnaire.

Attribute	The first choice	The second choice	Opt-out
N0. Death	3/10,000	0/10,000 No death	3/10,000
Travel time (min)	30	120	90
Alternative (Road upgrade)	Earth road 	Gravel road 	Earth road 
Tax (Thai Baht)	0	50	0
Preferred choice	☐	☐	☐

3.4.3.2 The survey for revealed preference techniques: the price elasticity

The survey was performed using the observation method, which divided the survey into agriculture data and road engineering data.

1) The observation of agriculture data

The study interviewed farmers who were cultivating crops alongside road projects and were transporting agricultural produce from their farms to a local collection point. A local collection point is a place where farmers gather to sell their crops. The farmers were observed with the following data:

1. the amount of crops to be transported
2. the distance from the farm to the collection point
3. the crop types transported
4. the crop amount per area (1 rai = 1,600 m^2)
5. the total cultivation area of each participant
6. the crop selling price
7. the average loading capacity

2) The observation of road engineering data

For the transport data that estimated the freight that affected the farmers' net incomes, the following were collected:

1. vehicle type
2. loading capacity of each vehicle
3. the condition of the road and other areas, e.g. steep or flat, via visual inspection
4. the distance of a round trip from the farm to the collection point

3.4.4 Road economic appraisal

CBA was used to conduct a road economic appraisal that included monetised social benefits. The main goal of the CBA was to explore the effect of including social benefits in a rural road economic appraisal and whether the size of the benefit compared with the cost of the benefit was sufficient to be considered a worthwhile benefit. The CBA aimed to

1. integrate social benefits into the appraisal
2. justify an appropriate road alternative and work programme
3. prioritise road projects

The net present value, internal rate of return and benefit–cost ratio decision rules (Section 2.2) were used to assess the appropriateness of various road investment alternatives, namely gravel, cape seal and asphaltic concrete.

3.4.4.1 Road agency cost

For the purposes of this research, the road agency costs included the construction cost and maintenance costs – routine, periodic and special maintenance costs. These costs were calculated for each type of road surfacing intervention: earth road, gravel road, cape seal road and asphaltic road. Table 5-12 (see Chapter 5) provides the values of the costs identified in the case studies. These costs were proposed by an agent from the DRR.

3.4.4.2 Economic benefit of savings in RUC

The road conditions were assessed using visual inspection to determine a measure of the condition known as road roughness, per the guidelines set by Sayers and Karamihas (1998). Road roughness was chosen to estimate vehicle operation costs and determine road interventions. The guidelines provide a diagram that shows how a visual inspection of the road surface can be used to quantify the international roughness index (IRI) (see Figure 3-9). For this research, roads that were in good, fair, poor and very poor conditions were considered, as seen in Table 3-12 and advised by an agent from the DRR.

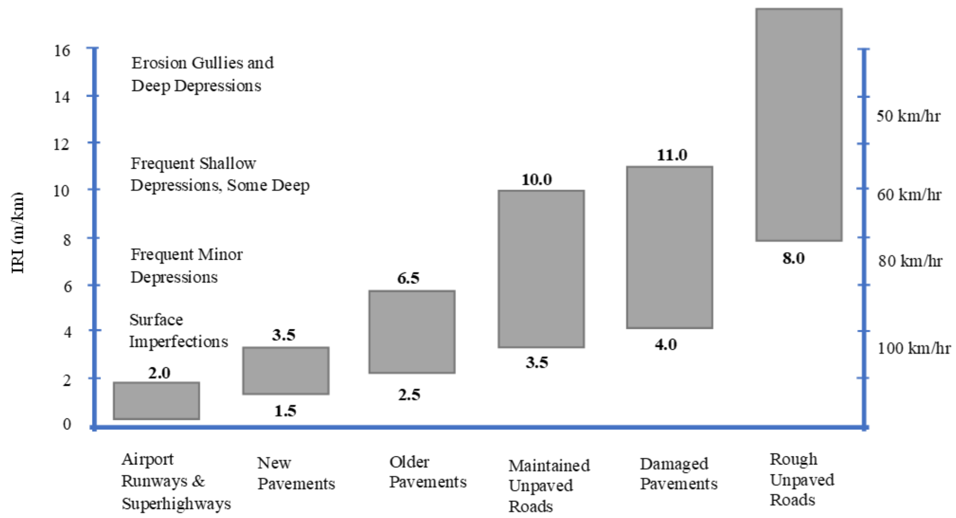

Figure 3-9. Interpretation chart (Sayers and Karamihas, 1998).

The IRI for each road condition was used to estimate the vehicle operation cost (VOC) using the road economic decision (RED) model developed by the World Bank, as shown in Table 3-12. Table 3-13 shows the estimates of VOC for each road condition. The data for the estimates, e.g. vehicle calibration, are shown in Appendix D.

3.4.4.3 Economic analysis

Present value (PV) is used as economic indicator, as shown in Eq. 3-13 (Julius, 2021).

$$PV = \sum_{t=1}^{n} \frac{B_t}{(1+i)^t} \qquad \text{Eq. 3-13}$$

Where:

B_t = Benefit during a single period t

i = Discount rate or return that could be earned in alternative investments

t = Number of time periods

Table 3-12. The conditions of the roads (source: the author).

Road Condition	Image	IRI (m/km)
Good		3
Fair		5

Road Condition	Image	IRI (m/km)
Poor		7
Very poor		9

This research estimates vehicle operation cost (VOC) associated with IRI and pavement types using the RED model, which is based on local condition of Thailand. The data for this estimate see Appendix D.

Table 3-13. Vehicle operation costs

		Good condition	Fair condition	Poor condition	Very poot condition
		VOC at IRI = 3 m/km (THB/veh-km)	VOC at IRI = 5.0 m/km (THB/veh-km)	VOC at IRI = 7.0 m/km (THB/veh-km)	VOC at IRI = 9.0 m/km (THB/veh-km)
Terrain: C Mountainous Road: X Paved	Motorcycle	1.71	1.74	1.77	1.80
	Car Small	6.06	6.24	6.57	6.93
	Car Medium	8.94	9.24	9.72	10.32
	Pickup	7.83	8.01	8.37	8.79
	Four-Wheel Drive	7.83	8.04	8.49	9.00
	Truck Light	12.75	13.17	13.80	14.49
	Truck Medium	22.14	22.62	23.43	24.33
	E-Tak	11.52	11.61	11.85	12.18
	E-Tan	4.98	5.01	5.16	5.37
Terrain: C Mountainous Road: Y Gravel	Motorcycle	1.77	1.80	1.86	1.92
	Car Small	6.12	6.36	6.75	7.20
	Car Medium	9.03	9.33	9.90	10.56
	Pickup	7.89	8.13	8.55	9.06
	Four-Wheel Drive	7.89	8.16	8.64	9.21
	Truck Light	12.93	13.41	14.16	15.00
	Truck Medium	22.47	23.10	24.15	25.29
	E-Tak	11.70	11.82	12.09	12.45
	E-Tan	5.16	5.22	5.43	5.73
Terrain: C Mountainous Road: Z Earth	Motorcycle	1.86	1.89	1.95	2.01
	Car Small	7.20	7.41	7.77	8.13
	Car Medium	11.04	11.37	11.88	12.45
	Pickup	9.51	9.78	10.17	10.56
	Four-Wheel Drive	9.99	10.26	10.71	11.19
	Truck Light	14.16	14.64	15.36	16.11
	Truck Medium	23.58	24.24	25.23	26.28
	E-Tak	13.17	13.32	13.50	13.68
	E-Tan	6.60	6.66	6.75	6.87

3.5 Summary

The methodology described in this chapter was grouped into three stages. The methodology began with a literature review in Chapter 2, which explored the need for the monetisation of social benefits in road investment appraisals. Measures of social benefits were identified and based on a review of approaches used in other sectors. Potential means of monetising these measures were also highlighted. Utilising the potential measures and techniques identified in the literature review, this chapter included an expert's opinion to describe the development of a theoretical social benefits framework for road appraisals (Section 3.2.2) and the development of a model to monetise social benefits (Section 3.3.1 to 3.3.3). To demonstrate the model, i.e. the third stage, data from remote areas in Thailand were collected. Focus groups were conducted to help select the areas of study and identify model development. This chapter described the selection of the areas and the methods by which the data were collected.

The following chapter monetises the social benefits of healthcare and farm access. It compares the VSL of the contingent valuation and the discrete choice experiment with the VSL of net income to demonstrate whether they are valid as inputs for road appraisals.

CHAPTER 4 MONETISATION

4.1 Introduction

The theoretical social benefits framework for road appraisal developed in Section 3.2.2 and shown in Figure 3-3 was used together with expert opinion, as described in 3.2.2.1 to 3.2.2.4, to select approaches to monetise social benefits for road appraisal. This process resulted in the selection of social indicators of the number of deaths and farmers' revenue to be monetised in terms of the value of statistical life (VSL) and net income, respectively. In each case, the VSL and the net income are to be monetised as a function of road surfacing type. As discussed in Chapter 3, VSL is quantified by the contingent valuation (CV) and discrete choice experiment (DCE) methods. The additional income can be calculated by the elasticity of price method, which is a relationship between income change and transport cost change. The way in which each of these three economic valuation techniques has been monetised is further described in this chapter.

The monetisation approaches are illustrated using two remote areas in Thailand. Section 4.2 narrates the selection of the case studies. Section 4.3 describes the monetisation of healthcare access benefits in terms of VSL. Specifically, Section 4.3.1 focuses on contingent valuation, while Section 4.3.2 focuses on the discrete choice experiment approach. Section 4.4 is on the monetisation of agricultural access benefits, i.e. the additional income of farmers. Section 4.5 compares and discusses the results of the analysis of the preceding two chapters, highlighting the advantages and disadvantages of each technique for use in the context of general rural roads and the particular case study sites.

4.2 Case study

Road project 1 (R1), which runs between the villages of Hin Ngon and Sak Nga (see Figure 4-1), is 10 km long. It is separated into two sections. The first section (R1S1) passes through Hin Ngon village, is 5 km long and has a paved surface that was in good condition when the research was carried out. The second section (R1S2) is also 5 km long, but it is an earth road and was in very poor condition. The first section of the road connects with a collector road managed by the Department of Rural Roads (DRR).

Figure 4-1. Road project 1 (Hin Ngon to Sak Nga)

Road project 2 (R2), shown in Figure 4-2, serves the villages of Pao Thai and Rom Klao and is 10 km long. It also has two sections. The first section (R2S1) passes through Pao

Thai village and is 5 km long; its surface is paved and was in good condition when the research was conducted. The second section (R2S2) is 5 km long and is an earth road that was in very poor condition. Section R2S1 connects to a higher-order collector road, managed by the DRR, that links to the subdistrict of Chompu.

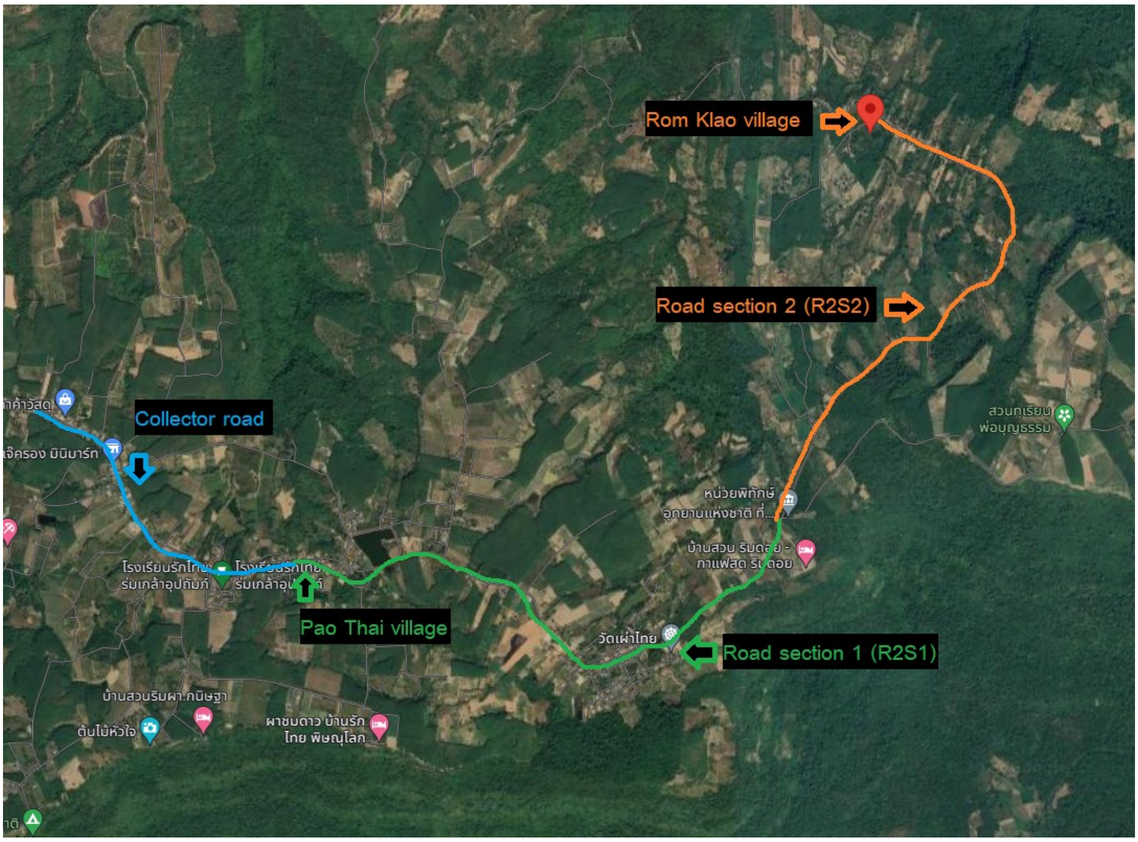

Figure 4-2. Road project 2 (Rom Klao village)

- **The characteristics of the two roads**

The two selected roads (R1 and R2) are the only way for the people in the four villages and local farms to access outside facilities, such as community centres, hospitals and markets. According to the American Association of Highway and Transportation Officials (AASHTO, 2001), they meet the criteria for low volume roads since their average traffic volume is less than 400 vehicles per day. Table 4-1 summarises some of their relevant characteristics.

Table 4-1. The characteristics of the two roads

Road characteristic	**Road 1**		**Road 2**	
	R1S1 Hin Ngon	R1S2 Sak Nga	R2S1 Pao Thai	R2S2 Rom Klao
Terrain	Rolling	Rolling	Mountainous	Mountainous
Road condition	Good	Very poor	Good	Very poor
Surface type	Asphalt concrete	Earth	Asphalt concrete	Earth
length (km)	5	5	6	5
Traffic volume (Veh/day)	<400	<50	<400	<50
Carriage way	6	4	6	6

- **Road condition**

Visual inspection of the road surfaces revealed that the paved sections of the two roads were still in good condition, despite having been constructed over a decade prior. In contrast, the unpaved sections were found to be in very poor condition. As described in Section 3.3.5.1, *The Little Book of Profiling* (Sayers and Karamihas, 1998) was used to help interpret the visual inspection into the condition of the roads using the international roughness index (IRI) since this research cannot measure IRI directly. Instead, visual inspection can be economical for rural road projects. Note that IRI was used to estimate the VOC as show in the table 3-13. Accordingly, the paved road sections were estimated to have an IRI of 3 m/km, and the earth road sections were estimated at 9 m/km, i.e. in very poor condition. Table 4-2 shows typical sections of the roads.

Table 4-2. The condition of the roads (Source: the author)

Road project	Image
R1S1 (Hin Ngon)	
R1S2 (Sak Nga)	
R2S1 (Pao Thai)	
R2S2 (Rom Klao)	

➢ **Socio-economic characteristics**

The demographics and household economics of the people living alongside the two roads are similar in terms of earnings and occupation. Most of the adult population works in the agricultural and manual labour sectors. According to the National Statistical Office of Thailand (NSO, 2020), their earnings are around minimum wage, which is ฿9,030 per month (£226). Alongside the two roads, there are large farms that produce cassava and corn, which are the commercial crops of the country and are sold to the processing industry rather than used for subsistence. The population size and household statistics for each village, according to NSO data (NSO, 2020), are summarised in Table 4-3.

Table 4-3. Socio-demographics

Socio demographics and economy	**R1S1 Hin Ngon**	**R1S2 Sak Nga**	**R2S1 Pao Thai**	**R2S2 Rom Klao**
Population (Household) in village	764 (209)	200 (56)	553 (208)	391 (196)
Male (Female) in village	396(368)	113(87)	307(246)	225(166)
The number of students in the nearby school (2019)	15		454	
Number of subdistrict healthcare	2		1	
Number of private clinics in the subdistrict	5		2	
Drug store in subdistrict	1		1	
Temple in subdistrict	9		8	
Number of Bank in subdistrict	0		0	
Number of industries	0		0	
Number of mill and collection points	5		8	

Figure 4-3. An example of houses alongside the Sak Nga road (R1S2)

Figure 4-4. An example of a farm alongside the Sak Nga road (R1S2)

Figure 4-3 illustrates some typical housing adjacent to the Sak Nga road section. These homes were constructed using low-quality materials. Figure 4-4 illustrates a typical farm alongside the Sak Nga road section. The farms in this area grow crops without any formal irrigation systems. Instead, farmers pump water from nearby natural resources.

Figure 4-5. The subdistrict hospital of Chompu (R1)

Figure 4-6. The subdistrict hospital of Sila (R2)

Figure 4-5 and 4-6 illustrate the healthcare facilities in the subdistricts of Chompu and Sila, respectively. Doctors attend the facilities twice a week.

4.3 The monetisation of health benefits of rural access

As discussed in Section 3.2.2, the social benefits to remote society regarding access to health facilities are assessed in this research by the number of deaths that could accrue due to a lack of access to healthcare facilities or mobile emergency services. In terms of economic measurement (monetary value), the literature refers to this as the value of statistical life (VSL). Section 3.2.1.3 discussed why the contingent valuation and discrete choice experiment were selected to quantify the VSL.

For the two paved road sections, the VSL associated with maintenance regimes, i.e. the maintenance of good roads, fair roads, poor roads and very poor roads, was computed. For the two earth road sections, the VSL associated with upgrading the roads to gravel, cape seal or asphalt roads was determined.

4.3.1 Contingent valuation (CV)

As discussed in Section 3.3.1, the contingent valuation (CV) approach was also developed to elicit the amount willing to pay (WTP) for improved road projects to avoid the risk of death. The CV adopted herein was based on an open-ended questionnaire survey in which respondents could state directly the WTP for annual council tax to improve road projects. The CV questionnaire and survey method were presented in Appendix A and its example questionnaire in Section 3.3.4.1. The CV questionnaire result was in Appendix B.

Briefly, in the first section (paved road), the respondents were asked to state their WTP additional council taxes to maintain their existing roads in good condition. It indicates that roads can deteriorate from good condition (IRI = 3 m/km) to fair (IRI = 5 m/km) to poor (IRI = 7 m/km) and to very poor condition (IRI > 9 m/km). Note that to maintain and keep road projects in good condition for 20 years of pavement life, road agencies would spend more than if they left them in fair, poor and very poor road conditions, respectively. In the second section (earth road), the respondents were asked to state their WTP additional (council) taxes per year to upgrade the road outside their houses from the existing earth road to gravel, cape sealed or asphaltic road, and in doing so, facilitate their access to a medical centre in an emergency, i.e. to reduce their risk of death. Note that the asphaltic road was the most expensive option.

- **Survey method**

Data was collected using the CV questionnaire, which had three sections. The questionnaire survey was conducted by interviewing villagers in their homes alongside the road sections (see Figure 4-10). The first questionnaire section stated the purpose of the research to ensure that respondents understood the context, were motivated to cooperate and could participate in an informed manner. It then asked how often they visited the hospital and how the road condition impacted their access to healthcare facilities. The questionnaire survey is in Appendix A.

In the second questionnaire section, the scenarios of road improvements (maintenance or upgrade) were presented to the respondents (show picture). Each scenario presented considered the impact of healthcare access by considering the death risk from not being able to access hospital and emergency services in time due to road conditions. This research led respondents to imagine that if no action (maintenance or upgrade) was taken, the road quality would be expected to deteriorate in the next few years, which could risk deaths from not being able to access a hospital in time. To get the road back to its current state – good road condition (show picture) – the government would have to spend money, which would mean raising taxes. Note that the scenario defines the maintenance of good road conditions as not allowing the road to deteriorate in quality. The tax payment describes how the respondent is (hypothetically) expected to pay for the good road. Note that the tax is an annual tax paid for 20 years of pavement life for one project (5 km). Therefore, the WTP was obtained for Thai baht per year per project.

The CV questionnaire was designed to draw out peoples' willingness to pay for road projects to avoid the risk of death (or impacts). In this process, it is essential to elicit the maximum WTP. Round numbers were used, e.g. 40 or 50 THB (1 GBP = 40 THB) to allow for easier answering.

In the second section (CV questionnaire), the respondents were asked the following.

- For the paved section, the WTP for maintaining good road conditions (R1S1 and R2S1):

How much would you be willing to pay (WTP) for council taxes for 20 years of pavement life to maintain your road projects in good condition, to maintain when leaving the roads to fair, poor and very poor conditions. This would reduce the risk of death by 1/10,000 VKT (1 death per 10,000 Vehicle-Kilometre-Travel, ΔP).

- For the unpaved section, the WTP for upgrading earth road (R1S2 and R2S2):

How much would you be willing to pay (WTP) for council taxes for 20 years of pavement life to upgrade your road projects (existing earth road) to gravel, cape seal and asphaltic surfacing to reduce the risk of death by 1/10,000 VKT (1 death per 10,000 Vehicle-Kilometre-Travel, ΔP).

The third section of the questionnaire asked for the socio-economic characteristics of the respondents. This information was used to test whether the WTP answers varied with demographics, such as income.

Figure 4-7 shows the researcher collecting data at a villager's house located alongside a road in Rom Klao (R2S2). Formal approval to conduct the questionnaires was obtained from the University of Birmingham's Ethics Committee. In accordance with this, respondents were recruited voluntarily; the purposes of the research, their rights to later withdraw (and the mechanism of doing so) and how their data would be stored (and later anonymised following the elapse of the period to withdraw) were carefully explained to potential respondents. Each respondent was also asked to sign a consent form.

Figure 4-7. Field survey

- **Result**

This research interviewed 120 in-person interviewees from the four villages (30 interviewees from each village) that were served by the two roads described above, namely, Hin Ngon (R1S1)–Sak Nga (R1S2) and Pao Thai (R2S1)–Rom Klao (R2S2).

The descriptive statistic for these respondents is shown in Table 4-5, and data for these respondent see Appendix B. According to Mandy et al. (2012), the number of respondents for the stated preference techniques should not be less than 30. Thirty interviewees represent 14.4% of the households in Hin Ngon (R1S1), 53% in Sak Nga (R2S2), 14.4% in Pao Thai (R2S1) and 15.3% in Rom Klao (R2S2).

The collected data were analysed using the statistical software for data sciences (STATA) (Mandy et al., 2012). Socio-demographic variables are shown in Table 4-4. Descriptive statistics regarding the 120 people interviewed are presented in Table 4-5. The full dataset is shown in Appendix B. From Table 4-4, most participants were above 40 years of age in the four villages, with an age range between 18 and 65 years old. Alongside the paved sections of R1S1 and R2S1, the number of non-farm workers was equal to farm workers (50% to 50%). On the other hand, many participants living along the unpaved sections of R1S2 and R2S2 worked in the agriculture sector (70% to 30%). About 60% of the participants in the four villages had incomes higher than the national average minimum wage of 9,000 THB per month (£225), except in R1S2 where 40% of the respondents' earned wages that were lower than the average. Most vehicles used to travel to hospitals were motorcycles (60%). The average household consisted of three people. Surprisingly, the average number of sick individuals per household living alongside R1S1 was 0.5. This was almost twice the number among those living alongside R1S2, which was 0.23, despite villagers along R1S1 being connected to a paved road like R2S1.

Table 4-4. Relevant socio-demographic variables

Variable	Description	Value
GEN	A categorical variable representing the gender of the respondent	0 for female; 1 for male
AGE	Age of the respondent	Number of years old
EDU	A categorical variable representing the average educational level of the respondent	0 = No education, Primary school and lower 1 = Secondary school, otherwise
OCC	Occupation	0 = farm worker 1 = non-farm worker
HH	The number of family members	Number
SICK	The number of family sickness members; Sickness member is a family member who has to attend to hospital regularly according to health condition.	Number
INC	Monthly income (9,000 THB is minimum wage)	0 = ≤ 9,000 THB ($300) 1 = Otherwise
VEH	Vehicle Type	0 = Motorcycle 1 = Pickup/Car
PERC	Perception of deaths (Number of death per 10,000 VKT) VKT for emergency trips	0 = 0 death 1 = 1 death 2 = 2 deaths 3 = 3 deaths

Figures 4-8 (R1S1) and 4-9 (R2S1) illustrate the WTP by type of road condition maintenance associated with income groups and vehicle types. Surprisingly, the respondents for the two villages only stated the WTP for maintaining good roads and fair roads. They did not want to state the WTP for maintaining their roads in poor and very poor conditions, implying that they would not accept their roads to be kept in such poor conditions. As expected, the WTP for maintaining good road conditions was higher than for maintaining fair conditions. The WTP from higher income group (greater than 9,000 THB) can be greater than from lower income group if those use car to travel on these paved road projects.

Table 4-5. Descriptive statistics

Variable	Road 1		Road 2	
	Paved	Unpaved	Paved	Unpaved
	R1S1 (Hin Ngon)	R1S2 (Sak Nga)	R2S1 (Pao Thai)	R2S2 (Rom Klao)
	Mean (Standard deviation)			
Number of participants	30	30	30	30
Gender	.500 (.508)	.367 (.490)	.428 (.502)	.600 (.498)
Age	40.267 (14.541)	41.166 (12.776)	42.233 (13.840)	44.333 (14.145)
Education	.600 (.498)	.233 (.430)	.700 (.566)	.400 (.498)
Occupation	.500 (.508)	.266 (.449)	.566 (.504)	.333 (.479)
Income	.533 (.507)	.466 (.507)	.600 (.498)	.633 (.490)
No_HH	3.366 (.999)	2.966 (.808)	2.766 (1.006)	3.533 (1.041)
No_Sick	.500 (.682)	.266 (.449)	.333 (.600)	.433 (.504)
Veh_Type	.500 (.508)	.466 (.507)	.457 (.505)	.600 (.498)
Perc_good /asphaltic	1.766 (1.250)	.233 (.430)	1.733 (1.172)	.900 (.480)
Perc_fair/ capeseal	2.200 (0.924)	1.1 (.994)	2.166 (.833)	1.733 (.583)
Perc_gravel		2.433 (.773)		2.733 (.583)

Figures 4-10 (R1S2) and 4-11 (R2S2) illustrate the WTP for upgrading earth roads to better road surfaces. As expected, the respondents for the two villages did state the WTP for the upgrading of an earth road to an asphaltic road was the highest for the two villages. They did state the WTP for upgrading their earth roads to asphaltic road, accounting of up to 150 THB; while the WTP for upgrading earth road to gravel road was just 20 THB, implying that they would not accept their roads to be kept in unpaved road. Moreover,

villagers with income higher than minimum wage (9,000 THB per month) and car owner stated higher WTP than those with lower income.

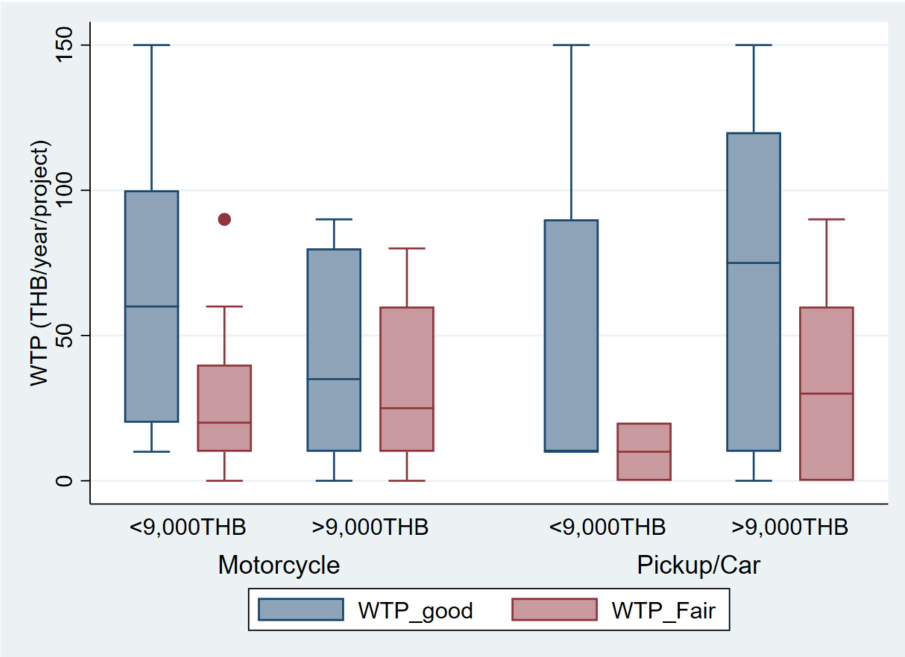

Figure 4-8. WTP by type of road condition maintenance for R1S1

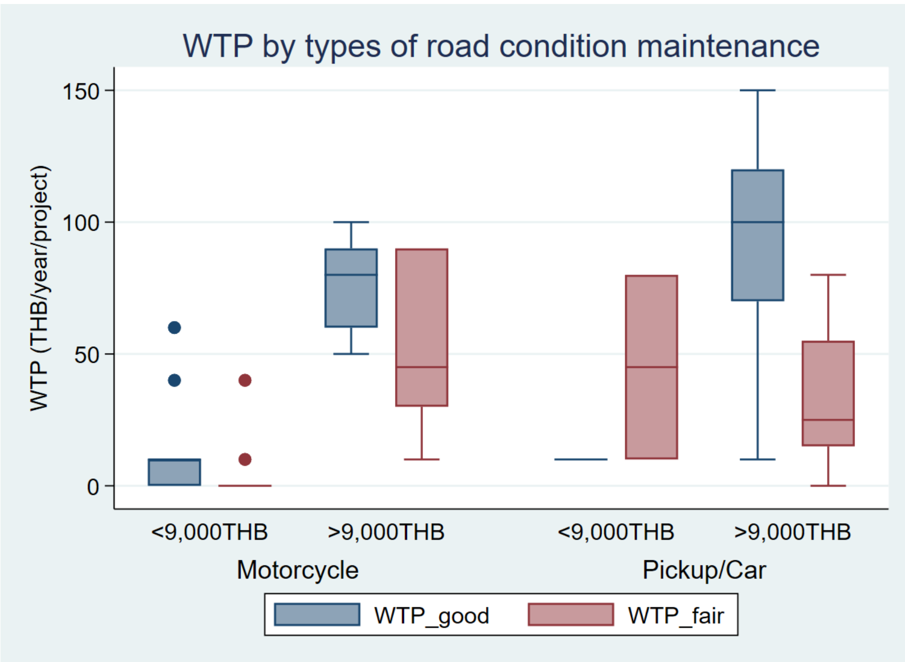

Figure 4-9. WTP by type of road condition maintenance for R2S1

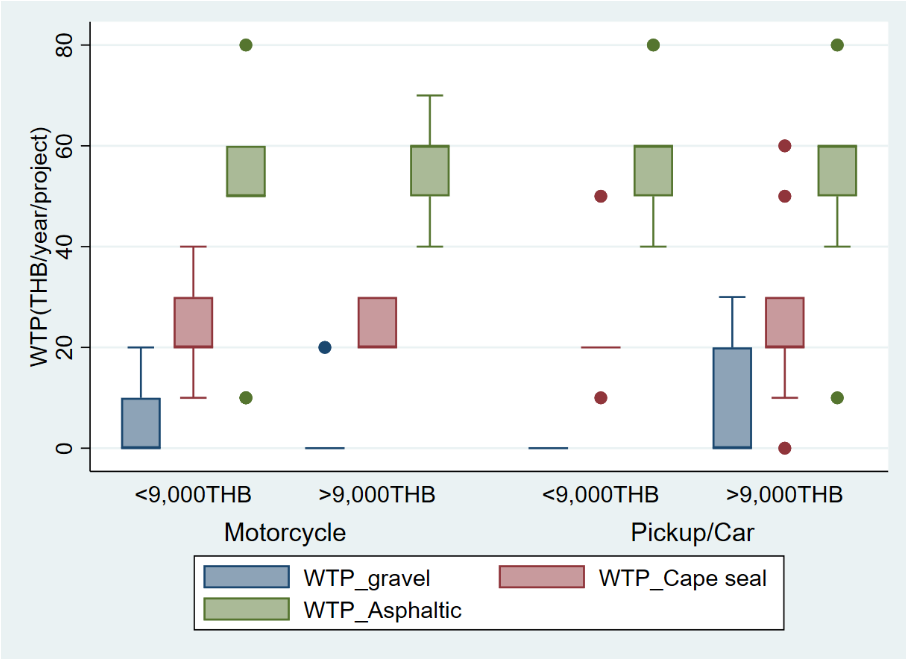

Figure 4-10. WTP by type of road condition upgrading for R1S2

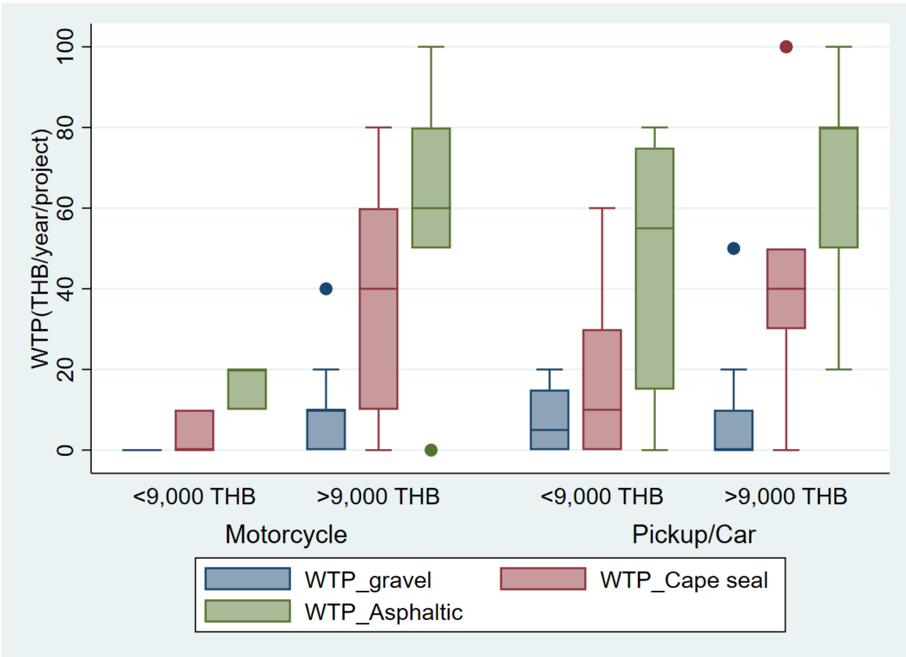

Figure 4-11. WTP by type of road condition upgrading for R2S2

The range of WTP obtained for each interviewee for the four road sections considered are given in Appendix B and shown in Tables 4-6 and 4-7, together with the associated VSLs. It can be seen from Figures 4-8 to 4-11 that the WTP per year per project for each road section and each type of road work ranges from 0 to 150 THB.

Overall, Tables 4-6 and 4-7 show that the average WTP and the calculated VSL for respondents living alongside a paved road and an earth road were found to be statistically similar for the two villages when considered separately and when compared (quote the p values for each comparison, respectively). Tables 4-10 to 4-14 illustrate the t-test for the average WTP between villages.

The VSL in terms of an individual's willingness to pay (WTP) for a marginal reduction in the risk of death (1/10,000 VKT), as described in Section 3.3.1 and Eq. 3-1, can be seen from the VSL for participants with existing paved roads (R1S1 and R2S1). Table 4-6 were almost equal statistically (see t-test in Tables 4-10 and 4-11). Similarly, in Table 4-7, the VSL for participants with existing paved roads (R1S2 and R2S2) were almost equal.

As mentioned in Section 3.3.1, by means of CV, the WTP for an individual is obtained in term of THB/year/project (5 km). To estimate the VSL, it should be converted such WTP to the term of THB/VKT. The following steps are used:

1. the WTP per year per project (5 km) is divided by 5 to obtain the WTP per year per km
2. the WTP per VKT can be given by the WTP per year per km divided by 12 trips per year (1 trip per month). According to this survey the respondent had 1 trip per month to travel to hospital appointment.

The VSL for an individual can be given by the WTP per VKT (for an individual) divided by the probability (1/10,000 VKT). The VSL for a community can be given by the VSL for an individual multiplied by average population for these four villages that is about 500 population.

For example, in R1S1, the WTP obtained by CV for keeping paved road in good condition is 59.64 THB/year/project (5 km). The WTP per VKT (for an individual) can be obtained by 59.64 divided by 5 (km) and 12 (trip), given 0.99 THB/VKT. To estimate the community VSL, 0.99 THB/VKT is divided by 1/10,000 VKT (the probability) and multiplied by 500 (population), given the community VSL for 4,972,500 THB/year.

Table 4-6. The WTP by CV and the VSL for types of road maintenance

Maintenance regimes	**R1S1**			**R2S1**		
	WTP by CV	***WTP**	***VSL**	**WTP by CV**	***WTP**	***VSL**
Good (IRI = 3)	59.67	0.99	4,972,500	57.67	0.96	4,805,833
Fair (IRI = 5)	28.33	0.47	2,360,833	28.67	0.48	2,389,167
Poor/ Very poor (IRI = 7/9)	0	0	0	0	0	0

*WTP per VKT; *VSL for a community

Table 4-7. The WTP and the VSL for types of road surfacing upgrade

Upgrade regimes	**R1S2**			**R2S2**		
	WTP by CV	***WTP**	***VSL**	**WTP by CV**	***WTP**	***VSL**
Asphaltic (IRI = 3)	53	0.88	4,416,667	55	0.92	4,583,333
Cape seal (IRI = 5)	24	0.40	2,000,000	32	0.53	2,666,667
Gravel (IRI = 7)	5	0.08	416,667	8	0.13	666,667
Earth (IRI = 9)	0	0	0	0	0	0

*WTP per VKT; *VSL for a community

Table 4-6 summarises the WTP and the calculated VSL for the road maintenance scenarios for the participants living alongside roads R1S1 and R2S1. As expected, the WTP for improving and maintaining good road conditions provided the highest WTP, followed by maintaining fair road conditions, implying that the villagers were aware that road conditions could affect their travel to healthcare facilities. None of the villagers living alongside R1S1 and R2S2 were prepared to pay for the maintenance of their roads if they were in poor or fair condition. This appears to suggest that such residents feel that roads already in poor and very poor condition have huge impacts on their travel, and they do not see the value in paying to have their roads kept in poor condition. Accordingly, the resulting WTP for such poor conditions equalled zero THB.

Table 4-7 summarises the WTP per year per project for the interviewees living alongside the two earth road sections (R1S2 and R2S2). The average WTP for villagers in R2S2 was slightly greater than for those living on R1S2, although not statistically significantly so (see t-test in Table 4-12 to 4-14). As expected, the WTP for upgrading to asphaltic roads was the highest (53 THB for R2S1 and 55 THB for R2S2), followed by upgrading to a cape seal treatment (24 and 32 THB) and a gravel road (5 and 8 THB). The WTP for upgrades to gravel for the two sections were almost zero, implying that the respondents did not perceive that a gravel road could improve their restricted access.

Tables 4-8 and 4-9 present the WTP using the linear regression model. The dependent variable was the WTP, and the independent variables were socio-demographics, as described in Tables 4-4 and 4-5. From Table 4-8 and 4-9, They show that the WTP from observation can be varying from the model for the four road sections because R-square can be low due to several demographic variables be insignificant.

Table 4-8. The comparison between the model and survey for road maintenance

Maintenance	R1S1		R2S1	
	Survey (THB)	Model (THB)	Survey (THB)	Model (THB)
Good road	59.67	130.65	57.67	44.74
Fair road	28.33	13.53	28.67	31.23

Table 4-9. The comparison of WTP between the model and survey for road upgrades

Upgrades	R1S2		R2S2	
	Survey (THB)	Model (THB)	Survey (THB)	Model (THB)
AC road	53.0	30.40	55	33.00
Cape seal road	24.0	19.30	32	12.78
Gravel road	5.0	1.94	8.0	5.07

Table 4-10 provides the coefficient from the analysis for R1S1 and R2S1, which is separate for each road maintenance type. P-values less than 0.2 was chosen to determine a statistically significant result. The coefficients of the perceptions of keeping road surface conditions in the two villages were negative and statistically significant, meaning that increased deaths were associated with a reduced WTP. However, the negative coefficient for the perception means that there is an inverse relationship between death perception and WTP. Even though individuals were aware that an asphaltic road would reduce the risk of death, they still preferred not to pay for it if road projects could not reduce death numbers. The coefficient of occupation was negative and statistically significant for road maintenance in R1S1, meaning that agriculture workers would pay less than other types of employees. Income was positive and significant for the two villages, meaning that the greater the income, the higher the WTP. In Pao Thai along R1S2, the number of occupants and sickness in households were negative and statistically significant, meaning that an increase in the given number reduced the WTP.

Table 4-10. Socio-demographic coefficients for road maintenance by village

Variable	R1S1 (Hin Ngon)			R2S1 (Pao Thai)		
	Coefficients ß (p-value)					
	Maintain good road	fair	Poor/very poor	Maintain good road	fair	Poor/very poor
Constant	155.395 *(.024)	40.297 (.279)	-	70.368 *(.060)	80.911 *(.013)	-
GENDER	-6.261 (.746)	-12.386 (.266)	-	-.897 .944	10.297 (.352)	-
AGE	-.701 (.400)	.765 **(.136)	-	-.031 .957	-.175 (.719)	-
EDU	-3.228 (.902)	9.069 (.546)	-	10.580 .487	5.320 (.674)	-
OCC	-49.488 *(.023)	-16.723 **(.164)	-	13.570 .292	-14.357 (.189)	-
INC	-16.211 (.518)	29.842 *(.054)	-	46.938 *(.004)	20.443 *(.087)	-
NO_HH	-5.917 (.609)	-4.918 (.485)	-	-10.305 **(.117)	-11.661 *(.040)	-
NO_SICK	.710 (.965)	12.799 **(.160)	-	-14.638 (.227)	-0.425 (.965)	-
VEH	8.558 (.703)	-16.413 **(.207)	-	9.345 (.488)	-5.301 (.645)	-
PERCETP	-7.769 (.369)	-14.190 *(.059)	-	-14.589 *(.022)	-9.953 (.110)	-
R square	.332	.416	-	.735	.511	-

Note that * p-value < 0.10; ** p-value < 0.20

Table 4-11 provides the coefficient from the analysis for R1S2 and R2S2, which is separate for each road upgrade type. A significance value of 0.2 was chosen to determine a statistically significant result. For Sak Nga village (R1S2), occupation was the only parameter that reached this significance level for the gravel road model, meaning that farmers were likely to pay less when compared with those working in the labour sector. Also, most of the individuals in the village preferred not to pay to upgrade the road serving their village from the existing earth road to a gravel road. For the cape seal road model, gender and the number of households were shown to be significant. It means that WTP can be increased by the number of occupants in a household and male inhabitants preferred to pay for a road upgrade more than female inhabitants. For the asphalt road model, similarly, the number of occupants in a household was significantly positively related to WTP, implying that individuals in larger households were willing to pay more than those in smaller households.

Table 4-11. Socio-demographic coefficients for road upgrade by village

Variable	**R1S2 (Sak Nga)**			**R2S2 (Rom Klao)**		
	Coefficients ß (p-value)					
	Gravel	Cape seal	Asphaltic	Gravel	Cape seal	Asphaltic
Constant	1.259 (.929)	-1.605 (.927)	26.330 (.240)	-1.464 (.938)	20.534 (.425)	37.656 (.225)
GENDER	5.300 **(.200)	11.037 *(.067)	5.633 (.449)	-3.446 (.467)	-11.803 *(.102)	1.131 (.901)
AGE	-.157 (.407)	.060 (.832)	-.247 (.531)	.114 (.691)	-.608 **(.110)	-.909 (.274)
EDU	4.499 (.378)	5.384 (.488)	12.310 (.229)	12.69 **(.152)	19.132 **(.114)	16.245 (.308)
OCC	-5.664 (.227)	4.623 (.507)	-11.227 (.219)	7.065 (.259)	5.418 (.518)	-3.575 (.738)
INC	3.926 (.305)	5.163 (.380)	5.871 (.446)	-2.844 (.645)	11.251 **(.151)	12.252 (.224)
NO_HH	1.654 (.453)	5.143 **(.127)	10.252 **(.020)	-.887 (.785)	8.786 *(.072)	9.342 **(.135)
NO_SICK	-4.870 (.206)	-2.707 (.635)	6.308 (.403)	5.674 (.434)	-13.818 **(.190)	-14.136 (.298)
VEH	-3.070 (.419)	-2.037 (.723)	-4.901 (.516)	5.519 (.307)	11.652 **(.133)	12.546 (.225)
PERCETP	-1.948 (.435)	.519 (.847)	10.189 (.212)	-.668 (.919)	-1.977 (.739)	10.948 (.267)
R square	.356	.323	.410	.396	.775	.656

Note that * p-value < 0.10; ** p-value < 0.20

In Table 4-11, for R2S2 (Rom Klao), the level of education was significant for all three road types, meaning that respondents obtained secondary school stated the WTP more than non-educated respondents. Occupation was significant for upgrading to a cape seal road model, meaning that villagers not working in agriculture had a higher WTP when compared with farmers. Regarding a cape seal road, age was significantly negatively correlated, meaning that as aged increased, WTP decreased. Moreover, villagers who owned a car or pickup truck tended to have a higher WTP than those who did not.

In R1S2 and R2S2, the perception of death was not significant for all upgrading models of eliciting WTP. This can be implied that those villagers might not envisage that existing earth road could not bring them to death, just having difficulty getting access to healthcare.

Tables 4-12 and 4-13 present the t-test results for the WTP analysis for the interviewees living alongside the paved road sections of R1S1 and R2S1. Since the p-value was greater than 0.05, it is considered statistically insignificant; the results accepted the null hypothesis, implying that the two villages had equal WTP.

Table 4-12. T-test between WTP for R1S1 and R2S1 for maintaining a good road

Two-sample t test with equal variances

Variable	Obs	Mean	Std. err.	Std. dev.	[95% conf.	interval]
w~d_R1S1	30	59.66667	9.090646	49.79152	41.07421	78.25913
w~d_R2S1	30	57.66667	8.73207	47.82752	39.80758	75.52575
Combined	60	58.66667	6.250273	48.41441	46.1599	71.17343
diff		2	12.60511		-23.23188	27.23188

```
    diff = mean(wtp_good_R1S1) - mean(wtp_good_R2S1)              t =   0.1587
H0: diff = 0                                     Degrees of freedom =       58

    Ha: diff < 0                 Ha: diff != 0                 Ha: diff > 0
 Pr(T < t) = 0.5628         Pr(|T| > |t|) = 0.8745          Pr(T > t) = 0.4372
```

Table 4-13. T-test between WTP for R1S1 and R2S1 for maintaining a fair road

Two-sample t test with equal variances

Variable	Obs	Mean	Std. err.	Std. dev.	[95% conf.	interval]
w~r_R1S1	30	28.33333	5.489453	30.06698	17.10614	39.56053
w~r_R2S1	30	28.66667	5.440025	29.79624	17.54057	39.79277
Combined	60	28.5	3.831368	29.67765	20.83345	36.16655
diff		-.3333333	7.728387		-15.80338	15.13671

```
    diff = mean(wtp_fair_R1S1) - mean(wtp_fair_R2S1)              t =  -0.0431
H0: diff = 0                                     Degrees of freedom =       58

    Ha: diff < 0                 Ha: diff != 0                 Ha: diff > 0
 Pr(T < t) = 0.4829         Pr(|T| > |t|) = 0.9657          Pr(T > t) = 0.5171
```

Tables 4-14 to 4-16 show the t-test results obtained from the WTP for the villagers living alongside the two earth road sections. As above, the results show that the null hypothesis can be accepted. The WTP for the two villages to upgrade their existing earth road to a gravel road is the same. Similarly, the WTP for the two villages for an upgrade to a cape seal road is the same as an upgrade to an asphaltic road.

Table 4-14. T-test between WTP for R1S2 and R2S2 for the gravel road upgrade

```
. ttest wtp_gravel_R2S2 == wtp_gravel_R1S2, unpaired

Two-sample t test with equal variances
------------------------------------------------------------------------------
Variable |     Obs        Mean    Std. err.   Std. dev.   [95% conf. interval]
---------+--------------------------------------------------------------------
~el_R2S2 |      30           8    2.269235    12.42911    3.358894    12.64111
~el_R1S2 |      30           5    1.572026    8.610339    1.784847    8.215153
---------+--------------------------------------------------------------------
Combined |      60         6.5    1.382395    10.70799    3.733833    9.266167
---------+--------------------------------------------------------------------
    diff |                   3     2.76056               -2.525861    8.525861
------------------------------------------------------------------------------
    diff = mean(wtp_gravel_R2S2) - mean(wtp_gravel_R1S2)          t =   1.0867
H0: diff = 0                                     Degrees of freedom =       58

    Ha: diff < 0                 Ha: diff != 0                 Ha: diff > 0
 Pr(T < t) = 0.8592         Pr(|T| > |t|) = 0.2816          Pr(T > t) = 0.1408
```

Table 4-15. T-test between WTP for R1S2 and R2S2 for the seal road upgrade

```
. ttest wtp_capeseal_R2S2 == wtp_capeseal_R1S2, unpaired

Two-sample t test with equal variances
------------------------------------------------------------------------------
Variable |     Obs        Mean    Std. err.   Std. dev.   [95% conf. interval]
---------+--------------------------------------------------------------------
~al_R2S2 |      30    31.66667    5.340871    29.25316    20.74336    42.58997
~al_R1S2 |      30          24    2.329225    12.75769     19.2362     28.7638
---------+--------------------------------------------------------------------
Combined |      60    27.83333    2.931339    22.70606    21.96774    33.69893
---------+--------------------------------------------------------------------
    diff |          7.666667    5.826679               -3.996699    19.33003
------------------------------------------------------------------------------
    diff = mean(wtp_capeseal~2S2) - mean(wtp_capeseal~1S2)        t =   1.3158
H0: diff = 0                                     Degrees of freedom =       58

    Ha: diff < 0                 Ha: diff != 0                 Ha: diff > 0
 Pr(T < t) = 0.9033         Pr(|T| > |t|) = 0.1934          Pr(T > t) = 0.0967

. ttest wtp_capeseal_R2S2 == wtp_capeseal_R1S2
```

Table 4-16. T-test between WTP for R1S2 and R2S2 for the asphaltic upgrade

Two-sample t test with equal variances

Variable	Obs	Mean	Std. err.	Std. dev.	[95% conf.	interval]
w~c_R2S2	30	55.33333	5.60651	30.70812	43.86673	66.79993
w~c_R1S2	30	53	3.257176	17.84029	46.33833	59.66167
Combined	60	54.16667	3.21799	24.92645	47.72748	60.60585
diff		2.333333	6.483991		-10.64579	15.31245

```
    diff = mean(wtp_asphalti~2S2) - mean(wtp_asphalti~1S2)        t =   0.3599
H0: diff = 0                                     Degrees of freedom =       58

    Ha: diff < 0                 Ha: diff != 0                 Ha: diff > 0
 Pr(T < t) = 0.6399         Pr(|T| > |t|) = 0.7203          Pr(T > t) = 0.3601
```

4.3.2 Discrete choice experiment (DCE)

The discrete choice experiment (DCE) aims, by means of a questionnaire, to elicit from respondents their preferred types of road improvement. The DCE is regarded as an indirect means of eliciting their WTP because it observes the preferred choices the respondents make. A different model and associated questionnaires to elicit the information required by the model were developed for those villagers living beside one of the two paved road sections, i.e. R1S1 and R2S, compared to those living beside one of the two earth road sections, i.e. R1S2 and R2S2. For the former, the model is associated with choosing road maintenance standards, while for the latter, it is associated with upgrading the road sections. The DCE model was developed in Section 3.3.3 and the design of the DCE questionnaire was shown in Section 3.4.3.2.

- **Survey method**

Note that the respondents for the DCE questionnaire were the same as the CV questionnaire in the previous section. However, the questionnaire for the first and second road sections was designed separately.

- **Results**

The DCE's questionnaire was answers provided by 120 respondents (30 respondents for each of the four road sections). The Questionnaire illustrates in Appendix A. The conditional logit DCE model (Eq. 3-6) analysed the coefficients of independent variables for the utility model (Eq. 3-9). The VSL can be calculated using Eq. 3-10. Note that the descriptive statistics for DCE were the same as for CV, as shown in Table 4-4. For the DCE, the choice data for road alternatives are shown in Appendix B. Tables 4-17 and 4-18 summarise the VSL for road section 1 (R1S1 and R2S1) and road section 2 (R1S2 and R2S2), respectively. The analyses of the model coefficients are summarised in Tables 4-19 to 4-22.

Table 4-17. The VSL for each of the four road conditions

Maintenance regimes	**R1S1**			**R2S1**		
	WTP by DCE	***WTP**	***VSL**	**WTP by DCE**	***WTP**	***VSL**
Good (IRI = 3)	32.97	0.55	2,747,500	39.42	0.66	3,285,000
Fair (IRI = 5)	-7.26	-0.12	-605,000	2.29	0.04	190,833
Poor/ (IRI = 7)	-16.28	-0.27	-1,356,667	-9.27	-0.15	-772,500
Very poor (IRI = 9)	-42.66	-0.71	-3,555,000	-17.86	-0.30	-1,488,333

*WTP per VKT; *VSL for a community

Table 4-18. The VSL for each road surfacing type

Upgrade regimes	**R1S2**			**R2S2**		
	WTP by DCE	***WTP**	***VSL**	**WTP by DCE**	***WTP**	***VSL**
Asphaltic (IRI = 3)	12.77	0.21	1,064,167	7.86	0.13	655,000
Cape seal (IRI = 5)	-43.15	-0.72	-3,595,833	9.08	0.15	756,667
Gravel (IRI = 7)	-51.46	-0.86	-4,288,333	-20.64	-0.34	-1,720,000
Earth (IRI = 9)	-64.62	-1.08	-5,385,000	-35.16	-0.59	-2,930,000

*WTP per VKT; *VSL for a community

Tables 4-19 to 4-22 illustrate the resulting coefficients from the logit model. In these tables, Column **A** presents the independent variables for the utility model. Note that the dependent variable was the utility of choice for road alternatives. Column **B** presents the coefficient for these variables. Columns **D** to **G** were used to estimate the utility of choice for road intervention standards. Using Eq. 3-9, the utility for road interventions was shown in **D**⑧ to **G**⑧. The the following is an example of the calculation of the utility.

$$U_{\text{good road}} = \beta(X_{\text{good}}) + \beta(X_{\text{fair}}) + \beta(X_{\text{poor}}) + \beta(X_{\text{death}}) + \beta(X_{\text{tax}})$$

$$= 0.71(1) + 0.33(0) + 0.24(0) - 0.40(1) - 0.009(0)$$

$$= 0.31$$

Note that the WTP for road projects to reduce death can be estimated as the marginal substitution between the marginal change in the number of deaths ($\partial MU_{\text{Death}} = \beta_{\text{Death}}$) and the marginal change in the tax ($\partial MU_{\text{Tax}} = \beta_{\text{Tax}}$) (see Eq. 3-10). **D**⑨ to **G**⑨ present the WTP for each road intervention. Using Eq. 3-11, In Table 4-19, the coefficient of death (β_{death}) in **B②** was −0.401; the negative sign implies that an increase in the number of deaths by 1 reduced the utility by 0.401. Similarly, in **B③,** the coefficient of death (β_{tax}) was also negative, which implies that an increase in the tax by 50 Thai baht reduced the utility by 0.0094. In **D**⑨, the average WTP for the asphaltic road was positive, at 32.97 THB/year, which implies that people prefer to pay 32.97 more for good roads than for very poor roads. From **E**⑨ to **G**⑨, the WTP was negative, which implies that people did not prefer to pay, or it can say that it is compensation cost and social cost that people should be given if road conditions were fair, poor or very poor.

Table 4-19. DCE coefficients for R1S1 (paved section)

	A	B	C	D	E	F	G
①	**R1S1**	β	(p-value)	Good	Fair	Poor	Verypoor
②	Death	-0.401	0.000	1	1	1	1
③	Tax	-0.009	0.000	0	0	0	0
④	Death×Good	0.711	0.000	1	0	0	0
⑤	Death×Fair	0.333	0.012	0	1	0	0
⑥	Death×Poor	0.248	0.036	0	0	1	0
⑦	Death×VeryPoor						
⑧	Utility			0.31	-0.07	-0.15	-0.40
⑨	−∂MU/∂MU[WTP]			32.97	-7.26	-16.28	-42.66
⑩	Likelihood	-465.64					

Table 4-20. DCE coefficients for R2S1 (paved section)

	A	B	C	D	E	F	G
①	**R2S1**	β	(p-value)	Good	Fair	Poor	Verypoor
②	Death	-0.177	0.077	1	1	1	1
③	Tax	-0.010	0.021	0	0	0	0
④	Death×Good	0.567	0.000	1	0	0	0
⑤	Death×Fair	0.200	0.000	0	1	0	0
⑥	Death×Poor	0.085	0.085	0	0	1	0
⑦	Death×VeryPoor						
⑧	Utility			0.39	0.02	-0.09	-0.18
⑨	−∂MU/∂MU[WTP]			39.42	2.29	-9.27	-17.86
⑩	Likelihood	-465.69					

Table 4-21. DCE coefficients for R1S2 village (unpaved section)

	A	B	C	D	E	F	G
①	**R1S2**	β	(p-value)	Asphaltic	Cape Seal	Gravel	Earth
②	Death	-0.840	0.000	1	1	1	1
③	Tax	-0.013	0.210	0	0	0	0
④	Death×Asphaltic	1.006	0.000	1	0	0	0
⑤	Death×CapeSeal	0.279	0.095	0	1	0	0
⑥	Death×Gravel	0.171	0.355	0	0	1	0
⑦	Death×Earth						
⑧	Utility			0.17	-0.56	-0.67	-0.84
⑨	−∂MU/∂MU[WTP]			12.77	-43.15	-51.46	-64.62
⑩	Likelihood	-397.81					

Table 4-22. DCE coefficients for R2S2 (unpaved section)

	A	B	C	D	E	F	G
①	**R2S2**	β	(p-value)	Asphaltic	Cape Seal	Gravel	Earth
②	Death	-0.429	0.000	1	1	1	1
③	Tax	-0.012	0.000	0	0	0	0
④	Death×Asphaltic	0.525	0.000	1	0	0	0
⑤	Death×CapeSeal	0.540	0.000	0	1	0	0
⑥	Death×Gravel	0.177	0.215	0	0	1	0
⑦	Death×Earth						
⑧	Utility			0.10	0.11	-0.25	-0.43
⑨	−∂MU/∂MU[WTP]			7.86	9.08	-20.64	-35.16
⑩	Likelihood	-424.97					

4.3.3 Comparison between VSL for road maintenance and road upgrading

The comparison of the VSL between road maintenance and road upgrading is presented in terms of IRI. Good roads and asphaltic roads have an IRI of 3, fair roads and cape seal roads have an IRI of 5, poor roads and gravel roads have an IRI of 7, and very poor roads and earth roads have an IRI of 9.

Figure 4-12 illustrates the comparison for the VSL by CV. Overall, at the IRI of 3 m/km, the VSL by CV was the highest, and the VSL by CV for R1S1 and R2S2 is as equal as for R1S2 and R2S2. When these two road sections were in very poor condition, the VSL was relatively low. For IRI of 9 m/km, the VSL can be zero as the villagers did not state the WTP for.

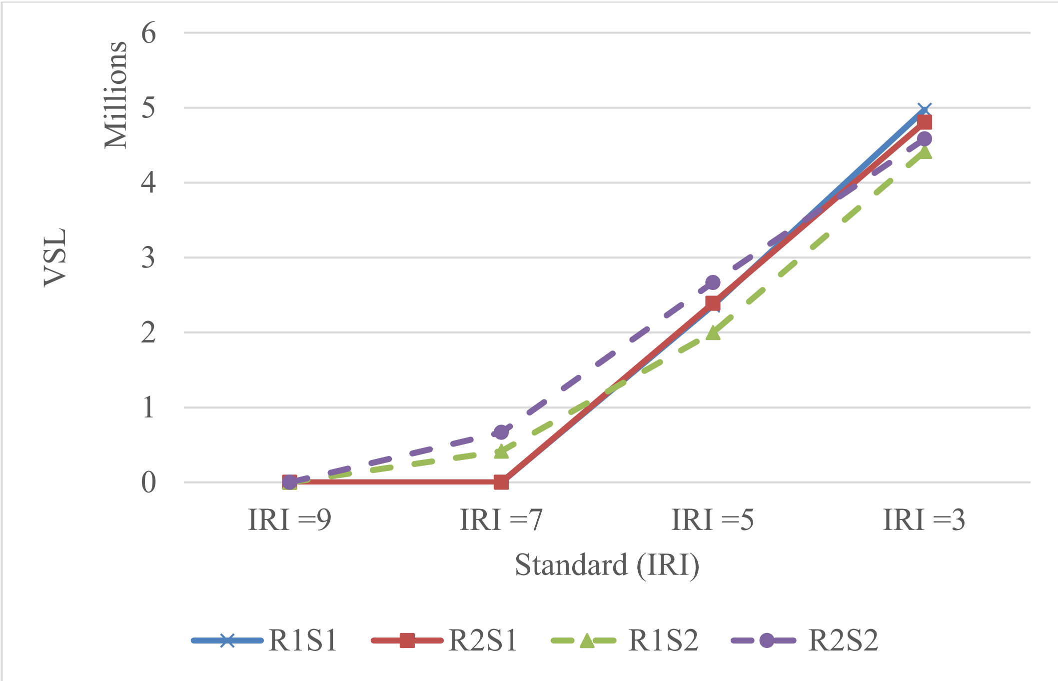

Figure 4-12. The comparison between VSL by CV for road maintenance and upgrading

Figure 4-16 illustrates the comparison for VSL by DCE. Overall, at the IRI of 3 m/km, the VSL by DCE was relatively high. In R2S2, the VSL by DCE for cape seal upgrade was a bit greater than for asphaltic upgrade. However, at IRI of 9 m/km (i.e. earth road and very poor condition, the VSL can be negative value. This implies that poor surfacing roads could yield higher social costs (compensation costs) for health access. However, when road conditions improved, the VSL increased. On the maintenance regime, at IRI of 3, the community VSL for R1S1 and R2S1 and was greater than for R1S2 and R2S2 for about 3 million THB.

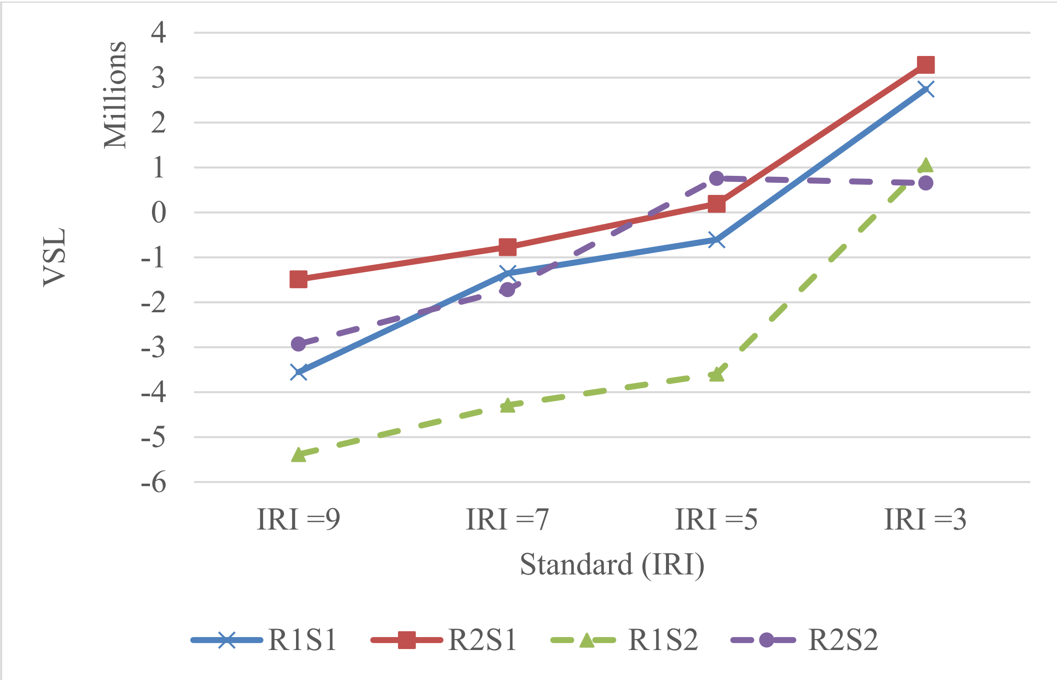

Figure 4-13. The comparison between VSL by DCE for road maintenance and upgrading

4.3.4 Comparison between the VSL for CV and DCE

As mentioned in section 2.4, a concern about economic valuation techniques, particularly the stated preference approach, is consistency in the values of monetary benefit that they produce for a particular benefit. Since the techniques are based on different concepts, the values obtained can be expected to vary. Bearing this in mind, this section compares the VSL determined from the CV method with the DCE method for the four road sections considered. Note that the VSL is for a community.

Figures 4-17 and 4-18 compare the VSL determined using the two approaches for road sections R1S1 and R2S1, respectively. As can be seen from the figure, the VSL by the CV and DCE approaches for the different maintenance standards are not equal when a road is to be maintained in a good condition; the VSL determined by CV is higher than that determined by the DCE approach by over 50%. For a road section maintained in good condition, the VSL computed by CV is lower than that computed by the DCE approach by approximately 60%.

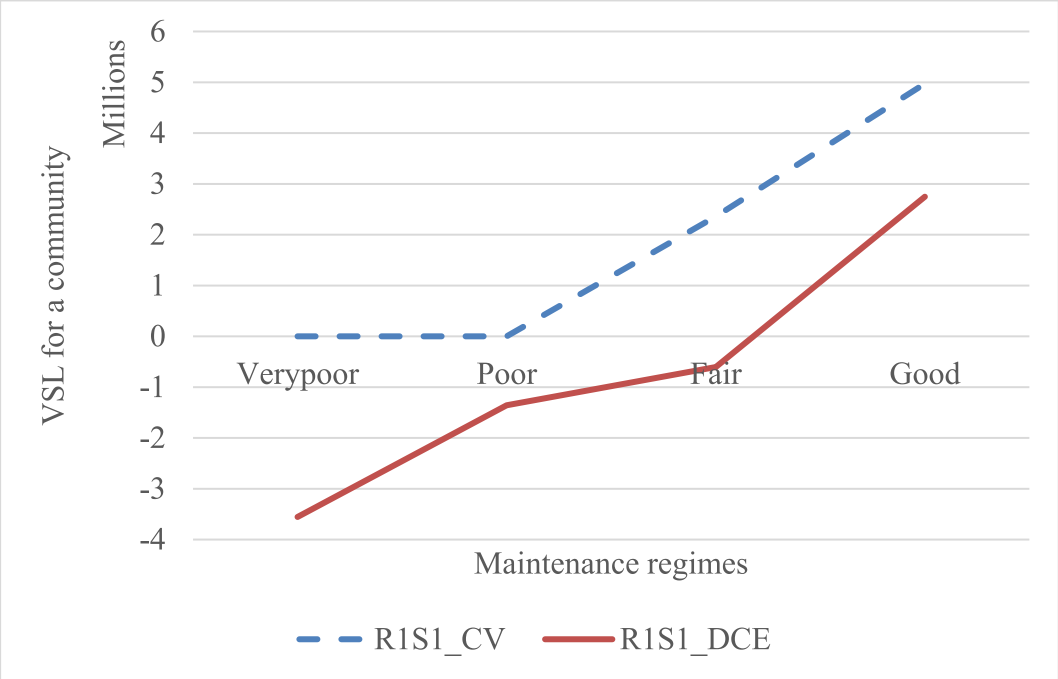

Figure 4-14. The comparison between the VSL for CV and DCE for R1S1

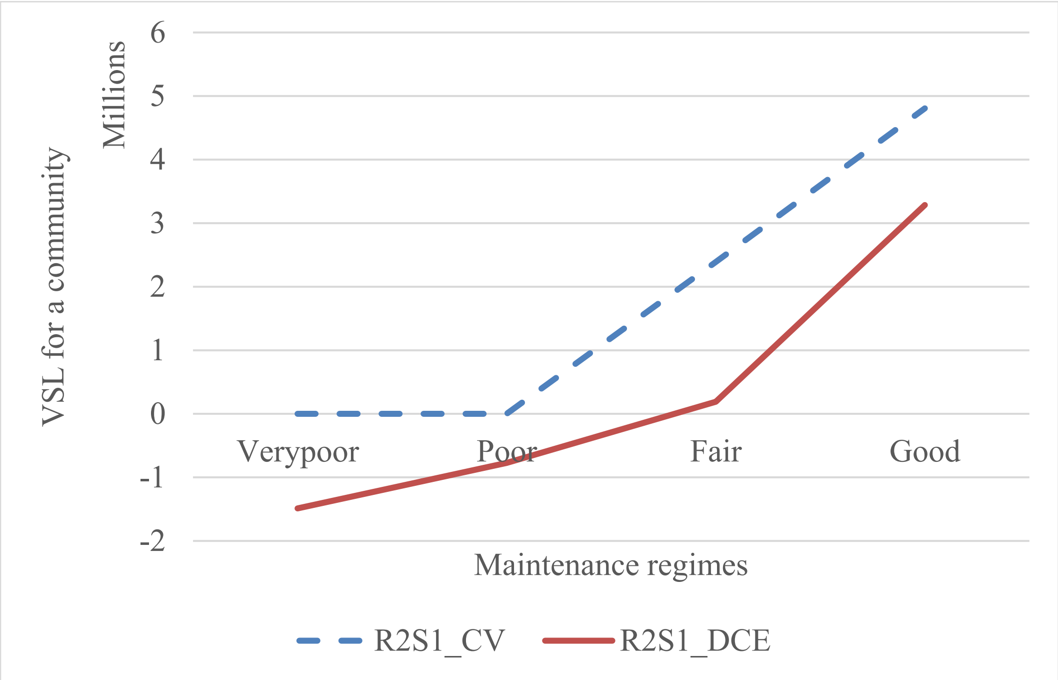

Figure 4-15. The comparison between the VSL for CV and DCE for R2S1

Similarly, Figures 4-19 and 4-20 show the VSL determined using CV and the DCE approaches for upgrading road sections R1S2 and R2S2 are not equal. Moreover, the VSL by CV was greater than by DCE.

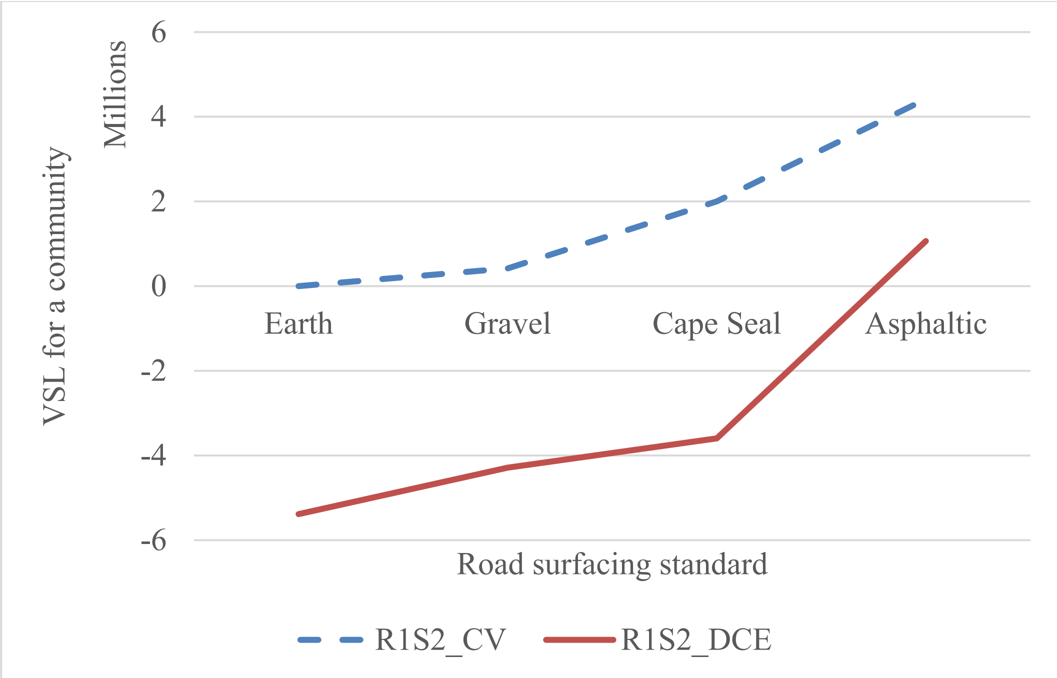

Figure 4-16. The comparison between the VSL for CV and DCE for R1S2

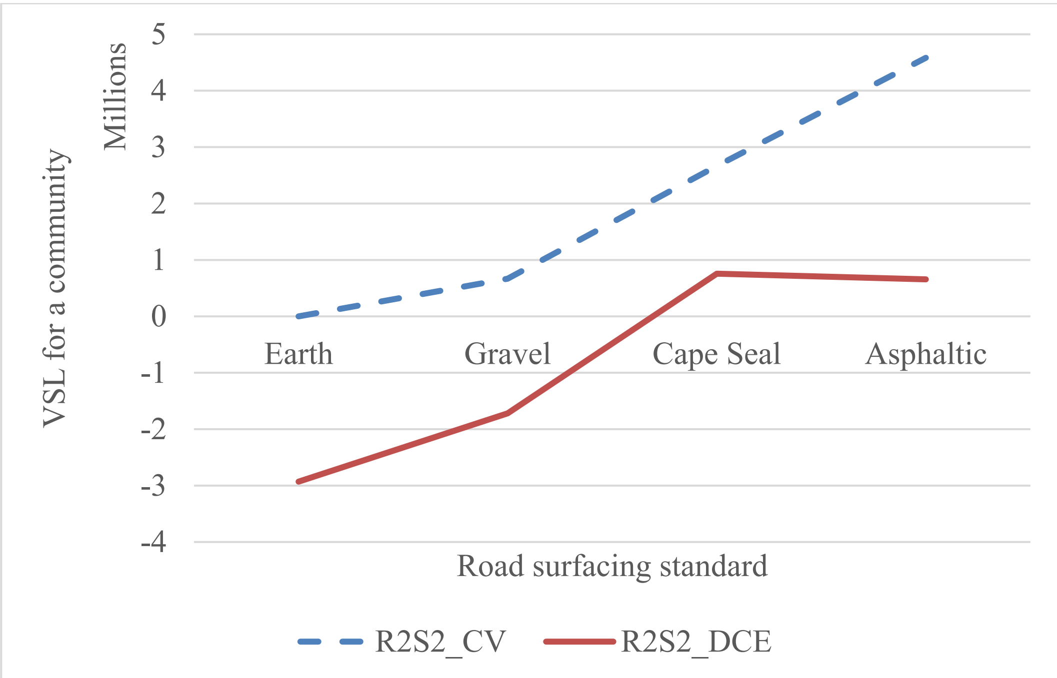

Figure 4-17. The comparison between the VSL for CV and DCE for R2S2

4.4 Monetisation of agricultural impact

This section describes how the data collected from the farmers in the four villages were used within the model developed in Section 3.3 (see Eq. 3-12) to monetise the impact of rural road investment to improve access from farms to collection points. As mentioned in the framework in Section 3.2.2, revenue was chosen as the indicator to be monetised, noting that revenue is not typically considered in economic terms to be suitable for use within a CBA. Therefore, the economic valuation technique chosen for this purpose was the elasticity of price, i.e. the relationship between the net income and transport costs (Workman et al., 2018).

4.4.1 Overview of agricultural transport in the areas

Regarding the transportation of agricultural produce in remote areas in Thailand, crop transportation is generally conducted by farmers, who ferry their produce over short distances from their farms to local collection points. At these points, farmers sell their produce to middlemen, who then sell the produce for industrial processing. The transportation mode used in the areas of study is the modern truck. However, along R1S2 (Sak Nga village) standard trucks cannot access the farms because of challenging road conditions and gradients. Instead, farmers utilise Thailand’s traditional tractors, known as E-Taks (Figure 4-21) to transport their produce. These vehicles can carry loads from a half to one tonne. E-Taks are capable of transporting produce up and down steep gradients and on poor roads, but they carry lighter loads than modern trucks. The smaller the load that a farmer’s vehicle can take due to poor road conditions, the greater the number of trips required, resulting in an increase in transportation costs. For example, in R1S2 (Sak Nga village), the load capacity per vehicle journey is lower than for other villages by approximately half because the condition of the roads is very poor, and the terrain is steep and mountainous.

Figure 4-18. E-Tak (Source: author)

Figure 4-19. Medium truck (Source: author)

Figure 4-20. Pickup (Source: author)

Figure 4-21. Local cottage for crop storage in Sak Nga (R1S2) (Source: author)

Figure 4-22. Local collection point in Sak Nga (R1S2) (Source: author)

Farmers in these regions farm cassava and corn, which suffer little damage during transportation; their value is affected by moisture rather than any damage caused during transportation. Therefore, farmers are not generally concerned about the effect of the condition of the roads on their crops. At the time of this research, corn was the major crop in the area, with a sale price of about 5 THB/kg, and cassava had a sale price of about 2.5 THB/kg. However, the cassava production was about 1.6 tons/rai (1 rai = 1,600 m^2), while corn was just 0.75 tons/rai. In the mountainous areas, people prefer corn to cassava, since corn can be cultivated with ease, while farmers have to dig cassava from the ground (see Figure 4-26).

Figure 4-23. Farmers loading cassava onto an E-Tak vehicle (left) and corn cultivation (right) (Source: author)

4.4.2 Elasticity of price

The elasticity of price was selected to ascertain the relationship between the net income (gross revenue from crop sales minus transport cost) and transport costs, i.e. the percentage change in income divided by the percentage change in transport cost. The model for the elasticity of price was developed in Section 3.3.3.

- **Data collection**

The collected data from each farmer in the R2S2 village are shown in Table 4-23, and the data from the other villages are provided in full in Appendix C. The data for all villages are summarised in Table 4-24. Survey data, including details of the farmed areas, local crop types, crop amounts, crop sale price and types of vehicles used to transport goods from the farm to the relevant collection point, were obtained by interviewing farmers at two local collection points, served by farms located along the two road projects. Figure 4-27 illustrates the researcher collecting data at a farm in Sak Nga village (R1S2).

Figure 4-24. Collecting data at a farm (Source: author)

Overall, 83 farmers were interviewed, approximately 20 for each of the four villages. This represents approximately 32% of the total farmers who use the collection points. The number of farmers could be considered representative of the total number because it can be challenging to obtain data for all farmers in such remote areas. The number of farmers interviewed was not the total number of farmers in any of the four villages considered (and therefore the associated metrics, such as the total amount of a particular crop, are not equal to the totals from the villages). However, this research obtained secondary data from a local authority, such as the total cultivation areas and the total number of farmers so that the calculation reflected the total economic value of agriculture-related transport in the areas.

According to the Department of Agricultural Extension, in 2019, corn and cassava were the main crop types in the area of the study. Farmers growing fruits and vegetables were excluded from this research as these were not found in this survey. Moreover, there is no irrigation system that is sufficient for those fruits and vegetables. Corn and cassava are crops that can grow using rainwater. Note that corn and cassava are cultivated twice a year. Farmers plant the seeds in the ground and then leave them to grow for a few months at a time.

Table 4-23 presents the collected data for farmers in the R2S2 village (Rom Klao); for other villages see Appendix C. From the table, for agriculture, data on farm area, crop types and crop volume were collected. These three datasets were used to calculate total transport cost and total agricultural volume in the areas. Transportation data included vehicle type, loading capacity and distance. As mentioned earlier, the mode of transport in R1S1, R2S1 and R2S2 is based on the medium truck that can transport crops at its full capacity, accounting for four tons per trip. The average distance for each farmer is assumed to be the distance from the villages to the point. Therefore, transportation data for each farmer in each of the three villages are assumed to be the same within each village.

Table 4-23. Data collection for farmers in R2S2 (Rom Klao)

Agriculture Data				Transport Data		
Number Of farmers	Farm Area (Rai)	Crop type	Crop volume (Ton/rai)	Vehicle type	Load capacity (Ton)	Distance (km)
1	7	Corn	0.78	The truck	4	10
2	7	Corn	0.68	The truck	4	10
3	8	Corn	0.64	The truck	4	10
4	9	Corn	0.8	The truck	4	10
5	9	Corn	0.69	The truck	4	10
6	5	Corn	0.67	The truck	4	10
7	10	Corn	0.85	The truck	4	10
8	9	Corn	0.86	The truck	4	10
9	7	Corn	0.67	The truck	4	10
10	6	Corn	0.69	The truck	4	10
11	9	Corn	0.72	The truck	4	10
12	6	Corn	0.74	The truck	4	10
13	7	Corn	0.75	The truck	4	10
14	10	Corn	0.74	The truck	4	10
15	8	Casava	1.68	The truck	4	10
16	7	Casava	1.6	The truck	4	10
17	8	Corn	0.65	The truck	4	10
18	7	Corn	0.73	The truck	4	10
19	13	Corn	0.85	The truck	4	10
20	11	Corn	0.72	The truck	4	10

Figure 4-28 presents the average farm areas for each household in each village. From the figure, villages for R1S1, R2S1 and R2S2 have average farm areas of about 8 rai per household (1 rai = 1,600 m^2). However, R1S2 has an average area of about 3 rai per household.

Figure 4-29 presents the average crop production for each farmer's household in each village. From the figure, corn has an average output of 750 kg/rai and cassava about 1,700 kg/rai. Note that the sale price of corn was 5 THB/kg and cassava was 2.5 THB/kg at the time of this study. In the areas of study, most of the crops grown were corn because it had a better price and can grow well in mountainous area. Corn is used for animal food, which is not sufficient in Thailand and needs to be imported from neighbouring countries.

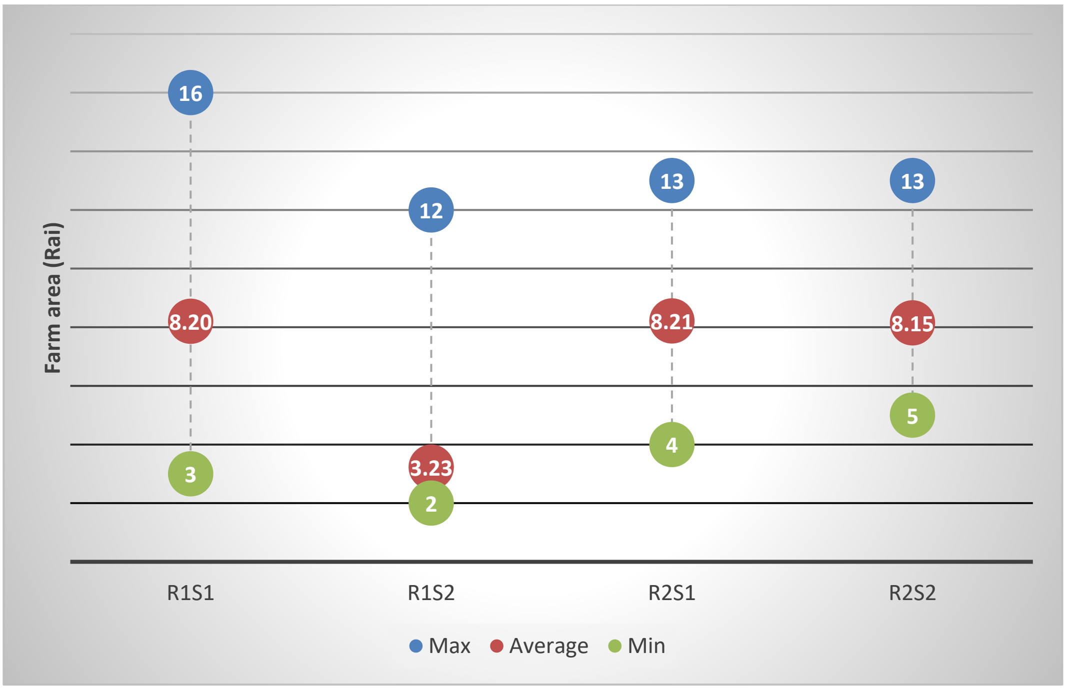

Figure 4-25. Farm area per household

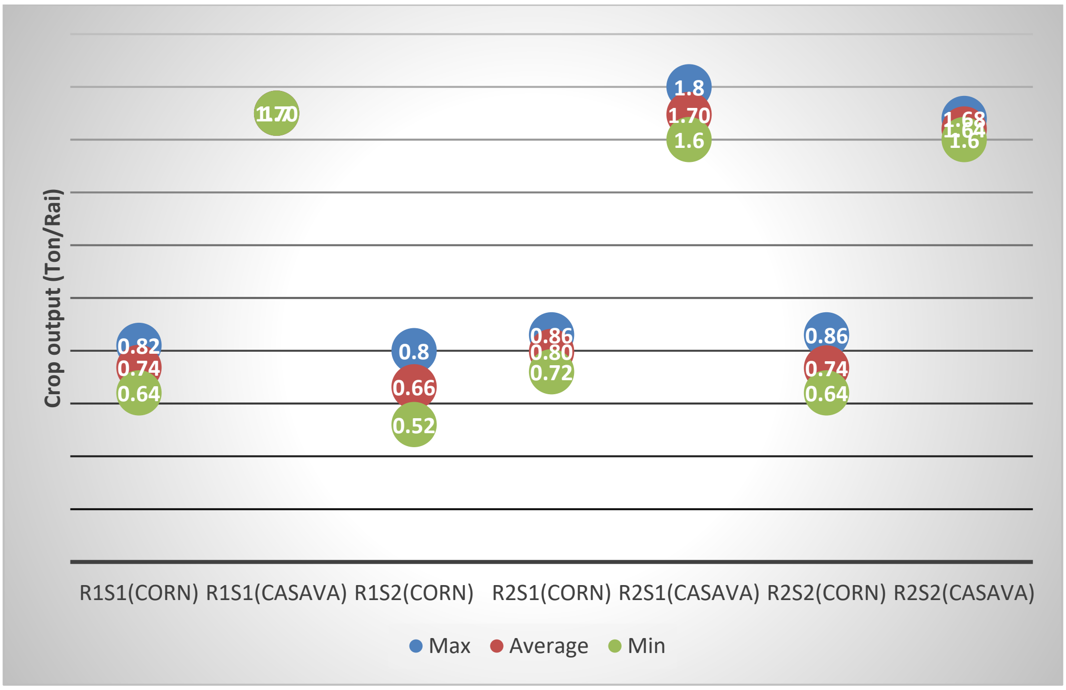

Figure 4-26. Crop volume per household

Figure 4-27. Farmers' revenue per household

Figure 4-30 presents the average revenue per household for each village. The revenue for each farmer can be estimated by multiplying the total crop amount for each farmer by the crop sale price. From the figure, the average earning for R1S1, R2S1 and R2S2 was about 60,000 THB/household/year (1 THB = 40 GBP). However, the average earning for R1S2 was just 20,000 THB/household/year. This is because the farmable area in R1S2 was just 3 rai per household.

The transportation data included vehicle type, vehicle loading capacity and the distance from farms to the collection points. These were used to estimate freight costs. Note that this research focused on the road conditions that affected freight cost; it did not consider the rental cost for the truck. The freight cost was derived from vehicle operation cost (VOC), which can be estimated by the RED model, in which the VOC is a function of the road condition (IRI). The RED model requires vehicle kilometres travelled (VKT) to estimate the VOC. In this research, the truck owners in the areas were interviewed to find out their mileage, which was about 40,000 km/year because they do not only work in one area. E-Taks and pickups belong to the farmers. Therefore, these vehicle costs were estimated by the total crop volume in the area. For example, in R1S2, the total crop volume was 210,000 kg. This number was divided by the E-Tak's capacity of 1,000 kg/trip. The total number of trips in the area was 210 trips, and each trip (round trip) was 20 km/trip. As a result, the VKT of the E-Taks was about 4,200 km/year. For other data from the RED, such as tire cost and fuel depletion, see Appendix D.

Figure 4-31 presents the VOC for each vehicle type for various road surface types and conditions (IRI). Note that the VOC is a function of road conditions (IRI) and surface type, e.g. gravel, which can be calculated from the RED. From the figure, the VOC for medium trucks is greater than for E-Taks and pickups by almost 10 THB/km for all surface types and conditions. However, agricultural transport considers freight cost that can be given by the VOC divided by load capacity (Ellis, 1996).

Figure 4-32 presents the freight cost for each vehicle type at full load capacity. From the figure, when compared with E-Taks and pickup trucks, the freight cost for medium trucks was the lowest. The VOC in Figure 4-32 was used to calculate the freight cost for transporting crops for each vehicle type. These VOCs were then divided by the vehicle load capacity for each vehicle type. The maximum load capacity for medium trucks is 4,000 kg per trip while pickups and E-Taks have a maximum load capacity of 1,000 kg per trip each. This implies that the medium truck is the most effective vehicle for transporting crops. The calculations showed that E-Taks were the most expensive mode of transport, which makes them the least effective.

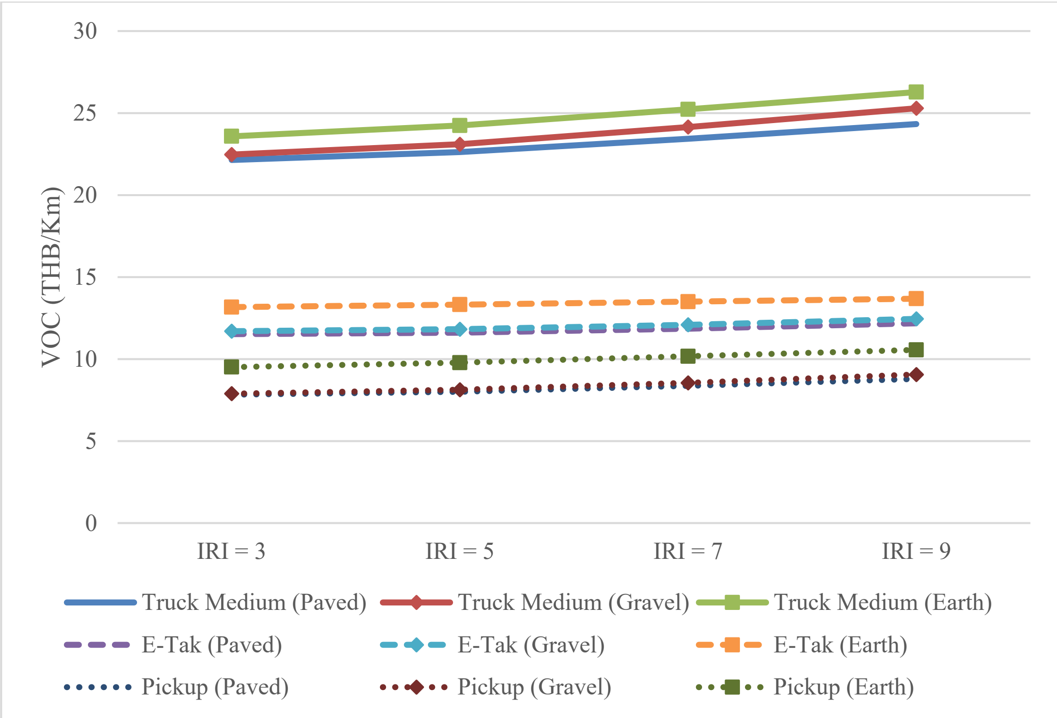

Figure 4-28. VOC by vehicle type

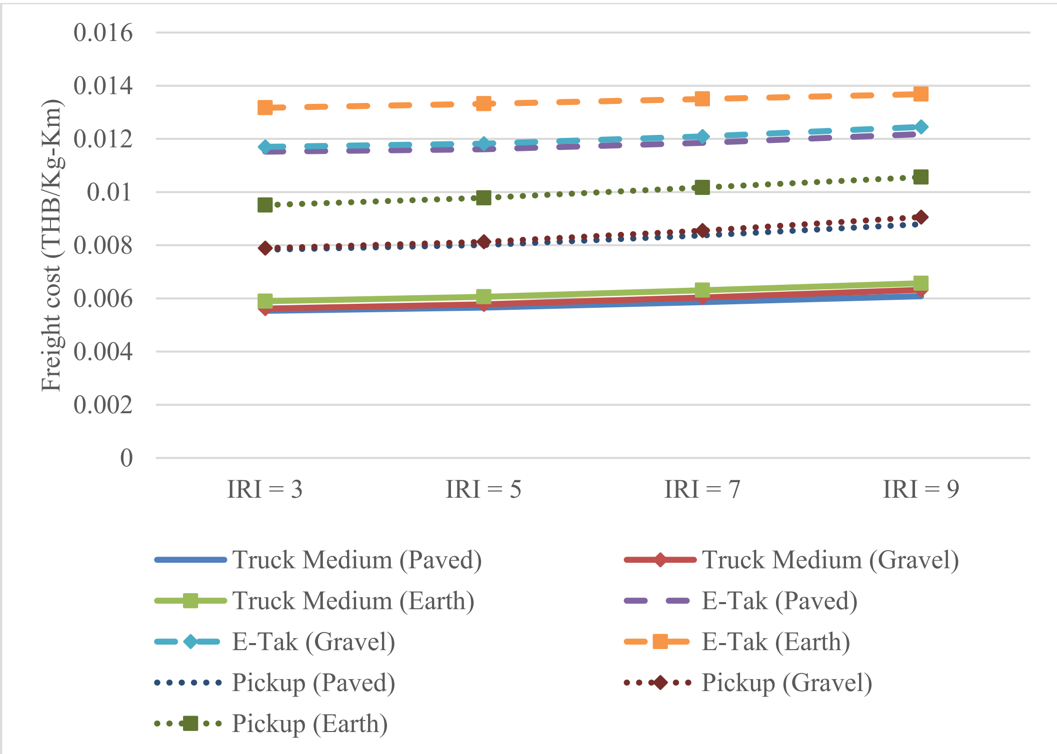

Figure 4-29. Freight cost by vehicle type

Figure 4-33 shows the freight cost for R1S2 (Sak Nga) on earth roads (existing condition) for various vehicle types. Note that in R1S2, the medium truck cannot access this road because it is in a steep, mountainous area. The assumption in the figure is that the truck had to reduce its load capacity by half (from 4 to 2 tonnes) to access the R1S2 farms. Its freight cost could be equal to that of an E-Tak, but greater than that of a pickup. Therefore, the medium truck was not effective if it could not carry crops at its full capacity.

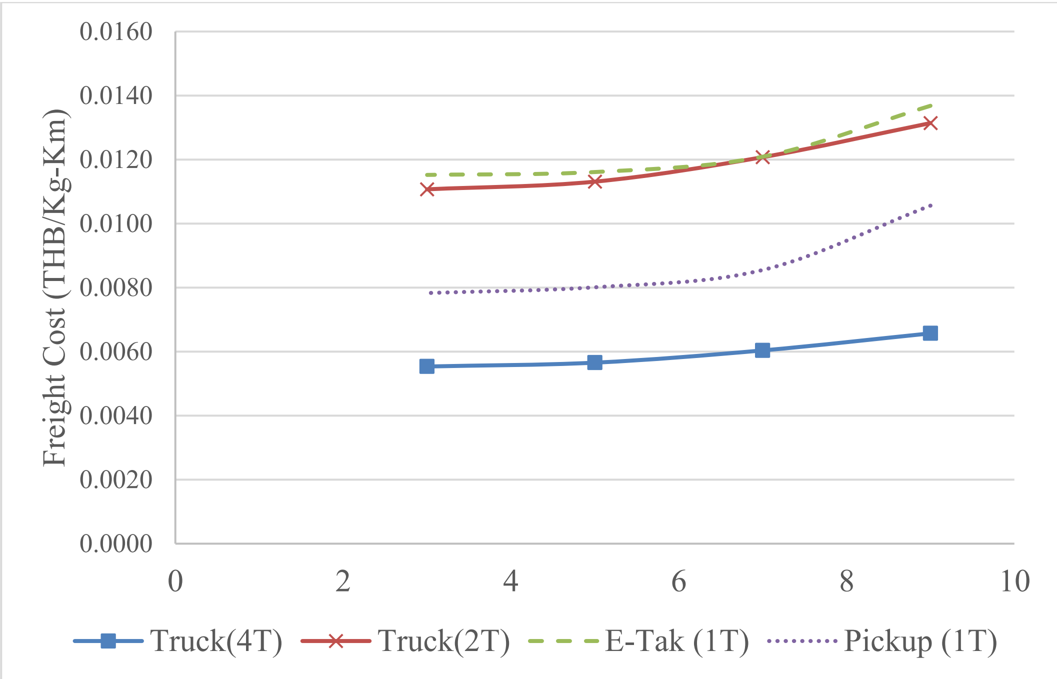

Figure 4-30. Freight cost for the medium truck at a 2-tonne load capacity

Figure 4-34 presents the average freight cost per household. Figure 4-35 presents the proportion of freight cost to the farmers' revenue. As expected, in R1S2 where medium trucks cannot access, freight cost accounts for 3% of revenue, while in other areas that the truck can access freight cost accounts for 1%.

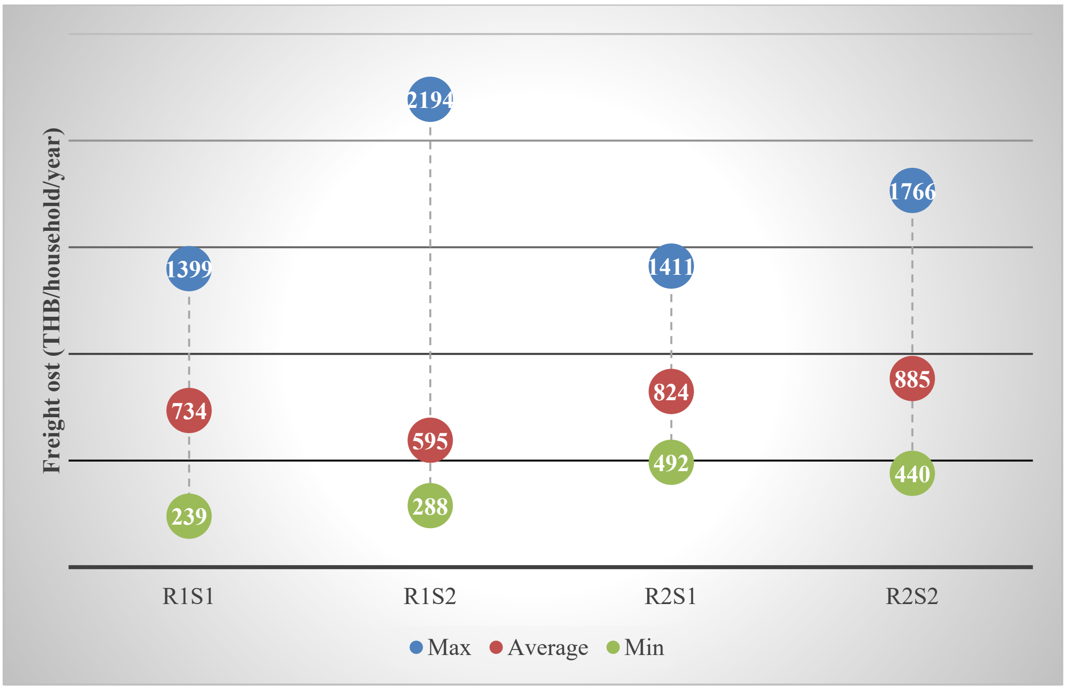

Figure 4-31. Farmers' transport cost per household/year

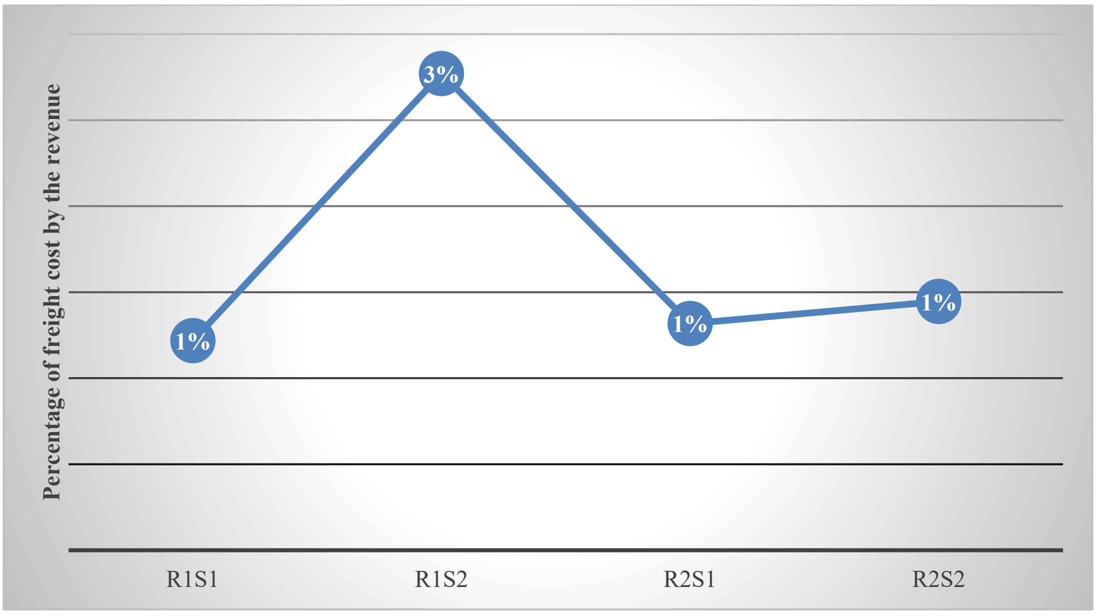

Figure 4-32. The proportion of freight cost to revenue by village

Table 4-24. The summary of agricultural produce and transportation data

Agriculture produces and transport data	**R1S1 Hin Ngon**	**R1S2 Sak Nga**	**R2S1 Pao Thai**	**R2S2 Rom Klao**
(1) Total agriculture area (Rai)*	797	140	550	290
(2) Total household number of farmers *	98	43	75	37
(3) The household number of farmers (By interview)	20	22	21	20
– Corn	18 (90%)	22 (100%)	17 (81%)	18 (90%)
– Casava	2 (10%)	0 (0%)	4 (19%)	2 (10%)
(4) Crop amount per area (Tonne/Rai) (By interview)				
– Corn	0.75	0.66	0.8	0.78
– Casava	1.70	-	1.70	1.64
(5) Crop price @ the point (THB/Kg)				
– Corn	5	5	5	5
– Casava	2.5	2.5	2.5	2.5
(6) The utilization of vehicle type (By survey)				
– E-Tak (The farmer vehicle)	-	86%	-	-
– Pickup	-	14%	-	-
– Middle truck	100%	-	100%	100%
(7) Loading (Tonne) (By interview)				
– E-Tak (The farmer vehicle)	-	1.0	-	-
– Pickup	-	1.0	-	-
– Middle truck	4.0	-	4.0	4.0

*Data derived from local road authority in the villages

Table 4-24, which looks at the vehicle types used to transport crops, shows that only E-Taks and pickups were used by farmers living alongside R1S2. E-Taks, which can only carry half a tonne of agricultural goods per trip, made up 86% of the total; the remaining 14% were pickups. This is because the road conditions in R1S2 were very poor and were not accessible to medium-sized trucks. All farmers in the other villages relied completely on hiring medium-sized trucks for all their transport.

- **Calculations**

The scenarios for each road project that varied road conditions, vehicle types and load capacity were determined in Section 3.2.5. Tables 4-25 to 4-28 present the calculations of the additional income and the elasticity for each of the four roads. Note that elasticity is a measure of a variable's sensitivity to a change in another variable. Elasticity refers to the degree to which freight cost supplied in response to income changes.

In Tables 4-25 to 4-28, the calculations from steps ① to ⑤ were for transport data to estimate total freight costs. Step ① presents four road alternative scenarios. Step ② presents the IRI for each scenario. Step ③ presents vehicle types used to transport agricultural products from farms to the points. Step ④ presents VOCs for each vehicle type, obtained using the RED model in Appendix D. Step ⑤ presents the load capacity for each vehicle type. In step ⑥, the freight cost for each type of road standard is determined from the VOC (step ④) for each vehicle type divided by the achievable load capacity (step ⑤).

The calculations from step ⑧ to ⑫ are for agricultural data to estimate gross revenue. Step ⑧ presents the cultivation time in which farmers cultivate crops twice a year. Step ⑨ presents the total farm areas. Steps ⑩ and ⑪ present crop quantity and crop sale price, respectively. Step ⑫ presents the total agriculture demand for transport in the area, given by cultivation time (step ⑧) multiplied by crop quantity (step ⑨) and crop area (step ⑩). Step ⑬ presents the total freight cost, given by the demand for transport (Step ⑫) multiplied by freight cost (Step ⑥) and distance (Step ⑦).

In step ⑭, revenue is determined by multiplying the demand for the produce (Step ⑫) by its sale price (step ⑪). In step ⑮, net income is determined by revenue (Step ⑭) minus total freight cost (step ⑬). Step ⑯ estimates additional income, given by the difference between the base case scenario and other alternative scenarios. Finally, in step ⑲, the elasticity income change (step ⑰) to freight cost (step ⑱) can be calculated using Eq. 3-12.

Table 4-25. The calculation of the elasticity for R1S1

① Scenario	**Very poor**	**Poor**	**Fair**	**Good**
② Road condition by IRI	VOC at IRI = 9.0 m/km	VOC at IRI = 7.0 m/km	VOC at IRI = 5.0 m/km	VOC at IRI = 3.0 m/km
③ Vehicle type	Middle Truck	Middle Truck	Middle Truck	Middle Truck
④ VOC (THB/Km)	26.28	24.15	22.62	22.14
⑤ Loading (Kg)	4,000.00	4,000.00	4,000.00	4,000.00
⑥ Freight cost (THB/Kg-Km)	0.0066	0.0060	0.0057	0.0055
⑦ Average distance (Km)	10.00	10.00	10.00	10.00
⑧ Cultivation (Time/year)	2	2	2	2
⑨ Area (Rai)	797.00	797.00	797.00	797.00
⑩ Crop amount (Kg/Rai)	750.00	750.00	750.00	750.00
⑪ Crop sale price (THB/Kg)	5	5	5	5
⑫ Demand for transport (Kg)	1,195,500	1,195,500	1,195,500	1,195,500
⑬ Total freight cost (THB)	78,544	71,730	67,606	66,171
⑭ Revenue (THB)	5,977,500	5,977,500	5,977,500	5,977,500
⑮ Net income (THB)	5,898,956	5,905,770	5,909,894	5,911,329
⑯ Additioinal income (THB)		-6,814	-10,939	-12,373
⑰ Income change %		0.12	0.07	0.02
⑱ Freight cost change %		-8.68	-5.75	-2.12
⑲ Elasticity demand		-0.013	-0.012	-0.011

Table 4-26. The calculation of the elasticity for R1S2 (Sak Nga)

① Scenario	**Earth road**	**Gravel Road**	**Cape Seal**	**Asphaltic**
② Road condition by IRI	VOC at IRI = 9.0 m/km	VOC at IRI = 7.0 m/km	VOC at IRI = 5.0 m/km	VOC at IRI = 3.0 m/km
③ Vehicle type	E-Tak	E-Tak	Pickup	Pickup
④ VOC (THB/Km)	13.68	12.09	8.10	7.83
⑤ Loading (Kg)	1,000	1,000	1,000	1,000
⑥ Freight cost (THB/Kg-Km)	THB 0.0137	THB 0.0121	THB 0.0081	THB 0.0078
⑦ Average distance (Km)	20.00	20.00	20.00	20.00
⑧ Cultivation (Time/year)	2	2	2	2
⑨ Area (Rai)	140	140	140	140
⑩ Crop amount (Kg/Rai)	750	750	750	750
⑪ Crop sale price (THB/Kg)	5	5	5	5
⑫ Demand for transport (Kg)	210,000	210,000	210,000	210,000
⑬ Total freight cost (THB)	57,456	50,778	34,020	32,886
⑭ Revenue (THB)	525,000	525,000	525,000	525,000
⑮ Net income (THB)	467,544	474,222	490,980	492,114
⑯ Additioinal income (THB)		-6,678	-23,436	-24,570
⑰ Income change %		1.43	3.53	0.23
⑱ Freight cost change %		-11.62	-33.00	-3.33
⑲ Elasticity demand		-0.123	-0.107	-0.069

Table 4-27. The calculation of the elasticity for R2S1

①	Scenario	**Very poor**	**Poor**	**Fair**	**Good**
②	Road condition by IRI	VOC at IRI = 9.0 m/km	VOC at IRI = 7.0 m/km	VOC at IRI = 5.0 m/km	VOC at IRI = 3.0 m/km
③	Vehicle type	Middle Truck	Middle Truck	Middle Truck	Middle Truck
④	VOC (THB/Km)	26.28	24.15	22.62	22.14
⑤	Loading (Kg)	4,000	4,000	4,000	4,000
⑥	Freight cost (THB/Kg-Km)	THB 0.0066	THB 0.0060	THB 0.0057	THB 0.0055
⑦	Average distance (Km)	10.00	10.00	10.00	10.00
⑧	Cultivation (Time/year)	2	2	2	2
⑨	Area (Rai)	550	550	550	550
⑩	Crop amount (Kg/Rai)	750	750	750	750
⑪	Crop sale price (THB/Kg)	5	5	5	5
⑫	Demand for transport (Kg)	825,000	825,000	825,000	825,000
⑬	Total freight cost (THB)	54,203	49,809	46,654	45,664
⑭	Revenue (THB)	2,062,500	2,062,500	2,062,500	2,062,500
⑮	Net income (THB)	2,008,298	2,012,691	2,015,846	2,016,836
⑯	Additioinal income (THB)		-4,393	-7,549	-8,539
⑰	Income change %		0.22	0.16	0.05
⑱	Freight cost change %		-8.11	-6.34	-2.12
⑲	Elasticity demand		-0.027	-0.025	-0.023

Table 4-28. The calculation of the elasticity for R2S2

①	Scenario	**Earth road**	**Gravel Road**	**Cape Seal**	**Asphaltic**
②	Road condition by IRI	VOC at IRI = 9.0 m/km	VOC at IRI = 7.0 m/km	VOC at IRI = 5.0 m/km	VOC at IRI = 3.0 m/km
③	Vehicle type	Middle Truck	Middle Truck	Middle Truck	Middle Truck
④	VOC (THB/Km)	26.28	24.15	22.62	22.14
⑤	Loading (Kg)	4,000	4,000	4,000	4,000
⑥	Freight cost (THB/Kg-Km)	THB 0.0066	THB 0.0060	THB 0.0057	THB 0.0055
⑦	Average distance (Km)	20.00	20.00	20.00	20.00
⑧	Cultivation (Time/year)	2	2	2	2
⑨	Area (Rai)	290	290	290	290
⑩	Crop amount (Kg/Rai)	750	750	750	750
⑪	Crop sale price (THB/Kg)	5	5	5	5
⑫	Demand for transport (Kg)	435,000	435,000	435,000	435,000
⑬	Total freight cost (THB)	57,159	52,526	49,199	48,155
⑭	Revenue (THB)	1,087,500	1,087,500	1,087,500	1,087,500
⑮	Net income (THB)	1,030,341	1,034,974	1,038,302	1,039,346
⑯	Additioinal income (THB)		-4,633	-7,961	-9,005
⑰	Income change %		0.45	0.32	0.10
⑱	Freight cost change %		-8.11	-6.34	-2.12
⑲	Elasticity demand		-0.055	-0.051	-0.047

➢ **Results**

The above section showed the calculation for the villages. Using the above data, the elasticity of income for each study was obtained, using the equations given in Section 3.2.5. Table 4-29 summarises the elasticity for the four areas (step ⑲), and Table 4-30 summarises the additional income (Thai baht/village/year; Step ⑯) that farmers in the village could obtain from each type of road intervention (scenarios).

Table 4-29 shows that the elasticity for each village ranges between −0.013 and −0.123 for each road scenario. This means that a 1% increase in freight cost reduces the net income by 1.3% to 12.3%. In other words, a 1% decline in the cost is associated with a 1.3% to 12.3% increase in farmers' incomes.

Table 4-29 shows that R1S2 was affected most by road interventions, as its elasticity was -0.12%, since those farmers utilised E-Taks, which are ineffective for crop transport. In R1S1, R2S1 and R2S2 where the medium trucks already had access, improvements in road conditions had little effect on farmers' income. The elasticity of each road improvement can gradually decrease, i.e., very poor road (IRI = 9) to poor road (IRI = 7), and very poor road (IRI = 9) to good road (IRI = 3), which implies that road projects could increase additional income for farmers.

Table 4-29. The elasticity for each section in percent

IRI	Road project 1		Road project 2	
	R1S1 (Hin Ngon)	**R1S2 (Sak Nga)**	**R2S1 (Pao Thai)**	**R2S2 (Rom Klao)**
7	-0.013	-0.123	-0.027	-0.055
5	-0.012	-0.107	-0.025	-0.051
3	-0.011	-0.069	-0.023	-0.047

Table 4-30 presents the additional income (THB/village/year) per road scenario. The additional income can be estimated as the difference between the net income for based case and the three scenarios. From the figure, the additional income from improved road projects for each village was very tiny. For example, for a good road scenario (IRI = 3) in R1S1, by dividing the additional income (12,373 THB) by the number of farmers in the village (98 farmers), these farmers could earn an additional income of 126 ($4) THB/farmer/year. Note that the additional income will be used as a monetary value for agricultural benefit in the appraisal.

Table 4-30. Additional income by type of road improvement (THB/village/year)

IRI	Road project 1		Road project 2	
	R1S1 (Hin Ngon)	**R1S2 (Sak Nga)**	**R2S1 (Pao Thai)**	**R2S2 (Rom Klao)**
7	6,366	6,678	4,393	4,633
5	10,939	23,436	7,549	7,961
3	12,373	24,570	8,539	9,005

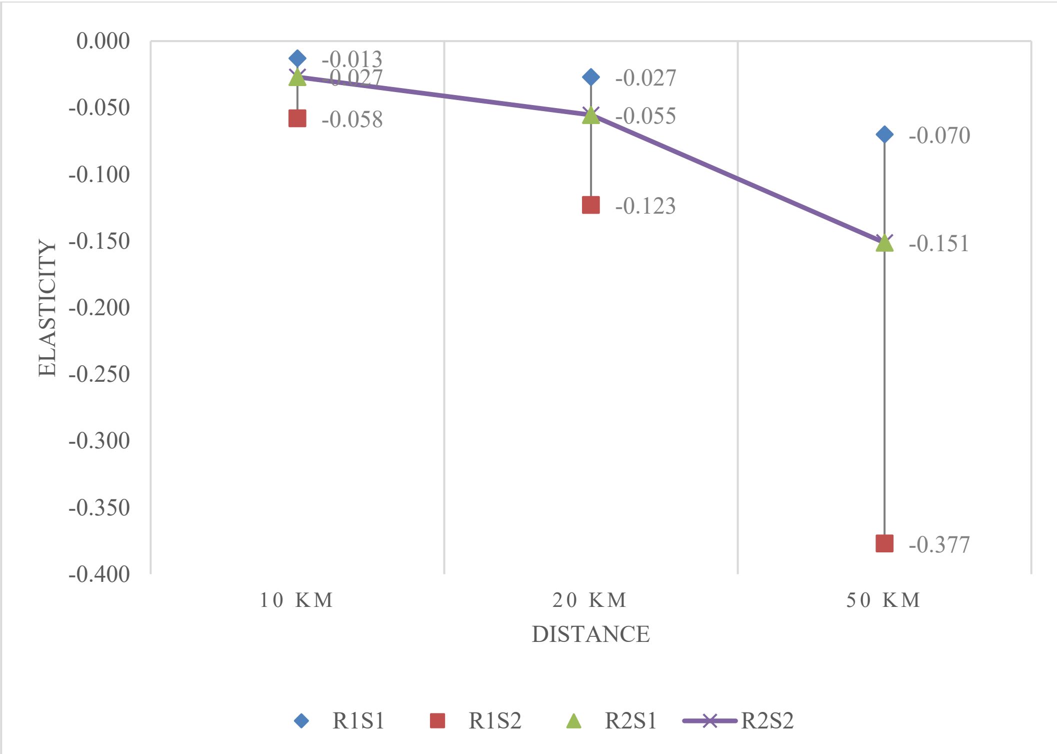

Figure 4-33. Elasticity by distance at IRI of 7

Figure 4-33 presents the variation in elasticity at IRI of 7 m/km (poor road condition) by distance from farms to local collection points. From the figure, overall, at 10 km from farms to the point, the elasticity was less negative than at 20 km (within the sub-district area) and 50 km (in the district area). This implies that increases in distance from farms to the point reduces farmer's income. Therefore, the point should not be far away from the farms for small-scale farmers for the freight cost to not affect their income. For example, in R1S2, if the point was just 10 km from their farms (in the village), the freight cost reduced the net income by just 5.8% (elasticity = −0.058). However, if the points were 50 km away (in-district), the freight cost could reduce up to 37.7% of the income (elasticity = −0.377). This can be a strategy for the local authorities for relocating collection points.

4.5 Discussion

This section discusses the results of the monetisation approaches described in sections 4.3.1, 4.3.2 and 4.4.2 in terms of comparison. The VSL and the additional income for each of the four-village roads were compared. In general, and as might be expected, the less upgrading or the lower the maintenance standard, the lower the value of the social benefit that is accrued, with all other things being equal. From this monetisation, it is apparent that three issues should be considered.

First, varying road interventions could yield varying social values, low standard of road treatment can yield relatively low the value of social benefits. As expected, the case studies used in this research found that both the VSL and net income are a function of the type of road intervention, be it upgrading a road to an improved standard or improving the standard of an existing road via maintenance. Figures 4-37 to 4-40 illustrate the relationship between the VSL and the additional income and road conditions. From the figures, the VSL and the additional income can increase as the road condition is improved to a higher standard.

On the other hand, price elasticity was used to identify the sensitivity of the relationship between transport cost (freight cost) and income. The income can vary as a result of changes in transport cost from different types of road interventions. However, transport costs had little effect on the income, as the elasticity was just −0.013 to −0.123. Moreover, the transport cost derived from the actual WTP was a function of IRI. Therefore, the additional income obtained could relate to the economic benefits of savings in RUC.

Secondly, varying economic valuation techniques could yield varying social values. The comparison between CV and DEC identifies varying the VSL despite that fact that these two techniques are modelled using the corresponding variables (Table 4-4). The monetised concept of economic valuation techniques is important to identify the social benefits rising from rural road projects. The selection of these techniques depends on the purpose of road projects themselves. Road projects that are proposed mainly for reducing health risk should be examined by health-related techniques. The projects that are built for the purpose of recreational travel should be monetised by travel cost method. Accordingly, it can be strongly said that not all techniques are appropriate for all social benefits.

Finally, the value of social benefits can be varied by household demographics such as income, health condition, occupation, which these demographic variables necessitate the model development. As shown in Figure 4-8 to 4-11, villagers whose are income greater than minimum wage stated WTP greater than those with lower income. Research should focus on demographics since social benefit could be varied by community's demographics.

Figures 4-37 to 4-40 illustrate the total social benefit, which is the sum of the VSL and the additional income. From the figures, the VSL is considerably greater than the additional income. However, this may not indicate that healthcare access would be more important than agricultural access, since VSL and income were based on different monetisation concepts.

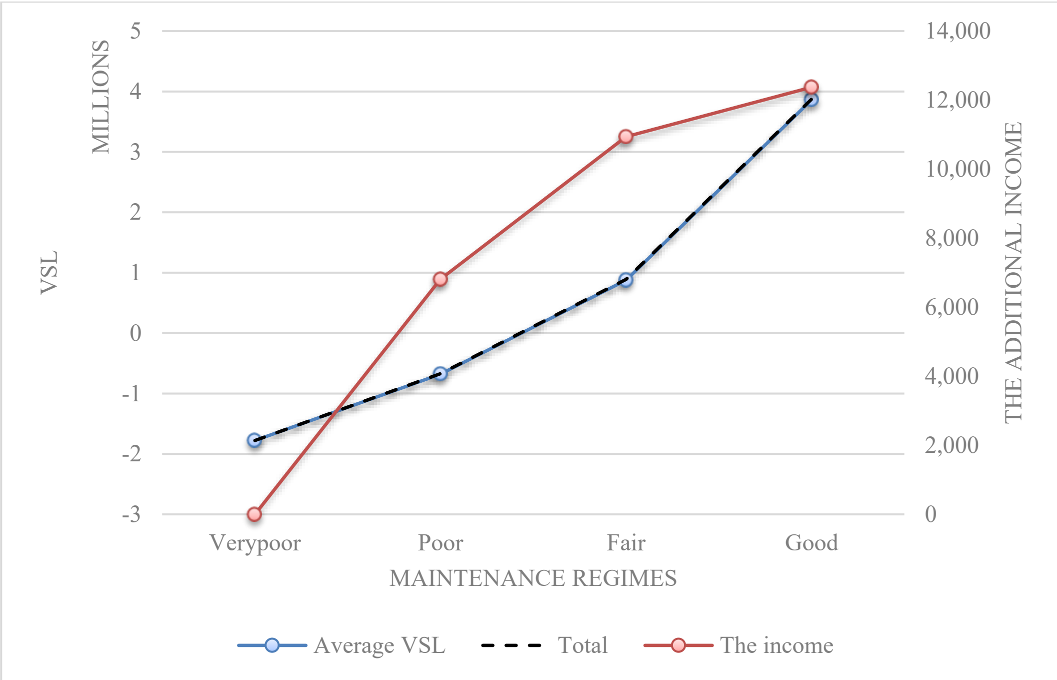

Figure 4-34. The total social benefit for R1S1

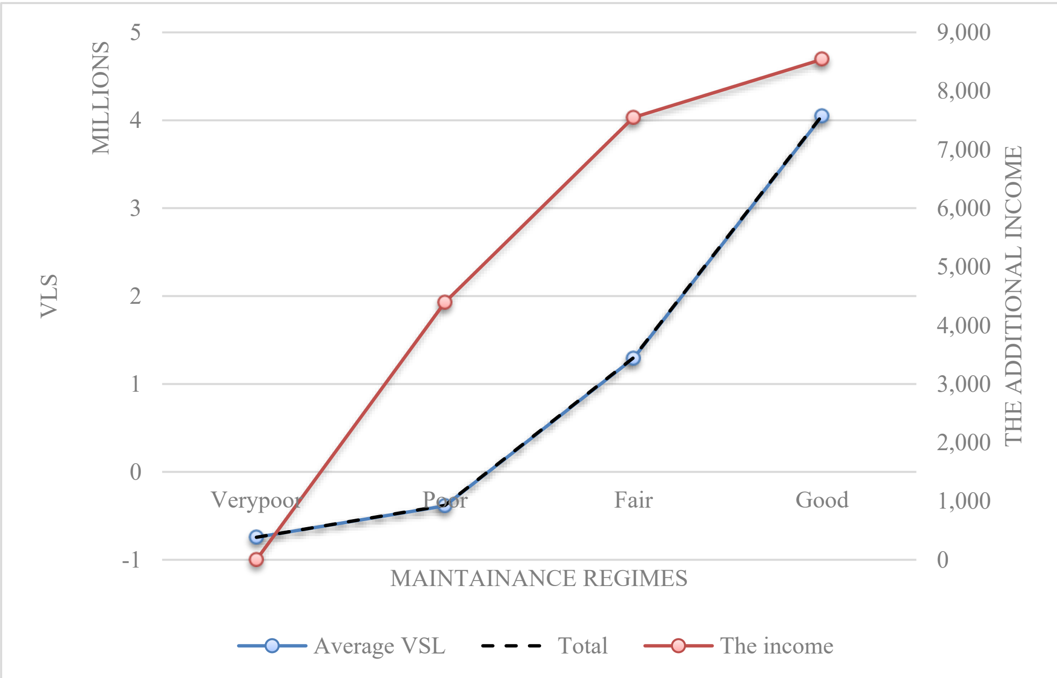

Figure 4-35. The total social benefit for R2S1

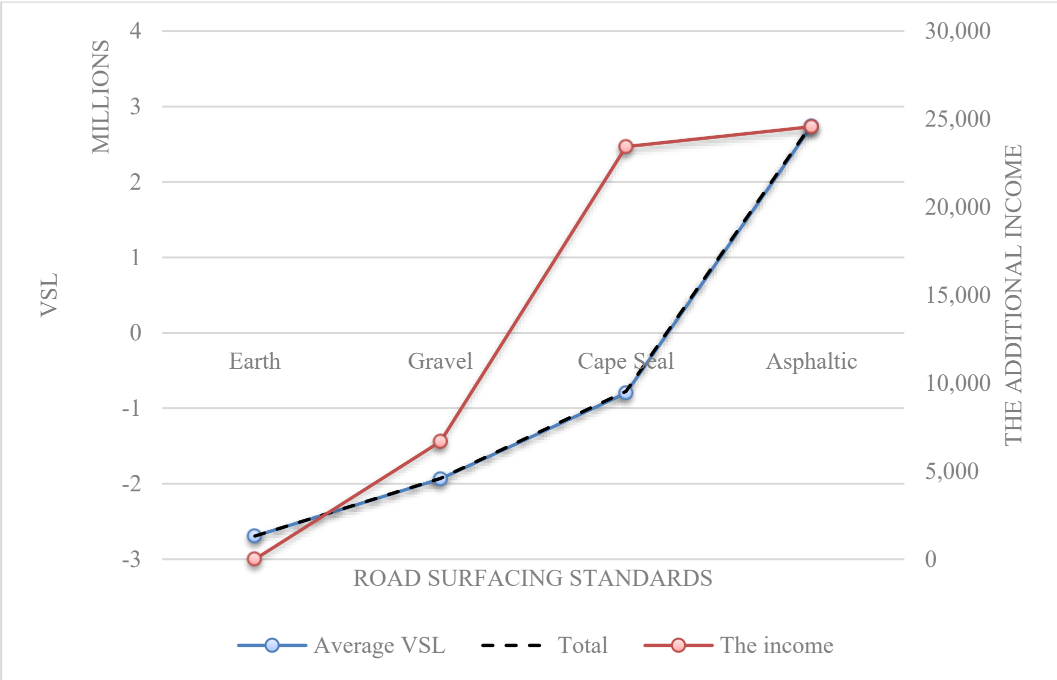

Figure 4-36. The total social benefit for R1S2

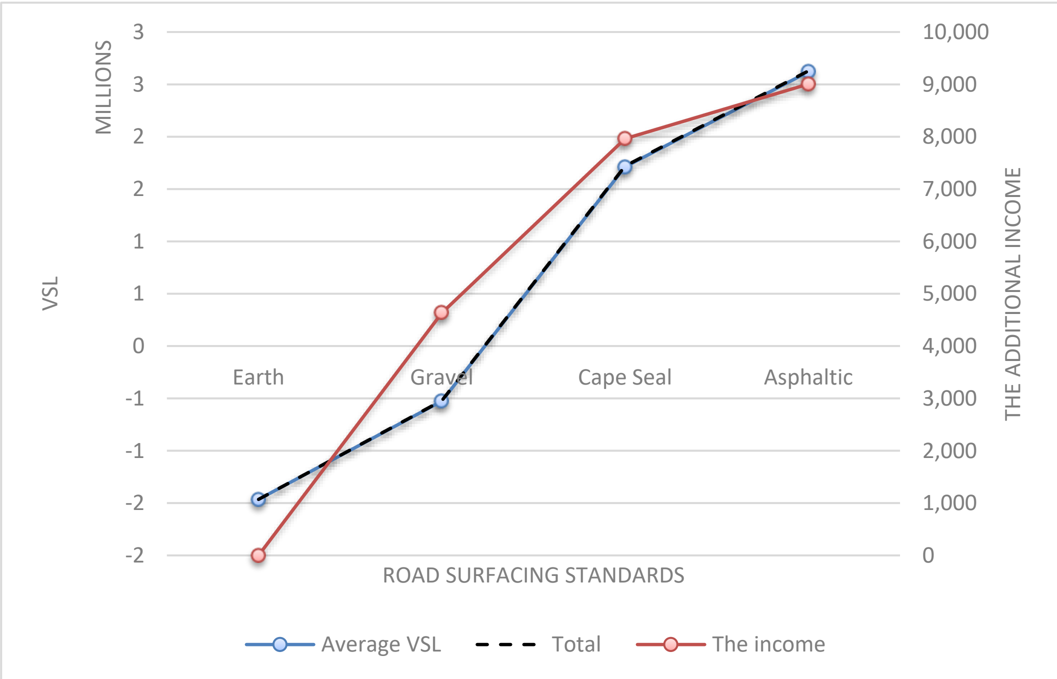

Figure 4-37. The total social benefit for R2S2

Tables 4-31 to 4-34 demonstrate the total social benefit (Thai baht/project/year) that will be used for the road appraisal in Chapter 5.

Table 4-31. The total social benefit for R1S1

	R1S1_CV	R1S1_DCE	Average VSL	The income	Total
Very poor	0	-3,555,000	-1,777,500	0	-1,777,500
Poor	0	-1,356,667	-678,333	6,814	-671,519
Fair	2,360,833	-605,000	877,917	10,939	888,856
Good	4,972,500	2,747,500	3,860,000	12,373	3,872,373

Table 4-32. The total social benefit for R2S1

	R2S1_CV	R2S1_DCE	Average VSL	The income	Total
Very poor	0	-1,488,333	-744,167	0	-744,167
Poor	0	-772,500	-386,250	4,393	-381,857
Fair	2389167	190,833	1,290,000	7,549	1,297,549
Good	4,805,833	3,285,000	4,045,417	8,539	4,053,956

Table 4-33. The total social benefit for R1S2

	R1S2_CV	R1S2_DCE	Average VSL	The income	Total
Earth	0	-5,385,000	-2,692,500	0	-2,692,500
Gravel	416,667	-4,288,333	-1,935,833	6,678	-1,929,155
Cape Seal	2,000,000	-3,595,833	-797,917	23,436	-774,481
Asphaltic	4,416,667	1,064,167	2,740,417	24,570	2,764,987

Table 4-34. The total social benefit for R2S2

	R2S2_CV	R2S2_DCE	Average VSL	The income	Total
Earth	0	-2,930,000	-1,465,000	0	-1,465,000
Gravel	666,667	-1,720,000	-526,667	4,633	-522,034
Cape Seal	2,666,667	756,667	1,711,667	7,961	1,719,628
Asphaltic	4,583,333	655,000	2,619,167	9,005	2,628,172

4.6 Summary

This chapter presents case study data obtained from two road projects – each road has two sections passing through four villages. The data were used to demonstrate how the techniques identified in Sections 3.3.1 and 3.3.2 could be used to quantify the VSL in monetary terms using the CV and DCE techniques, respectively. Moreover, the agricultural data were used to show how the net income to farmers alongside the road sections could be determined using the elasticity of income approach identified in Section 3.3.3.

For the VSL calculation, it was found that the CV and DCE techniques yielded different results (see Section 4.3.4). For the net income calculations, it was found that the elasticity of price method concluded that improved road projects – freight costs – did less affect the income distributed to farmers, as the elasticity was low.

With a few exceptions, both the VSL and net income methods showed increased monetised social benefits with increased investment, be it improved road standards resulting from a more durable road surfacing or maintenance of existing paved road surfaces.

This chapter also compared the VSL to the income and found that for all villages, the VSL was greater than the income. However, this does not imply that health access is more important than farm access because these access types were estimated using different concepts. However, improving these road projects could alleviate the health impact on this remote society.

Chapter 5 presents the road economic appraisal by considering the VSL and the net income obtained from Chapter 4.

CHAPTER 5 ECONOMIC APPRAISAL

5.1 Introduction

As far as this research is concerned, appraising rural road projects is associated with maintaining existing asphaltic roads to various standards (R1S1 and R2S1) and upgrading existing earthen roads to varying surfaced roads to provide all-year access to rural communities in Sak Nga (R1S2) and Rom Klao (R2S2) villages. Significant precipitation in the rainy season results in the closure of sections of the earthen roads for several months every year and inhibits the ability of rural communities in agricultural production and access to healthcare.

In Chapter 4, the healthcare and farm access associated benefits were monetised. These potential benefits of improved access were quantified using the VSL and additional income economic approaches. Objective 6.1 of this research is to do with whether the VSL and the additional income obtained are effective measures for improving road appraisal and the objective is the subject of this chapter. To this end, this chapter describes a road economic appraisal by means of CBA for the two road projects, with the four road sections included in the appraised. It also compares the resulting appraisal with and without the identified monetary benefits. Section 5.2 presents rural road economic appraisal, while Section 5.3 examines feedback obtained from Thailand's Rural Roads Department (DRR) and local road authorities (LA). Section 5.4 discusses the economic appraisal and the feedback obtained from the road agencies.

5.2 Rural road economic appraisal

To appraise the economic feasibility of rural road projects, the use of resources and project benefits were analysed by comparing the with and without project scenarios using

CBA. The approach is summarised in Figure 5.1. In addition, to try to model data uncertainties, a sensitivity analysis was carried out to investigate the effect of potential variations in costs and benefits in economic appraisal.

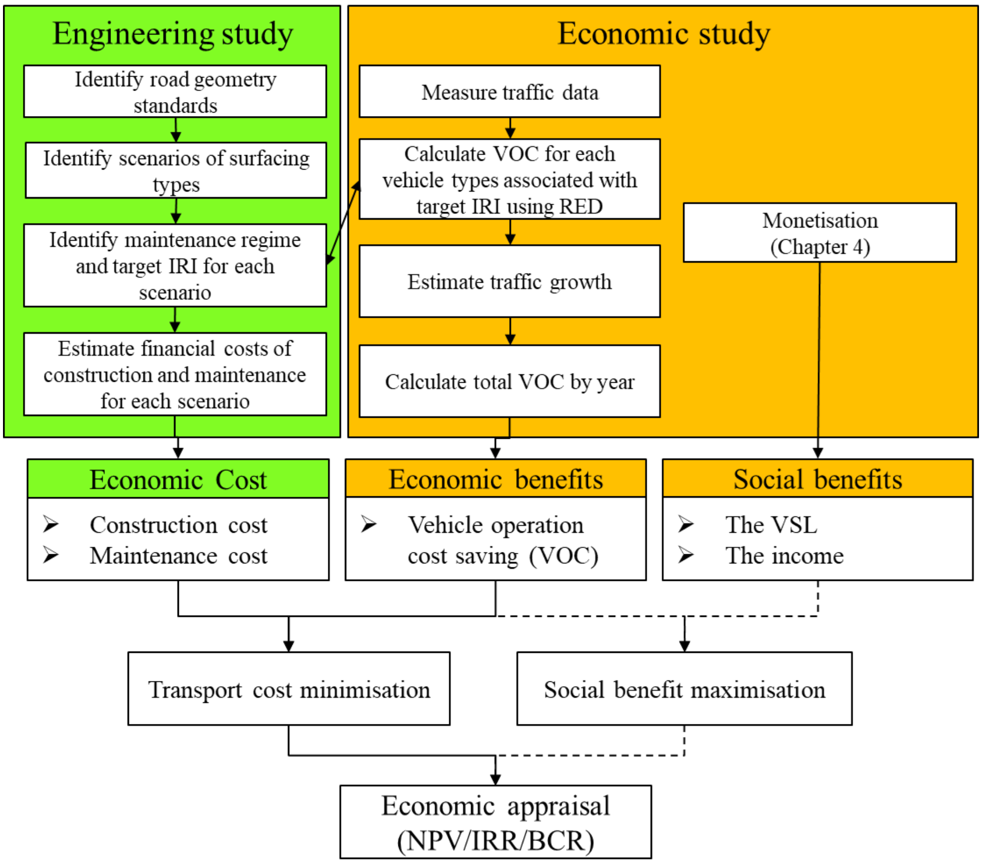

Figure 5-1 Appraisal methodology

5.2.1 Methodology

5.2.1.1 Engineering study

As described in earlier chapters (See Chapter 4; Section 4.2), the analysis concerned two sections of two roads: an asphaltic section of road and a section of earth road. The appraisal of the asphaltic sections of the two road was used to investigate the economic viability of maintenance regimes, and the appraisal of the earth road section examines the viability upgrading the earth road to surface types such as gravel, cape seal or asphalt.

Figures 5-2 and 5-3 illustrate the prevailing road conditions of the roads that are the focus of project 1 (R1S1 and R1S2). Figure 5-3, R1S1 is an asphaltic concrete road in good condition, while R1S2 is an earth road in very poor condition. Each road section is 5 km long, and R1S1 connects to a collector road.

Figure 5-2. Road project 1 (Hin Ngon to Sak Nga village)

Figure 5-3 Road conditions for project 1

Figures 5-4 and 5-5 illustrate the conditions of the roads in project 2 (R2S1 and R2S2). In Figure 5-5, R2S1 is an asphaltic concrete road that is in good condition, and R2S2 is an earth road in very poor condition. Each road section is 5 km long, and R2S1 connects to a collector road.

The characteristics of the two roads and their traffic levels are given in Tables 5.1 and 5.2 respectively.

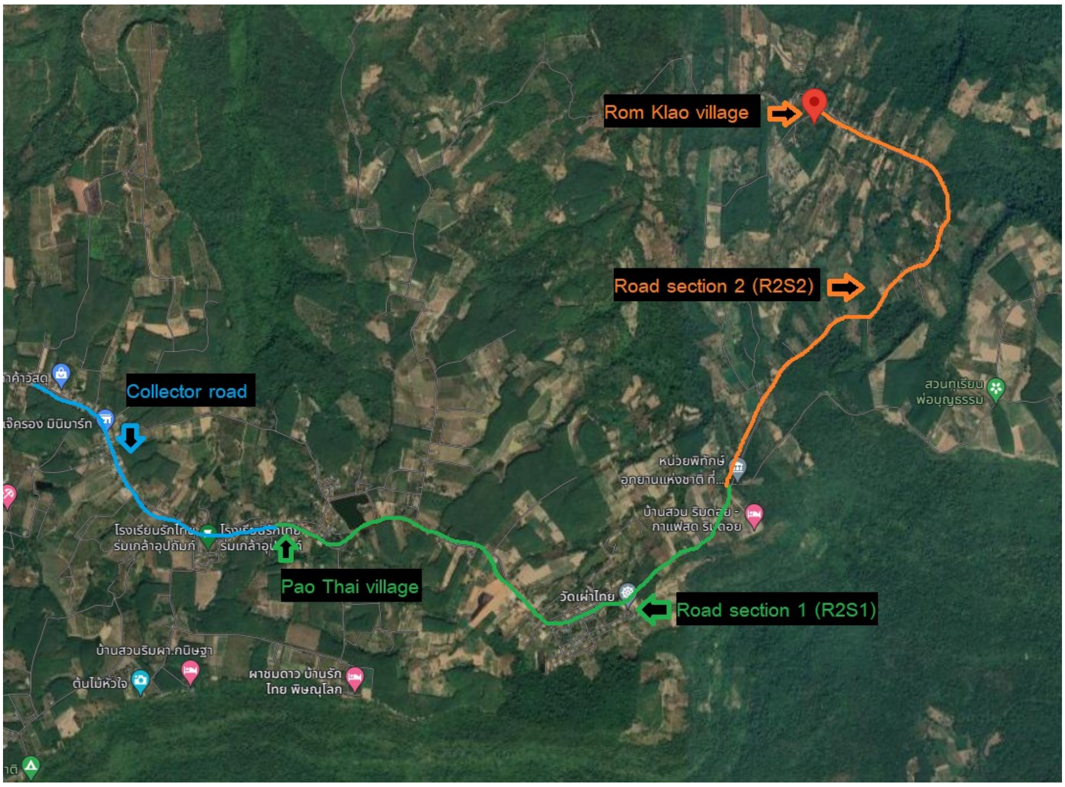

Figure 5-4 Road project 2 (Rom Klao village)

Figure 5-5 Road conditions for road project 2

Table 5-1 Road project characteristics

Road characteristic	Road project 1		Road project 2	
	R1S1 (Hin ngon)	**R1S2 (Sak nga)**	**R2S1 (Pao thai**	**R2S2 (Rom klao)**
Terrain	Mountainous	Mountainous	Mountainous	Mountainous
Road condition	Good	Very poor	Good	Very poor
IRI m/km	3	20	3	20
Surface type	AC	Earth road	AC	Earth road
length (km)	5	5	5	5
Traffic volume (Veh/day)	165	23	180	45
Carriage way	6	4	6	6

Table 5-2 Average daily traffic volume

Vehicle fleet	R1S1 (Hin ngon)	R1S2 (Sak nga)	R2S1 (Pao thai	R2S2 (Rom klao)
E-Tak	10	10	0	0
E-Tan	0	0	0	0
Motorcycle	45	8	50	10
Small car	0	0	30	0
Car medium	30	0	30	0
Pickup	50	5	50	25
Light truck	10	0	10	0
Middle Truck	20	0	10	10
Total No. traffic	165	23	180	45

The focus group with the Department of Rural Roads (DRR) recommended the road geometry design to upgrade R1S2 and R2S2, which is as same as the geometry standard for R1S1 and R2S1. As these road projects can be classified as low-volume roads, a 6-metre wide carriageway without a shoulder was considered suitable, as shown in Figure 5-6.

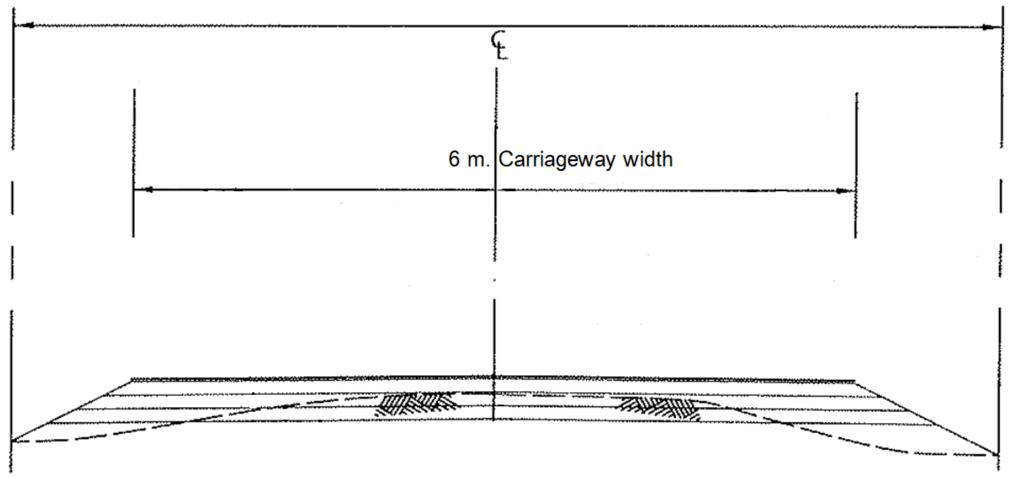

Figure 5-6 The proposed road geometry design

The construction and maintenance costs for this road standard were derived from DRR's flat rate estimate, as shown in Table 5-3 (note that 1 GBP = 40 THB).

Table 5-3 Financial costs of construction and maintenance

Surfacing standard	Construction cost (THB million/km)	Routine maintenance (THB/km)	Periodic maintenance (THB million/km)
Earth road	0.15	10,000 Grading	-
Gravel road	1.0	15,000 Pothole repair	0.41 Surface levelling
Cape seal road	3.0	20,000 Pothole repair	2.3 Hot mix recycling
Asphaltic road	5.9	20,000 Pothole repair	3.9 Hot mix recycling

- **Road maintenance standards**

To estimate road maintenance costs over the period of the analysis, the DRR's actual maintenance regime and associated condition standards for each scenario were used. The maintenance programmes for each scenario are shown in the Table 5-4.

From Table 5-4 it can be seen that to keep the asphaltic concrete road (R1S1 and R2S1) in good condition, over a 20-year period, routine maintenance is required every year and periodic maintenance once every 10 years. Routine maintenance consists of pothole repair and periodic maintenance was hot-mix recycling. A target IRI of 3 m/km was used as this represents road condition for new road. This maintenance regime was also used for the asphaltic upgrade scenario of R1S2 and R2S2.

To keep the cape seal road, DRR's target IRI equal to 5 m/km, routine maintenance should be conducted every year, and periodic maintenance every 7 years. For the gravel roads, DRR aims to achieve an IRI equal to 7 m/km, and this requires spot regravelling routine maintenance annually, and periodic maintenance consisting of surface levelling every 3 years. For earth roads, routine maintenance (without project/based case) is conducted every 4 months to achieve the DRR's target IRI of 9 m/km.

Table 5-4 The average IRI and the work programme

Scenario	**Road standard**	**Intervention types**		**Program**	**Target IRI**
1	Asphaltic road/ Maintaining good condition	Routine	Pothole repair	Every year	3.0
		Periodic	Hot mix recycling	1 time over 10 years	
2	Cape seal	Routine	Pothole repair	Every year	5.0
		Periodic	Hot mix recycling	1 time over 7 years	
3	Gravel road	Routine	Pothole repair	Every year	7.0
		Periodic	Hot mix recycling	1 time over 5 years	
4	Earth road	Routine	Pothole repair	2 times a year	9.0

Table 5-5 presents the economic cost of the construction and maintenance regime for 20 years. This is calculated based on the financial cost of construction and maintenance from Table 5-4 multiplied by 0.88—Construction conversion factor (See table 5-6).

Table 5-5 Construction and maintenance cost for 20 years

Year	Asphaltic/ good road	Cape seal road	Gravel road	Earth road
0	*25,960,000	13,200,000	4,400,000	660,000
1	88,000	88,000	66,000	88,000
2	88,000	88,000	66,000	88,000
3	88,000	88,000	66,000	88,000
4	88,000	88,000	66,000	88,000
5	88,000	88,000	1,804,000	88,000
6	88,000	88,000	66,000	88,000
7	17,160,000	10,120,000	66,000	88,000
8	88,000	88,000	66,000	88,000
9	88,000	88,000	66,000	88,000
10	88,000	88,000	1,804,000	88,000
11	88,000	88,000	66,000	88,000
12	88,000	88,000	66,000	88,000
13	88,000	88,000	66,000	88,000
14	17,160,000	10,120,000	66,000	88,000
15	88,000	88,000	1,804,000	88,000
16	88,000	88,000	66,000	88,000
17	88,000	88,000	66,000	88,000
18	88,000	88,000	66,000	88,000
19	88,000	88,000	66,000	88,000
20	88,000	88,000	66,000	88,000
Sum	**61,864,000**	**35,024,000**	**10,934,000**	**2,420,000**

* For maintaining R1S1 and R2S1 construction is excluded.

5.2.1.2 Economic study

The conduct economic analysis, the following assumptions were made. Table 5-6 demonstrates the criteria of economic analysis.

Table 5-6 Economic analysis of criteria

Criteria	value
1. Discounted rate	12% per year (Soparat et al., 2019).
2. Construction period	1 year
3. Period of analysis	20 years (Rung-in, 2016).
4. Traffic growth rate	1.56 % for all vehicle types
5. Generated traffic	elasticity equivalent to 1
6. Construction conversion factor (CCF)	0.88

Criteria	value
CCF was converted from financial cost of construction to economic cost (Department of Rural Roads, 2021).	
7. Standard conversion factor (SCF) SCF was converted from the VOC to economic benefit (Department of Rural Roads, 2021).	0.92
8. Inflated rate	3% per year

The project benefits considered are the economic benefit of VOC savings. The economic benefit is the value that can be saved from the comparison of the VOC received in the case with a project (with project) and the case without a project (without project). For this research VOCs were estimated using the Roads Economic Decision Model (RED) developed by the World Bank (Archondo Callao, 2008). RED takes as input the vehicle technical and operational characteristics, vehicle prices, tyre prices, fuel prices, maintenance and vehicle operation staff costs (see Appendix D).

Table 5-7 presents the calculated VOC per/km by vehicle type, road surface type and road condition as a function IRI. The good, fair, poor and very poor road ratings equate to an IRI of 3, 5, 7 and 9, respectively. As would be expected, the table demonstrates that VOCs are in inverse function of road condition, i.e. VOC is high when the road condition is very poor, and when the road condition is good the VOC is low.

Table 5-7 The unit cost of VOC by IRI

		Good condition	Fair condition	Poor condition	Very poot condition
		VOC at IRI = 3 m/km (THB/veh-km)	VOC at IRI = 5.0 m/km (THB/veh-km)	VOC at IRI = 7.0 m/km (THB/veh-km)	VOC at IRI = 9.0 m/km (THB/veh-km)
Terrain: C Mountainous Road: X Paved	Motorcycle	1.71	1.74	1.77	1.80
	Car Small	6.06	6.24	6.57	6.93
	Car Medium	8.94	9.24	9.72	10.32
	Pickup	7.83	8.01	8.37	8.79
	Four-Wheel Drive	7.83	8.04	8.49	9.00
	Truck Light	12.75	13.17	13.80	14.49
	Truck Medium	22.14	22.62	23.43	24.33
	E-Tak	11.52	11.61	11.85	12.18
	E-Tan	4.98	5.01	5.16	5.37
Terrain: C Mountainous Road: Y Gravel	Motorcycle	1.77	1.80	1.86	1.92
	Car Small	6.12	6.36	6.75	7.20
	Car Medium	9.03	9.33	9.90	10.56
	Pickup	7.89	8.13	8.55	9.06
	Four-Wheel Drive	7.89	8.16	8.64	9.21
	Truck Light	12.93	13.41	14.16	15.00
	Truck Medium	22.47	23.10	24.15	25.29
	E-Tak	11.70	11.82	12.09	12.45
	E-Tan	5.16	5.22	5.43	5.73
Terrain: C Mountainous Road: Z Earth	Motorcycle	1.86	1.89	1.95	2.01
	Car Small	7.20	7.41	7.77	8.13
	Car Medium	11.04	11.37	11.88	12.45
	Pickup	9.51	9.78	10.17	10.56
	Four-Wheel Drive	9.99	10.26	10.71	11.19
	Truck Light	14.16	14.64	15.36	16.11
	Truck Medium	23.58	24.24	25.23	26.28
	E-Tak	13.17	13.32	13.50	13.68
	E-Tan	6.60	6.66	6.75	6.87

The VOC per year for a given road section is the unit cost of VOC multiplied by the number of vehicle kilometres travelled (VKT) on the road section over a year. Table 5-8 presents VOC for R1S2 over a 20-year period for the four scenarios given in Table 5-4.

Table 5-8 Calculated VOCs for R1S2

Year	Without project	Scenario1 (Gravel)	Scenario2 (Cape Seal)	Scenario3 (Asphaltic)
0	690,673	599,504	571,095	564,245
1	704,487	611,494	582,517	575,530
2	718,577	623,724	594,167	587,040
3	732,948	636,198	606,051	598,781
4	747,607	648,922	618,172	610,757
5	762,559	661,901	630,535	622,972
6	777,810	675,139	643,146	635,431
7	793,367	688,641	656,009	648,140
8	809,234	702,414	669,129	661,103
9	825,419	716,462	682,511	674,325
10	841,927	730,792	696,162	687,811
11	858,766	745,408	710,085	701,567
12	875,941	760,316	724,287	715,599
13	893,460	775,522	738,772	729,911
14	911,329	791,032	753,548	744,509
15	929,556	806,853	768,619	759,399
16	948,147	822,990	783,991	774,587
17	967,110	839,450	799,671	790,079
18	986,452	856,239	815,664	805,880
19	1,006,181	873,364	831,978	821,998
20	1,026,304	890,831	848,617	838,438
Sum	17,807,852	15,457,195	14,724,725	14,548,101
Saving VOC		2,350,657	3,083,127	3,259,751

- Social benefits

The social benefits, including the VSL and the additional income outlined in Chapter 4, see Tables 4-31 to 4-34 of Section 4.5. The example in Table 5-9 shows the monetary value of these benefits for R1S2 over 20 years, with growth estimated at 3% based on the inflation rate, see the assumption of economic analysis in Table 5-6. The negative value of social benefits is the compensation cost if road project is earth road, gravel road, and cape seal road, as shown in Table 5-9.

Table 5-9 Social benefits for R1S2 (the VSL by DCE)

Year	Earth	Gravel	Cape seal	Asphaltic
0	-5,385,000	-4,288,333	-3,595,833	1,064,167
1	-5,546,550	-4,416,983	-3,703,708	1,096,092
2	-5,712,947	-4,549,492	-3,814,819	1,128,975
3	-5,884,335	-4,685,977	-3,929,264	1,162,844
4	-6,060,865	-4,826,557	-4,047,142	1,197,729
5	-6,242,691	-4,971,353	-4,168,556	1,233,661
6	-6,429,972	-5,120,494	-4,293,613	1,270,671
7	-6,622,871	-5,274,109	-4,422,421	1,308,791
8	-6,821,557	-5,432,332	-4,555,094	1,348,055
9	-7,026,204	-5,595,302	-4,691,746	1,388,497
10	-7,236,990	-5,763,161	-4,832,499	1,430,151
11	-7,454,099	-5,936,056	-4,977,474	1,473,056
12	-7,677,722	-6,114,137	-5,126,798	1,517,248
13	-7,908,054	-6,297,562	-5,280,602	1,562,765
14	-8,145,296	-6,486,488	-5,439,020	1,609,648
15	-8,389,655	-6,681,083	-5,602,191	1,657,938
16	-8,641,344	-6,881,516	-5,770,256	1,707,676
17	-8,900,584	-7,087,961	-5,943,364	1,758,906
18	-9,167,602	-7,300,600	-6,121,665	1,811,673
19	-9,442,630	-7,519,618	-6,305,315	1,866,023
20	-9,725,909	-7,745,206	-6,494,474	1,922,004
Sum	**-154,422,876**	**-122,974,320**	**-103,115,854**	**30,516,570**

- **Sensitivity analysis**

The sensitivity analysis consisted of changing the computed costs and benefits as follows:

1. Project costs change by ± 10 and ± 20%
2. Project benefits change by ± 10 and ± 20%

- **Cost-benefit analysis (CBA)**

The cost and benefit streams for each project were determined and used within Equation 3-9 to determine the NPV of alternative.

As mentioned above, R1S1 and R2S1 were appraised in terms of road maintenance regimes, with a base scenario (without project) of the roads being left in very poor condition, and a with project scenario of maintaining the roads in a good road condition. For R1S2 and R2S2 the alternatives were associated with upgrading the surfacing, where the do-nothing case was the status quo (i.e. s earth road), and the alternatives were a gravel road, cape seal road and asphaltic road respectively. Moreover, these four road sections are appraised by considering social benefits (the concept of social benefit maximisation) and without considering social benefits.

Table 5-10 presents the example of economic analysis of the standard appraisal for R1S2 where the base case is the existing earth, and the with-project (alternative) is an asphaltic road. This analysis bases on the concept of transport cost minimisation, as mentioned in Section 2.3. The NPV was negative for about 35 million THB/year.

Table 5-11 presents the above appraisal but with consideration of social benefits (VSL by DCE and income) and the VOC saving. From the table, the social cost that is the negative VSL is included for the base case (earth road). The NPV was negative for about 23 million THB/year

Table 5-10 The standard appraisal for R1S2 for the upgrade of asphaltic road surfacing

Year	Based case (earth road)				Alternative (asphaltic road)		
	Economic cost (Agency cost)	Economic benefit (VOC)	Total cost		Economic cost (Agency cost)	Economic benefit (VOC)	Total cost
0	660,000		660,000		25,960,000		25,960,000
1	88,000	704,487	792,487		88000	575,530	663,530
2	88,000	718,577	806,577		88000	587,040	675,040
3	88,000	732,948	820,948		88000	598,781	686,781
4	88,000	747,607	835,607		88000	610,757	698,757
5	88,000	762,559	850,559		88000	622,972	710,972
6	88,000	777,810	865,810		88000	635,431	723,431
7	88,000	793,367	881,367		17160000	648,140	17,808,140
8	88,000	809,234	897,234		88000	661,103	749,103
9	88,000	825,419	913,419		88000	674,325	762,325
10	88,000	841,927	929,927		88000	687,811	775,811
11	88,000	858,766	946,766		88000	701,567	789,567
12	88,000	875,941	963,941		88000	715,599	803,599
13	88,000	893,460	981,460		88000	729,911	817,911
14	88,000	911,329	999,329		17160000	744,509	17,904,509
15	88,000	929,556	1,017,556		88000	759,399	847,399
16	88,000	948,147	1,036,147		88000	774,587	862,587
17	88,000	967,110	1,055,110		88000	790,079	878,079
18	88,000	986,452	1,074,452		88000	805,880	893,880
19	88,000	1,006,181	1,094,181		88000	821,998	909,998
20	88,000	1,026,304	1,114,304		88000	838,438	926,438
	NPV (Without project) = 7,276,965					NPV (With project)	42,701,817
	NPV = -35,424,853 THB/year						

Table 5-11 The appraisal for R1S2 with the VSL by DCE and the saving VOC for an asphaltic road

Year	Based case (earth road)				Alternative (asphaltic road)			
	Economic cost (Agency cost)	Social Cost	Benefit-Cost		Economic cost (Agency cost)	Social benefit (+VSL)	The saving VOC	Benefit-Cost
0	660,000		-660,000		25,960,000			-25,960,000
1	88,000	-5,385,000	-5,473,000		88,000	1,096,092	128,957	1,137,049
2	88,000	-5,546,550	-5,634,550		88,000	1,128,975	131,536	1,172,511
3	88,000	-5,712,947	-5,800,947		88,000	1,162,844	134,167	1,209,011
4	88,000	-5,884,335	-5,972,335		88,000	1,197,729	136,850	1,246,580
5	88,000	-6,060,865	-6,148,865		88,000	1,233,661	139,588	1,285,249
6	88,000	-6,242,691	-6,330,691		88,000	1,270,671	142,379	1,325,050
7	88,000	-6,429,972	-6,517,972		17,160,000	1,308,791	145,227	-15,705,982
8	88,000	-6,622,871	-6,710,871		88,000	1,348,055	148,131	1,408,186
9	88,000	-6,821,557	-6,909,557		88,000	1,388,497	151,094	1,451,591
10	88,000	-7,026,204	-7,114,204		88,000	1,430,151	154,116	1,496,267
11	88,000	-7,236,990	-7,324,990		88,000	1,473,056	157,198	1,542,254
12	88,000	-7,454,099	-7,542,099		88,000	1,517,248	160,342	1,589,590
13	88,000	-7,677,722	-7,765,722		88,000	1,562,765	163,549	1,638,314
14	88,000	-7,908,054	-7,996,054		17,160,000	1,609,648	166,820	-15,383,532
15	88,000	-8,145,296	-8,233,296		88,000	1,657,938	170,156	1,740,094
16	88,000	-8,389,655	-8,477,655		88,000	1,707,676	173,560	1,793,235
17	88,000	-8,641,344	-8,729,344		88,000	1,758,906	177,031	1,847,937
18	88,000	-8,900,584	-8,988,584		88,000	1,811,673	180,571	1,904,244
19	88,000	-9,167,602	-9,255,602		88,000	1,866,023	184,183	1,962,206
20	88,000	-9,442,630	-9,530,630		88000	1,922,004	187,866	2,021,870
	NPV (Based case) = -49,947,827							NPV (With project) = -26,843,645
	NPV = 23,104,182 THB/year							

5.2.2 Appraisal results

The economic appraisal analyses the followings.

1) The standard appraisal (only the VOC)
2) The appraisal with social benefits (the VSL and income)
3) The appraisal with social benefit (the VSL) and the VOC saving

Regarding the appraisal with social benefit (VSL), it compares between the VSL by DCE technique and by CV one to identify differences. Moreover, these appraisals are conducted the sensitivity analysis, as mentioned in section in the previous section. Therefore, there are five economic analyses. The appraisal result is shown in Table 5-12.

From the Table 5-12, the standard appraisal (column ❶) yielded negative NPV for all four road sections and treatments (alternative). As expected, the most negative NPV is for asphaltic surfacing upgrade as its agency cost can be the highest.

The appraisal with social benefits (VSL and income) can yield positive NPV for a certain treatment. Overall, the VSL by DCE (column ❷) and CV (column ❸) yield varying results. For example, for R2S2, by means of VSL by CV, it suggests asphaltic upgrade R2S2, the associated NPV is positive about 6 million THB/year. Whist, by means of the VSL by DCE, it does not suggest the asphaltic upgrade as the associated NPV is negative for about -3 million THB/year, instead, the cape seal surfacing is suggested as the associated NPV is 15 million THB. Moreover, this appraisal with social benefits suggests the maintenance for R1S1 and R2S1 in good condition.

Social benefit when it come to the appraisal with economic benefit (the VOC saving) can improve rural road appraisal since the appraisal with social benefit (VSL by DCE) and

VOC saving can rise the NPV for asphaltic upgrade for R2S2 from -3 million THB to about 94,000 THB (column ❹).

Table 5-12 The result of the appraisal

Road section	Alternative	Economic indicator	Standard appraisal	Social benefit		Social benefit + VOC saving	
			❶	❷ DCE	❸ CV	❹ DCE	❺ CV
R1S2	Gravel	NPV	-4,652,294	3,365,047	-1,501,165	4,089,612	-776,600
		IRR	N/A!	24%	4%	27%	7%
		BRC	-0.11	1.04	0.30	1.15	0.41
	Cape seal	NPV	-18,098,900	-3,729,414	-309,402	-2,915,595	504,417
		IRR	N/A	7%	12%	8%	13%
		BRC	-0.17	0.34	0.47	0.37	0.50
	Asphaltic	NPV	-35,424,853	22,241,801	4,795,095	23,104,182	5,657,476
		IRR	N/A	24%	15%	25%	15%
		BRC	-0.17	1.00	0.66	1.02	0.67
R2S2	Gravel	NPV	-3,322,325	5,859,126	805,228	7,932,682	2,878,784
		IRR	-6%	32%	15%	39%	23%
		BRC	0.05	1.41	0.67	1.71	0.97
	Cape seal	NPV	-16,144,802	15,235,455	5,747,763	18,147,316	8,659,625
		IRR	N/A	29%	19%	32%	22%
		BRC	0.11	1.06	0.70	1.18	0.81
	Asphaltic	NPV	-33,251,700	<u>-3,085,568</u>	<u>6,200,585</u>	<u>94,746</u>	9,380,899
		IRR	N/A	10%	16%	12%	17%
		BRC	-0.13	0.47	0.66	0.53	0.73
R1S1	Good	NPV	-17,984,449	3,014,670	23,710,860	7,571,858	28,268,049
		IRR	-13%	15%	31%	19%	34%
		BRC	-0.02	0.74	1.49	0.90	1.66
R2S1	Good	NPV	-17,639,579	7,978,648	23,964,650	12,916,370	28,902,371
		IRR	-12%	19%	28%	23%	32%
		BRC	-0.01	0.92	1.74	1.10	1.95

Table 5-13 presents sensitivity analysis in case of benefits increased by 20% and costs reduced by 20%, which is the case that could yield the highest NPV. As a result, from the table 5-13, the standard appraisal still yielded negative NPV for all four road sections and treatment. On the other hand, the appraisal with social benefit could yield positive for all.

Table 5-13 The sensitivity for 20% increased benefits and 20% reduced costs

Road section	Alternative	Economic indicator	Standard appraisal	Social benefit		Social benefit + VOC saving	
			❶	❷ DCE	❸ CV	❹ DCE	❺ CV
R1S2	Gravel	NPV	-3,407,163	6,213,647	374,192	7,083,125	1,243,670
		IRR	-16%	39%	14%	42%	18%
		BRC	-0.06	1.35	0.49	1.48	0.62
	Cape seal	NPV	-14,066,395	3,176,988	7,281,003	4,153,571	8,257,586
		IRR	N/A	17%	22%	18%	24%
		BRC	-0.15	0.51	0.66	0.54	0.70
	Asphaltic	NPV	-27,903,513	41,296,471	20,360,425	42,331,328	21,395,282
		IRR	N/A	39%	26%	39%	27%
		BRC	-0.16	1.29	0.85	1.32	0.88
R2S2	Gravel	NPV	-1,811,200	9,206,541	3,141,864	11,694,809	5,630,131
		IRR	1%	50%	26%	61%	37%
		BRC	0.17	1.79	0.90	2.16	1.27
	Cape seal	NPV	-11,721,477	25,934,832	14,549,601	29,429,065	18,043,835
		IRR	N/A	46%	32%	50%	36%
		BRC	-0.06	1.38	0.94	1.51	1.08
	Asphaltic	NPV	-25,295,730	10,903,629	22,047,012	14,720,006	25,863,389
		IRR	N/A	20%	27%	22%	29%
		BRC	-0.11	0.65	0.89	0.74	0.97
R1S1	Good	NPV	-12,518,648	12,680,294	37,515,723	18,148,921	42,984,349
		IRR	-8%	25%	47%	30%	52%
		BRC	0.04	0.96	1.87	1.16	2.07
R2S1	Good	NPV	-12,104,804	18,637,069	37,084,378	24,562,334	43,009,643
		IRR	-7%	30%	47%	36%	52%
		BRC	0.06	1.18	2.18	1.40	2.43

Table 5-14 presents sensitivity analysis in case of benefits decreased by 20% and costs increased by 20%, which is the case that could yield the lowest NPV. As a result, from the table 5-14, the standard appraisal still yielded negative NPV for all four road sections and treatment. Moreover, NPV from the appraisal with social benefit could be reduced for all.

Table 5-14 The sensitivity for 20% reduced benefits and 20% increased costs

Road section	Alternative	Economic indicator	Standard appraisal	Social benefit		Social benefit + VOC saving	
			❶	❷ DCE	❸ CV	❹ DCE	❺ CV
R1S2	Gravel	NPV	-5,897,426	516,448	-3,376,522	1,096,099	-2,796,870
		IRR	N/A	14%	-1%	15%	1%
		BRC	-0.14	0.73	0.16	0.82	0.25
	Cape seal	NPV	-22,131,406	-10,635,817	-7,899,807	-9,984,761	-7,248,752
		IRR	N/A	-1%	3%	0%	4%
		BRC	-0.18	0.17	0.27	0.19	0.30
	Asphaltic	NPV	-42,946,192	3,187,131	-10,770,234	3,877,035	-10,080,329
		IRR	N/A	14%	6%	14%	6%
		BRC	-0.18	0.71	0.41	0.72	0.43
R2S2	Gravel	NPV	-4,833,450	2,511,710	-1,531,408	4,170,555	127,437
		IRR	-13%	20%	7%	25%	12%
		BRC	-0.03	1.03	0.43	1.27	0.68
	Cape seal	NPV	-20,568,127	4,536,079	-3,054,075	6,865,568	-724,586
		IRR	N/A	17%	9%	19%	11%
		BRC	-0.14	0.75	0.46	0.84	0.55
	Asphaltic	NPV	-41,207,670	-17,074,764	-9,645,842	-14,530,513	-7,101,591
		IRR	N/A	2%	7%	4%	8%
		BRC	-0.15	0.28	0.44	0.33	0.49
R1S1	Good	NPV	-23,450,250	-6,650,955	9,905,997	-3,005,204	13,551,748
		IRR	N/A	7%	19%	10%	22%
		BRC	-0.07	0.51	1.11	0.64	1.25
R2S1	Good	NPV	-23,174,354	-2,679,772	10,844,922	1,270,405	14,795,099
		IRR	N/A	10%	20%	13%	22%
		BRC	-0.06	0.65	1.34	0.80	1.51

- **Prioritisation**

The four road sections are prioritised using the result from Table 5-12. Table 5-15 ranks the interventions for the four road sections, using the NPV as the metric for prioritisation. Overall, these economic appraisals yield varying rankings.

From the table 5-15, the standard appraisal (column ❶) ranks the gravel road upgrade for R1S2 and R2S2 as the first two rankings, respectively. By mean of the VSL by DCE (column ❷), the first two ranking suggests the upgrade of paved road for R1S2 and R2S2: R1S2 for asphaltic road and R2S2 for cape seal road.

On the other hand, by means of the VSL by CV (column ❸), the first two ranking suggests the maintenance of exiting paved road in good condition, which R2S1 and R1S1are the first and second rank, respectively.

The appraisal with the VOC saving and VSL by both DCE (column ❹) and CV (column ❺) yields the same rank as the appraisal with only social benefits (VSL and income). This implies that the VSL has an influence on these appraisals.

Table 5-15 Prioritisation of interventions

Road section	**Alternative**	**Standard appraisal**	**Social benefit**		**Social benefit + VOC saving**	
		❶	❷ DCE	❸ CV	❹ DCE	❺ CV
R1S2	Gravel	*1	5	*8	6	*8
	Cape seal	*6	*8	*7	*8	7
	Asphaltic	*8	1	5	1	5
R2S2	Gravel	*2	4	6	4	6
	Cape seal	*3	2	4	2	4
	Asphaltic	*7	*7	3	7	3
R1S1	Good	*5	6	2	5	2
R2S1	Good	*4	3	1	3	1

* Ranks by negative NPV

The rankings in Table 5-15 will be used to obtain the feedback of the appraisal from the relevant authorities in the next section.

5.3 Feedback

In this research, Objective 6.2 was to draw conclusions on whether the monetisation of social benefits is useful in supporting rural road investment appraisal. The assumption was that feedback obtained from DRR and local authorities could be used to gauge whether including social benefits within an analysis would change possible investment decision.

The following issues were considered:

1) Whether the monetization procedure (i.e., economic measure and model) are suitable for use in this context.
2) Discuss the prioritisation of the interventions suggested for the road sections (Table 5-15).

- Meeting

With COVID-19 restrictions, it was not possible for groups of people to meet in person or for local agencies in different parts of Thailand to travel, so online meetings were utilised.

- Participants

The relevant road agencies participated, including the Department of Rural Roads (DRR), which oversees local road budgetary planning, and the respective local road authorities (LA) responsible for the maintenance of the Sak Nga (project 1) and Rom Klao (project 2) road projects. This facilitated feedback about the social benefits that could affect investment decision-making in such projects.

The following sections summarise the participants' feedback, based on interviews conducted after the monetisation and appraisal processes. The feedback for the proposed methodology and model was recommended by the experts (Section 3.2.1).

5.3.1 Feedback process

Feedback was collected from four voluntary participants: two from the DRR, and two from the respective local authorities (Sak Nga and Rom Klao). The researcher knew the participants from the local authorities based on initial contact made during the field survey stage. The participants from the DRR were the researcher's colleagues; one had extensive overall expertise in the field, and the other was a professional highway engineer. The researcher called the participants directly to arrange individual online meetings at a convenient time. Through the process of interviewing, the researcher presented the study so that the participants could understand the research objectives.

The aim was to investigate whether these approaches and appraisals were suitable and if social benefits arising from these projects could influence investment decisions. The relevant questionnaire is shown in Table 5-16.

Prior to the online meetings, the researcher summarised the research methodology, the relevant results, and the approach adopted to determining benefits accruing from better healthcare access and more efficient transportation of agricultural produce. The researcher then asked the participants if they required any clarifications on the factsheets before proceeding to the interview sessions.

Table 5-16 Feedback issues and results

	Topic/question	DRR	LA
	1. Economic valuation approach		
1	Do you think it makes sense to use WTP council tax for measuring the impact of rural road infrastructure on access to hospitals?	+ +	+ +
2	Do you think it makes sense to use WTP transportation costs for measuring the impact on agricultural produce transportation?	+ +	+ +
3	What do you think about the proposed approaches to the monetisation of the social benefits? – Practice (ease of use) – Methodology (e.g. survey, model and variables)	 – – ○ ○	 – – ○ ○
	2. Investment decisions		
4	What are your opinions about keeping the Sak Nga (R1S2) and Rom Klao (R2S2) road sections in their current condition (earthen road)?	– –	– –
5	What are your opinions about upgrading the Sak Nga (R1S2) and Rom Klao (R2S1) road sections to a gravel road?	– –	– –
6	What are your opinions about upgrading the Sak Nga (R1S2) and Rom Klao (R2S1) road sections to a paved road?	+ +	+ +

+ Positive response; – Negative response; ○ Neutral response; DRR = Department of Rural Road; LA = Local Authority

5.3.2 Feedback results

The feedback obtained from the four participants is summarised below.

1. The four participants agreed about using the willingness to pay council tax for improved road projects to measure the economic value of the social benefits accruing from such projects. The participants were not economists, however, they acknowledged that in the case of other projects, such as agriculture-related infrastructure, villagers sometimes must pay to have irrigation provided to their farms.
2. The four participants agreed about using transportation costs to measure the impact of improved rural roads on the transportation of agricultural produce. They believed transportation costs affect farmers directly, and farmers should not have to pay for increased costs caused by poor road conditions (such as extra vehicle maintenance costs).
3. The two participants from the DRR felt that compared to the benefits from major collector roads and highways that generate up to 100 million THB per year, the VSL and the additional income are too low to be included in budgetary planning. However, when comparing the proposed road projects to other roads within the same network classification, the use of social benefits could be useful in identifying problems in remote communities and for prioritising investment between villages. The two LA participants reported having never been involved in assessing the economic and social benefits of rural roads, and as such did not feel they could comment.

4. All four participants thought that earthen roads were not suitable for Thailand. They agreed that traditional appraisals (without taking social benefits into account) were not appropriate for rural road projects with low traffic volume.
5. The four participants thought constructing a gravel road as the best option for the two villages was not appropriate because, in their view, a gravel road would still affect the villagers' ability to travel easily. Moreover, they suggested that if a gravel road was built, it would add considerably to their road maintenance workload, and they would find it challenging to maintain such a gravel road every year.
6. Although the results of the standard appraisal showed that a paved road would not be economical for R1S2 and R2S2, the inclusion of social benefits could improve rural road appraisal, resulting in positive NPV for asphaltic and cape seal upgrade for R1S1 and R2S2, respectively. The four participants believed a paved road should be constructed. They thought that the second road section should be of the same paving standard as the first section (the first section is an asphalt/concrete road). Accordingly, they satisfied the ranking from the appraisal with the social benefits (the VSL by DCE) since such appraisal yield the rank they expected.

5.4 Discussion

This section discusses the appraisal results. It focuses on:

1) the magnitude of benefits
2) the social cost or compensation cost in the appraisal (negative value of the VSL).
3) the prioritisation and road treatment (alternative)

- The magnitude of benefits

CBA measures economic efficiency that is concerned with economic inputs (agency cost) and economic outputs (social and economic benefit). Theoretically, for a project to be improved, the economic benefit should be greater than the economic cost (Striguer, 2008). The most efficient project is the one that yields the highest positive NPV, while projects that yields negative NPVs should be rejected. However, as shown in Table 5-12, by standard appraisal considering economic benefit (Column❶), it demonstrates that these road projects should not be invested as yielding the negative return. While the appraisal with social benefits (Column ❷) yielded the positive return for these projects for road maintenance and surfacing strategies. Moreover, in R1S2 and R2S2 (existing earth road), the social benefits suggest the upgrade of earth road to asphaltic paved road better than to gravel road since the NPV from asphaltic road upgrade can be greater.

So far this research show that the monetary value of social benefit could improve the appraisal by CBA. The magnitude of the VSL can overcome construction and maintenance cost in CBA, resulting positive return to remote society. However, the additional income and the VOC saving can be very tiny and double counting and yielded negative return.

- Social cost

Initially, only the monetising of social benefits in relation to healthcare access was considered (positive WTP). However, this research found negative WTP that was the social costs of healthcare access resulting in negative VSL if road projects are in poor condition and unpaved surfacing technologies, as shown in Section 4.3.2. Therefore, this chapter includes these social costs in the appraisal. When the social cost was included in the appraisal, it did increase NPV (or less negative NPV for this appraisal). This suggests that an improved road project helps those villagers overcome the disadvantages associated with a poor road.

- The prioritisation and road treatment

As shown in Table 5-15 including and excluding social benefits yield different priorities, implying that the road agency must decide whether the road project should be developed for the purpose of the reduction in transport costs or the maximisation of social benefits. The feedback from road agency help identify road treatment from these prioritisations. As a result, these road agencies preferred the appraisal with social benefits from the VSL by DCE because such appraisal suggest a paved road for R1S2 and R2S2 as they expected.

5.5 Summary

This chapter presented the economic appraisal used to assess the economic viability of the four road sections, by considering a road project in the medium term (over 20 years) as a tactical appraisal in measuring the return of these projects to society. Two rural road projects in remote areas of Thailand were appraised: the first sections were paved roads, which the appraisal considered for road maintenance; the second sections were unpaved roads, which considered the appropriateness of road upgrades.

The economic return for each section was compared based on the road surface alternatives: earth (without project), gravel, cape seal and asphalt concrete. As expected, the standard appraisal yielded negative return for all road section and treatment since the VOC was tiny compared to construction and maintenance cost. However, when including social benefits within the appraisal, the results of the appraisals showed that paved road can yield positive return to society. A sensitivity analysis was conducted based on varying agency costs and benefits this showed an increase in the benefits and a reduction in the cost the NPV by the standard appraisal was still negative. The project alternatives were prioritised based on NPV, and the feedback from the DRR and local agencies agreed with the identified priorities by the social benefits.

The next chapter, the penultimate of this thesis, discusses research methodology.

CHAPTER 6 DISCUSSION

6.1 Introduction

This thesis has identified the benefits arising from rural road projects and developed a social benefits framework for rural road appraisal, as shown in Figure 3-3 of Section 3.2.2 (see Chapter 3). The framework addresses how appropriate methods of social benefits can be selected for the task in hand and how the appropriate economic measure(s), and economic valuation techniques for these methods can be selected. The approach was demonstrated by using the methodology to identify and use techniques to monetise the benefits associated with improved access to healthcare and agriculture. Using the approach, the benefits of different road surfaces (i.e., gravel and asphaltic) and maintenance strategies (i.e., maintain the road in good condition) were examined

This chapter provides a critical review of the methodology followed in this research to monetise the social benefits for road appraisal.

6.2 Summary of the Research

The research carried out in this project can be summarised as follows:

1. The development of a theoretical social benefits framework for road appraisal

Based on the discussion of the literature review (Section 2.6.8, Chapter 2), a methodology was proposed to develop a theoretical rural roads benefits framework for rural road investment appraisal.

To develop the framework, Section 2.3 (Chapter 2) reviewed social impact assessment studies to identify the social indicators appropriate to rural roads (Objective 1 of the research), as summarised in Table 2-1. The finding from the review show that these social indicators cannot be used for CBA directly as they do not value in monetary terms welfare or wellbeing. Section 2.5 identified from the literature potential economic measures of wellbeing used in other disciplines that are used to calculate the monetary value of social benefits such as the VSL and income (Objective 2 of the research). These economic measures were assigned appropriately to associated social indicators, based on the concept of each measure. For example, the VSL that can be estimated by the number of death (social indicator) was considered as economic measure for health benefit. The consequence of this review identified the need for economic valuation techniques appropriate for economic measures. Section 2.6 outlined economic valuation techniques, and reviewed preference techniques, which are used in practice to quantify the economic measures and discussed the usefulness of these techniques for the task at hand (Research Objective 3).

In Section 3.2.2, the framework, therefore, was developed to select social indicators, economic measures, and economic valuation techniques appropriate for road economic appraisal (Research Objective 4). The framework included four modules to contribute robustly the monetisation and application of social benefits for the appraisal i.e., 1) social assessment, 2) economic measure, 3) economic valuation technique and 4) economic appraisal. Social assessment provides social indicators to assess social benefits from rural road projects. Economic measure assign types of monetary value into intangible social benefits such as consumer surplus. Economic valuation technique provides tool that examines economic measure. And economic appraisal evaluates and integrates social benefits for road investment.

2. Developing a model to monetise benefits from rural road projects

As shown in Table 2-6, several literature studies identified some evidence that the economic benefits of savings in RUC was a function of road work standards, which facilitates the appraisal. Therefore, in Chapter 3, it was decided that the models developed in this research must be able to monetise the social benefits as a function of road standard/ surfacing type (Objective 5 of the research). The models for economic valuation techniques namely contingent valuation, discrete choice experiment and the elasticity of price method were developed based on literature review, expert opinion, and pilot testing (Sections 3.3.1 to 3.3.3).

3. Demonstrating monetisation and appraisal for social benefits

Data from two rural road projects in a remote region of Thailand was collected for input into the models (Objective 6). The monetary values of the benefits obtained from the process (Chapter 4) were also used within a road investment appraisal, to investigate if these approaches could be used to support and improve the appraisal (Objective 6.1). The appraisal was carried out with and without the inclusion of benefits to explore the effectiveness of the identified approaches. NPV, IRR and BRC were used to assess the appropriateness of the suggested road interventions, and the relative merits of the overall methodology used to monetise the social benefits were discussed (Objective 6.2).

6.3 Critical Review of the Research

The approaches adopted in the research to monetise the social benefits accrued from rural road projects are discussed under the following headings:

1. The theoretical social benefits framework for road appraisal (6.3.1)
2. Model development for remote and poor communities (6.3.2)
3. Rural road economic appraisal (6.3.3)
4. Case study (6.3.4)

6.3.1 The theoretical social benefits framework for road appraisal

The developed framework consists of four modules, namely: (1) social assessment, (2) economic measure, (3) economic valuation technique and (4) economic appraisal.

The first module (social assessment) identified the social benefits to be monetised. It provided a range of social indicators to assess the impact of road projects on society, which also help identify possible social benefits that could rise from road investment. As shown in Section 4.3 (Chapter 4), this research interviewed village heads using varying social indicators from Table 2-1. Such interview help identify possible social benefits that could rise if road projects are invested in the future i.e., death numbers and farm-gate access vehicles. Therefore, the first module help scope the social benefits that refers those communities to be monetised. This module should implement in early stage of the monetised process so that road agency could select any benefits to monetise that might relate to society's needs for the projects and therefore the appraisal could yield decision transparently.

The first module, however, focuses only on the social benefits to local communities (positive impact) of the rural road project. Incidentally, it might find any social impact in the wider society. For example, research from a project in Ethiopia (Nakamura et al., 2019) considered if rural road projects could lead to increased transmission of HIV. In welfare economics, this transmission produced social costs and negative impact. The social costs can be illustrated by negative WTP (willingness to accept, WTA) and affected the appraisal with CBA. This research show that social costs happened to society if the road projects were in poor condition and in unpaved surfacing technologies, as shown in Table 4-31 to 4-34 (Chapter 4). Also, a negative WTP can be regarded as a compensation cost (Galgani et al., 2020) i.e. in this case villagers, through their responses, suggest that they would need to be compensated for a particular outcome. E.g., they would need to be compensated (possibly financially) in an average for 1,775,500 THB per year for a community for R1S1 (Hin Ngon), if the road project was still very poor condition, as shown in Table 4-31.

The second module of the framework (economic measure) helps identify economic measure of welfare and well-being that is the monetary value for the selected social benefits. For example, the VSL could be monetary value for the reduction in death numbers and the net income for household could be that for increases in farm-gate access vehicles (see Figure 3-3). Note that social indicators from the first module could not be used directly for the appraisal i.e., death numbers. Some social indicators, despite already being a monetary term, i.e., revenue, are not suitable to be used directly within a CBA without first being changed into a relevant economic measure of well-being. Therefore, the second module is needed to assign an appropriate economic measure to the identified social benefits. However, it is challenging to assign economic measures into certain social benefits (e.g., the impact on school enrolment and job opportunities), which could rise in the long run (in future) i.e., school enrolment can be referred future income of students, which could be difficult to estimate. However, this research did not seek economic measures (monetised approach) for all possible social benefits. The research on the monetisation of the social benefits still needs to study comprehensively a by-product of road projects to identify appropriate economic measures.

The third module (economic valuation technique) helps select economic valuation techniques to quantify the possible economic measures identified from the second module. Note that not all techniques (stated and revealed preference techniques) are suitable for monetising all social benefits and quantifying all economic measures.

Moreover, different techniques can require various survey methods (questionnaire or observation) to process the data obtained and monetised models i.e., econometric models. This research suggested that when selecting an appropriate economic valuation technique, the techniques' effectiveness, applicability, and reliability should be considered.

Firstly, the effectiveness, or suitability, requires consideration of the concept behind each technique with each economic measure. Section 2.6 (Chapter 2) and Figure 2-8 in the literature review summarises the frequency of use, by other researchers, of each technique for each economic measure (VSL, CS and income). Secondly, the reliability of the monetised technique depends on economic market (pavement types) to observe where community places a value on road projects i.e., tax, capital, cost and purchasing, as shown in Section 2.6 (Chapter 2) and Figure 2-10. Focusing on public infrastructure projects, the economist (expert opinion in Section 3.2.2) suggested the taxation to measure. Several communities themselves might pay for improving their roads and do not wait for government fund. However, not all techniques are suitable for all payment types. For example, travel cost method cannot be used to capture local taxation for, instead it observes recreational expense. Finally, the applicability of the techniques refers to their usefulness for a road economic appraisal. For example, can they be used examine the relationship between social benefits and maintenance strategies? Ideally, techniques based on econometrics should be able to yield the marginal utility or WTP for one additional unit change of road condition (e.g., a change in IRI and road geometry standard and pavement condition index).

The fourth module (economic appraisal) considers the monetised social benefits within a CBA, adjusted to consider the full spectrum of costs and benefits borne by society as a whole as a result of an intervention. Its use demonstrated how social benefits can help develop a maintenance regime for pavement's life cycle as shown in Table 5-8.

6.3.2 Model development

The models used to monetise health and agriculture benefits rising from rural road projects were based on econometric models and demand functions, as shown in Eq. 3-1 to Eq. 3-12 (Chapter 3). The novelty was that these models were developed for monetising the social benefits associated with road conditions and maintenance option strategies since the appraisal required each value of social benefits for each option strategy to justify. The case study analysis showed that social benefits can rise associated with improved road standards. For example, paved road standards for rural road networks can yield greater the monetary value of social benefits than gravel roads (see Figures 4.17 to 4.20 in Section 4.3.4 (Chapter 4)). Moreover, the models can examine social benefits distributed to varying demographic groups in a society since they took demographic variables into consideration such as income, education, occupation were included in, see Table 4-4 and 4-5 (Chapter 4). For example, In R1S1, the model analysis illustrated that those villagers whose family members were sick could pay the taxation for 12 THB per year more than those without sick family member for maintaining the existing paved road in good condition, see Table 4-10 (Chapter 4). Moreover, these models helped address double counting between the economics of saving in RUC and social benefits as allowed to consider varying means of payment such as tax, capital, purchasing, which must be distinct from travel cost of road user.

As recommended by expert opinion (see Section 3.2.1 (Chapter 3)), this PhD developed models to measure WTP based on local taxation. Such an approach to determine WTP is reasonable for Thailand as those villagers also pay local taxes for other infrastructures such as buildings and houses. Moreover, this research compared the WTP of taxation from the models and surveys to demonstrate the effectiveness of the models, as shown in Tables 4-7 and 4-8. Moreover, a comparison was made between the model for contingent valuation (linear regression) and discrete choice experiment (logistic regression) to identify appropriate economic valuation techniques in the context of rural roads. As a result, these two models, despite of using corresponding variables and respondents, still yielded divergent results of monetised social benefits, the VSL from contingent value was different to that from discrete choice experiment, as shown in Section 4.3 (Chapter 4). Thus, it still needs to use more than one technique of models to compare monetised results to help identify appropriate social value for the appraisal.

6.3.3 Road economic appraisal

Chapter 5 carried out different road investment appraisals, using CBA, that included and excluded social benefits. For the strategies considered, it was found that NPV is positive if social benefits were considered, as shown in Table 5-11 (Chapter 5). Moreover, the prioritisation method was used to rank the road investment strategies. From this priotitisation it was found that projects which proposed an upgrade to an asphaltic surface had the highest ranking, as shown in Table 5-14 of Section 5.2.2 (Chapter 5). The results were presented to the relevant road agency to identify if the findings were according to their expectations and would facilitate budget allocation. As shown in Table 5-15, Section 5.3 (Chapter 5), the agency would rather agree with the appraisal with social benefits as it could yield positive return from the upgrade of existing unpaved road to paved road in R1S2 and R2S2 village, while the appraisal without social benefits cannot. The agencies thought that without the consideration of social benefits, most remote villages in Thailand are still served by unpaved roads.

The approach advocated here in, i.e., the inclusion of social benefits could also be used to inform broader policies for investment. These include formulating policies about land use (e.g. relocation of agriculture collection points) and transport technology (e.g. types of vehicles to transport crop from farms to markets), to provide road agencies with sufficient information to justify maintaining the rural road network to meet the social need for mobility, and to prioritise expenditure where budgets are limited (Workman et al., 2018). For example, the inclusion of additional income to farmers in an appraisal could help estimate the number of years after a road project that villages could live above the poverty line. Moreover, social CBA could contribute to social return on investment (SROI), which is an outcomes-based measurement tool that helps road agencies understand and quantify the social, environmental, and economic value their road projects are creating. The SROI can be estimated based on the social benefits derived from this research and the investment amount.

6.3.4 Case study

This research conducted two case studies of rural road projects in remote areas of Thailand, as described in Section 4.2 (Chapter 4). The data for WTP to avoid death risk was collected using stated preference techniques, contingent valuation (CV) and discrete choice experiments (DCE) based on questionnaire surveys. As there was concern among the researchers about the uncertainty of the WTP from the stated preference techniques, the questionnaire was developed using literature reviews and pilot tests, as shown in Sections 3.3.1 and 3.3.2 (Chapter 3). The pilot test was crucial for the questionnaire development as it helped identify the range of WTP applicable to some of the remote villages, particularly as the remote villages can be very poor and unable to state if WTP was too high. Accordingly, it is recommended that practitioners conduct a qualitative pilot study as this would provide some insight into the limitations of the questionnaire.

The survey also used a method that was not sensitive to those respondents stating WTP i.e., the pictures that show the levels of death risk associated with road condition, as shown in Table 3-2 (Chapter 3). The qualitative study found that respondents felt more engaged with the questionnaire when the risk of death associated with road projects was presented, as a paper-based questionnaire, with the clear pictures. Such an approach it was found helps respondents more clearly understand the importance of different options of rural road investment and their impacts and to be able to state their WTP. Such a visual based approach is recommended for other researchers who wish to determine from remote villagers, who are unused to technical language and may be illiterate, their WTP for improved road conditions that could reduce the risk of death.

After eliciting WTP, this research also captured additional information in the questionnaire. Supplementary questions were asked about demographics, including sex and age, as well as previous experience from rural areas; education, including prior training programs; and occupational experience. The questionnaire became relatively long prior to the CV and DCE exercises. The questionnaire (including the DCE) took an average of half an hour for each person to complete. Information collected about demographics was presented in Table 4-4 (Chapter 4). Collecting this sort of supplemental data is often beneficial as it helps to disaggregate the findings by age, gender etc, describe how villagers stated WTP and develop models for monetisation. Table 4-5 demonstrates descriptive statistics from the survey. Table 4-10 analysed and described, using linear regression analysis, the coefficients of these demographic variables as a function of suggested road condition. The findings suggested that certain demographics, such as income and occupation, affected the WTP stated by respondents. Note that on a national scale, people have varying demographics (i.e., a variety of income levels and occupations) than in remote areas, resulting in varying WTP. To make informed decisions, policymakers need to account for these variations in any analysis.

6.4 Applicability of the research to the industry

Road agencies can adopt this research as a guideline to appraise rural road projects since it has demonstrated the comprehensive use of social benefits for road appraisal. An agency can use the theoretical social benefits framework to select appropriate social indicators and economic measures appropriate for rural road appraisal, thereby making any appraisal transparently and robustly. Moreover, the model developed to quantify the relationship between road surfacing technologies and social benefits allows road agencies to select appropriate investment options that meet social requirements and maintain social activities. The appraisal with social benefits can help road agencies develop broader policies, not just those associated with road investment, to improve the economy in remote areas. For example, the relocation of agricultural collection points to reduce freight costs.

6.5 Summary

This chapter has discussed the research methodology that was used to achieve the aim of the study, which is to compare, contrast and develop means of monetising the social benefits and apply them within a rural road project appraisal. It discussed the framework developed to integrate social benefits within a rural road economic appraisal of different types of road works and standards. The applicability, advantages and disadvantages of the monetisation processes developed in this research were discussed in the context of the case study, model development and the support of investment decision making. While suggestions were offered to facilitate future use of the monetisation of social benefits in road planning. It also envisaged about long term impact on those remote communities if their projects were improved (e.g., land use change and poverty reduction).

Conclusions from the research together with recommendations for future research are presented in the following chapter.

CHAPTER 7 CONCLUSION

7.1 Introduction

Rural road investment appraisal that incorporates monetised values of the benefits of the investment has long been recognised as necessary to improve the justification of investment. The benefits of such investment have long been recognised, however despite this there has a been a paucity of research into how such benefits can be recorded in a transparent and rational manner.

7.2 Accomplished work

To address the above, the research developed a procedural framework that can be used to select appropriate benefits and economic valuation techniques that can be used to obtain monetary values of rural road investment. In addition, it developed relevant models that can be used to monetise the benefits of rural roads and demonstrated the application of the framework and the developed models by means of data collected from two remote regions in Thailand.

By so doing, the accomplished work met the objectives of the research as follows:

1. Developing the procedural framework consisting of the following (Objectives 1 to 4):
    I. The assessment of rural road impact to identify related benefit indicators.
    II. The identification of economic measures that can be used to assign a monetary value to indicators appropriately.
    III. The identification of economic valuation techniques appropriate for each economic measure.
    IV. The use of the above within an investment appraisal methodology.

2. Developing relevant models to monetise rural road benefits (Objective 5).
3. Demonstrating the procedure using data collected in rural Thailand (Objective 6).

7.3 Research conclusions

The key conclusions of this research concern the following:

1. There are a wide range of social dimensions and indicators associated with the impact of rural access.
2. There are several economic valuation techniques which have been used successfully in other disciplines (such as social sciences) which can be used to monetise rural road benefits.
3. The developed procedural framework can be used successfully to support a transparent, monetised, rural road investment cost benefit appraisal.
4. The application of social benefits in road economic appraisal.

7.4 Findings

The following are the major findings of the research:

1. Literature review

- **The inclusion of benefits of rural roads in road economic appraisal**
    - There is a gap in knowledge in relation to procedures for the inclusion of the social benefits into a traditional rural road invest appraisal methodology; it was not clear how to identify the benefits to be monetised.
    - There are several studies in the literature which monetised social benefits in other disciplines and included these in an CBA approach. However, it was not obvious from these studies which benefits should

be included, nor how the benefits could be evaluated in monetary terms.

- **Types of road work in relation to the monetary value of benefits**
    - Standard road economic appraisal recognises that RUC are a function of road condition, and this relationship is fundamental to selecting an appropriate road standard. However, as far as rural road benefits are concerned, there is a paucity of research into whether their benefits are also function of the standard of the road.
    - Note that in road economic appraisal sometimes it requires a few alternatives that should come with varying benefit values. For example, asphaltic road should come with social value that is higher than earth road.
- **Economic evaluation approaches**
    - Although there are several economic valuation techniques which have been used successfully in other disciplines which may be suitable for monetising rural road benefits, it is necessary to carefully select the valuation technique according to the benefit to be valued since not all valuations techniques give the same value. The economic metrics (payment types) are to make the monetisation reliable.
    - Few studies show the appraisal with the inclusion of the monetary value of social benefits to identify wider investment policy. It is not clear if road projects could maintain societal activities and improve poverty.

2. Developed procedural framework

The following were found with respect to the procedural framework

- **Framework**
  - A social dimension can be measured by varying social indicators. For instance, health impact can be measured by death, days of sickness.
  - Social indicators cannot be used directly for road appraisal even though they are monetary. They need to interpret to economic measures of wellbeing i.e., the VSL, CS and income.
  - There are a wide range of social indicators that have never referred to economic measures.
  - An economic valuation technique can quantify varying economic measures. The selection of those techniques bases on their concepts.
- **Models developed to monetise rural road benefits**
  - Contingent valuation (CV) and discrete choice experiment (DCE) economic techniques could be used to value the monetary value for healthcare access. The two techniques produced different values of the VSL, which further highlights the finding from the literature that valuation techniques need to carefully be selected according to the analysis being carried out and the benefits to be valued.
  - The economic technique of the elasticity of price could be used successfully to evaluate the monetary value for farm access, which the monetary value using in the appraisal was the additional income.

3. Case study

For two villages in rural Thailand, it was found that:

- **Models developed to monetise rural road benefits**
  - All three evaluation techniques (for health and agriculture) demonstrated that the magnitude of the benefits calculated are a function of road condition, and that improved road standards could yield higher benefits.
  - Demographic variables such as income vehicle ownership and health condition could affect the WTP of taxation.
- **Including rural road benefits in standard economic appraisals**
  - For the case study area, it was found that including VSL in the analysis can yield a positive NPV for a paved road, while not including VSL can yield a negative return.
  - Social cost (or compensation) was found in this research if road condition was very poor, meaning that improving rural road could rise people from poverty. And it was also included within CBA.
- **Other findings**
  - Medium-sized trucks were found to be the most economical to use when their use cost is evaluated by the additional income.
  - The prioritisation by considering social benefits can meet road authorises' expectation of upgrading a paved road for Sak nga and Rom klao village.

7.5 Research contribution

This research has contributed to the knowledge and understanding of the monetisation of benefits arising from rural roads and by so doing can improve the appraisal process. It has developed a procedural framework by which decisions regarding the benefits to include in the appraisal can be determined and through which appropriate economic tools may be identified. It also developed, as far as the rural road sector is concerned novel techniques to monetise health and agriculture benefit through the VSL and the income, respectively. By so doing the work has provided a transparent approach by which rural road agencies in Thailand and elsewhere can consider the often-neglected impact of improved rural roads on remote communities more seriously, especially in terms of the money that villagers in remote areas often must expend to overcome the negative impact on their livelihood of poor roads. Further, relevant agencies can use the results of monetising rural road improvement benefits, such as by the VSL, income and CS methods developed and demonstrated in this research to develop new investment policies which are transparent to all stakeholders. For example, health agencies can improve mobile healthcare to reduce the risk of death and the VSL can used to evaluate the implemented policy. Further, the income that farmers could lose due to poor roads can be used to develop compensation policies for farmers until new road projects are implemented.

In monetising the impact on agricultural produce transportation costs, this research considered a study of vehicle types used for transporting agricultural produce, in terms of loading capacity, and it was found that medium-sized trucks are the most economical to use. Farmers can use this knowledge to select more effective transportation means and thus reduce the cost of transporting their produce.

7.6 Recommendations for future research

While the results presented in Chapters 4 and 5 have demonstrated the use of the monetary value of social benefits accruing from rural road projects in road appraisals, to further develop and improve this approach for road agencies and researchers, the following additional research is recommended:

1. Socio-demographic data

Socio-demographic data are relevant to model development. Approaches based on an analysis of econometrics require data that can increase the precision of the monetisation model. Certain indicators, such as income levels and occupation, can affect willingness to pay. Thus, research is required to assess the impact of socio-economic status on the size of the monetised benefits obtained.

2. Level of road management

This research has developed a procedural framework and associated tools which can be used at the tactical level of road asset management. Further research is required to assess the applicability of the developed procedures and tools for strategic level investment appraisal. This would require the consideration of benefits in larger areas of the community, rather than adjacent to the intended road project as per this research. It may also therefore require different modes of data gathering.

3. Other social indicators

This research focused on developing approaches to provided monetary values for healthcare and farm access. However, as identified in the literature review there are many other indicators of rural road benefit that have not been monetised and means of so doing require further research. For example, the benefit of improved road condition on access to education can determine the literacy rate, to which future income streams can be assigned as an economic value. Moreover, it is necessary to include all dimensions of investment benefit and their respective monetised values, so that road projects can be compared fairly in road appraisals.

4. Road alternatives

The research case study focused only on quantify the benefit of improving road condition, with the alternatives being different surface types, such as gravel or asphalt. However, future studies could consider whether other road characteristics, such as geometric design/road width may have a beneficial impact on access to rural facilities. For example, paved roads with narrow carriageways can reduce the mobility of emergency services.

7.7 Summary

This chapter has summarised how all the objectives of this research were met. The aim of this research was to provide a methodology by which the benefits arising from rural road projects can be monetised using economic valuation approaches, and to apply the method within a rural road appraisal. This was because rural road projects yield a wide range of potential benefits, but these benefits have rarely been used in appraisals by CBA.

Accordingly, this research has focused on the use of the monetary value of benefits using economic valuation techniques. This included the contingent valuation and discrete choice experiment for the value of statistical life (VSL) and the elasticity of price for additional income to farmers. The approaches proposed in this research will help promote more systematic, comprehensive and promising approaches to road appraisal. Studies of rural road benefits can encourage road agencies to be more aware of projects that affect remote communities. These agencies can and should include these benefits in their investment policies and this research has provided a methodology and associated techniques by which they can so do.   Although the research has contributed significantly to understanding what benefits need to be monetised, how such benefits can be monetised and provided a procedural framework for so doing, it was recognised that further research is required to further improve and refine the approach

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Appendix A

Questionnaire and observation list

Section 1 Questionnaire (Healthcare access)

The stated preference's questionnaire (contingent valuation and discrete choice experiment) is separated to three parts.

Part 1 Introductory session

In this session, participant will be presented about the impact of rural road condition on access to healthcare and farms in remote areas in Thailand.

1. **What is the aim of this survey?**

This survey aims to examine WTP that villagers would prefer to pay for improving a road project to reduce their risk of death and severity as not being able to access healthcare facilities including ambulance in time to save their life.

2. **What is council tax?**

In order to pay for the improvement, villagers need to imagine the amount of council tax they would pay yearly. The tax starts from 0 Thai Bath (THB), meaning that villagers do not want to pay.

3. **How does road condition affect to death risk?**

Very poor road condition may defer people to access hospital and emergency service. Evident based medical reveals that remote villagers had more death risk than those living in urban areas.

4. **Will you go to hospital where it is 10 km. distance away from your village if road condition is very poor? (See picture).** (Villagers will think about travel time, travel cost, travel comfort, unpleasant experience and so on.)

Figure A-1 very poor road condition

<u>Part 2 Eliciting the WTP</u>

A. Contingent Valuation (CV)

How much will you pay for council tax (Thai Baht per year per project) to improve the following road projects? Noted that, the road project is about 5 km. long.

Table A1 is the CV’s questionnaire used for R1S1 and R2S1 (Paved section)

Table A2 is the CV’s questionnaire used for R1S2 and R2S2 (Unpaved section)

Table A1 Contingent valuation questionnaire for road maintenance regime

Maintenance regime	Alternative	WTP/year
Leaving very poor road **Very poor road condition** means road that deteriorates for both pavement surface and sub-based structure for entire road. And, road can be impassable at this condition		0

Maintenance regime	Alternative	WTP/year
Leaving poor road **Poor road condition** means road that deteriorates for both pavement surface and sub-based structure for most road. But, road can be passable with difficulty at this condition		
Keeping fair road **Fair road condition** means road that deteriorates for pavement surface for certain road sections.		
Keeping good road **Good road conditon** is the road that there is no damage such as pothole and surface deforming		

Table A2 Contingent valuation questionnaire for road upgrade regime

Upgrading regime	Alternative	WTP
Earth road (current condition); living with earth road without tax payment		0
Improved 'earth road' to 'Gravel road'		
Improved 'earth road' to 'cape seal road'		

Upgrading regime	Alternative	WTP
Improved 'earth road' to 'Asphaltic concrete road'		

B. Discrete choice Experiment (DCE)

DCE's questionnaire contained 16 choice sets, each choice set has three choices. Third choice for each set is option out that villages can choose when they do not want to pay for road project.

Table A3 is the DCE's questionnaire used for R1S1 and R2S1 (Paved section)

Table A4 is the DCE's questionnaire used for R1S2 and R2S2 (Unpaved section)

Which situation would you choose to pay more for vehicle tax? If choice 1 and 2 are not your preference, please put your preference in choice 3.

Table A3 the DCE's questionnaire for road maintenance type

Card ID	Road maintenance	Travel Time	Death/10,000 VKT	Tax	Make a choice
1	Very poor 	120	3	0	1☐
1	Poor 	30	0	50	2☐
1	Very poor 	90	3	0	3☐
2	Fair 	60	3	100	1☐
2	Good 	90	0	200	2☐
2	Very poor 	90	3	0	3☐
3	Good 	30	3	200	1☐
3	Very Poor 	60	0	0	2☐
3	Very poor 	90	3	0	3☐
4	Poor 	90	3	50	1☐
4	Fair 	120	0	100	2☐
4	Very poor 	90	3	0	3☐
5	Poor	30	2	0	1☐

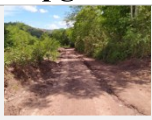
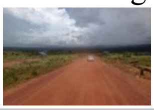
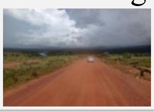
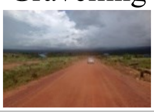
Card ID	Road maintenance	Travel Time	Death/10,000 VKT	Tax	Make a choice
					
5	Fair 	60	3	50	2☐
5	Very poor 	90	3	0	3☐
6	Good 	60	1	0	1☐
6	Very poor 	90	2	50	2☐
6	Very poor 	90	3	0	3☐
7	Fair 	90	0	0	1☐
7	Good 	120	1	50	2☐
7	Very poor 	90	3	0	3☐
8	Very poor 	30	0	100	1☐
8	Poor 	60	1	200	2☐
8	Very poor 	90	3	0	3☐
9	Good 	120	0	50	1☐

Card ID	Road maintenance	Travel Time	Death/10,000 VKT	Tax	Make a choice
9	Very Poor 	30	1	100	2☐
9	Very poor 	90	3	0	3☐
10	Very poor 	60	2	50	1☐
10	Poor 	90	3	100	2☐
10	Very poor 	90	3	0	3☐
11	Poor 	60	0	200	1☐
11	Fair 	90	1	0	2☐
11	Very poor 	90	3	0	3☐
12	Poor 	120	1	100	1☐
12	Fair 	30	2	200	2☐
12	Very poor 	90	3	0	3☐
13	Fair 	120	2	200	1☐
13	Good	30	3	0	2☐

Card ID	Road maintenance	Travel Time	Death/10,000 VKT	Tax	Make a choice
					
13	Very poor 	90	3	0	3☐
14	Fair 	30	1	50	1☐
14	Good 	60	2	100	2☐
14	Very poor 	90	3	0	3☐
15	Good 	90	2	100	1☐
15	Very poor 	12	3	200	2☐
15	Very poor 	90	3	0	3☐
16	Very poor 	90	1	200	1☐
16	Poor 	120	2	0	2☐
16	Very poor 	90	3	0	3☐

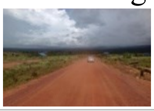
Table A4 The DCE's Questionnaire for road upgrade

Card ID	Road Upgrade	Death/ 10,000 VKT	Travel Time	Tax	Make a choice
1	Without	3	30	0	1☐

Card ID	Road Upgrade	Death/ 10,000 VKT	Travel Time	Tax	Make a choice
					
1	Gravelling 	0	60	50	2☐
1	Without 	3	90	0	3☐
2	Without 	2	90	100	1☐
2	Gravelling 	3	120	200	2☐
2	Without 	3	90	0	3☐
3	Without 	0	120	200	1☐
3	Gravelling 	1	30	0	2☐
3	Without 	3	90	0	3☐
4	Without 	1	60	50	1☐
4	Gravelling 	2	90	100	2☐
4	Without	3	90	0	3☐

Card ID	Road Upgrade	Death/ 10,000 VKT	Travel Time	Tax	Make a choice
					
5	Cape seal 	1	120	0	1☐
5	AC 	2	30	50	2☐
5	Without 	3	90	0	3☐
6	Gravelling 	0	90	0	1☐
6	Cape seal 	1	120	50	2☐
6	Without 	3	90	0	3☐
7	AC 	2	60	0	1☐
7	Without 	3	90	50	2☐
7	Without 	3	90	0	3☐
8	AC 	3	120	100	1☐
8	Without	0	30	200	2☐

Card ID	Road Upgrade	Death/ 10,000 VKT	Travel Time	Tax	Make a choice
					
8	Without 	3	90	0	3☐
9	AC 	0	30	50	1☐
9	Without 	1	60	100	2☐
9	Without 	3	90	0	3☐
10	Cape seal 	3	90	50	1☐
10	AC 	0	120	100	2☐
10	Without 	3	90	0	3☐
11	AC 	1	90	200	1☐
11	Without 	2	120	0	2☐
11	Without 	3	90	0	3☐

Card ID	Road Upgrade	Death/ 10,000 VKT	Travel Time	Tax	Make a choice
12	Gravelling 	1	30	100	1☐
12	Cape seal 	2	60	200	2☐
12	Without 	3	90	0	3☐
13	Cape seal 	2	30	200	1☐
13	AC 	3	60	0	2☐
13	Without 	3	90	0	3☐
14	Gravelling 	2	120	50	1☐
14	Cape seal 	3	30	100	2☐
14	Without 	3	90	0	3☐
15	Cape seal 	0	60	100	1☐
15	AC 	1	90	200	2☐

Card ID	Road Upgrade	Death/ 10,000 VKT	Travel Time	Tax	Make a choice
15	Without 	3	90	0	3☐
16	Gravelling 	3	60	200	1☐
16	Cape seal 	0	90	0	2☐
16	Without 	3	90	0	3☐

<u>Part 3</u> Socio-economic questions

Household Characteristic

1. What is your age?
2. What is your gender?
3. What is your education?
4. What is your occupation?
5. What is your monthly income?
6. What is your monthly family income?
7. How many is the number of family member?
8. How many is the number of family member who are sickness?
9. Of your total income how much do you spent for transport for a month?

Section 2 Observation list (Farm access)

Agricultural data

1. Where is your farm?

Village in which it locates. □ Hin Ngon □ Sak Nga □ Pao Thai □ Rom Klao

2. How much are your farm areas?

_____________Rai (1 Rai = 0.394 Acre)

3. What is kind of crop, you are producing?

□ Cassava □ Corn □ Other……

4. How much is product per Rai?

_____________Ton/Rai

5. What is vehicle type used in agriculture freight transport?

□ E-Tak □ E-Tan □ Pick Up □ Middle truck □ Other……

6. How much is fuel cost per round trip? (if any)

I pay for________________________THB

7. How much is loading per trip (if any)

____________Ton

8. How far is pick up point? (if any)

____________Km.

9. How many trips per rai? (if any)

____________Trip

10. Distance from farm to paved road (if any)

____________Km.

11. Distance from farm to earth road (if any)

____________Km.

Appendix B

Data for state preference approach

<u>Section 1</u> Data for contingent valuation approach

ID	Respondent number
WTP	WTP for gravel, cape seal and asphaltic concrete road in Thai Baht
Perception	The Perception of death risk reduction for gravel, cape seal and asphaltic concrete road in percentage
Gender	0 = female; 1 = male
Age	Age of the respondent
Education	0 = No education, Primary school 1 = Secondary school, otherwise
Occupation	0 = Non-farm worker 1 = farm worker
No_HH	The number of family members
No_sick	The number of family sickness members
Vehicle Types	0 = Motorcycle 1 = Pickup/Car

Table B1 CV's Data for R1S1 (Hin Ngon)

Id	WTP_Good	WTP_Fair	Gender	Age	Education	Occupation	Income	No_HH	No_sick	Veh_type	Perception_Good	Pereption_Fair
1	70	70	0	30	0	1	>9,000THB	2	0	Pickup/Car	0	0
2	60	30	1	25	1	0	<9,000THB	5	0	Motorcycle	2	2
3	70	0	0	42	1	1	>9,000THB	5	0	Pickup/Car	3	3
4	90	20	0	51	1	0	<9,000THB	4	0	Pickup/Car	0	2
5	20	10	0	36	0	1	<9,000THB	5	1	Motorcycle	1	2
6	0	0	1	23	1	0	>9,000THB	3	1	Pickup/Car	3	3
7	100	60	0	63	0	0	<9,000THB	2	0	Motorcycle	3	3
8	10	0	0	53	1	1	<9,000THB	5	0	Pickup/Car	0	1
9	150	10	1	43	1	0	<9,000THB	3	0	Motorcycle	2	2
10	10	10	1	36	0	1	>9,000THB	3	0	Motorcycle	3	3
11	90	60	1	35	0	0	>9,000THB	3	0	Motorcycle	1	1
12	10	10	0	25	1	1	<9,000THB	3	1	Pickup/Car	1	1
13	80	40	0	34	0	0	>9,000THB	3	0	Motorcycle	3	3
14	120	60	1	20	1	1	>9,000THB	4	1	Pickup/Car	2	1
15	150	60	1	33	1	0	>9,000THB	4	1	Pickup/Car	0	3
16	40	40	0	53	1	1	<9,000THB	4	0	Motorcycle	0	2
17	80	50	0	49	0	0	>9,000THB	4	0	Pickup/Car	3	3
18	10	80	1	62	1	0	>9,000THB	2	0	Motorcycle	3	3
19	60	90	0	62	0	1	<9,000THB	2	2	Motorcycle	1	1
20	100	10	0	25	1	0	>9,000THB	4	1	Pickup/Car	3	3
21	10	0	1	61	1	1	<9,000THB	4	2	Pickup/Car	3	3
22	150	20	1	29	1	0	<9,000THB	2	1	Pickup/Car	0	1
23	0	0	0	44	0	1	>9,000THB	3	0	Motorcycle	3	3
24	100	20	1	51	0	1	<9,000THB	2	0	Motorcycle	1	1
25	120	90	0	33	1	0	>9,000THB	3	1	Pickup/Car	3	3
26	60	10	0	20	1	0	>9,000THB	4	1	Motorcycle	1	2
27	10	0	1	23	1	1	<9,000THB	4	2	Motorcycle	3	3
28	10	0	1	26	1	1	>9,000THB	4	0	Pickup/Car	0	3
29	10	0	1	62	0	1	<9,000THB	3	0	Motorcycle	3	3
30	0	0	1	59	0	0	>9,000THB	2	0	Pickup/Car	2	2

Table B2 CV's Data for R2S1 (Pao Thai)

Id	WTP_Good	WTP_Fair	Gender	Age	Education	Occupation	Income	No_HH	No_sick	Veh_type	Perception_Good	Pereption_Fair
1	60	30	Female	65	1	farm worker	>9,000THB	2	3	Pickup/Car	0	3
2	80	30	Female	47	0	Non-farm	>9,000THB	1	2	Motorcycle	0	2
3	60	0	Female	60	1	Non-farm	<9,000THB	1	4	Motorcycle	3	3
4	90	20	Female	21	1	Non-farm	>9,000THB	0	3	Pickup/Car	1	2
5	20	10	Male	56	1	farm worker	>9,000THB	0	4	Pickup/Car	3	2
6	0	0	Male	55	0	farm worker	<9,000THB	0	4	Motorcycle	3	3
7	100	50	Male	23	1	Non-farm	>9,000THB	0	1	Pickup/Car	2	3
8	10	0	Male	43	1	Non-farm	<9,000THB	1	3	Motorcycle	3	1
9	140	80	Female	36	0	farm worker	>9,000THB	0	2	Pickup/Car	0	2
10	10	10	Male	55	0	Non-farm	<9,000THB	0	4	Pickup/Car	3	3
11	90	50	Female	38	1	Non-farm	>9,000THB	0	3	Motorcycle	1	1
12	10	10	Female	61	0	farm worker	<9,000THB	0	4	Motorcycle	1	1
13	80	40	Female	44	1	Non-farm	>9,000THB	0	2	Motorcycle	3	3
14	100	60	Male	46	0	Non-farm	>9,000THB	1	2	Pickup/Car	0	1
15	150	60	Male	50	1	Non-farm	>9,000THB	0	2	Pickup/Car	0	1
16	40	40	Male	49	1	Non-farm	<9,000THB	0	3	Motorcycle	1	2
17	80	50	Female	27	1	farm worker	>9,000THB	0	1	Pickup/Car	3	3
18	10	80	Female	38	1	farm worker	<9,000THB	1	1	Pickup/Car	2	2
19	60	90	Female	25	1	farm worker	>9,000THB	0	4	Motorcycle	1	1
20	100	10	Male	36	1	Non-farm	>9,000THB	0	4	Pickup/Car	0	3
21	10	0	Female	23	1	Non-farm	<9,000THB	1	2	Motorcycle	3	3
22	150	20	Female	24	1	farm worker	>9,000THB	0	2	Pickup/Car	2	1
23	0	0	Female	23	1	Non-farm	<9,000THB	0	2	Motorcycle	3	3
24	100	20	Female	50	0	Non-farm	>9,000THB	1	3	Pickup/Car	1	1
25	100	90	Male	43	1	farm worker	>9,000THB	0	2	Motorcycle	2	2
26	50	10	Male	40	1	Non-farm	>9,000THB	1	4	Motorcycle	1	2
27	10	0	Female	33	1	farm worker	<9,000THB	0	3	Motorcycle	3	3
28	10	0	Female	30	1	Non-farm	<9,000THB	0	4	Motorcycle	2	3
29	10	0	Female	65	0	farm worker	>9,000THB	0	3	Pickup/Car	3	3
30	0	0	Female	61	0	farm worker	<9,000THB	0	2	Motorcycle	2	2

Table B3 CV's Data for R1S2 (Sak Nga)

Id	WTP_Gravel	WTP_Capeseal	WTP_Asphaltic	Gender	Age	Education	Occupation	Income	No_HH	No_Sick	Veh_type	Perception_ Gravel	Perception_ Cape seal	Perception_ Asphaltic
1	0	20	50	0	62	0	Farm worker	<9,000THB	3	0	Motorcycle	3	1	1
2	0	20	60	0	47	0	Farm worker	>9,000THB	2	1	Motorcycle	3	3	1
3	0	30	60	0	60	0	Farm worker	<9,000THB	4	1	Motorcycle	3	1	0
4	20	30	60	0	21	1	Non farm	>9,000THB	3	0	Pickup/Car	3	3	0
5	30	60	80	1	40	0	Farm worker	>9,000THB	4	0	Pickup/Car	2	1	1
6	10	20	60	1	55	0	Farm worker	<9,000THB	4	0	Motorcycle	3	1	1
7	0	50	60	1	23	1	Non farm	>9,000THB	3	0	Pickup/Car	1	1	0
8	0	20	50	1	43	0	Farm worker	<9,000THB	3	1	Motorcycle	2	0	0
9	20	30	60	0	36	1	Farm worker	>9,000THB	2	0	Pickup/Car	3	2	1
10	0	50	60	1	55	0	Farm worker	<9,000THB	4	0	Pickup/Car	2	1	1
11	0	20	40	0	38	0	Non farm	>9,000THB	3	0	Motorcycle	1	0	0
12	0	30	80	0	61	0	Farm worker	<9,000THB	4	0	Motorcycle	1	0	0
13	0	30	50	0	44	0	Non farm	>9,000THB	2	0	Motorcycle	3	1	1
14	0	20	60	1	46	0	Farm worker	>9,000THB	2	1	Pickup/Car	2	0	0
15	0	20	50	1	50	0	Farm worker	>9,000THB	2	0	Pickup/Car	3	0	0
16	20	40	60	1	49	0	Farm worker	<9,000THB	3	0	Motorcycle	1	0	0
17	0	20	60	0	27	0	Farm worker	>9,000THB	3	0	Pickup/Car	3	0	0
18	0	20	80	0	38	1	Farm worker	<9,000THB	3	1	Pickup/Car	3	1	0
19	20	30	70	0	25	1	Farm worker	>9,000THB	4	0	Motorcycle	3	1	0
20	0	20	50	1	36	0	Farm worker	<9,000THB	4	0	Pickup/Car	1	0	0
21	0	20	10	0	23	0	Non farm	<9,000THB	2	1	Motorcycle	3	1	0
22	10	10	40	0	26	1	Farm worker	>9,000THB	2	0	Pickup/Car	2	1	0
23	0	20	50	0	23	0	Non farm	<9,000THB	2	0	Motorcycle	3	3	0
24	0	10	60	0	50	0	Farm worker	<9,000THB	3	1	Pickup/Car	3	3	0
25	10	10	50	1	43	0	Farm worker	<9,000THB	2	0	Motorcycle	3	3	0
26	0	20	40	1	40	0	Non farm	<9,000THB	4	1	Pickup/Car	2	1	0
27	0	10	60	0	33	1	Farm worker	<9,000THB	3	0	Motorcycle	3	1	0
28	0	20	60	0	30	0	Non farm	>9,000THB	4	0	Motorcycle	2	1	0
29	0	0	10	0	63	0	Farm worker	>9,000THB	3	0	Pickup/Car	3	1	0
30	10	20	10	0	48	0	Farm worker	<9,000THB	2	0	Motorcycle	3	1	0

Table B4 CV's Data for R2S2 (Rom Klao)

Id	WTP_Gravel	WTP_Capeseal	WTP_Asphaltic	Gender	Age	Education	Occupation	Income	No_HH	No_Sick	Veh_type	Perception_ Gravel	Perception_ Cape seal	Perception_ Asphaltic
1	0	30	50	1	38	0	Farm worker	>9,000 THB	2	0	Pickup/Car	3	1	1
2	0	0	10	1	48	0	Farm worker	<9,000 THB	3	0	Motorcycle	2	2	1
3	20	50	80	0	27	1	Non farm	>9,000 THB	3	1	Pickup/Car	3	1	1
4	0	0	0	1	65	0	Non farm	>9,000 THB	4	1	Motorcycle	3	2	1
5	10	30	70	0	44	0	Farm worker	<9,000 THB	3	0	Pickup/Car	2	2	1
6	0	0	20	1	60	0	Farm worker	<9,000 THB	4	1	Motorcycle	3	1	1
7	50	100	100	0	40	1	Non farm	>9,000 THB	3	0	Pickup/Car	3	1	2
8	10	50	80	1	34	1	Non farm	>9,000 THB	3	0	Motorcycle	3	1	0
9	0	0	10	1	54	0	Farm worker	<9,000 THB	3	0	Pickup/Car	2	2	0
10	10	40	80	1	28	1	Farm worker	>9,000 THB	3	0	Pickup/Car	3	2	1
11	10	60	80	0	20	1	Farm worker	>9,000 THB	5	1	Motorcycle	3	2	1
12	0	20	40	1	59	0	Farm worker	>9,000 THB	3	0	Pickup/Car	3	2	1
13	0	10	20	0	52	0	Farm worker	<9,000 THB	4	1	Motorcycle	3	2	1
14	20	60	80	0	29	1	Non farm	<9,000 THB	5	1	Pickup/Car	2	1	2
15	0	100	100	0	33	1	Farm worker	>9,000 THB	4	0	Pickup/Car	3	2	1
16	40	80	100	1	28	1	Non farm	>9,000 THB	5	1	Motorcycle	2	1	1
17	0	0	20	1	64	0	Farm worker	<9,000 THB	5	1	Pickup/Car	3	1	0
18	0	10	50	0	48	0	Farm worker	>9,000 THB	4	1	Motorcycle	3	2	1
19	0	0	0	1	59	0	Farm worker	<9,000 THB	2	0	Pickup/Car	2	2	1
20	20	60	60	0	37	1	Non farm	>9,000 THB	5	1	Motorcycle	3	3	1
21	10	30	50	1	49	0	Farm worker	>9,000 THB	5	1	Pickup/Car	3	2	1
22	0	10	60	1	60	0	Farm worker	>9,000 THB	5	1	Motorcycle	3	1	1
23	0	10	80	1	65	0	Farm worker	<9,000 THB	4	0	Pickup/Car	3	2	1
24	0	40	50	0	23	1	Non farm	>9,000 THB	3	0	Motorcycle	2	1	0
25	20	30	60	0	59	0	Farm worker	<9,000 THB	3	0	Pickup/Car	3	3	1
26	10	30	80	1	42	1	Farm worker	>9,000 THB	3	1	Motorcycle	3	2	1
27	0	0	20	0	63	0	Farm worker	>9,000 THB	2	0	Pickup/Car	3	2	1
28	10	10	50	1	41	0	Farm worker	<9,000 THB	2	0	Pickup/Car	3	2	1
29	0	40	80	1	33	1	Non farm	>9,000 THB	4	0	Pickup/Car	3	2	1
30	0	50	80	1	28	0	Non farm	>9,000 THB	2	0	Pickup/Car	2	2	0

<u>Section 2</u> Data for discrete choice experiment (DCE)

ID	Respondent number
Choice set	There are sixteen choice sets for a respondent, each choice set contains three choices.
Death reduction	Death per 10,000 VKT: 0,1,2,3 deaths
Travel time	Travel time to healthcare facility in miniute
Alternative	Road alternatives (0 = Earth Road; 1 = Gravel Road; 2 = Cape seal Road; 3 = Asphaltic concrete road)
Tax	Council tax in Thai Baht
R1S1	choice for Hin Ngon villagers
R2S1	choice for Pao Thai villagers
R1S2	choice for Sak Nga villagers
R2S2	choice for Rom Klao villagers

Table B5 DCE's data for R1S1 (Hin Ngon) and R2S1 (Pao Thai)

Id	Card_id	Case_id	Alternative	Death	Time	Road	Tax	Very Poor	Poor	Fair	Good	R1S1	R2S1
1	1	1	1	3	120	0	0	1	0	0	0	0	0
1	1	1	2	0	30	1	50	0	1	0	0	1	1
1	1	1	3	3	90	0	0	1	0	0	0	0	0
1	2	2	1	3	60	2	100	0	0	1	0	1	1
1	2	2	2	0	90	3	200	0	0	0	1	0	0
1	2	2	3	3	90	0	0	1	0	0	0	0	0
1	3	3	1	3	30	3	200	0	0	0	1	1	1
1	3	3	2	0	60	0	0	1	0	0	0	0	0
1	3	3	3	3	90	0	0	1	0	0	0	0	0
1	4	4	1	3	90	1	50	0	1	0	0	1	1
1	4	4	2	0	120	2	100	0	0	1	0	0	0
1	4	4	3	3	90	0	0	1	0	0	0	0	0
1	5	5	1	2	30	1	0	0	1	0	0	0	0
1	5	5	2	3	60	2	50	0	0	1	0	1	1
1	5	5	3	3	90	0	0	1	0	0	0	0	0
1	6	6	1	1	60	3	0	0	0	0	1	1	1
1	6	6	2	2	90	0	50	1	0	0	0	0	0
1	6	6	3	3	90	0	0	1	0	0	0	0	0
1	7	7	1	0	90	2	0	0	0	1	0	1	1
1	7	7	2	1	120	3	50	0	0	0	1	0	0
1	7	7	3	3	90	0	0	1	0	0	0	0	0
1	8	8	1	0	30	0	100	1	0	0	0	1	1
1	8	8	2	1	60	1	200	0	1	0	0	0	0
1	8	8	3	3	90	0	0	1	0	0	0	0	0
1	9	9	1	0	120	3	50	0	0	0	1	1	1
1	9	9	2	1	30	0	100	1	0	0	0	0	0
1	9	9	3	3	90	0	0	1	0	0	0	0	0
1	10	10	1	2	60	0	50	1	0	0	0	0	0
1	10	10	2	3	90	1	100	0	1	0	0	0	0
1	10	10	3	3	90	0	0	1	0	0	0	1	1
1	11	11	1	0	60	1	200	0	1	0	0	0	0
1	11	11	2	1	90	2	0	0	0	1	0	1	1
1	11	11	3	3	90	0	0	1	0	0	0	0	0
1	12	12	1	1	120	1	100	0	1	0	0	1	1
1	12	12	2	2	30	2	200	0	0	1	0	0	0
1	12	12	3	3	90	0	0	1	0	0	0	0	0
1	13	13	1	2	120	2	200	0	0	1	0	1	1
1	13	13	2	3	30	3	0	0	0	0	1	0	0
1	13	13	3	3	90	0	0	1	0	0	0	0	0
1	14	14	1	1	30	2	50	0	0	1	0	1	1
1	14	14	2	2	60	3	100	0	0	0	1	0	0
1	14	14	3	3	90	0	0	1	0	0	0	0	0
1	15	15	1	2	90	3	100	0	0	0	1	1	1
1	15	15	2	3	120	0	200	1	0	0	0	0	0
1	15	15	3	3	90	0	0	1	0	0	0	0	0
1	16	16	1	1	90	0	200	1	0	0	0	0	0
1	16	16	2	2	120	1	0	0	1	0	0	1	1
1	16	16	3	3	90	0	0	1	0	0	0	0	0

Id	Card_id	Case_id	Alternative	Death	Time	Road	Tax	Very Poor	Poor	Fair	Good	R1S1	R2S1
2	1	17	1	3	120	0	0	1	0	0	0	0	0
2	1	17	2	0	30	1	50	0	1	0	0	1	1
2	1	17	3	3	90	0	0	1	0	0	0	0	0
2	2	18	1	3	60	2	100	0	0	1	0	1	1
2	2	18	2	0	90	3	200	0	0	0	1	0	0
2	2	18	3	3	90	0	0	1	0	0	0	0	0
2	3	19	1	3	30	3	200	0	0	0	1	1	1
2	3	19	2	0	60	0	0	1	0	0	0	0	0
2	3	19	3	3	90	0	0	1	0	0	0	0	0
2	4	20	1	3	90	1	50	0	1	0	0	1	1
2	4	20	2	0	120	2	100	0	0	1	0	0	0
2	4	20	3	3	90	0	0	1	0	0	0	0	0
2	5	21	1	2	30	1	0	0	1	0	0	0	0
2	5	21	2	3	60	2	50	0	0	1	0	1	1
2	5	21	3	3	90	0	0	1	0	0	0	0	0
2	6	22	1	1	60	3	0	0	0	0	1	1	1
2	6	22	2	2	90	0	50	1	0	0	0	0	0
2	6	22	3	3	90	0	0	1	0	0	0	0	0
2	7	23	1	0	90	2	0	0	0	1	0	1	1
2	7	23	2	1	120	3	50	0	0	0	1	0	0
2	7	23	3	3	90	0	0	1	0	0	0	0	0
2	8	24	1	0	30	0	100	1	0	0	0	1	1
2	8	24	2	1	60	1	200	0	1	0	0	0	0
2	8	24	3	3	90	0	0	1	0	0	0	0	0
2	9	25	1	0	120	3	50	0	0	0	1	1	1
2	9	25	2	1	30	0	100	1	0	0	0	0	0
2	9	25	3	3	90	0	0	1	0	0	0	0	0
2	10	26	1	2	60	0	50	1	0	0	0	0	0
2	10	26	2	3	90	1	100	0	1	0	0	0	0
2	10	26	3	3	90	0	0	1	0	0	0	1	1
2	11	27	1	0	60	1	200	0	1	0	0	0	0
2	11	27	2	1	90	2	0	0	0	1	0	1	1
2	11	27	3	3	90	0	0	1	0	0	0	0	0
2	12	28	1	1	120	1	100	0	1	0	0	1	1
2	12	28	2	2	30	2	200	0	0	1	0	0	0
2	12	28	3	3	90	0	0	1	0	0	0	0	0
2	13	29	1	2	120	2	200	0	0	1	0	1	1
2	13	29	2	3	30	3	0	0	0	0	1	0	0
2	13	29	3	3	90	0	0	1	0	0	0	0	0
2	14	30	1	1	30	2	50	0	0	1	0	1	1
2	14	30	2	2	60	3	100	0	0	0	1	0	0
2	14	30	3	3	90	0	0	1	0	0	0	0	0
2	15	31	1	2	90	3	100	0	0	0	1	1	1
2	15	31	2	3	120	0	200	1	0	0	0	0	0
2	15	31	3	3	90	0	0	1	0	0	0	0	0
2	16	32	1	1	90	0	200	1	0	0	0	0	0
2	16	32	2	2	120	1	0	0	1	0	0	1	1
2	16	32	3	3	90	0	0	1	0	0	0	0	0

Id	Card_id	Case_id	Alternative	Death	Time	Road	Tax	Very Poor	Poor	Fair	Good	R1S1	R2S1
3	1	33	1	3	120	0	0	1	0	0	0	0	0
3	1	33	2	0	30	1	50	0	1	0	0	1	1
3	1	33	3	3	90	0	0	1	0	0	0	0	0
3	2	34	1	3	60	2	100	0	0	1	0	1	1
3	2	34	2	0	90	3	200	0	0	0	1	0	0
3	2	34	3	3	90	0	0	1	0	0	0	0	0
3	3	35	1	3	30	3	200	0	0	0	1	1	1
3	3	35	2	0	60	0	0	1	0	0	0	0	0
3	3	35	3	3	90	0	0	1	0	0	0	0	0
3	4	36	1	3	90	1	50	0	1	0	0	1	1
3	4	36	2	0	120	2	100	0	0	1	0	0	0
3	4	36	3	3	90	0	0	1	0	0	0	0	0
3	5	37	1	2	30	1	0	0	1	0	0	0	0
3	5	37	2	3	60	2	50	0	0	1	0	1	1
3	5	37	3	3	90	0	0	1	0	0	0	0	0
3	6	38	1	1	60	3	0	0	0	0	1	1	1
3	6	38	2	2	90	0	50	1	0	0	0	0	0
3	6	38	3	3	90	0	0	1	0	0	0	0	0
3	7	39	1	0	90	2	0	0	0	1	0	1	1
3	7	39	2	1	120	3	50	0	0	0	1	0	0
3	7	39	3	3	90	0	0	1	0	0	0	0	0
3	8	40	1	0	30	0	100	1	0	0	0	1	1
3	8	40	2	1	60	1	200	0	1	0	0	0	0
3	8	40	3	3	90	0	0	1	0	0	0	0	0
3	9	41	1	0	120	3	50	0	0	0	1	1	1
3	9	41	2	1	30	0	100	1	0	0	0	0	0
3	9	41	3	3	90	0	0	1	0	0	0	0	0
3	10	42	1	2	60	0	50	1	0	0	0	0	0
3	10	42	2	3	90	1	100	0	1	0	0	0	0
3	10	42	3	3	90	0	0	1	0	0	0	1	1
3	11	43	1	0	60	1	200	0	1	0	0	0	0
3	11	43	2	1	90	2	0	0	0	1	0	1	1
3	11	43	3	3	90	0	0	1	0	0	0	0	0
3	12	44	1	1	120	1	100	0	1	0	0	1	1
3	12	44	2	2	30	2	200	0	0	1	0	0	0
3	12	44	3	3	90	0	0	1	0	0	0	0	0
3	13	45	1	2	120	2	200	0	0	1	0	1	1
3	13	45	2	3	30	3	0	0	0	0	1	0	0
3	13	45	3	3	90	0	0	1	0	0	0	0	0
3	14	46	1	1	30	2	50	0	0	1	0	1	1
3	14	46	2	2	60	3	100	0	0	0	1	0	0
3	14	46	3	3	90	0	0	1	0	0	0	0	0
3	15	47	1	2	90	3	100	0	0	0	1	1	1
3	15	47	2	3	120	0	200	1	0	0	0	0	0
3	15	47	3	3	90	0	0	1	0	0	0	0	0
3	16	48	1	1	90	0	200	1	0	0	0	0	0
3	16	48	2	2	120	1	0	0	1	0	0	1	1
3	16	48	3	3	90	0	0	1	0	0	0	0	0

Id	Card_id	Case_id	Alternative	Death	Time	Road	Tax	Very Poor	Poor	Fair	Good	R1S1	R2S1
4	1	49	1	3	120	0	0	1	0	0	0	0	0
4	1	49	2	0	30	1	50	0	1	0	0	1	1
4	1	49	3	3	90	0	0	1	0	0	0	0	0
4	2	50	1	3	60	2	100	0	0	1	0	0	1
4	2	50	2	0	90	3	200	0	0	0	1	1	0
4	2	50	3	3	90	0	0	1	0	0	0	0	0
4	3	51	1	3	30	3	200	0	0	0	1	1	1
4	3	51	2	0	60	0	0	1	0	0	0	0	0
4	3	51	3	3	90	0	0	1	0	0	0	0	0
4	4	52	1	3	90	1	50	0	1	0	0	1	1
4	4	52	2	0	120	2	100	0	0	1	0	0	0
4	4	52	3	3	90	0	0	1	0	0	0	0	0
4	5	53	1	2	30	1	0	0	1	0	0	0	0
4	5	53	2	3	60	2	50	0	0	1	0	1	1
4	5	53	3	3	90	0	0	1	0	0	0	0	0
4	6	54	1	1	60	3	0	0	0	0	1	1	1
4	6	54	2	2	90	0	50	1	0	0	0	0	0
4	6	54	3	3	90	0	0	1	0	0	0	0	0
4	7	55	1	0	90	2	0	0	0	1	0	1	1
4	7	55	2	1	120	3	50	0	0	0	1	0	0
4	7	55	3	3	90	0	0	1	0	0	0	0	0
4	8	56	1	0	30	0	100	1	0	0	0	1	1
4	8	56	2	1	60	1	200	0	1	0	0	0	0
4	8	56	3	3	90	0	0	1	0	0	0	0	0
4	9	57	1	0	120	3	50	0	0	0	1	1	1
4	9	57	2	1	30	0	100	1	0	0	0	0	0
4	9	57	3	3	90	0	0	1	0	0	0	0	0
4	10	58	1	2	60	0	50	1	0	0	0	0	0
4	10	58	2	3	90	1	100	0	1	0	0	0	0
4	10	58	3	3	90	0	0	1	0	0	0	1	1
4	11	59	1	0	60	1	200	0	1	0	0	0	0
4	11	59	2	1	90	2	0	0	0	1	0	1	1
4	11	59	3	3	90	0	0	1	0	0	0	0	0
4	12	60	1	1	120	1	100	0	1	0	0	1	1
4	12	60	2	2	30	2	200	0	0	1	0	0	0
4	12	60	3	3	90	0	0	1	0	0	0	0	0
4	13	61	1	2	120	2	200	0	0	1	0	1	1
4	13	61	2	3	30	3	0	0	0	0	1	0	0
4	13	61	3	3	90	0	0	1	0	0	0	0	0
4	14	62	1	1	30	2	50	0	0	1	0	1	1
4	14	62	2	2	60	3	100	0	0	0	1	0	0
4	14	62	3	3	90	0	0	1	0	0	0	0	0
4	15	63	1	2	90	3	100	0	0	0	1	1	1
4	15	63	2	3	120	0	200	1	0	0	0	0	0
4	15	63	3	3	90	0	0	1	0	0	0	0	0
4	16	64	1	1	90	0	200	1	0	0	0	0	0
4	16	64	2	2	120	1	0	0	1	0	0	1	1
4	16	64	3	3	90	0	0	1	0	0	0	0	0

Id	Card_id	Case_id	Alternative	Death	Time	Road	Tax	Very Poor	Poor	Fair	Good	R1S1	R2S1
5	1	65	1	3	120	0	0	1	0	0	0	1	0
5	1	65	2	0	30	1	50	0	1	0	0	0	1
5	1	65	3	3	90	0	0	1	0	0	0	0	0
5	2	66	1	3	60	2	100	0	0	1	0	0	1
5	2	66	2	0	90	3	200	0	0	0	1	0	0
5	2	66	3	3	90	0	0	1	0	0	0	1	0
5	3	67	1	3	30	3	200	0	0	0	1	0	1
5	3	67	2	0	60	0	0	1	0	0	0	1	0
5	3	67	3	3	90	0	0	1	0	0	0	0	0
5	4	68	1	3	90	1	50	0	1	0	0	0	1
5	4	68	2	0	120	2	100	0	0	1	0	0	0
5	4	68	3	3	90	0	0	1	0	0	0	1	0
5	5	69	1	2	30	1	0	0	1	0	0	0	0
5	5	69	2	3	60	2	50	0	0	1	0	0	1
5	5	69	3	3	90	0	0	1	0	0	0	1	0
5	6	70	1	1	60	3	0	0	0	0	1	1	1
5	6	70	2	2	90	0	50	1	0	0	0	0	0
5	6	70	3	3	90	0	0	1	0	0	0	0	0
5	7	71	1	0	90	2	0	0	0	1	0	1	1
5	7	71	2	1	120	3	50	0	0	0	1	0	0
5	7	71	3	3	90	0	0	1	0	0	0	0	0
5	8	72	1	0	30	0	100	1	0	0	0	0	1
5	8	72	2	1	60	1	200	0	1	0	0	0	0
5	8	72	3	3	90	0	0	1	0	0	0	1	0
5	9	73	1	0	120	3	50	0	0	0	1	0	1
5	9	73	2	1	30	0	100	1	0	0	0	0	0
5	9	73	3	3	90	0	0	1	0	0	0	1	0
5	10	74	1	2	60	0	50	1	0	0	0	0	0
5	10	74	2	3	90	1	100	0	1	0	0	0	0
5	10	74	3	3	90	0	0	1	0	0	0	1	1
5	11	75	1	0	60	1	200	0	1	0	0	0	0
5	11	75	2	1	90	2	0	0	0	1	0	0	1
5	11	75	3	3	90	0	0	1	0	0	0	1	0
5	12	76	1	1	120	1	100	0	1	0	0	0	1
5	12	76	2	2	30	2	200	0	0	1	0	0	0
5	12	76	3	3	90	0	0	1	0	0	0	1	0
5	13	77	1	2	120	2	200	0	0	1	0	0	1
5	13	77	2	3	30	3	0	0	0	0	1	1	0
5	13	77	3	3	90	0	0	1	0	0	0	0	0
5	14	78	1	1	30	2	50	0	0	1	0	0	1
5	14	78	2	2	60	3	100	0	0	0	1	0	0
5	14	78	3	3	90	0	0	1	0	0	0	1	0
5	15	79	1	2	90	3	100	0	0	0	1	0	1
5	15	79	2	3	120	0	200	1	0	0	0	0	0
5	15	79	3	3	90	0	0	1	0	0	0	1	0
5	16	80	1	1	90	0	200	1	0	0	0	0	0
5	16	80	2	2	120	1	0	0	1	0	0	1	1
5	16	80	3	3	90	0	0	1	0	0	0	0	0

Id	Card_id	Case_id	Alternative	Death	Time	Road	Tax	Very Poor	Poor	Fair	Good	R1S1	R2S1
6	1	81	1	3	120	0	0	1	0	0	0	1	1
6	1	81	2	0	30	1	50	0	1	0	0	0	0
6	1	81	3	3	90	0	0	1	0	0	0	0	0
6	2	82	1	3	60	2	100	0	0	1	0	0	0
6	2	82	2	0	90	3	200	0	0	0	1	0	0
6	2	82	3	3	90	0	0	1	0	0	0	1	1
6	3	83	1	3	30	3	200	0	0	0	1	0	0
6	3	83	2	0	60	0	0	1	0	0	0	1	1
6	3	83	3	3	90	0	0	1	0	0	0	0	0
6	4	84	1	3	90	1	50	0	1	0	0	0	0
6	4	84	2	0	120	2	100	0	0	1	0	0	0
6	4	84	3	3	90	0	0	1	0	0	0	1	1
6	5	85	1	2	30	1	0	0	1	0	0	0	0
6	5	85	2	3	60	2	50	0	0	1	0	0	0
6	5	85	3	3	90	0	0	1	0	0	0	1	1
6	6	86	1	1	60	3	0	0	0	0	1	1	1
6	6	86	2	2	90	0	50	1	0	0	0	0	0
6	6	86	3	3	90	0	0	1	0	0	0	0	0
6	7	87	1	0	90	2	0	0	0	1	0	1	1
6	7	87	2	1	120	3	50	0	0	0	1	0	0
6	7	87	3	3	90	0	0	1	0	0	0	0	0
6	8	88	1	0	30	0	100	1	0	0	0	0	0
6	8	88	2	1	60	1	200	0	1	0	0	0	0
6	8	88	3	3	90	0	0	1	0	0	0	1	1
6	9	89	1	0	120	3	50	0	0	0	1	0	0
6	9	89	2	1	30	0	100	1	0	0	0	0	0
6	9	89	3	3	90	0	0	1	0	0	0	1	1
6	10	90	1	2	60	0	50	1	0	0	0	0	0
6	10	90	2	3	90	1	100	0	1	0	0	0	0
6	10	90	3	3	90	0	0	1	0	0	0	1	1
6	11	91	1	0	60	1	200	0	1	0	0	0	0
6	11	91	2	1	90	2	0	0	0	1	0	0	0
6	11	91	3	3	90	0	0	1	0	0	0	1	1
6	12	92	1	1	120	1	100	0	1	0	0	0	0
6	12	92	2	2	30	2	200	0	0	1	0	0	0
6	12	92	3	3	90	0	0	1	0	0	0	1	1
6	13	93	1	2	120	2	200	0	0	1	0	0	0
6	13	93	2	3	30	3	0	0	0	0	1	1	1
6	13	93	3	3	90	0	0	1	0	0	0	0	0
6	14	94	1	1	30	2	50	0	0	1	0	0	0
6	14	94	2	2	60	3	100	0	0	0	1	0	0
6	14	94	3	3	90	0	0	1	0	0	0	1	1
6	15	95	1	2	90	3	100	0	0	0	1	0	0
6	15	95	2	3	120	0	200	1	0	0	0	0	0
6	15	95	3	3	90	0	0	1	0	0	0	1	1
6	16	96	1	1	90	0	200	1	0	0	0	0	0
6	16	96	2	2	120	1	0	0	1	0	0	1	1
6	16	96	3	3	90	0	0	1	0	0	0	0	0

Id	Card_id	Case_id	Alternative	Death	Time	Road	Tax	Very Poor	Poor	Fair	Good	R1S1	R2S1
7	1	97	1	3	120	0	0	1	0	0	0	0	1
7	1	97	2	0	30	1	50	0	1	0	0	1	0
7	1	97	3	3	90	0	0	1	0	0	0	0	0
7	2	98	1	3	60	2	100	0	0	1	0	1	0
7	2	98	2	0	90	3	200	0	0	0	1	0	0
7	2	98	3	3	90	0	0	1	0	0	0	0	1
7	3	99	1	3	30	3	200	0	0	0	1	0	1
7	3	99	2	0	60	0	0	1	0	0	0	0	0
7	3	99	3	3	90	0	0	1	0	0	0	1	0
7	4	100	1	3	90	1	50	0	1	0	0	1	0
7	4	100	2	0	120	2	100	0	0	1	0	0	0
7	4	100	3	3	90	0	0	1	0	0	0	0	1
7	5	101	1	2	30	1	0	0	1	0	0	0	0
7	5	101	2	3	60	2	50	0	0	1	0	1	1
7	5	101	3	3	90	0	0	1	0	0	0	0	0
7	6	102	1	1	60	3	0	0	0	0	1	1	0
7	6	102	2	2	90	0	50	1	0	0	0	0	0
7	6	102	3	3	90	0	0	1	0	0	0	0	1
7	7	103	1	0	90	2	0	0	0	1	0	1	1
7	7	103	2	1	120	3	50	0	0	0	1	0	0
7	7	103	3	3	90	0	0	1	0	0	0	0	0
7	8	104	1	0	30	0	100	1	0	0	0	1	1
7	8	104	2	1	60	1	200	0	1	0	0	0	0
7	8	104	3	3	90	0	0	1	0	0	0	0	0
7	9	105	1	0	120	3	50	0	0	0	1	1	1
7	9	105	2	1	30	0	100	1	0	0	0	0	0
7	9	105	3	3	90	0	0	1	0	0	0	0	0
7	10	106	1	2	60	0	50	1	0	0	0	0	0
7	10	106	2	3	90	1	100	0	1	0	0	0	1
7	10	106	3	3	90	0	0	1	0	0	0	1	0
7	11	107	1	0	60	1	200	0	1	0	0	0	1
7	11	107	2	1	90	2	0	0	0	1	0	1	0
7	11	107	3	3	90	0	0	1	0	0	0	0	0
7	12	108	1	1	120	1	100	0	1	0	0	1	0
7	12	108	2	2	30	2	200	0	0	1	0	0	0
7	12	108	3	3	90	0	0	1	0	0	0	0	1
7	13	109	1	2	120	2	200	0	0	1	0	1	0
7	13	109	2	3	30	3	0	0	0	0	1	0	1
7	13	109	3	3	90	0	0	1	0	0	0	0	0
7	14	110	1	1	30	2	50	0	0	1	0	1	0
7	14	110	2	2	60	3	100	0	0	0	1	0	0
7	14	110	3	3	90	0	0	1	0	0	0	0	1
7	15	111	1	2	90	3	100	0	0	0	1	1	0
7	15	111	2	3	120	0	200	1	0	0	0	0	1
7	15	111	3	3	90	0	0	1	0	0	0	0	0
7	16	112	1	1	90	0	200	1	0	0	0	0	0
7	16	112	2	2	120	1	0	0	1	0	0	1	1
7	16	112	3	3	90	0	0	1	0	0	0	0	0

Id	Card_id	Case_id	Alternative	Death	Time	Road	Tax	Very Poor	Poor	Fair	Good	R1S1	R2S1
8	1	113	1	3	120	0	0	1	0	0	0	1	1
8	1	113	2	0	30	1	50	0	1	0	0	0	0
8	1	113	3	3	90	0	0	1	0	0	0	0	0
8	2	114	1	3	60	2	100	0	0	1	0	0	0
8	2	114	2	0	90	3	200	0	0	0	1	0	0
8	2	114	3	3	90	0	0	1	0	0	0	1	1
8	3	115	1	3	30	3	200	0	0	0	1	1	1
8	3	115	2	0	60	0	0	1	0	0	0	0	0
8	3	115	3	3	90	0	0	1	0	0	0	0	0
8	4	116	1	3	90	1	50	0	1	0	0	0	0
8	4	116	2	0	120	2	100	0	0	1	0	0	0
8	4	116	3	3	90	0	0	1	0	0	0	1	1
8	5	117	1	2	30	1	0	0	1	0	0	0	0
8	5	117	2	3	60	2	50	0	0	1	0	1	1
8	5	117	3	3	90	0	0	1	0	0	0	0	0
8	6	118	1	1	60	3	0	0	0	0	1	0	0
8	6	118	2	2	90	0	50	1	0	0	0	0	0
8	6	118	3	3	90	0	0	1	0	0	0	1	1
8	7	119	1	0	90	2	0	0	0	1	0	1	1
8	7	119	2	1	120	3	50	0	0	0	1	0	0
8	7	119	3	3	90	0	0	1	0	0	0	0	0
8	8	120	1	0	30	0	100	1	0	0	0	1	1
8	8	120	2	1	60	1	200	0	1	0	0	0	0
8	8	120	3	3	90	0	0	1	0	0	0	0	0
8	9	121	1	0	120	3	50	0	0	0	1	1	1
8	9	121	2	1	30	0	100	1	0	0	0	0	0
8	9	121	3	3	90	0	0	1	0	0	0	0	0
8	10	122	1	2	60	0	50	1	0	0	0	0	0
8	10	122	2	3	90	1	100	0	1	0	0	1	1
8	10	122	3	3	90	0	0	1	0	0	0	0	0
8	11	123	1	0	60	1	200	0	1	0	0	1	1
8	11	123	2	1	90	2	0	0	0	1	0	0	0
8	11	123	3	3	90	0	0	1	0	0	0	0	0
8	12	124	1	1	120	1	100	0	1	0	0	0	0
8	12	124	2	2	30	2	200	0	0	1	0	0	0
8	12	124	3	3	90	0	0	1	0	0	0	1	1
8	13	125	1	2	120	2	200	0	0	1	0	0	0
8	13	125	2	3	30	3	0	0	0	0	1	1	1
8	13	125	3	3	90	0	0	1	0	0	0	0	0
8	14	126	1	1	30	2	50	0	0	1	0	0	0
8	14	126	2	2	60	3	100	0	0	0	1	0	0
8	14	126	3	3	90	0	0	1	0	0	0	1	1
8	15	127	1	2	90	3	100	0	0	0	1	0	0
8	15	127	2	3	120	0	200	1	0	0	0	1	1
8	15	127	3	3	90	0	0	1	0	0	0	0	0
8	16	128	1	1	90	0	200	1	0	0	0	0	0
8	16	128	2	2	120	1	0	0	1	0	0	1	1
8	16	128	3	3	90	0	0	1	0	0	0	0	0

Id	Card_id	Case_id	Alternative	Death	Time	Road	Tax	Very Poor	Poor	Fair	Good	R1S1	R2S1
9	1	129	1	3	120	0	0	1	0	0	0	1	1
9	1	129	2	0	30	1	50	0	1	0	0	0	0
9	1	129	3	3	90	0	0	1	0	0	0	0	0
9	2	130	1	3	60	2	100	0	0	1	0	0	0
9	2	130	2	0	90	3	200	0	0	0	1	0	0
9	2	130	3	3	90	0	0	1	0	0	0	1	1
9	3	131	1	3	30	3	200	0	0	0	1	1	1
9	3	131	2	0	60	0	0	1	0	0	0	0	0
9	3	131	3	3	90	0	0	1	0	0	0	0	0
9	4	132	1	3	90	1	50	0	1	0	0	0	0
9	4	132	2	0	120	2	100	0	0	1	0	0	0
9	4	132	3	3	90	0	0	1	0	0	0	1	1
9	5	133	1	2	30	1	0	0	1	0	0	0	0
9	5	133	2	3	60	2	50	0	0	1	0	1	1
9	5	133	3	3	90	0	0	1	0	0	0	0	0
9	6	134	1	1	60	3	0	0	0	0	1	0	0
9	6	134	2	2	90	0	50	1	0	0	0	0	0
9	6	134	3	3	90	0	0	1	0	0	0	1	1
9	7	135	1	0	90	2	0	0	0	1	0	1	1
9	7	135	2	1	120	3	50	0	0	0	1	0	0
9	7	135	3	3	90	0	0	1	0	0	0	0	0
9	8	136	1	0	30	0	100	1	0	0	0	1	1
9	8	136	2	1	60	1	200	0	1	0	0	0	0
9	8	136	3	3	90	0	0	1	0	0	0	0	0
9	9	137	1	0	120	3	50	0	0	0	1	1	1
9	9	137	2	1	30	0	100	1	0	0	0	0	0
9	9	137	3	3	90	0	0	1	0	0	0	0	0
9	10	138	1	2	60	0	50	1	0	0	0	0	0
9	10	138	2	3	90	1	100	0	1	0	0	1	1
9	10	138	3	3	90	0	0	1	0	0	0	0	0
9	11	139	1	0	60	1	200	0	1	0	0	1	1
9	11	139	2	1	90	2	0	0	0	1	0	0	0
9	11	139	3	3	90	0	0	1	0	0	0	0	0
9	12	140	1	1	120	1	100	0	1	0	0	0	0
9	12	140	2	2	30	2	200	0	0	1	0	0	0
9	12	140	3	3	90	0	0	1	0	0	0	1	1
9	13	141	1	2	120	2	200	0	0	1	0	0	0
9	13	141	2	3	30	3	0	0	0	0	1	1	1
9	13	141	3	3	90	0	0	1	0	0	0	0	0
9	14	142	1	1	30	2	50	0	0	1	0	0	0
9	14	142	2	2	60	3	100	0	0	0	1	0	0
9	14	142	3	3	90	0	0	1	0	0	0	1	1
9	15	143	1	2	90	3	100	0	0	0	1	0	0
9	15	143	2	3	120	0	200	1	0	0	0	1	1
9	15	143	3	3	90	0	0	1	0	0	0	0	0
9	16	144	1	1	90	0	200	1	0	0	0	0	0
9	16	144	2	2	120	1	0	0	1	0	0	1	1
9	16	144	3	3	90	0	0	1	0	0	0	0	0

Id	Card_id	Case_id	Alternative	Death	Time	Road	Tax	Very Poor	Poor	Fair	Good	R1S1	R2S1
10	1	145	1	3	120	0	0	1	0	0	0	1	1
10	1	145	2	0	30	1	50	0	1	0	0	0	0
10	1	145	3	3	90	0	0	1	0	0	0	0	0
10	2	146	1	3	60	2	100	0	0	1	0	0	0
10	2	146	2	0	90	3	200	0	0	0	1	0	0
10	2	146	3	3	90	0	0	1	0	0	0	1	1
10	3	147	1	3	30	3	200	0	0	0	1	1	1
10	3	147	2	0	60	0	0	1	0	0	0	0	0
10	3	147	3	3	90	0	0	1	0	0	0	0	0
10	4	148	1	3	90	1	50	0	1	0	0	0	0
10	4	148	2	0	120	2	100	0	0	1	0	0	0
10	4	148	3	3	90	0	0	1	0	0	0	1	1
10	5	149	1	2	30	1	0	0	1	0	0	0	0
10	5	149	2	3	60	2	50	0	0	1	0	1	1
10	5	149	3	3	90	0	0	1	0	0	0	0	0
10	6	150	1	1	60	3	0	0	0	0	1	0	0
10	6	150	2	2	90	0	50	1	0	0	0	0	0
10	6	150	3	3	90	0	0	1	0	0	0	1	1
10	7	151	1	0	90	2	0	0	0	1	0	1	1
10	7	151	2	1	120	3	50	0	0	0	1	0	0
10	7	151	3	3	90	0	0	1	0	0	0	0	0
10	8	152	1	0	30	0	100	1	0	0	0	1	1
10	8	152	2	1	60	1	200	0	1	0	0	0	0
10	8	152	3	3	90	0	0	1	0	0	0	0	0
10	9	153	1	0	120	3	50	0	0	0	1	1	1
10	9	153	2	1	30	0	100	1	0	0	0	0	0
10	9	153	3	3	90	0	0	1	0	0	0	0	0
10	10	154	1	2	60	0	50	1	0	0	0	0	0
10	10	154	2	3	90	1	100	0	1	0	0	1	1
10	10	154	3	3	90	0	0	1	0	0	0	0	0
10	11	155	1	0	60	1	200	0	1	0	0	1	1
10	11	155	2	1	90	2	0	0	0	1	0	0	0
10	11	155	3	3	90	0	0	1	0	0	0	0	0
10	12	156	1	1	120	1	100	0	1	0	0	0	0
10	12	156	2	2	30	2	200	0	0	1	0	0	0
10	12	156	3	3	90	0	0	1	0	0	0	1	1
10	13	157	1	2	120	2	200	0	0	1	0	0	0
10	13	157	2	3	30	3	0	0	0	0	1	1	1
10	13	157	3	3	90	0	0	1	0	0	0	0	0
10	14	158	1	1	30	2	50	0	0	1	0	0	0
10	14	158	2	2	60	3	100	0	0	0	1	0	0
10	14	158	3	3	90	0	0	1	0	0	0	1	1
10	15	159	1	2	90	3	100	0	0	0	1	0	0
10	15	159	2	3	120	0	200	1	0	0	0	1	1
10	15	159	3	3	90	0	0	1	0	0	0	0	0
10	16	160	1	1	90	0	200	1	0	0	0	0	0
10	16	160	2	2	120	1	0	0	1	0	0	1	1
10	16	160	3	3	90	0	0	1	0	0	0	0	0

Id	Card_id	Case_id	Alternative	Death	Time	Road	Tax	Very Poor	Poor	Fair	Good	R1S1	R2S1
11	1	161	1	3	120	0	0	1	0	0	0	1	1
11	1	161	2	0	30	1	50	0	1	0	0	0	0
11	1	161	3	3	90	0	0	1	0	0	0	0	0
11	2	162	1	3	60	2	100	0	0	1	0	0	0
11	2	162	2	0	90	3	200	0	0	0	1	0	0
11	2	162	3	3	90	0	0	1	0	0	0	1	1
11	3	163	1	3	30	3	200	0	0	0	1	1	1
11	3	163	2	0	60	0	0	1	0	0	0	0	0
11	3	163	3	3	90	0	0	1	0	0	0	0	0
11	4	164	1	3	90	1	50	0	1	0	0	0	0
11	4	164	2	0	120	2	100	0	0	1	0	0	0
11	4	164	3	3	90	0	0	1	0	0	0	1	1
11	5	165	1	2	30	1	0	0	1	0	0	0	0
11	5	165	2	3	60	2	50	0	0	1	0	1	1
11	5	165	3	3	90	0	0	1	0	0	0	0	0
11	6	166	1	1	60	3	0	0	0	0	1	0	0
11	6	166	2	2	90	0	50	1	0	0	0	0	0
11	6	166	3	3	90	0	0	1	0	0	0	1	1
11	7	167	1	0	90	2	0	0	0	1	0	1	1
11	7	167	2	1	120	3	50	0	0	0	1	0	0
11	7	167	3	3	90	0	0	1	0	0	0	0	0
11	8	168	1	0	30	0	100	1	0	0	0	1	1
11	8	168	2	1	60	1	200	0	1	0	0	0	0
11	8	168	3	3	90	0	0	1	0	0	0	0	0
11	9	169	1	0	120	3	50	0	0	0	1	1	1
11	9	169	2	1	30	0	100	1	0	0	0	0	0
11	9	169	3	3	90	0	0	1	0	0	0	0	0
11	10	170	1	2	60	0	50	1	0	0	0	0	0
11	10	170	2	3	90	1	100	0	1	0	0	1	1
11	10	170	3	3	90	0	0	1	0	0	0	0	0
11	11	171	1	0	60	1	200	0	1	0	0	1	1
11	11	171	2	1	90	2	0	0	0	1	0	0	0
11	11	171	3	3	90	0	0	1	0	0	0	0	0
11	12	172	1	1	120	1	100	0	1	0	0	0	0
11	12	172	2	2	30	2	200	0	0	1	0	0	0
11	12	172	3	3	90	0	0	1	0	0	0	1	1
11	13	173	1	2	120	2	200	0	0	1	0	0	0
11	13	173	2	3	30	3	0	0	0	0	1	1	1
11	13	173	3	3	90	0	0	1	0	0	0	0	0
11	14	174	1	1	30	2	50	0	0	1	0	0	0
11	14	174	2	2	60	3	100	0	0	0	1	0	0
11	14	174	3	3	90	0	0	1	0	0	0	1	1
11	15	175	1	2	90	3	100	0	0	0	1	0	0
11	15	175	2	3	120	0	200	1	0	0	0	1	1
11	15	175	3	3	90	0	0	1	0	0	0	0	0
11	16	176	1	1	90	0	200	1	0	0	0	0	0
11	16	176	2	2	120	1	0	0	1	0	0	1	1
11	16	176	3	3	90	0	0	1	0	0	0	0	0

Id	Card_id	Case_id	Alternative	Death	Time	Road	Tax	Very Poor	Poor	Fair	Good	R1S1	R2S1
12	1	177	1	3	120	0	0	1	0	0	0	0	1
12	1	177	2	0	30	1	50	0	1	0	0	1	0
12	1	177	3	3	90	0	0	1	0	0	0	0	0
12	2	178	1	3	60	2	100	0	0	1	0	0	0
12	2	178	2	0	90	3	200	0	0	0	1	0	0
12	2	178	3	3	90	0	0	1	0	0	0	1	1
12	3	179	1	3	30	3	200	0	0	0	1	0	0
12	3	179	2	0	60	0	0	1	0	0	0	1	1
12	3	179	3	3	90	0	0	1	0	0	0	0	0
12	4	180	1	3	90	1	50	0	1	0	0	0	0
12	4	180	2	0	120	2	100	0	0	1	0	0	0
12	4	180	3	3	90	0	0	1	0	0	0	1	1
12	5	181	1	2	30	1	0	0	1	0	0	0	0
12	5	181	2	3	60	2	50	0	0	1	0	0	0
12	5	181	3	3	90	0	0	1	0	0	0	1	1
12	6	182	1	1	60	3	0	0	0	0	1	1	1
12	6	182	2	2	90	0	50	1	0	0	0	0	0
12	6	182	3	3	90	0	0	1	0	0	0	0	0
12	7	183	1	0	90	2	0	0	0	1	0	1	1
12	7	183	2	1	120	3	50	0	0	0	1	0	0
12	7	183	3	3	90	0	0	1	0	0	0	0	0
12	8	184	1	0	30	0	100	1	0	0	0	0	0
12	8	184	2	1	60	1	200	0	1	0	0	0	0
12	8	184	3	3	90	0	0	1	0	0	0	1	1
12	9	185	1	0	120	3	50	0	0	0	1	0	0
12	9	185	2	1	30	0	100	1	0	0	0	0	0
12	9	185	3	3	90	0	0	1	0	0	0	1	1
12	10	186	1	2	60	0	50	1	0	0	0	0	0
12	10	186	2	3	90	1	100	0	1	0	0	0	0
12	10	186	3	3	90	0	0	1	0	0	0	1	1
12	11	187	1	0	60	1	200	0	1	0	0	0	0
12	11	187	2	1	90	2	0	0	0	1	0	0	0
12	11	187	3	3	90	0	0	1	0	0	0	1	1
12	12	188	1	1	120	1	100	0	1	0	0	0	0
12	12	188	2	2	30	2	200	0	0	1	0	0	0
12	12	188	3	3	90	0	0	1	0	0	0	1	1
12	13	189	1	2	120	2	200	0	0	1	0	0	0
12	13	189	2	3	30	3	0	0	0	0	1	1	1
12	13	189	3	3	90	0	0	1	0	0	0	0	0
12	14	190	1	1	30	2	50	0	0	1	0	0	0
12	14	190	2	2	60	3	100	0	0	0	1	0	0
12	14	190	3	3	90	0	0	1	0	0	0	1	1
12	15	191	1	2	90	3	100	0	0	0	1	0	0
12	15	191	2	3	120	0	200	1	0	0	0	0	0
12	15	191	3	3	90	0	0	1	0	0	0	1	1
12	16	192	1	1	90	0	200	1	0	0	0	0	0
12	16	192	2	2	120	1	0	0	1	0	0	1	1
12	16	192	3	3	90	0	0	1	0	0	0	0	0

Id	Card_id	Case_id	Alternative	Death	Time	Road	Tax	Very Poor	Poor	Fair	Good	R1S1	R2S1
13	1	193	1	3	120	0	0	1	0	0	0	1	1
13	1	193	2	0	30	1	50	0	1	0	0	0	0
13	1	193	3	3	90	0	0	1	0	0	0	0	0
13	2	194	1	3	60	2	100	0	0	1	0	0	0
13	2	194	2	0	90	3	200	0	0	0	1	0	0
13	2	194	3	3	90	0	0	1	0	0	0	1	1
13	3	195	1	3	30	3	200	0	0	0	1	0	0
13	3	195	2	0	60	0	0	1	0	0	0	1	1
13	3	195	3	3	90	0	0	1	0	0	0	0	0
13	4	196	1	3	90	1	50	0	1	0	0	0	0
13	4	196	2	0	120	2	100	0	0	1	0	0	0
13	4	196	3	3	90	0	0	1	0	0	0	1	1
13	5	197	1	2	30	1	0	0	1	0	0	0	0
13	5	197	2	3	60	2	50	0	0	1	0	0	0
13	5	197	3	3	90	0	0	1	0	0	0	1	1
13	6	198	1	1	60	3	0	0	0	0	1	1	1
13	6	198	2	2	90	0	50	1	0	0	0	0	0
13	6	198	3	3	90	0	0	1	0	0	0	0	0
13	7	199	1	0	90	2	0	0	0	1	0	1	1
13	7	199	2	1	120	3	50	0	0	0	1	0	0
13	7	199	3	3	90	0	0	1	0	0	0	0	0
13	8	200	1	0	30	0	100	1	0	0	0	0	0
13	8	200	2	1	60	1	200	0	1	0	0	0	0
13	8	200	3	3	90	0	0	1	0	0	0	1	1
13	9	201	1	0	120	3	50	0	0	0	1	0	0
13	9	201	2	1	30	0	100	1	0	0	0	0	0
13	9	201	3	3	90	0	0	1	0	0	0	1	1
13	10	202	1	2	60	0	50	1	0	0	0	0	0
13	10	202	2	3	90	1	100	0	1	0	0	0	0
13	10	202	3	3	90	0	0	1	0	0	0	1	1
13	11	203	1	0	60	1	200	0	1	0	0	0	0
13	11	203	2	1	90	2	0	0	0	1	0	0	0
13	11	203	3	3	90	0	0	1	0	0	0	1	1
13	12	204	1	1	120	1	100	0	1	0	0	0	0
13	12	204	2	2	30	2	200	0	0	1	0	0	0
13	12	204	3	3	90	0	0	1	0	0	0	1	1
13	13	205	1	2	120	2	200	0	0	1	0	0	0
13	13	205	2	3	30	3	0	0	0	0	1	1	1
13	13	205	3	3	90	0	0	1	0	0	0	0	0
13	14	206	1	1	30	2	50	0	0	1	0	0	0
13	14	206	2	2	60	3	100	0	0	0	1	0	0
13	14	206	3	3	90	0	0	1	0	0	0	1	1
13	15	207	1	2	90	3	100	0	0	0	1	0	0
13	15	207	2	3	120	0	200	1	0	0	0	0	0
13	15	207	3	3	90	0	0	1	0	0	0	1	1
13	16	208	1	1	90	0	200	1	0	0	0	0	0
13	16	208	2	2	120	1	0	0	1	0	0	1	1
13	16	208	3	3	90	0	0	1	0	0	0	0	0

Id	Card_id	Case_id	Alternative	Death	Time	Road	Tax	Very Poor	Poor	Fair	Good	R1S1	R2S1
14	1	209	1	3	120	0	0	1	0	0	0	1	1
14	1	209	2	0	30	1	50	0	1	0	0	0	0
14	1	209	3	3	90	0	0	1	0	0	0	0	0
14	2	210	1	3	60	2	100	0	0	1	0	0	0
14	2	210	2	0	90	3	200	0	0	0	1	0	0
14	2	210	3	3	90	0	0	1	0	0	0	1	1
14	3	211	1	3	30	3	200	0	0	0	1	0	0
14	3	211	2	0	60	0	0	1	0	0	0	1	1
14	3	211	3	3	90	0	0	1	0	0	0	0	0
14	4	212	1	3	90	1	50	0	1	0	0	0	0
14	4	212	2	0	120	2	100	0	0	1	0	0	0
14	4	212	3	3	90	0	0	1	0	0	0	1	1
14	5	213	1	2	30	1	0	0	1	0	0	0	0
14	5	213	2	3	60	2	50	0	0	1	0	0	0
14	5	213	3	3	90	0	0	1	0	0	0	1	1
14	6	214	1	1	60	3	0	0	0	0	1	1	1
14	6	214	2	2	90	0	50	1	0	0	0	0	0
14	6	214	3	3	90	0	0	1	0	0	0	0	0
14	7	215	1	0	90	2	0	0	0	1	0	1	1
14	7	215	2	1	120	3	50	0	0	0	1	0	0
14	7	215	3	3	90	0	0	1	0	0	0	0	0
14	8	216	1	0	30	0	100	1	0	0	0	0	0
14	8	216	2	1	60	1	200	0	1	0	0	0	0
14	8	216	3	3	90	0	0	1	0	0	0	1	1
14	9	217	1	0	120	3	50	0	0	0	1	0	0
14	9	217	2	1	30	0	100	1	0	0	0	0	0
14	9	217	3	3	90	0	0	1	0	0	0	1	1
14	10	218	1	2	60	0	50	1	0	0	0	0	0
14	10	218	2	3	90	1	100	0	1	0	0	0	0
14	10	218	3	3	90	0	0	1	0	0	0	1	1
14	11	219	1	0	60	1	200	0	1	0	0	0	0
14	11	219	2	1	90	2	0	0	0	1	0	0	0
14	11	219	3	3	90	0	0	1	0	0	0	1	1
14	12	220	1	1	120	1	100	0	1	0	0	0	0
14	12	220	2	2	30	2	200	0	0	1	0	0	0
14	12	220	3	3	90	0	0	1	0	0	0	1	1
14	13	221	1	2	120	2	200	0	0	1	0	0	0
14	13	221	2	3	30	3	0	0	0	0	1	1	1
14	13	221	3	3	90	0	0	1	0	0	0	0	0
14	14	222	1	1	30	2	50	0	0	1	0	0	0
14	14	222	2	2	60	3	100	0	0	0	1	0	0
14	14	222	3	3	90	0	0	1	0	0	0	1	1
14	15	223	1	2	90	3	100	0	0	0	1	0	0
14	15	223	2	3	120	0	200	1	0	0	0	0	0
14	15	223	3	3	90	0	0	1	0	0	0	1	1
14	16	224	1	1	90	0	200	1	0	0	0	0	0
14	16	224	2	2	120	1	0	0	1	0	0	1	1
14	16	224	3	3	90	0	0	1	0	0	0	0	0

Id	Card_id	Case_id	Alternative	Death	Time	Road	Tax	Very Poor	Poor	Fair	Good	R1S1	R2S1
15	1	225	1	3	120	0	0	1	0	0	0	1	1
15	1	225	2	0	30	1	50	0	1	0	0	0	0
15	1	225	3	3	90	0	0	1	0	0	0	0	0
15	2	226	1	3	60	2	100	0	0	1	0	0	0
15	2	226	2	0	90	3	200	0	0	0	1	0	0
15	2	226	3	3	90	0	0	1	0	0	0	1	1
15	3	227	1	3	30	3	200	0	0	0	1	0	0
15	3	227	2	0	60	0	0	1	0	0	0	1	1
15	3	227	3	3	90	0	0	1	0	0	0	0	0
15	4	228	1	3	90	1	50	0	1	0	0	0	0
15	4	228	2	0	120	2	100	0	0	1	0	0	0
15	4	228	3	3	90	0	0	1	0	0	0	1	1
15	5	229	1	2	30	1	0	0	1	0	0	0	0
15	5	229	2	3	60	2	50	0	0	1	0	0	0
15	5	229	3	3	90	0	0	1	0	0	0	1	1
15	6	230	1	1	60	3	0	0	0	0	1	1	1
15	6	230	2	2	90	0	50	1	0	0	0	0	0
15	6	230	3	3	90	0	0	1	0	0	0	0	0
15	7	231	1	0	90	2	0	0	0	1	0	1	1
15	7	231	2	1	120	3	50	0	0	0	1	0	0
15	7	231	3	3	90	0	0	1	0	0	0	0	0
15	8	232	1	0	30	0	100	1	0	0	0	0	0
15	8	232	2	1	60	1	200	0	1	0	0	0	0
15	8	232	3	3	90	0	0	1	0	0	0	1	1
15	9	233	1	0	120	3	50	0	0	0	1	0	0
15	9	233	2	1	30	0	100	1	0	0	0	0	0
15	9	233	3	3	90	0	0	1	0	0	0	1	1
15	10	234	1	2	60	0	50	1	0	0	0	0	0
15	10	234	2	3	90	1	100	0	1	0	0	0	0
15	10	234	3	3	90	0	0	1	0	0	0	1	1
15	11	235	1	0	60	1	200	0	1	0	0	0	0
15	11	235	2	1	90	2	0	0	0	1	0	0	0
15	11	235	3	3	90	0	0	1	0	0	0	1	1
15	12	236	1	1	120	1	100	0	1	0	0	0	0
15	12	236	2	2	30	2	200	0	0	1	0	0	0
15	12	236	3	3	90	0	0	1	0	0	0	1	1
15	13	237	1	2	120	2	200	0	0	1	0	0	0
15	13	237	2	3	30	3	0	0	0	0	1	1	1
15	13	237	3	3	90	0	0	1	0	0	0	0	0
15	14	238	1	1	30	2	50	0	0	1	0	0	0
15	14	238	2	2	60	3	100	0	0	0	1	0	0
15	14	238	3	3	90	0	0	1	0	0	0	1	1
15	15	239	1	2	90	3	100	0	0	0	1	0	0
15	15	239	2	3	120	0	200	1	0	0	0	0	0
15	15	239	3	3	90	0	0	1	0	0	0	1	1
15	16	240	1	1	90	0	200	1	0	0	0	0	0
15	16	240	2	2	120	1	0	0	1	0	0	1	1
15	16	240	3	3	90	0	0	1	0	0	0	0	0

Id	Card_id	Case_id	Alternative	Death	Time	Road	Tax	Very Poor	Poor	Fair	Good	R1S1	R2S1
16	1	241	1	3	120	0	0	1	0	0	0	0	0
16	1	241	2	0	30	1	50	0	1	0	0	1	1
16	1	241	3	3	90	0	0	1	0	0	0	0	0
16	2	242	1	3	60	2	100	0	0	1	0	1	1
16	2	242	2	0	90	3	200	0	0	0	1	0	0
16	2	242	3	3	90	0	0	1	0	0	0	0	0
16	3	243	1	3	30	3	200	0	0	0	1	1	1
16	3	243	2	0	60	0	0	1	0	0	0	0	0
16	3	243	3	3	90	0	0	1	0	0	0	0	0
16	4	244	1	3	90	1	50	0	1	0	0	0	0
16	4	244	2	0	120	2	100	0	0	1	0	1	1
16	4	244	3	3	90	0	0	1	0	0	0	0	0
16	5	245	1	2	30	1	0	0	1	0	0	1	1
16	5	245	2	3	60	2	50	0	0	1	0	0	0
16	5	245	3	3	90	0	0	1	0	0	0	0	0
16	6	246	1	1	60	3	0	0	0	0	1	1	1
16	6	246	2	2	90	0	50	1	0	0	0	0	0
16	6	246	3	3	90	0	0	1	0	0	0	0	0
16	7	247	1	0	90	2	0	0	0	1	0	0	0
16	7	247	2	1	120	3	50	0	0	0	1	1	1
16	7	247	3	3	90	0	0	1	0	0	0	0	0
16	8	248	1	0	30	0	100	1	0	0	0	0	0
16	8	248	2	1	60	1	200	0	1	0	0	1	1
16	8	248	3	3	90	0	0	1	0	0	0	0	0
16	9	249	1	0	120	3	50	0	0	0	1	1	1
16	9	249	2	1	30	0	100	1	0	0	0	0	0
16	9	249	3	3	90	0	0	1	0	0	0	0	0
16	10	250	1	2	60	0	50	1	0	0	0	0	0
16	10	250	2	3	90	1	100	0	1	0	0	1	1
16	10	250	3	3	90	0	0	1	0	0	0	0	0
16	11	251	1	0	60	1	200	0	1	0	0	0	0
16	11	251	2	1	90	2	0	0	0	1	0	1	1
16	11	251	3	3	90	0	0	1	0	0	0	0	0
16	12	252	1	1	120	1	100	0	1	0	0	1	1
16	12	252	2	2	30	2	200	0	0	1	0	0	0
16	12	252	3	3	90	0	0	1	0	0	0	0	0
16	13	253	1	2	120	2	200	0	0	1	0	0	0
16	13	253	2	3	30	3	0	0	0	0	1	1	1
16	13	253	3	3	90	0	0	1	0	0	0	0	0
16	14	254	1	1	30	2	50	0	0	1	0	0	0
16	14	254	2	2	60	3	100	0	0	0	1	1	1
16	14	254	3	3	90	0	0	1	0	0	0	0	0
16	15	255	1	2	90	3	100	0	0	0	1	1	1
16	15	255	2	3	120	0	200	1	0	0	0	0	0
16	15	255	3	3	90	0	0	1	0	0	0	0	0
16	16	256	1	1	90	0	200	1	0	0	0	0	0
16	16	256	2	2	120	1	0	0	1	0	0	1	1
16	16	256	3	3	90	0	0	1	0	0	0	0	0

Id	Card_id	Case_id	Alternative	Death	Time	Road	Tax	Very Poor	Poor	Fair	Good	R1S1	R2S1
17	1	257	1	3	120	0	0	1	0	0	0	0	0
17	1	257	2	0	30	1	50	0	1	0	0	1	1
17	1	257	3	3	90	0	0	1	0	0	0	0	0
17	2	258	1	3	60	2	100	0	0	1	0	1	1
17	2	258	2	0	90	3	200	0	0	0	1	0	0
17	2	258	3	3	90	0	0	1	0	0	0	0	0
17	3	259	1	3	30	3	200	0	0	0	1	1	1
17	3	259	2	0	60	0	0	1	0	0	0	0	0
17	3	259	3	3	90	0	0	1	0	0	0	0	0
17	4	260	1	3	90	1	50	0	1	0	0	0	0
17	4	260	2	0	120	2	100	0	0	1	0	1	1
17	4	260	3	3	90	0	0	1	0	0	0	0	0
17	5	261	1	2	30	1	0	0	1	0	0	1	1
17	5	261	2	3	60	2	50	0	0	1	0	0	0
17	5	261	3	3	90	0	0	1	0	0	0	0	0
17	6	262	1	1	60	3	0	0	0	0	1	1	1
17	6	262	2	2	90	0	50	1	0	0	0	0	0
17	6	262	3	3	90	0	0	1	0	0	0	0	0
17	7	263	1	0	90	2	0	0	0	1	0	0	0
17	7	263	2	1	120	3	50	0	0	0	1	1	1
17	7	263	3	3	90	0	0	1	0	0	0	0	0
17	8	264	1	0	30	0	100	1	0	0	0	0	0
17	8	264	2	1	60	1	200	0	1	0	0	1	1
17	8	264	3	3	90	0	0	1	0	0	0	0	0
17	9	265	1	0	120	3	50	0	0	0	1	1	1
17	9	265	2	1	30	0	100	1	0	0	0	0	0
17	9	265	3	3	90	0	0	1	0	0	0	0	0
17	10	266	1	2	60	0	50	1	0	0	0	0	0
17	10	266	2	3	90	1	100	0	1	0	0	1	1
17	10	266	3	3	90	0	0	1	0	0	0	0	0
17	11	267	1	0	60	1	200	0	1	0	0	0	0
17	11	267	2	1	90	2	0	0	0	1	0	1	1
17	11	267	3	3	90	0	0	1	0	0	0	0	0
17	12	268	1	1	120	1	100	0	1	0	0	1	1
17	12	268	2	2	30	2	200	0	0	1	0	0	0
17	12	268	3	3	90	0	0	1	0	0	0	0	0
17	13	269	1	2	120	2	200	0	0	1	0	0	0
17	13	269	2	3	30	3	0	0	0	0	1	1	1
17	13	269	3	3	90	0	0	1	0	0	0	0	0
17	14	270	1	1	30	2	50	0	0	1	0	0	0
17	14	270	2	2	60	3	100	0	0	0	1	1	1
17	14	270	3	3	90	0	0	1	0	0	0	0	0
17	15	271	1	2	90	3	100	0	0	0	1	1	1
17	15	271	2	3	120	0	200	1	0	0	0	0	0
17	15	271	3	3	90	0	0	1	0	0	0	0	0
17	16	272	1	1	90	0	200	1	0	0	0	0	0
17	16	272	2	2	120	1	0	0	1	0	0	1	1
17	16	272	3	3	90	0	0	1	0	0	0	0	0

Id	Card_id	Case_id	Alternative	Death	Time	Road	Tax	Very Poor	Poor	Fair	Good	R1S1	R2S1
18	1	273	1	3	120	0	0	1	0	0	0	0	0
18	1	273	2	0	30	1	50	0	1	0	0	1	1
18	1	273	3	3	90	0	0	1	0	0	0	0	0
18	2	274	1	3	60	2	100	0	0	1	0	1	1
18	2	274	2	0	90	3	200	0	0	0	1	0	0
18	2	274	3	3	90	0	0	1	0	0	0	0	0
18	3	275	1	3	30	3	200	0	0	0	1	1	1
18	3	275	2	0	60	0	0	1	0	0	0	0	0
18	3	275	3	3	90	0	0	1	0	0	0	0	0
18	4	276	1	3	90	1	50	0	1	0	0	0	0
18	4	276	2	0	120	2	100	0	0	1	0	1	1
18	4	276	3	3	90	0	0	1	0	0	0	0	0
18	5	277	1	2	30	1	0	0	1	0	0	1	1
18	5	277	2	3	60	2	50	0	0	1	0	0	0
18	5	277	3	3	90	0	0	1	0	0	0	0	0
18	6	278	1	1	60	3	0	0	0	0	1	1	1
18	6	278	2	2	90	0	50	1	0	0	0	0	0
18	6	278	3	3	90	0	0	1	0	0	0	0	0
18	7	279	1	0	90	2	0	0	0	1	0	0	0
18	7	279	2	1	120	3	50	0	0	0	1	1	1
18	7	279	3	3	90	0	0	1	0	0	0	0	0
18	8	280	1	0	30	0	100	1	0	0	0	0	0
18	8	280	2	1	60	1	200	0	1	0	0	1	1
18	8	280	3	3	90	0	0	1	0	0	0	0	0
18	9	281	1	0	120	3	50	0	0	0	1	1	1
18	9	281	2	1	30	0	100	1	0	0	0	0	0
18	9	281	3	3	90	0	0	1	0	0	0	0	0
18	10	282	1	2	60	0	50	1	0	0	0	0	0
18	10	282	2	3	90	1	100	0	1	0	0	1	1
18	10	282	3	3	90	0	0	1	0	0	0	0	0
18	11	283	1	0	60	1	200	0	1	0	0	0	0
18	11	283	2	1	90	2	0	0	0	1	0	1	1
18	11	283	3	3	90	0	0	1	0	0	0	0	0
18	12	284	1	1	120	1	100	0	1	0	0	1	1
18	12	284	2	2	30	2	200	0	0	1	0	0	0
18	12	284	3	3	90	0	0	1	0	0	0	0	0
18	13	285	1	2	120	2	200	0	0	1	0	0	0
18	13	285	2	3	30	3	0	0	0	0	1	1	1
18	13	285	3	3	90	0	0	1	0	0	0	0	0
18	14	286	1	1	30	2	50	0	0	1	0	0	0
18	14	286	2	2	60	3	100	0	0	0	1	1	1
18	14	286	3	3	90	0	0	1	0	0	0	0	0
18	15	287	1	2	90	3	100	0	0	0	1	1	1
18	15	287	2	3	120	0	200	1	0	0	0	0	0
18	15	287	3	3	90	0	0	1	0	0	0	0	0
18	16	288	1	1	90	0	200	1	0	0	0	0	0
18	16	288	2	2	120	1	0	0	1	0	0	1	1
18	16	288	3	3	90	0	0	1	0	0	0	0	0

Id	Card_id	Case_id	Alternative	Death	Time	Road	Tax	Very Poor	Poor	Fair	Good	R1S1	R2S1
19	1	289	1	3	120	0	0	1	0	0	0	1	1
19	1	289	2	0	30	1	50	0	1	0	0	0	0
19	1	289	3	3	90	0	0	1	0	0	0	0	0
19	2	290	1	3	60	2	100	0	0	1	0	0	0
19	2	290	2	0	90	3	200	0	0	0	1	0	0
19	2	290	3	3	90	0	0	1	0	0	0	1	1
19	3	291	1	3	30	3	200	0	0	0	1	0	0
19	3	291	2	0	60	0	0	1	0	0	0	1	1
19	3	291	3	3	90	0	0	1	0	0	0	0	0
19	4	292	1	3	90	1	50	0	1	0	0	0	0
19	4	292	2	0	120	2	100	0	0	1	0	0	0
19	4	292	3	3	90	0	0	1	0	0	0	1	1
19	5	293	1	2	30	1	0	0	1	0	0	0	0
19	5	293	2	3	60	2	50	0	0	1	0	0	0
19	5	293	3	3	90	0	0	1	0	0	0	1	1
19	6	294	1	1	60	3	0	0	0	0	1	1	1
19	6	294	2	2	90	0	50	1	0	0	0	0	0
19	6	294	3	3	90	0	0	1	0	0	0	0	0
19	7	295	1	0	90	2	0	0	0	1	0	1	1
19	7	295	2	1	120	3	50	0	0	0	1	0	0
19	7	295	3	3	90	0	0	1	0	0	0	0	0
19	8	296	1	0	30	0	100	1	0	0	0	0	0
19	8	296	2	1	60	1	200	0	1	0	0	0	0
19	8	296	3	3	90	0	0	1	0	0	0	1	1
19	9	297	1	0	120	3	50	0	0	0	1	0	0
19	9	297	2	1	30	0	100	1	0	0	0	0	0
19	9	297	3	3	90	0	0	1	0	0	0	1	1
19	10	298	1	2	60	0	50	1	0	0	0	0	0
19	10	298	2	3	90	1	100	0	1	0	0	0	0
19	10	298	3	3	90	0	0	1	0	0	0	1	1
19	11	299	1	0	60	1	200	0	1	0	0	0	0
19	11	299	2	1	90	2	0	0	0	1	0	0	0
19	11	299	3	3	90	0	0	1	0	0	0	1	1
19	12	300	1	1	120	1	100	0	1	0	0	0	0
19	12	300	2	2	30	2	200	0	0	1	0	0	0
19	12	300	3	3	90	0	0	1	0	0	0	1	1
19	13	301	1	2	120	2	200	0	0	1	0	0	0
19	13	301	2	3	30	3	0	0	0	0	1	1	1
19	13	301	3	3	90	0	0	1	0	0	0	0	0
19	14	302	1	1	30	2	50	0	0	1	0	0	0
19	14	302	2	2	60	3	100	0	0	0	1	0	0
19	14	302	3	3	90	0	0	1	0	0	0	1	1
19	15	303	1	2	90	3	100	0	0	0	1	0	0
19	15	303	2	3	120	0	200	1	0	0	0	0	0
19	15	303	3	3	90	0	0	1	0	0	0	1	1
19	16	304	1	1	90	0	200	1	0	0	0	0	0
19	16	304	2	2	120	1	0	0	1	0	0	1	1
19	16	304	3	3	90	0	0	1	0	0	0	0	0

Id	Card_id	Case_id	Alternative	Death	Time	Road	Tax	Very Poor	Poor	Fair	Good	R1S1	R2S1
20	1	305	1	3	120	0	0	1	0	0	0	0	1
20	1	305	2	0	30	1	50	0	1	0	0	1	0
20	1	305	3	3	90	0	0	1	0	0	0	0	0
20	2	306	1	3	60	2	100	0	0	1	0	0	0
20	2	306	2	0	90	3	200	0	0	0	1	0	0
20	2	306	3	3	90	0	0	1	0	0	0	1	1
20	3	307	1	3	30	3	200	0	0	0	1	0	0
20	3	307	2	0	60	0	0	1	0	0	0	1	1
20	3	307	3	3	90	0	0	1	0	0	0	0	0
20	4	308	1	3	90	1	50	0	1	0	0	0	0
20	4	308	2	0	120	2	100	0	0	1	0	0	0
20	4	308	3	3	90	0	0	1	0	0	0	1	1
20	5	309	1	2	30	1	0	0	1	0	0	0	0
20	5	309	2	3	60	2	50	0	0	1	0	0	0
20	5	309	3	3	90	0	0	1	0	0	0	1	1
20	6	310	1	1	60	3	0	0	0	0	1	1	1
20	6	310	2	2	90	0	50	1	0	0	0	0	0
20	6	310	3	3	90	0	0	1	0	0	0	0	0
20	7	311	1	0	90	2	0	0	0	1	0	1	1
20	7	311	2	1	120	3	50	0	0	0	1	0	0
20	7	311	3	3	90	0	0	1	0	0	0	0	0
20	8	312	1	0	30	0	100	1	0	0	0	0	0
20	8	312	2	1	60	1	200	0	1	0	0	0	0
20	8	312	3	3	90	0	0	1	0	0	0	1	1
20	9	313	1	0	120	3	50	0	0	0	1	0	0
20	9	313	2	1	30	0	100	1	0	0	0	0	0
20	9	313	3	3	90	0	0	1	0	0	0	1	1
20	10	314	1	2	60	0	50	1	0	0	0	0	0
20	10	314	2	3	90	1	100	0	1	0	0	0	0
20	10	314	3	3	90	0	0	1	0	0	0	1	1
20	11	315	1	0	60	1	200	0	1	0	0	0	0
20	11	315	2	1	90	2	0	0	0	1	0	0	0
20	11	315	3	3	90	0	0	1	0	0	0	1	1
20	12	316	1	1	120	1	100	0	1	0	0	0	0
20	12	316	2	2	30	2	200	0	0	1	0	0	0
20	12	316	3	3	90	0	0	1	0	0	0	1	1
20	13	317	1	2	120	2	200	0	0	1	0	0	0
20	13	317	2	3	30	3	0	0	0	0	1	1	1
20	13	317	3	3	90	0	0	1	0	0	0	0	0
20	14	318	1	1	30	2	50	0	0	1	0	0	0
20	14	318	2	2	60	3	100	0	0	0	1	0	0
20	14	318	3	3	90	0	0	1	0	0	0	1	1
20	15	319	1	2	90	3	100	0	0	0	1	0	0
20	15	319	2	3	120	0	200	1	0	0	0	0	0
20	15	319	3	3	90	0	0	1	0	0	0	1	1
20	16	320	1	1	90	0	200	1	0	0	0	0	0
20	16	320	2	2	120	1	0	0	1	0	0	1	1
20	16	320	3	3	90	0	0	1	0	0	0	0	0

Id	Card_id	Case_id	Alternative	Death	Time	Road	Tax	Very Poor	Poor	Fair	Good	R1S1	R2S1
21	1	321	1	3	120	0	0	1	0	0	0	0	1
21	1	321	2	0	30	1	50	0	1	0	0	1	0
21	1	321	3	3	90	0	0	1	0	0	0	0	0
21	2	322	1	3	60	2	100	0	0	1	0	0	0
21	2	322	2	0	90	3	200	0	0	0	1	0	0
21	2	322	3	3	90	0	0	1	0	0	0	1	1
21	3	323	1	3	30	3	200	0	0	0	1	0	0
21	3	323	2	0	60	0	0	1	0	0	0	1	1
21	3	323	3	3	90	0	0	1	0	0	0	0	0
21	4	324	1	3	90	1	50	0	1	0	0	0	0
21	4	324	2	0	120	2	100	0	0	1	0	0	0
21	4	324	3	3	90	0	0	1	0	0	0	1	1
21	5	325	1	2	30	1	0	0	1	0	0	0	0
21	5	325	2	3	60	2	50	0	0	1	0	0	0
21	5	325	3	3	90	0	0	1	0	0	0	1	1
21	6	326	1	1	60	3	0	0	0	0	1	1	1
21	6	326	2	2	90	0	50	1	0	0	0	0	0
21	6	326	3	3	90	0	0	1	0	0	0	0	0
21	7	327	1	0	90	2	0	0	0	1	0	1	1
21	7	327	2	1	120	3	50	0	0	0	1	0	0
21	7	327	3	3	90	0	0	1	0	0	0	0	0
21	8	328	1	0	30	0	100	1	0	0	0	0	0
21	8	328	2	1	60	1	200	0	1	0	0	0	0
21	8	328	3	3	90	0	0	1	0	0	0	1	1
21	9	329	1	0	120	3	50	0	0	0	1	0	0
21	9	329	2	1	30	0	100	1	0	0	0	0	0
21	9	329	3	3	90	0	0	1	0	0	0	1	1
21	10	330	1	2	60	0	50	1	0	0	0	0	0
21	10	330	2	3	90	1	100	0	1	0	0	0	0
21	10	330	3	3	90	0	0	1	0	0	0	1	1
21	11	331	1	0	60	1	200	0	1	0	0	0	0
21	11	331	2	1	90	2	0	0	0	1	0	0	0
21	11	331	3	3	90	0	0	1	0	0	0	1	1
21	12	332	1	1	120	1	100	0	1	0	0	0	0
21	12	332	2	2	30	2	200	0	0	1	0	0	0
21	12	332	3	3	90	0	0	1	0	0	0	1	1
21	13	333	1	2	120	2	200	0	0	1	0	0	0
21	13	333	2	3	30	3	0	0	0	0	1	1	1
21	13	333	3	3	90	0	0	1	0	0	0	0	0
21	14	334	1	1	30	2	50	0	0	1	0	0	0
21	14	334	2	2	60	3	100	0	0	0	1	0	0
21	14	334	3	3	90	0	0	1	0	0	0	1	1
21	15	335	1	2	90	3	100	0	0	0	1	0	0
21	15	335	2	3	120	0	200	1	0	0	0	0	0
21	15	335	3	3	90	0	0	1	0	0	0	1	1
21	16	336	1	1	90	0	200	1	0	0	0	0	0
21	16	336	2	2	120	1	0	0	1	0	0	1	1
21	16	336	3	3	90	0	0	1	0	0	0	0	0

Id	Card_id	Case_id	Alternative	Death	Time	Road	Tax	Very Poor	Poor	Fair	Good	R1S1	R2S1
22	1	337	1	3	120	0	0	1	0	0	0	0	1
22	1	337	2	0	30	1	50	0	1	0	0	1	0
22	1	337	3	3	90	0	0	1	0	0	0	0	0
22	2	338	1	3	60	2	100	0	0	1	0	0	0
22	2	338	2	0	90	3	200	0	0	0	1	0	0
22	2	338	3	3	90	0	0	1	0	0	0	1	1
22	3	339	1	3	30	3	200	0	0	0	1	0	0
22	3	339	2	0	60	0	0	1	0	0	0	1	1
22	3	339	3	3	90	0	0	1	0	0	0	0	0
22	4	340	1	3	90	1	50	0	1	0	0	0	0
22	4	340	2	0	120	2	100	0	0	1	0	0	0
22	4	340	3	3	90	0	0	1	0	0	0	1	1
22	5	341	1	2	30	1	0	0	1	0	0	0	0
22	5	341	2	3	60	2	50	0	0	1	0	0	0
22	5	341	3	3	90	0	0	1	0	0	0	1	1
22	6	342	1	1	60	3	0	0	0	0	1	1	1
22	6	342	2	2	90	0	50	1	0	0	0	0	0
22	6	342	3	3	90	0	0	1	0	0	0	0	0
22	7	343	1	0	90	2	0	0	0	1	0	1	1
22	7	343	2	1	120	3	50	0	0	0	1	0	0
22	7	343	3	3	90	0	0	1	0	0	0	0	0
22	8	344	1	0	30	0	100	1	0	0	0	0	0
22	8	344	2	1	60	1	200	0	1	0	0	0	0
22	8	344	3	3	90	0	0	1	0	0	0	1	1
22	9	345	1	0	120	3	50	0	0	0	1	0	0
22	9	345	2	1	30	0	100	1	0	0	0	0	0
22	9	345	3	3	90	0	0	1	0	0	0	1	1
22	10	346	1	2	60	0	50	1	0	0	0	0	0
22	10	346	2	3	90	1	100	0	1	0	0	0	0
22	10	346	3	3	90	0	0	1	0	0	0	1	1
22	11	347	1	0	60	1	200	0	1	0	0	0	0
22	11	347	2	1	90	2	0	0	0	1	0	0	0
22	11	347	3	3	90	0	0	1	0	0	0	1	1
22	12	348	1	1	120	1	100	0	1	0	0	0	0
22	12	348	2	2	30	2	200	0	0	1	0	0	0
22	12	348	3	3	90	0	0	1	0	0	0	1	1
22	13	349	1	2	120	2	200	0	0	1	0	0	0
22	13	349	2	3	30	3	0	0	0	0	1	1	1
22	13	349	3	3	90	0	0	1	0	0	0	0	0
22	14	350	1	1	30	2	50	0	0	1	0	0	0
22	14	350	2	2	60	3	100	0	0	0	1	0	0
22	14	350	3	3	90	0	0	1	0	0	0	1	1
22	15	351	1	2	90	3	100	0	0	0	1	0	0
22	15	351	2	3	120	0	200	1	0	0	0	0	0
22	15	351	3	3	90	0	0	1	0	0	0	1	1
22	16	352	1	1	90	0	200	1	0	0	0	0	0
22	16	352	2	2	120	1	0	0	1	0	0	1	1
22	16	352	3	3	90	0	0	1	0	0	0	0	0

Id	Card_id	Case_id	Alternative	Death	Time	Road	Tax	Very Poor	Poor	Fair	Good	R1S1	R2S1
23	1	353	1	3	120	0	0	1	0	0	0	0	0
23	1	353	2	0	30	1	50	0	1	0	0	1	1
23	1	353	3	3	90	0	0	1	0	0	0	0	0
23	2	354	1	3	60	2	100	0	0	1	0	0	0
23	2	354	2	0	90	3	200	0	0	0	1	0	0
23	2	354	3	3	90	0	0	1	0	0	0	1	1
23	3	355	1	3	30	3	200	0	0	0	1	0	0
23	3	355	2	0	60	0	0	1	0	0	0	1	1
23	3	355	3	3	90	0	0	1	0	0	0	0	0
23	4	356	1	3	90	1	50	0	1	0	0	1	1
23	4	356	2	0	120	2	100	0	0	1	0	0	0
23	4	356	3	3	90	0	0	1	0	0	0	0	0
23	5	357	1	2	30	1	0	0	1	0	0	0	0
23	5	357	2	3	60	2	50	0	0	1	0	1	1
23	5	357	3	3	90	0	0	1	0	0	0	0	0
23	6	358	1	1	60	3	0	0	0	0	1	0	0
23	6	358	2	2	90	0	50	1	0	0	0	1	1
23	6	358	3	3	90	0	0	1	0	0	0	0	0
23	7	359	1	0	90	2	0	0	0	1	0	1	1
23	7	359	2	1	120	3	50	0	0	0	1	0	0
23	7	359	3	3	90	0	0	1	0	0	0	0	0
23	8	360	1	0	30	0	100	1	0	0	0	1	1
23	8	360	2	1	60	1	200	0	1	0	0	0	0
23	8	360	3	3	90	0	0	1	0	0	0	0	0
23	9	361	1	0	120	3	50	0	0	0	1	1	1
23	9	361	2	1	30	0	100	1	0	0	0	0	0
23	9	361	3	3	90	0	0	1	0	0	0	0	0
23	10	362	1	2	60	0	50	1	0	0	0	1	1
23	10	362	2	3	90	1	100	0	1	0	0	0	0
23	10	362	3	3	90	0	0	1	0	0	0	0	0
23	11	363	1	0	60	1	200	0	1	0	0	1	1
23	11	363	2	1	90	2	0	0	0	1	0	0	0
23	11	363	3	3	90	0	0	1	0	0	0	0	0
23	12	364	1	1	120	1	100	0	1	0	0	0	0
23	12	364	2	2	30	2	200	0	0	1	0	1	1
23	12	364	3	3	90	0	0	1	0	0	0	0	0
23	13	365	1	2	120	2	200	0	0	1	0	0	0
23	13	365	2	3	30	3	0	0	0	0	1	1	1
23	13	365	3	3	90	0	0	1	0	0	0	0	0
23	14	366	1	1	30	2	50	0	0	1	0	0	0
23	14	366	2	2	60	3	100	0	0	0	1	1	1
23	14	366	3	3	90	0	0	1	0	0	0	0	0
23	15	367	1	2	90	3	100	0	0	0	1	1	1
23	15	367	2	3	120	0	200	1	0	0	0	0	0
23	15	367	3	3	90	0	0	1	0	0	0	0	0
23	16	368	1	1	90	0	200	1	0	0	0	0	0
23	16	368	2	2	120	1	0	0	1	0	0	1	1
23	16	368	3	3	90	0	0	1	0	0	0	0	0

Id	Card_id	Case_id	Alternative	Death	Time	Road	Tax	Very Poor	Poor	Fair	Good	R1S1	R2S1
24	1	369	1	3	120	0	0	1	0	0	0	0	0
24	1	369	2	0	30	1	50	0	1	0	0	1	1
24	1	369	3	3	90	0	0	1	0	0	0	0	0
24	2	370	1	3	60	2	100	0	0	1	0	0	0
24	2	370	2	0	90	3	200	0	0	0	1	0	0
24	2	370	3	3	90	0	0	1	0	0	0	1	1
24	3	371	1	3	30	3	200	0	0	0	1	0	0
24	3	371	2	0	60	0	0	1	0	0	0	1	1
24	3	371	3	3	90	0	0	1	0	0	0	0	0
24	4	372	1	3	90	1	50	0	1	0	0	1	1
24	4	372	2	0	120	2	100	0	0	1	0	0	0
24	4	372	3	3	90	0	0	1	0	0	0	0	0
24	5	373	1	2	30	1	0	0	1	0	0	0	0
24	5	373	2	3	60	2	50	0	0	1	0	1	1
24	5	373	3	3	90	0	0	1	0	0	0	0	0
24	6	374	1	1	60	3	0	0	0	0	1	0	0
24	6	374	2	2	90	0	50	1	0	0	0	1	1
24	6	374	3	3	90	0	0	1	0	0	0	0	0
24	7	375	1	0	90	2	0	0	0	1	0	1	1
24	7	375	2	1	120	3	50	0	0	0	1	0	0
24	7	375	3	3	90	0	0	1	0	0	0	0	0
24	8	376	1	0	30	0	100	1	0	0	0	1	1
24	8	376	2	1	60	1	200	0	1	0	0	0	0
24	8	376	3	3	90	0	0	1	0	0	0	0	0
24	9	377	1	0	120	3	50	0	0	0	1	1	1
24	9	377	2	1	30	0	100	1	0	0	0	0	0
24	9	377	3	3	90	0	0	1	0	0	0	0	0
24	10	378	1	2	60	0	50	1	0	0	0	1	1
24	10	378	2	3	90	1	100	0	1	0	0	0	0
24	10	378	3	3	90	0	0	1	0	0	0	0	0
24	11	379	1	0	60	1	200	0	1	0	0	1	1
24	11	379	2	1	90	2	0	0	0	1	0	0	0
24	11	379	3	3	90	0	0	1	0	0	0	0	0
24	12	380	1	1	120	1	100	0	1	0	0	0	0
24	12	380	2	2	30	2	200	0	0	1	0	1	1
24	12	380	3	3	90	0	0	1	0	0	0	0	0
24	13	381	1	2	120	2	200	0	0	1	0	0	0
24	13	381	2	3	30	3	0	0	0	0	1	1	1
24	13	381	3	3	90	0	0	1	0	0	0	0	0
24	14	382	1	1	30	2	50	0	0	1	0	0	0
24	14	382	2	2	60	3	100	0	0	0	1	1	1
24	14	382	3	3	90	0	0	1	0	0	0	0	0
24	15	383	1	2	90	3	100	0	0	0	1	1	1
24	15	383	2	3	120	0	200	1	0	0	0	0	0
24	15	383	3	3	90	0	0	1	0	0	0	0	0
24	16	384	1	1	90	0	200	1	0	0	0	0	0
24	16	384	2	2	120	1	0	0	1	0	0	1	1
24	16	384	3	3	90	0	0	1	0	0	0	0	0

Id	Card_id	Case_id	Alternative	Death	Time	Road	Tax	Very Poor	Poor	Fair	Good	R1S1	R2S1
25	1	385	1	3	120	0	0	1	0	0	0	0	0
25	1	385	2	0	30	1	50	0	1	0	0	1	1
25	1	385	3	3	90	0	0	1	0	0	0	0	0
25	2	386	1	3	60	2	100	0	0	1	0	0	0
25	2	386	2	0	90	3	200	0	0	0	1	0	0
25	2	386	3	3	90	0	0	1	0	0	0	1	1
25	3	387	1	3	30	3	200	0	0	0	1	0	0
25	3	387	2	0	60	0	0	1	0	0	0	1	1
25	3	387	3	3	90	0	0	1	0	0	0	0	0
25	4	388	1	3	90	1	50	0	1	0	0	1	1
25	4	388	2	0	120	2	100	0	0	1	0	0	0
25	4	388	3	3	90	0	0	1	0	0	0	0	0
25	5	389	1	2	30	1	0	0	1	0	0	0	0
25	5	389	2	3	60	2	50	0	0	1	0	1	1
25	5	389	3	3	90	0	0	1	0	0	0	0	0
25	6	390	1	1	60	3	0	0	0	0	1	0	0
25	6	390	2	2	90	0	50	1	0	0	0	1	1
25	6	390	3	3	90	0	0	1	0	0	0	0	0
25	7	391	1	0	90	2	0	0	0	1	0	1	1
25	7	391	2	1	120	3	50	0	0	0	1	0	0
25	7	391	3	3	90	0	0	1	0	0	0	0	0
25	8	392	1	0	30	0	100	1	0	0	0	1	1
25	8	392	2	1	60	1	200	0	1	0	0	0	0
25	8	392	3	3	90	0	0	1	0	0	0	0	0
25	9	393	1	0	120	3	50	0	0	0	1	1	1
25	9	393	2	1	30	0	100	1	0	0	0	0	0
25	9	393	3	3	90	0	0	1	0	0	0	0	0
25	10	394	1	2	60	0	50	1	0	0	0	1	1
25	10	394	2	3	90	1	100	0	1	0	0	0	0
25	10	394	3	3	90	0	0	1	0	0	0	0	0
25	11	395	1	0	60	1	200	0	1	0	0	1	1
25	11	395	2	1	90	2	0	0	0	1	0	0	0
25	11	395	3	3	90	0	0	1	0	0	0	0	0
25	12	396	1	1	120	1	100	0	1	0	0	0	0
25	12	396	2	2	30	2	200	0	0	1	0	1	1
25	12	396	3	3	90	0	0	1	0	0	0	0	0
25	13	397	1	2	120	2	200	0	0	1	0	0	0
25	13	397	2	3	30	3	0	0	0	0	1	1	1
25	13	397	3	3	90	0	0	1	0	0	0	0	0
25	14	398	1	1	30	2	50	0	0	1	0	0	0
25	14	398	2	2	60	3	100	0	0	0	1	1	1
25	14	398	3	3	90	0	0	1	0	0	0	0	0
25	15	399	1	2	90	3	100	0	0	0	1	1	1
25	15	399	2	3	120	0	200	1	0	0	0	0	0
25	15	399	3	3	90	0	0	1	0	0	0	0	0
25	16	400	1	1	90	0	200	1	0	0	0	0	0
25	16	400	2	2	120	1	0	0	1	0	0	1	1
25	16	400	3	3	90	0	0	1	0	0	0	0	0

Id	Card_id	Case_id	Alternative	Death	Time	Road	Tax	Very Poor	Poor	Fair	Good	R1S1	R2S1
26	1	401	1	3	120	0	0	1	0	0	0	0	0
26	1	401	2	0	30	1	50	0	1	0	0	1	1
26	1	401	3	3	90	0	0	1	0	0	0	0	0
26	2	402	1	3	60	2	100	0	0	1	0	0	0
26	2	402	2	0	90	3	200	0	0	0	1	0	0
26	2	402	3	3	90	0	0	1	0	0	0	1	1
26	3	403	1	3	30	3	200	0	0	0	1	0	0
26	3	403	2	0	60	0	0	1	0	0	0	1	1
26	3	403	3	3	90	0	0	1	0	0	0	0	0
26	4	404	1	3	90	1	50	0	1	0	0	1	1
26	4	404	2	0	120	2	100	0	0	1	0	0	0
26	4	404	3	3	90	0	0	1	0	0	0	0	0
26	5	405	1	2	30	1	0	0	1	0	0	0	0
26	5	405	2	3	60	2	50	0	0	1	0	1	1
26	5	405	3	3	90	0	0	1	0	0	0	0	0
26	6	406	1	1	60	3	0	0	0	0	1	0	0
26	6	406	2	2	90	0	50	1	0	0	0	1	1
26	6	406	3	3	90	0	0	1	0	0	0	0	0
26	7	407	1	0	90	2	0	0	0	1	0	1	1
26	7	407	2	1	120	3	50	0	0	0	1	0	0
26	7	407	3	3	90	0	0	1	0	0	0	0	0
26	8	408	1	0	30	0	100	1	0	0	0	1	1
26	8	408	2	1	60	1	200	0	1	0	0	0	0
26	8	408	3	3	90	0	0	1	0	0	0	0	0
26	9	409	1	0	120	3	50	0	0	0	1	1	1
26	9	409	2	1	30	0	100	1	0	0	0	0	0
26	9	409	3	3	90	0	0	1	0	0	0	0	0
26	10	410	1	2	60	0	50	1	0	0	0	1	1
26	10	410	2	3	90	1	100	0	1	0	0	0	0
26	10	410	3	3	90	0	0	1	0	0	0	0	0
26	11	411	1	0	60	1	200	0	1	0	0	1	1
26	11	411	2	1	90	2	0	0	0	1	0	0	0
26	11	411	3	3	90	0	0	1	0	0	0	0	0
26	12	412	1	1	120	1	100	0	1	0	0	0	0
26	12	412	2	2	30	2	200	0	0	1	0	1	1
26	12	412	3	3	90	0	0	1	0	0	0	0	0
26	13	413	1	2	120	2	200	0	0	1	0	0	0
26	13	413	2	3	30	3	0	0	0	0	1	1	1
26	13	413	3	3	90	0	0	1	0	0	0	0	0
26	14	414	1	1	30	2	50	0	0	1	0	0	0
26	14	414	2	2	60	3	100	0	0	0	1	1	1
26	14	414	3	3	90	0	0	1	0	0	0	0	0
26	15	415	1	2	90	3	100	0	0	0	1	1	1
26	15	415	2	3	120	0	200	1	0	0	0	0	0
26	15	415	3	3	90	0	0	1	0	0	0	0	0
26	16	416	1	1	90	0	200	1	0	0	0	0	0
26	16	416	2	2	120	1	0	0	1	0	0	1	1
26	16	416	3	3	90	0	0	1	0	0	0	0	0

Id	Card_id	Case_id	Alternative	Death	Time	Road	Tax	Very Poor	Poor	Fair	Good	R1S1	R2S1
27	1	417	1	3	120	0	0	1	0	0	0	0	1
27	1	417	2	0	30	1	50	0	1	0	0	1	0
27	1	417	3	3	90	0	0	1	0	0	0	0	0
27	2	418	1	3	60	2	100	0	0	1	0	0	0
27	2	418	2	0	90	3	200	0	0	0	1	0	0
27	2	418	3	3	90	0	0	1	0	0	0	1	1
27	3	419	1	3	30	3	200	0	0	0	1	0	0
27	3	419	2	0	60	0	0	1	0	0	0	1	1
27	3	419	3	3	90	0	0	1	0	0	0	0	0
27	4	420	1	3	90	1	50	0	1	0	0	0	0
27	4	420	2	0	120	2	100	0	0	1	0	0	0
27	4	420	3	3	90	0	0	1	0	0	0	1	1
27	5	421	1	2	30	1	0	0	1	0	0	0	0
27	5	421	2	3	60	2	50	0	0	1	0	0	0
27	5	421	3	3	90	0	0	1	0	0	0	1	1
27	6	422	1	1	60	3	0	0	0	0	1	1	1
27	6	422	2	2	90	0	50	1	0	0	0	0	0
27	6	422	3	3	90	0	0	1	0	0	0	0	0
27	7	423	1	0	90	2	0	0	0	1	0	1	1
27	7	423	2	1	120	3	50	0	0	0	1	0	0
27	7	423	3	3	90	0	0	1	0	0	0	0	0
27	8	424	1	0	30	0	100	1	0	0	0	0	0
27	8	424	2	1	60	1	200	0	1	0	0	0	0
27	8	424	3	3	90	0	0	1	0	0	0	1	1
27	9	425	1	0	120	3	50	0	0	0	1	0	0
27	9	425	2	1	30	0	100	1	0	0	0	0	0
27	9	425	3	3	90	0	0	1	0	0	0	1	1
27	10	426	1	2	60	0	50	1	0	0	0	0	0
27	10	426	2	3	90	1	100	0	1	0	0	0	0
27	10	426	3	3	90	0	0	1	0	0	0	1	1
27	11	427	1	0	60	1	200	0	1	0	0	0	0
27	11	427	2	1	90	2	0	0	0	1	0	0	0
27	11	427	3	3	90	0	0	1	0	0	0	1	1
27	12	428	1	1	120	1	100	0	1	0	0	0	0
27	12	428	2	2	30	2	200	0	0	1	0	0	0
27	12	428	3	3	90	0	0	1	0	0	0	1	1
27	13	429	1	2	120	2	200	0	0	1	0	0	0
27	13	429	2	3	30	3	0	0	0	0	1	1	1
27	13	429	3	3	90	0	0	1	0	0	0	0	0
27	14	430	1	1	30	2	50	0	0	1	0	0	0
27	14	430	2	2	60	3	100	0	0	0	1	0	0
27	14	430	3	3	90	0	0	1	0	0	0	1	1
27	15	431	1	2	90	3	100	0	0	0	1	0	0
27	15	431	2	3	120	0	200	1	0	0	0	0	0
27	15	431	3	3	90	0	0	1	0	0	0	1	1
27	16	432	1	1	90	0	200	1	0	0	0	0	0
27	16	432	2	2	120	1	0	0	1	0	0	1	1
27	16	432	3	3	90	0	0	1	0	0	0	0	0

Id	Card_id	Case_id	Alternative	Death	Time	Road	Tax	Very Poor	Poor	Fair	Good	R1S1	R2S1
28	1	433	1	3	120	0	0	1	0	0	0	0	1
28	1	433	2	0	30	1	50	0	1	0	0	1	0
28	1	433	3	3	90	0	0	1	0	0	0	0	0
28	2	434	1	3	60	2	100	0	0	1	0	0	0
28	2	434	2	0	90	3	200	0	0	0	1	0	0
28	2	434	3	3	90	0	0	1	0	0	0	1	1
28	3	435	1	3	30	3	200	0	0	0	1	0	0
28	3	435	2	0	60	0	0	1	0	0	0	1	1
28	3	435	3	3	90	0	0	1	0	0	0	0	0
28	4	436	1	3	90	1	50	0	1	0	0	0	0
28	4	436	2	0	120	2	100	0	0	1	0	0	0
28	4	436	3	3	90	0	0	1	0	0	0	1	1
28	5	437	1	2	30	1	0	0	1	0	0	0	0
28	5	437	2	3	60	2	50	0	0	1	0	0	0
28	5	437	3	3	90	0	0	1	0	0	0	1	1
28	6	438	1	1	60	3	0	0	0	0	1	1	1
28	6	438	2	2	90	0	50	1	0	0	0	0	0
28	6	438	3	3	90	0	0	1	0	0	0	0	0
28	7	439	1	0	90	2	0	0	0	1	0	1	1
28	7	439	2	1	120	3	50	0	0	0	1	0	0
28	7	439	3	3	90	0	0	1	0	0	0	0	0
28	8	440	1	0	30	0	100	1	0	0	0	0	0
28	8	440	2	1	60	1	200	0	1	0	0	0	0
28	8	440	3	3	90	0	0	1	0	0	0	1	1
28	9	441	1	0	120	3	50	0	0	0	1	0	0
28	9	441	2	1	30	0	100	1	0	0	0	0	0
28	9	441	3	3	90	0	0	1	0	0	0	1	1
28	10	442	1	2	60	0	50	1	0	0	0	0	0
28	10	442	2	3	90	1	100	0	1	0	0	0	0
28	10	442	3	3	90	0	0	1	0	0	0	1	1
28	11	443	1	0	60	1	200	0	1	0	0	0	0
28	11	443	2	1	90	2	0	0	0	1	0	0	0
28	11	443	3	3	90	0	0	1	0	0	0	1	1
28	12	444	1	1	120	1	100	0	1	0	0	0	0
28	12	444	2	2	30	2	200	0	0	1	0	0	0
28	12	444	3	3	90	0	0	1	0	0	0	1	1
28	13	445	1	2	120	2	200	0	0	1	0	0	0
28	13	445	2	3	30	3	0	0	0	0	1	1	1
28	13	445	3	3	90	0	0	1	0	0	0	0	0
28	14	446	1	1	30	2	50	0	0	1	0	0	0
28	14	446	2	2	60	3	100	0	0	0	1	0	0
28	14	446	3	3	90	0	0	1	0	0	0	1	1
28	15	447	1	2	90	3	100	0	0	0	1	0	0
28	15	447	2	3	120	0	200	1	0	0	0	0	0
28	15	447	3	3	90	0	0	1	0	0	0	1	1
28	16	448	1	1	90	0	200	1	0	0	0	0	0
28	16	448	2	2	120	1	0	0	1	0	0	1	1
28	16	448	3	3	90	0	0	1	0	0	0	0	0

Id	Card_id	Case_id	Alternative	Death	Time	Road	Tax	Very Poor	Poor	Fair	Good	R1S1	R2S1
29	1	449	1	3	120	0	0	1	0	0	0	0	1
29	1	449	2	0	30	1	50	0	1	0	0	1	0
29	1	449	3	3	90	0	0	1	0	0	0	0	0
29	2	450	1	3	60	2	100	0	0	1	0	0	0
29	2	450	2	0	90	3	200	0	0	0	1	0	0
29	2	450	3	3	90	0	0	1	0	0	0	1	1
29	3	451	1	3	30	3	200	0	0	0	1	0	0
29	3	451	2	0	60	0	0	1	0	0	0	1	1
29	3	451	3	3	90	0	0	1	0	0	0	0	0
29	4	452	1	3	90	1	50	0	1	0	0	0	0
29	4	452	2	0	120	2	100	0	0	1	0	0	0
29	4	452	3	3	90	0	0	1	0	0	0	1	1
29	5	453	1	2	30	1	0	0	1	0	0	0	0
29	5	453	2	3	60	2	50	0	0	1	0	0	0
29	5	453	3	3	90	0	0	1	0	0	0	1	1
29	6	454	1	1	60	3	0	0	0	0	1	1	1
29	6	454	2	2	90	0	50	1	0	0	0	0	0
29	6	454	3	3	90	0	0	1	0	0	0	0	0
29	7	455	1	0	90	2	0	0	0	1	0	1	1
29	7	455	2	1	120	3	50	0	0	0	1	0	0
29	7	455	3	3	90	0	0	1	0	0	0	0	0
29	8	456	1	0	30	0	100	1	0	0	0	0	0
29	8	456	2	1	60	1	200	0	1	0	0	0	0
29	8	456	3	3	90	0	0	1	0	0	0	1	1
29	9	457	1	0	120	3	50	0	0	0	1	0	0
29	9	457	2	1	30	0	100	1	0	0	0	0	0
29	9	457	3	3	90	0	0	1	0	0	0	1	1
29	10	458	1	2	60	0	50	1	0	0	0	0	0
29	10	458	2	3	90	1	100	0	1	0	0	0	0
29	10	458	3	3	90	0	0	1	0	0	0	1	1
29	11	459	1	0	60	1	200	0	1	0	0	0	0
29	11	459	2	1	90	2	0	0	0	1	0	0	0
29	11	459	3	3	90	0	0	1	0	0	0	1	1
29	12	460	1	1	120	1	100	0	1	0	0	0	0
29	12	460	2	2	30	2	200	0	0	1	0	0	0
29	12	460	3	3	90	0	0	1	0	0	0	1	1
29	13	461	1	2	120	2	200	0	0	1	0	0	0
29	13	461	2	3	30	3	0	0	0	0	1	1	1
29	13	461	3	3	90	0	0	1	0	0	0	0	0
29	14	462	1	1	30	2	50	0	0	1	0	0	0
29	14	462	2	2	60	3	100	0	0	0	1	0	0
29	14	462	3	3	90	0	0	1	0	0	0	1	1
29	15	463	1	2	90	3	100	0	0	0	1	0	0
29	15	463	2	3	120	0	200	1	0	0	0	0	0
29	15	463	3	3	90	0	0	1	0	0	0	1	1
29	16	464	1	1	90	0	200	1	0	0	0	0	0
29	16	464	2	2	120	1	0	0	1	0	0	1	1
29	16	464	3	3	90	0	0	1	0	0	0	0	0

Id	Card_id	Case_id	Alternative	Death	Time	Road	Tax	Very Poor	Poor	Fair	Good	R1S1	R2S1
30	1	465	1	3	120	0	0	1	0	0	0	0	1
30	1	465	2	0	30	1	50	0	1	0	0	1	0
30	1	465	3	3	90	0	0	1	0	0	0	0	0
30	2	466	1	3	60	2	100	0	0	1	0	0	0
30	2	466	2	0	90	3	200	0	0	0	1	0	0
30	2	466	3	3	90	0	0	1	0	0	0	1	1
30	3	467	1	3	30	3	200	0	0	0	1	1	0
30	3	467	2	0	60	0	0	1	0	0	0	0	1
30	3	467	3	3	90	0	0	1	0	0	0	0	0
30	4	468	1	3	90	1	50	0	1	0	0	1	0
30	4	468	2	0	120	2	100	0	0	1	0	0	0
30	4	468	3	3	90	0	0	1	0	0	0	0	1
30	5	469	1	2	30	1	0	0	1	0	0	0	0
30	5	469	2	3	60	2	50	0	0	1	0	1	0
30	5	469	3	3	90	0	0	1	0	0	0	0	1
30	6	470	1	1	60	3	0	0	0	0	1	1	1
30	6	470	2	2	90	0	50	1	0	0	0	0	0
30	6	470	3	3	90	0	0	1	0	0	0	0	0
30	7	471	1	0	90	2	0	0	0	1	0	1	1
30	7	471	2	1	120	3	50	0	0	0	1	0	0
30	7	471	3	3	90	0	0	1	0	0	0	0	0
30	8	472	1	0	30	0	100	1	0	0	0	0	0
30	8	472	2	1	60	1	200	0	1	0	0	1	0
30	8	472	3	3	90	0	0	1	0	0	0	0	1
30	9	473	1	0	120	3	50	0	0	0	1	1	0
30	9	473	2	1	30	0	100	1	0	0	0	0	0
30	9	473	3	3	90	0	0	1	0	0	0	0	1
30	10	474	1	2	60	0	50	1	0	0	0	1	0
30	10	474	2	3	90	1	100	0	1	0	0	0	0
30	10	474	3	3	90	0	0	1	0	0	0	0	1
30	11	475	1	0	60	1	200	0	1	0	0	1	0
30	11	475	2	1	90	2	0	0	0	1	0	0	0
30	11	475	3	3	90	0	0	1	0	0	0	0	1
30	12	476	1	1	120	1	100	0	1	0	0	1	0
30	12	476	2	2	30	2	200	0	0	1	0	0	0
30	12	476	3	3	90	0	0	1	0	0	0	0	1
30	13	477	1	2	120	2	200	0	0	1	0	0	0
30	13	477	2	3	30	3	0	0	0	0	1	1	1
30	13	477	3	3	90	0	0	1	0	0	0	0	0
30	14	478	1	1	30	2	50	0	0	1	0	0	0
30	14	478	2	2	60	3	100	0	0	0	1	1	0
30	14	478	3	3	90	0	0	1	0	0	0	0	1
30	15	479	1	2	90	3	100	0	0	0	1	1	0
30	15	479	2	3	120	0	200	1	0	0	0	0	0
30	15	479	3	3	90	0	0	1	0	0	0	0	1
30	16	480	1	1	90	0	200	1	0	0	0	0	0
30	16	480	2	2	120	1	0	0	1	0	0	0	1
30	16	480	3	3	90	0	0	1	0	0	0	1	0

Table B6 DCE's data for R1S2 (Sak Nga) and R2S2 (Rom Klao)

Id	Card_id	Case_id	Alternative	Death	Time	Road	Tax	Earth	Gravel	Cape seal	Asphalt	R1S2	R2S2
1	1	1	1	3	30	0	0	1	0	0	0	0	0
1	1	1	2	0	60	1	50	0	1	0	0	1	0
1	1	1	3	3	90	0	0	1	0	0	0	0	1
1	2	2	1	2	90	0	100	1	0	0	0	0	0
1	2	2	2	3	120	1	200	0	1	0	0	0	0
1	2	2	3	3	90	0	0	1	0	0	0	1	1
1	3	3	1	0	120	0	200	1	0	0	0	0	0
1	3	3	2	1	30	1	0	0	1	0	0	1	0
1	3	3	3	3	90	0	0	1	0	0	0	0	1
1	4	4	1	1	60	0	50	1	0	0	0	0	0
1	4	4	2	2	90	1	100	0	1	0	0	0	0
1	4	4	3	3	90	0	0	1	0	0	0	1	1
1	5	5	1	1	120	2	0	0	0	1	0	0	1
1	5	5	2	2	30	3	50	0	0	0	1	0	0
1	5	5	3	3	90	0	0	1	0	0	0	1	0
1	6	6	1	0	90	1	0	0	1	0	0	1	0
1	6	6	2	1	120	2	50	0	0	1	0	0	1
1	6	6	3	3	90	0	0	1	0	0	0	0	0
1	7	7	1	2	60	3	0	0	0	0	1	1	1
1	7	7	2	3	90	0	50	1	0	0	0	0	0
1	7	7	3	3	90	0	0	1	0	0	0	0	0
1	8	8	1	3	120	3	100	0	0	0	1	0	0
1	8	8	2	0	30	0	200	1	0	0	0	0	0
1	8	8	3	3	90	0	0	1	0	0	0	1	1
1	9	9	1	0	30	3	50	0	0	0	1	0	0
1	9	9	2	1	60	0	100	1	0	0	0	0	0
1	9	9	3	3	90	0	0	1	0	0	0	1	1
1	10	10	1	3	90	2	50	0	0	1	0	0	0
1	10	10	2	0	120	3	100	0	0	0	1	0	0
1	10	10	3	3	90	0	0	1	0	0	0	1	1
1	11	11	1	1	90	3	200	0	0	0	1	0	0
1	11	11	2	2	120	0	0	1	0	0	0	0	1
1	11	11	3	3	90	0	0	1	0	0	0	1	0
1	12	12	1	1	30	1	100	0	1	0	0	0	0
1	12	12	2	2	60	2	200	0	0	1	0	0	0
1	12	12	3	3	90	0	0	1	0	0	0	1	1
1	13	13	1	2	30	2	200	0	0	1	0	0	0
1	13	13	2	3	60	3	0	0	0	0	1	1	1
1	13	13	3	3	90	0	0	1	0	0	0	0	0
1	14	14	1	2	120	1	50	0	1	0	0	1	0
1	14	14	2	3	30	2	100	0	0	1	0	0	0
1	14	14	3	3	90	0	0	1	0	0	0	0	1
1	15	15	1	0	60	2	100	0	0	1	0	0	0
1	15	15	2	1	90	3	200	0	0	0	1	0	0
1	15	15	3	3	90	0	0	1	0	0	0	1	1
1	16	16	1	3	60	1	200	0	1	0	0	0	0
1	16	16	2	0	90	2	0	0	0	1	0	1	1
1	16	16	3	3	90	0	0	1	0	0	0	0	0

Id	Card_id	Case_id	Alternative	Death	Time	Road	Tax	Earth	Gravel	Cape seal	Asphalt	R1S2	R2S2
2	1	17	1	3	30	0	0	1	0	0	0	0	0
2	1	17	2	0	60	1	50	0	1	0	0	1	0
2	1	17	3	3	90	0	0	1	0	0	0	0	1
2	2	18	1	2	90	0	100	1	0	0	0	0	0
2	2	18	2	3	120	1	200	0	1	0	0	0	0
2	2	18	3	3	90	0	0	1	0	0	0	1	1
2	3	19	1	0	120	0	200	1	0	0	0	0	0
2	3	19	2	1	30	1	0	0	1	0	0	1	0
2	3	19	3	3	90	0	0	1	0	0	0	0	1
2	4	20	1	1	60	0	50	1	0	0	0	0	0
2	4	20	2	2	90	1	100	0	1	0	0	0	0
2	4	20	3	3	90	0	0	1	0	0	0	1	1
2	5	21	1	1	120	2	0	0	0	1	0	0	1
2	5	21	2	2	30	3	50	0	0	0	1	0	0
2	5	21	3	3	90	0	0	1	0	0	0	1	0
2	6	22	1	0	90	1	0	0	1	0	0	1	0
2	6	22	2	1	120	2	50	0	0	1	0	0	1
2	6	22	3	3	90	0	0	1	0	0	0	0	0
2	7	23	1	2	60	3	0	0	0	0	1	1	1
2	7	23	2	3	90	0	50	1	0	0	0	0	0
2	7	23	3	3	90	0	0	1	0	0	0	0	0
2	8	24	1	3	120	3	100	0	0	0	1	0	0
2	8	24	2	0	30	0	200	1	0	0	0	0	0
2	8	24	3	3	90	0	0	1	0	0	0	1	1
2	9	25	1	0	30	3	50	0	0	0	1	0	0
2	9	25	2	1	60	0	100	1	0	0	0	0	0
2	9	25	3	3	90	0	0	1	0	0	0	1	1
2	10	26	1	3	90	2	50	0	0	1	0	0	0
2	10	26	2	0	120	3	100	0	0	0	1	0	0
2	10	26	3	3	90	0	0	1	0	0	0	1	1
2	11	27	1	1	90	3	200	0	0	0	1	0	0
2	11	27	2	2	120	0	0	1	0	0	0	0	1
2	11	27	3	3	90	0	0	1	0	0	0	1	0
2	12	28	1	1	30	1	100	0	1	0	0	0	0
2	12	28	2	2	60	2	200	0	0	1	0	0	0
2	12	28	3	3	90	0	0	1	0	0	0	1	1
2	13	29	1	2	30	2	200	0	0	1	0	0	0
2	13	29	2	3	60	3	0	0	0	0	1	1	1
2	13	29	3	3	90	0	0	1	0	0	0	0	0
2	14	30	1	2	120	1	50	0	1	0	0	1	0
2	14	30	2	3	30	2	100	0	0	1	0	0	0
2	14	30	3	3	90	0	0	1	0	0	0	0	1
2	15	31	1	0	60	2	100	0	0	1	0	0	0
2	15	31	2	1	90	3	200	0	0	0	1	0	0
2	15	31	3	3	90	0	0	1	0	0	0	1	1
2	16	32	1	3	60	1	200	0	1	0	0	0	0
2	16	32	2	0	90	2	0	0	0	1	0	1	1
2	16	32	3	3	90	0	0	1	0	0	0	0	0

Id	Card_id	Case_id	Alternative	Death	Time	Road	Tax	Earth	Gravel	Cape seal	Asphalt	R1S2	R2S2
3	1	33	1	3	30	0	0	1	0	0	0	0	0
3	1	33	2	0	60	1	50	0	1	0	0	1	0
3	1	33	3	3	90	0	0	1	0	0	0	0	1
3	2	34	1	2	90	0	100	1	0	0	0	0	0
3	2	34	2	3	120	1	200	0	1	0	0	0	0
3	2	34	3	3	90	0	0	1	0	0	0	1	1
3	3	35	1	0	120	0	200	1	0	0	0	0	0
3	3	35	2	1	30	1	0	0	1	0	0	1	0
3	3	35	3	3	90	0	0	1	0	0	0	0	1
3	4	36	1	1	60	0	50	1	0	0	0	0	0
3	4	36	2	2	90	1	100	0	1	0	0	0	0
3	4	36	3	3	90	0	0	1	0	0	0	1	1
3	5	37	1	1	120	2	0	0	0	1	0	0	1
3	5	37	2	2	30	3	50	0	0	0	1	0	0
3	5	37	3	3	90	0	0	1	0	0	0	1	0
3	6	38	1	0	90	1	0	0	1	0	0	1	0
3	6	38	2	1	120	2	50	0	0	1	0	0	1
3	6	38	3	3	90	0	0	1	0	0	0	0	0
3	7	39	1	2	60	3	0	0	0	0	1	1	1
3	7	39	2	3	90	0	50	1	0	0	0	0	0
3	7	39	3	3	90	0	0	1	0	0	0	0	0
3	8	40	1	3	120	3	100	0	0	0	1	0	0
3	8	40	2	0	30	0	200	1	0	0	0	0	0
3	8	40	3	3	90	0	0	1	0	0	0	1	1
3	9	41	1	0	30	3	50	0	0	0	1	0	0
3	9	41	2	1	60	0	100	1	0	0	0	0	0
3	9	41	3	3	90	0	0	1	0	0	0	1	1
3	10	42	1	3	90	2	50	0	0	1	0	0	0
3	10	42	2	0	120	3	100	0	0	0	1	0	0
3	10	42	3	3	90	0	0	1	0	0	0	1	1
3	11	43	1	1	90	3	200	0	0	0	1	0	0
3	11	43	2	2	120	0	0	1	0	0	0	0	1
3	11	43	3	3	90	0	0	1	0	0	0	1	0
3	12	44	1	1	30	1	100	0	1	0	0	0	0
3	12	44	2	2	60	2	200	0	0	1	0	0	0
3	12	44	3	3	90	0	0	1	0	0	0	1	1
3	13	45	1	2	30	2	200	0	0	1	0	0	0
3	13	45	2	3	60	3	0	0	0	0	1	1	1
3	13	45	3	3	90	0	0	1	0	0	0	0	0
3	14	46	1	2	120	1	50	0	1	0	0	1	0
3	14	46	2	3	30	2	100	0	0	1	0	0	0
3	14	46	3	3	90	0	0	1	0	0	0	0	1
3	15	47	1	0	60	2	100	0	0	1	0	0	0
3	15	47	2	1	90	3	200	0	0	0	1	0	0
3	15	47	3	3	90	0	0	1	0	0	0	1	1
3	16	48	1	3	60	1	200	0	1	0	0	0	0
3	16	48	2	0	90	2	0	0	0	1	0	1	1
3	16	48	3	3	90	0	0	1	0	0	0	0	0

Id	Card_id	Case_id	Alternative	Death	Time	Road	Tax	Earth	Gravel	Cape seal	Asphalt	R1S2	R2S2
4	1	49	1	3	30	0	0	1	0	0	0	0	0
4	1	49	2	0	60	1	50	0	1	0	0	1	0
4	1	49	3	3	90	0	0	1	0	0	0	0	1
4	2	50	1	2	90	0	100	1	0	0	0	0	0
4	2	50	2	3	120	1	200	0	1	0	0	0	0
4	2	50	3	3	90	0	0	1	0	0	0	1	1
4	3	51	1	0	120	0	200	1	0	0	0	0	0
4	3	51	2	1	30	1	0	0	1	0	0	1	0
4	3	51	3	3	90	0	0	1	0	0	0	0	1
4	4	52	1	1	60	0	50	1	0	0	0	0	0
4	4	52	2	2	90	1	100	0	1	0	0	0	0
4	4	52	3	3	90	0	0	1	0	0	0	1	1
4	5	53	1	1	120	2	0	0	0	1	0	0	1
4	5	53	2	2	30	3	50	0	0	0	1	0	0
4	5	53	3	3	90	0	0	1	0	0	0	1	0
4	6	54	1	0	90	1	0	0	1	0	0	1	0
4	6	54	2	1	120	2	50	0	0	1	0	0	1
4	6	54	3	3	90	0	0	1	0	0	0	0	0
4	7	55	1	2	60	3	0	0	0	0	1	1	1
4	7	55	2	3	90	0	50	1	0	0	0	0	0
4	7	55	3	3	90	0	0	1	0	0	0	0	0
4	8	56	1	3	120	3	100	0	0	0	1	0	0
4	8	56	2	0	30	0	200	1	0	0	0	0	0
4	8	56	3	3	90	0	0	1	0	0	0	1	1
4	9	57	1	0	30	3	50	0	0	0	1	0	0
4	9	57	2	1	60	0	100	1	0	0	0	0	0
4	9	57	3	3	90	0	0	1	0	0	0	1	1
4	10	58	1	3	90	2	50	0	0	1	0	0	0
4	10	58	2	0	120	3	100	0	0	0	1	0	0
4	10	58	3	3	90	0	0	1	0	0	0	1	1
4	11	59	1	1	90	3	200	0	0	0	1	0	0
4	11	59	2	2	120	0	0	1	0	0	0	0	1
4	11	59	3	3	90	0	0	1	0	0	0	1	0
4	12	60	1	1	30	1	100	0	1	0	0	0	0
4	12	60	2	2	60	2	200	0	0	1	0	0	0
4	12	60	3	3	90	0	0	1	0	0	0	1	1
4	13	61	1	2	30	2	200	0	0	1	0	0	0
4	13	61	2	3	60	3	0	0	0	0	1	1	1
4	13	61	3	3	90	0	0	1	0	0	0	0	0
4	14	62	1	2	120	1	50	0	1	0	0	0	0
4	14	62	2	3	30	2	100	0	0	1	0	0	0
4	14	62	3	3	90	0	0	1	0	0	0	1	1
4	15	63	1	0	60	2	100	0	0	1	0	0	0
4	15	63	2	1	90	3	200	0	0	0	1	0	0
4	15	63	3	3	90	0	0	1	0	0	0	1	1
4	16	64	1	3	60	1	200	0	1	0	0	0	0
4	16	64	2	0	90	2	0	0	0	1	0	1	1
4	16	64	3	3	90	0	0	1	0	0	0	0	0

Id	Card_id	Case_id	Alternative	Death	Time	Road	Tax	Earth	Gravel	Cape seal	Asphalt	R1S2	R2S2
5	1	65	1	3	30	0	0	1	0	0	0	0	0
5	1	65	2	0	60	1	50	0	1	0	0	1	0
5	1	65	3	3	90	0	0	1	0	0	0	0	1
5	2	66	1	2	90	0	100	1	0	0	0	0	0
5	2	66	2	3	120	1	200	0	1	0	0	0	0
5	2	66	3	3	90	0	0	1	0	0	0	1	1
5	3	67	1	0	120	0	200	1	0	0	0	0	0
5	3	67	2	1	30	1	0	0	1	0	0	1	0
5	3	67	3	3	90	0	0	1	0	0	0	0	1
5	4	68	1	1	60	0	50	1	0	0	0	0	0
5	4	68	2	2	90	1	100	0	1	0	0	0	0
5	4	68	3	3	90	0	0	1	0	0	0	1	1
5	5	69	1	1	120	2	0	0	0	1	0	0	1
5	5	69	2	2	30	3	50	0	0	0	1	0	0
5	5	69	3	3	90	0	0	1	0	0	0	1	0
5	6	70	1	0	90	1	0	0	1	0	0	1	0
5	6	70	2	1	120	2	50	0	0	1	0	0	1
5	6	70	3	3	90	0	0	1	0	0	0	0	0
5	7	71	1	2	60	3	0	0	0	0	1	1	1
5	7	71	2	3	90	0	50	1	0	0	0	0	0
5	7	71	3	3	90	0	0	1	0	0	0	0	0
5	8	72	1	3	120	3	100	0	0	0	1	0	0
5	8	72	2	0	30	0	200	1	0	0	0	0	0
5	8	72	3	3	90	0	0	1	0	0	0	1	1
5	9	73	1	0	30	3	50	0	0	0	1	0	0
5	9	73	2	1	60	0	100	1	0	0	0	0	0
5	9	73	3	3	90	0	0	1	0	0	0	1	1
5	10	74	1	3	90	2	50	0	0	1	0	0	0
5	10	74	2	0	120	3	100	0	0	0	1	0	0
5	10	74	3	3	90	0	0	1	0	0	0	1	1
5	11	75	1	1	90	3	200	0	0	0	1	0	0
5	11	75	2	2	120	0	0	1	0	0	0	0	1
5	11	75	3	3	90	0	0	1	0	0	0	1	0
5	12	76	1	1	30	1	100	0	1	0	0	0	0
5	12	76	2	2	60	2	200	0	0	1	0	0	0
5	12	76	3	3	90	0	0	1	0	0	0	1	1
5	13	77	1	2	30	2	200	0	0	1	0	0	0
5	13	77	2	3	60	3	0	0	0	0	1	1	1
5	13	77	3	3	90	0	0	1	0	0	0	0	0
5	14	78	1	2	120	1	50	0	1	0	0	0	0
5	14	78	2	3	30	2	100	0	0	1	0	0	0
5	14	78	3	3	90	0	0	1	0	0	0	1	1
5	15	79	1	0	60	2	100	0	0	1	0	0	0
5	15	79	2	1	90	3	200	0	0	0	1	0	0
5	15	79	3	3	90	0	0	1	0	0	0	1	1
5	16	80	1	3	60	1	200	0	1	0	0	0	0
5	16	80	2	0	90	2	0	0	0	1	0	1	1
5	16	80	3	3	90	0	0	1	0	0	0	0	0

Id	Card_id	Case_id	Alternative	Death	Time	Road	Tax	Earth	Gravel	Cape seal	Asphalt	R1S2	R2S2
6	1	81	1	3	30	0	0	1	0	0	0	0	0
6	1	81	2	0	60	1	50	0	1	0	0	1	1
6	1	81	3	3	90	0	0	1	0	0	0	0	0
6	2	82	1	2	90	0	100	1	0	0	0	0	1
6	2	82	2	3	120	1	200	0	1	0	0	0	0
6	2	82	3	3	90	0	0	1	0	0	0	1	0
6	3	83	1	0	120	0	200	1	0	0	0	0	0
6	3	83	2	1	30	1	0	0	1	0	0	1	1
6	3	83	3	3	90	0	0	1	0	0	0	0	0
6	4	84	1	1	60	0	50	1	0	0	0	0	0
6	4	84	2	2	90	1	100	0	1	0	0	0	1
6	4	84	3	3	90	0	0	1	0	0	0	1	0
6	5	85	1	1	120	2	0	0	0	1	0	0	1
6	5	85	2	2	30	3	50	0	0	0	1	0	0
6	5	85	3	3	90	0	0	1	0	0	0	1	0
6	6	86	1	0	90	1	0	0	1	0	0	1	0
6	6	86	2	1	120	2	50	0	0	1	0	0	1
6	6	86	3	3	90	0	0	1	0	0	0	0	0
6	7	87	1	2	60	3	0	0	0	0	1	1	1
6	7	87	2	3	90	0	50	1	0	0	0	0	0
6	7	87	3	3	90	0	0	1	0	0	0	0	0
6	8	88	1	3	120	3	100	0	0	0	1	0	1
6	8	88	2	0	30	0	200	1	0	0	0	0	0
6	8	88	3	3	90	0	0	1	0	0	0	1	0
6	9	89	1	0	30	3	50	0	0	0	1	0	0
6	9	89	2	1	60	0	100	1	0	0	0	0	0
6	9	89	3	3	90	0	0	1	0	0	0	1	1
6	10	90	1	3	90	2	50	0	0	1	0	0	1
6	10	90	2	0	120	3	100	0	0	0	1	0	0
6	10	90	3	3	90	0	0	1	0	0	0	1	0
6	11	91	1	1	90	3	200	0	0	0	1	0	0
6	11	91	2	2	120	0	0	1	0	0	0	0	1
6	11	91	3	3	90	0	0	1	0	0	0	1	0
6	12	92	1	1	30	1	100	0	1	0	0	0	1
6	12	92	2	2	60	2	200	0	0	1	0	0	0
6	12	92	3	3	90	0	0	1	0	0	0	1	0
6	13	93	1	2	30	2	200	0	0	1	0	0	1
6	13	93	2	3	60	3	0	0	0	0	1	1	0
6	13	93	3	3	90	0	0	1	0	0	0	0	0
6	14	94	1	2	120	1	50	0	1	0	0	0	1
6	14	94	2	3	30	2	100	0	0	1	0	0	0
6	14	94	3	3	90	0	0	1	0	0	0	1	0
6	15	95	1	0	60	2	100	0	0	1	0	0	0
6	15	95	2	1	90	3	200	0	0	0	1	0	1
6	15	95	3	3	90	0	0	1	0	0	0	1	0
6	16	96	1	3	60	1	200	0	1	0	0	0	1
6	16	96	2	0	90	2	0	0	0	1	0	1	0
6	16	96	3	3	90	0	0	1	0	0	0	0	0

Id	Card_id	Case_id	Alternative	Death	Time	Road	Tax	Earth	Gravel	Cape seal	Asphalt	R1S2	R2S2
7	1	97	1	3	30	0	0	1	0	0	0	0	0
7	1	97	2	0	60	1	50	0	1	0	0	1	0
7	1	97	3	3	90	0	0	1	0	0	0	0	1
7	2	98	1	2	90	0	100	1	0	0	0	0	0
7	2	98	2	3	120	1	200	0	1	0	0	0	0
7	2	98	3	3	90	0	0	1	0	0	0	1	1
7	3	99	1	0	120	0	200	1	0	0	0	1	0
7	3	99	2	1	30	1	0	0	1	0	0	0	0
7	3	99	3	3	90	0	0	1	0	0	0	0	1
7	4	100	1	1	60	0	50	1	0	0	0	0	0
7	4	100	2	2	90	1	100	0	1	0	0	0	0
7	4	100	3	3	90	0	0	1	0	0	0	1	1
7	5	101	1	1	120	2	0	0	0	1	0	0	1
7	5	101	2	2	30	3	50	0	0	0	1	1	0
7	5	101	3	3	90	0	0	1	0	0	0	0	0
7	6	102	1	0	90	1	0	0	1	0	0	0	0
7	6	102	2	1	120	2	50	0	0	1	0	0	1
7	6	102	3	3	90	0	0	1	0	0	0	1	0
7	7	103	1	2	60	3	0	0	0	0	1	1	1
7	7	103	2	3	90	0	50	1	0	0	0	0	0
7	7	103	3	3	90	0	0	1	0	0	0	0	0
7	8	104	1	3	120	3	100	0	0	0	1	1	0
7	8	104	2	0	30	0	200	1	0	0	0	0	0
7	8	104	3	3	90	0	0	1	0	0	0	0	1
7	9	105	1	0	30	3	50	0	0	0	1	1	0
7	9	105	2	1	60	0	100	1	0	0	0	0	0
7	9	105	3	3	90	0	0	1	0	0	0	0	1
7	10	106	1	3	90	2	50	0	0	1	0	0	0
7	10	106	2	0	120	3	100	0	0	0	1	1	0
7	10	106	3	3	90	0	0	1	0	0	0	0	1
7	11	107	1	1	90	3	200	0	0	0	1	1	0
7	11	107	2	2	120	0	0	1	0	0	0	0	1
7	11	107	3	3	90	0	0	1	0	0	0	0	0
7	12	108	1	1	30	1	100	0	1	0	0	0	0
7	12	108	2	2	60	2	200	0	0	1	0	0	0
7	12	108	3	3	90	0	0	1	0	0	0	1	1
7	13	109	1	2	30	2	200	0	0	1	0	0	0
7	13	109	2	3	60	3	0	0	0	0	1	1	1
7	13	109	3	3	90	0	0	1	0	0	0	0	0
7	14	110	1	2	120	1	50	0	1	0	0	0	0
7	14	110	2	3	30	2	100	0	0	1	0	0	0
7	14	110	3	3	90	0	0	1	0	0	0	1	1
7	15	111	1	0	60	2	100	0	0	1	0	0	0
7	15	111	2	1	90	3	200	0	0	0	1	1	0
7	15	111	3	3	90	0	0	1	0	0	0	0	1
7	16	112	1	3	60	1	200	0	1	0	0	0	0
7	16	112	2	0	90	2	0	0	0	1	0	1	1
7	16	112	3	3	90	0	0	1	0	0	0	0	0

Id	Card_id	Case_id	Alternative	Death	Time	Road	Tax	Earth	Gravel	Cape seal	Asphalt	R1S2	R2S2
8	1	113	1	3	30	0	0	1	0	0	0	0	0
8	1	113	2	0	60	1	50	0	1	0	0	1	1
8	1	113	3	3	90	0	0	1	0	0	0	0	0
8	2	114	1	2	90	0	100	1	0	0	0	0	1
8	2	114	2	3	120	1	200	0	1	0	0	0	0
8	2	114	3	3	90	0	0	1	0	0	0	1	0
8	3	115	1	0	120	0	200	1	0	0	0	1	0
8	3	115	2	1	30	1	0	0	1	0	0	0	1
8	3	115	3	3	90	0	0	1	0	0	0	0	0
8	4	116	1	1	60	0	50	1	0	0	0	0	0
8	4	116	2	2	90	1	100	0	1	0	0	0	1
8	4	116	3	3	90	0	0	1	0	0	0	1	0
8	5	117	1	1	120	2	0	0	0	1	0	0	1
8	5	117	2	2	30	3	50	0	0	0	1	1	0
8	5	117	3	3	90	0	0	1	0	0	0	0	0
8	6	118	1	0	90	1	0	0	1	0	0	0	0
8	6	118	2	1	120	2	50	0	0	1	0	0	1
8	6	118	3	3	90	0	0	1	0	0	0	1	0
8	7	119	1	2	60	3	0	0	0	0	1	1	1
8	7	119	2	3	90	0	50	1	0	0	0	0	0
8	7	119	3	3	90	0	0	1	0	0	0	0	0
8	8	120	1	3	120	3	100	0	0	0	1	1	1
8	8	120	2	0	30	0	200	1	0	0	0	0	0
8	8	120	3	3	90	0	0	1	0	0	0	0	0
8	9	121	1	0	30	3	50	0	0	0	1	1	0
8	9	121	2	1	60	0	100	1	0	0	0	0	0
8	9	121	3	3	90	0	0	1	0	0	0	0	1
8	10	122	1	3	90	2	50	0	0	1	0	0	1
8	10	122	2	0	120	3	100	0	0	0	1	1	0
8	10	122	3	3	90	0	0	1	0	0	0	0	0
8	11	123	1	1	90	3	200	0	0	0	1	1	0
8	11	123	2	2	120	0	0	1	0	0	0	0	1
8	11	123	3	3	90	0	0	1	0	0	0	0	0
8	12	124	1	1	30	1	100	0	1	0	0	0	1
8	12	124	2	2	60	2	200	0	0	1	0	0	0
8	12	124	3	3	90	0	0	1	0	0	0	1	0
8	13	125	1	2	30	2	200	0	0	1	0	0	1
8	13	125	2	3	60	3	0	0	0	0	1	1	0
8	13	125	3	3	90	0	0	1	0	0	0	0	0
8	14	126	1	2	120	1	50	0	1	0	0	0	1
8	14	126	2	3	30	2	100	0	0	1	0	0	0
8	14	126	3	3	90	0	0	1	0	0	0	1	0
8	15	127	1	0	60	2	100	0	0	1	0	0	0
8	15	127	2	1	90	3	200	0	0	0	1	1	1
8	15	127	3	3	90	0	0	1	0	0	0	0	0
8	16	128	1	3	60	1	200	0	1	0	0	0	1
8	16	128	2	0	90	2	0	0	0	1	0	1	0
8	16	128	3	3	90	0	0	1	0	0	0	0	0

Id	Card_id	Case_id	Alternative	Death	Time	Road	Tax	Earth	Gravel	Cape seal	Asphalt	R1S2	R2S2
9	1	129	1	3	30	0	0	1	0	0	0	0	0
9	1	129	2	0	60	1	50	0	1	0	0	1	0
9	1	129	3	3	90	0	0	1	0	0	0	0	1
9	2	130	1	2	90	0	100	1	0	0	0	0	0
9	2	130	2	3	120	1	200	0	1	0	0	0	0
9	2	130	3	3	90	0	0	1	0	0	0	1	1
9	3	131	1	0	120	0	200	1	0	0	0	1	0
9	3	131	2	1	30	1	0	0	1	0	0	0	0
9	3	131	3	3	90	0	0	1	0	0	0	0	1
9	4	132	1	1	60	0	50	1	0	0	0	0	0
9	4	132	2	2	90	1	100	0	1	0	0	0	0
9	4	132	3	3	90	0	0	1	0	0	0	1	1
9	5	133	1	1	120	2	0	0	0	1	0	0	1
9	5	133	2	2	30	3	50	0	0	0	1	1	0
9	5	133	3	3	90	0	0	1	0	0	0	0	0
9	6	134	1	0	90	1	0	0	1	0	0	0	0
9	6	134	2	1	120	2	50	0	0	1	0	0	1
9	6	134	3	3	90	0	0	1	0	0	0	1	0
9	7	135	1	2	60	3	0	0	0	0	1	1	1
9	7	135	2	3	90	0	50	1	0	0	0	0	0
9	7	135	3	3	90	0	0	1	0	0	0	0	0
9	8	136	1	3	120	3	100	0	0	0	1	1	0
9	8	136	2	0	30	0	200	1	0	0	0	0	0
9	8	136	3	3	90	0	0	1	0	0	0	0	1
9	9	137	1	0	30	3	50	0	0	0	1	1	0
9	9	137	2	1	60	0	100	1	0	0	0	0	0
9	9	137	3	3	90	0	0	1	0	0	0	0	1
9	10	138	1	3	90	2	50	0	0	1	0	0	0
9	10	138	2	0	120	3	100	0	0	0	1	1	0
9	10	138	3	3	90	0	0	1	0	0	0	0	1
9	11	139	1	1	90	3	200	0	0	0	1	1	0
9	11	139	2	2	120	0	0	1	0	0	0	0	1
9	11	139	3	3	90	0	0	1	0	0	0	0	0
9	12	140	1	1	30	1	100	0	1	0	0	0	0
9	12	140	2	2	60	2	200	0	0	1	0	0	0
9	12	140	3	3	90	0	0	1	0	0	0	1	1
9	13	141	1	2	30	2	200	0	0	1	0	0	0
9	13	141	2	3	60	3	0	0	0	0	1	1	1
9	13	141	3	3	90	0	0	1	0	0	0	0	0
9	14	142	1	2	120	1	50	0	1	0	0	0	0
9	14	142	2	3	30	2	100	0	0	1	0	0	0
9	14	142	3	3	90	0	0	1	0	0	0	1	1
9	15	143	1	0	60	2	100	0	0	1	0	0	0
9	15	143	2	1	90	3	200	0	0	0	1	1	0
9	15	143	3	3	90	0	0	1	0	0	0	0	1
9	16	144	1	3	60	1	200	0	1	0	0	0	0
9	16	144	2	0	90	2	0	0	0	1	0	1	1
9	16	144	3	3	90	0	0	1	0	0	0	0	0

Id	Card_id	Case_id	Alternative	Death	Time	Road	Tax	Earth	Gravel	Cape seal	Asphalt	R1S2	R2S2
10	1	145	1	3	30	0	0	1	0	0	0	0	0
10	1	145	2	0	60	1	50	0	1	0	0	1	0
10	1	145	3	3	90	0	0	1	0	0	0	0	1
10	2	146	1	2	90	0	100	1	0	0	0	0	0
10	2	146	2	3	120	1	200	0	1	0	0	0	0
10	2	146	3	3	90	0	0	1	0	0	0	1	1
10	3	147	1	0	120	0	200	1	0	0	0	1	0
10	3	147	2	1	30	1	0	0	1	0	0	0	0
10	3	147	3	3	90	0	0	1	0	0	0	0	1
10	4	148	1	1	60	0	50	1	0	0	0	0	0
10	4	148	2	2	90	1	100	0	1	0	0	0	0
10	4	148	3	3	90	0	0	1	0	0	0	1	1
10	5	149	1	1	120	2	0	0	0	1	0	0	1
10	5	149	2	2	30	3	50	0	0	0	1	1	0
10	5	149	3	3	90	0	0	1	0	0	0	0	0
10	6	150	1	0	90	1	0	0	1	0	0	0	0
10	6	150	2	1	120	2	50	0	0	1	0	0	1
10	6	150	3	3	90	0	0	1	0	0	0	1	0
10	7	151	1	2	60	3	0	0	0	0	1	1	1
10	7	151	2	3	90	0	50	1	0	0	0	0	0
10	7	151	3	3	90	0	0	1	0	0	0	0	0
10	8	152	1	3	120	3	100	0	0	0	1	1	0
10	8	152	2	0	30	0	200	1	0	0	0	0	0
10	8	152	3	3	90	0	0	1	0	0	0	0	1
10	9	153	1	0	30	3	50	0	0	0	1	1	0
10	9	153	2	1	60	0	100	1	0	0	0	0	0
10	9	153	3	3	90	0	0	1	0	0	0	0	1
10	10	154	1	3	90	2	50	0	0	1	0	0	0
10	10	154	2	0	120	3	100	0	0	0	1	1	0
10	10	154	3	3	90	0	0	1	0	0	0	0	1
10	11	155	1	1	90	3	200	0	0	0	1	1	0
10	11	155	2	2	120	0	0	1	0	0	0	0	1
10	11	155	3	3	90	0	0	1	0	0	0	0	0
10	12	156	1	1	30	1	100	0	1	0	0	0	0
10	12	156	2	2	60	2	200	0	0	1	0	0	0
10	12	156	3	3	90	0	0	1	0	0	0	1	1
10	13	157	1	2	30	2	200	0	0	1	0	0	0
10	13	157	2	3	60	3	0	0	0	0	1	1	1
10	13	157	3	3	90	0	0	1	0	0	0	0	0
10	14	158	1	2	120	1	50	0	1	0	0	0	0
10	14	158	2	3	30	2	100	0	0	1	0	0	0
10	14	158	3	3	90	0	0	1	0	0	0	1	1
10	15	159	1	0	60	2	100	0	0	1	0	0	0
10	15	159	2	1	90	3	200	0	0	0	1	1	0
10	15	159	3	3	90	0	0	1	0	0	0	0	1
10	16	160	1	3	60	1	200	0	1	0	0	0	0
10	16	160	2	0	90	2	0	0	0	1	0	1	1
10	16	160	3	3	90	0	0	1	0	0	0	0	0

Id	Card_id	Case_id	Alternative	Death	Time	Road	Tax	Earth	Gravel	Cape seal	Asphalt	R1S2	R2S2
11	1	161	1	3	30	0	0	1	0	0	0	0	0
11	1	161	2	0	60	1	50	0	1	0	0	1	1
11	1	161	3	3	90	0	0	1	0	0	0	0	0
11	2	162	1	2	90	0	100	1	0	0	0	0	1
11	2	162	2	3	120	1	200	0	1	0	0	0	0
11	2	162	3	3	90	0	0	1	0	0	0	1	0
11	3	163	1	0	120	0	200	1	0	0	0	1	0
11	3	163	2	1	30	1	0	0	1	0	0	0	1
11	3	163	3	3	90	0	0	1	0	0	0	0	0
11	4	164	1	1	60	0	50	1	0	0	0	0	0
11	4	164	2	2	90	1	100	0	1	0	0	0	1
11	4	164	3	3	90	0	0	1	0	0	0	1	0
11	5	165	1	1	120	2	0	0	0	1	0	0	1
11	5	165	2	2	30	3	50	0	0	0	1	1	0
11	5	165	3	3	90	0	0	1	0	0	0	0	0
11	6	166	1	0	90	1	0	0	1	0	0	0	0
11	6	166	2	1	120	2	50	0	0	1	0	0	1
11	6	166	3	3	90	0	0	1	0	0	0	1	0
11	7	167	1	2	60	3	0	0	0	0	1	1	1
11	7	167	2	3	90	0	50	1	0	0	0	0	0
11	7	167	3	3	90	0	0	1	0	0	0	0	0
11	8	168	1	3	120	3	100	0	0	0	1	1	1
11	8	168	2	0	30	0	200	1	0	0	0	0	0
11	8	168	3	3	90	0	0	1	0	0	0	0	0
11	9	169	1	0	30	3	50	0	0	0	1	1	0
11	9	169	2	1	60	0	100	1	0	0	0	0	0
11	9	169	3	3	90	0	0	1	0	0	0	0	1
11	10	170	1	3	90	2	50	0	0	1	0	0	1
11	10	170	2	0	120	3	100	0	0	0	1	1	0
11	10	170	3	3	90	0	0	1	0	0	0	0	0
11	11	171	1	1	90	3	200	0	0	0	1	1	0
11	11	171	2	2	120	0	0	1	0	0	0	0	1
11	11	171	3	3	90	0	0	1	0	0	0	0	0
11	12	172	1	1	30	1	100	0	1	0	0	0	1
11	12	172	2	2	60	2	200	0	0	1	0	0	0
11	12	172	3	3	90	0	0	1	0	0	0	1	0
11	13	173	1	2	30	2	200	0	0	1	0	0	1
11	13	173	2	3	60	3	0	0	0	0	1	1	0
11	13	173	3	3	90	0	0	1	0	0	0	0	0
11	14	174	1	2	120	1	50	0	1	0	0	0	1
11	14	174	2	3	30	2	100	0	0	1	0	0	0
11	14	174	3	3	90	0	0	1	0	0	0	1	0
11	15	175	1	0	60	2	100	0	0	1	0	0	0
11	15	175	2	1	90	3	200	0	0	0	1	1	1
11	15	175	3	3	90	0	0	1	0	0	0	0	0
11	16	176	1	3	60	1	200	0	1	0	0	0	1
11	16	176	2	0	90	2	0	0	0	1	0	1	0
11	16	176	3	3	90	0	0	1	0	0	0	0	0

Id	Card_id	Case_id	Alternative	Death	Time	Road	Tax	Earth	Gravel	Cape seal	Asphalt	R1S2	R2S2
12	1	177	1	3	30	0	0	1	0	0	0	0	0
12	1	177	2	0	60	1	50	0	1	0	0	1	0
12	1	177	3	3	90	0	0	1	0	0	0	0	1
12	2	178	1	2	90	0	100	1	0	0	0	0	0
12	2	178	2	3	120	1	200	0	1	0	0	0	0
12	2	178	3	3	90	0	0	1	0	0	0	1	1
12	3	179	1	0	120	0	200	1	0	0	0	0	0
12	3	179	2	1	30	1	0	0	1	0	0	1	0
12	3	179	3	3	90	0	0	1	0	0	0	0	1
12	4	180	1	1	60	0	50	1	0	0	0	0	0
12	4	180	2	2	90	1	100	0	1	0	0	0	0
12	4	180	3	3	90	0	0	1	0	0	0	1	1
12	5	181	1	1	120	2	0	0	0	1	0	0	1
12	5	181	2	2	30	3	50	0	0	0	1	0	0
12	5	181	3	3	90	0	0	1	0	0	0	1	0
12	6	182	1	0	90	1	0	0	1	0	0	1	0
12	6	182	2	1	120	2	50	0	0	1	0	0	1
12	6	182	3	3	90	0	0	1	0	0	0	0	0
12	7	183	1	2	60	3	0	0	0	0	1	1	1
12	7	183	2	3	90	0	50	1	0	0	0	0	0
12	7	183	3	3	90	0	0	1	0	0	0	0	0
12	8	184	1	3	120	3	100	0	0	0	1	0	0
12	8	184	2	0	30	0	200	1	0	0	0	0	0
12	8	184	3	3	90	0	0	1	0	0	0	1	1
12	9	185	1	0	30	3	50	0	0	0	1	0	0
12	9	185	2	1	60	0	100	1	0	0	0	0	0
12	9	185	3	3	90	0	0	1	0	0	0	1	1
12	10	186	1	3	90	2	50	0	0	1	0	0	0
12	10	186	2	0	120	3	100	0	0	0	1	0	0
12	10	186	3	3	90	0	0	1	0	0	0	1	1
12	11	187	1	1	90	3	200	0	0	0	1	0	0
12	11	187	2	2	120	0	0	1	0	0	0	0	1
12	11	187	3	3	90	0	0	1	0	0	0	1	0
12	12	188	1	1	30	1	100	0	1	0	0	0	0
12	12	188	2	2	60	2	200	0	0	1	0	0	0
12	12	188	3	3	90	0	0	1	0	0	0	1	1
12	13	189	1	2	30	2	200	0	0	1	0	0	0
12	13	189	2	3	60	3	0	0	0	0	1	1	1
12	13	189	3	3	90	0	0	1	0	0	0	0	0
12	14	190	1	2	120	1	50	0	1	0	0	1	0
12	14	190	2	3	30	2	100	0	0	1	0	0	0
12	14	190	3	3	90	0	0	1	0	0	0	0	1
12	15	191	1	0	60	2	100	0	0	1	0	0	0
12	15	191	2	1	90	3	200	0	0	0	1	0	0
12	15	191	3	3	90	0	0	1	0	0	0	1	1
12	16	192	1	3	60	1	200	0	1	0	0	0	0
12	16	192	2	0	90	2	0	0	0	1	0	1	1
12	16	192	3	3	90	0	0	1	0	0	0	0	0

Id	Card_id	Case_id	Alternative	Death	Time	Road	Tax	Earth	Gravel	Cape seal	Asphalt	R1S2	R2S2
13	1	193	1	3	30	0	0	1	0	0	0	0	0
13	1	193	2	0	60	1	50	0	1	0	0	1	0
13	1	193	3	3	90	0	0	1	0	0	0	0	1
13	2	194	1	2	90	0	100	1	0	0	0	0	0
13	2	194	2	3	120	1	200	0	1	0	0	0	0
13	2	194	3	3	90	0	0	1	0	0	0	1	1
13	3	195	1	0	120	0	200	1	0	0	0	0	0
13	3	195	2	1	30	1	0	0	1	0	0	1	0
13	3	195	3	3	90	0	0	1	0	0	0	0	1
13	4	196	1	1	60	0	50	1	0	0	0	0	0
13	4	196	2	2	90	1	100	0	1	0	0	0	0
13	4	196	3	3	90	0	0	1	0	0	0	1	1
13	5	197	1	1	120	2	0	0	0	1	0	0	1
13	5	197	2	2	30	3	50	0	0	0	1	0	0
13	5	197	3	3	90	0	0	1	0	0	0	1	0
13	6	198	1	0	90	1	0	0	1	0	0	1	0
13	6	198	2	1	120	2	50	0	0	1	0	0	1
13	6	198	3	3	90	0	0	1	0	0	0	0	0
13	7	199	1	2	60	3	0	0	0	0	1	1	1
13	7	199	2	3	90	0	50	1	0	0	0	0	0
13	7	199	3	3	90	0	0	1	0	0	0	0	0
13	8	200	1	3	120	3	100	0	0	0	1	0	0
13	8	200	2	0	30	0	200	1	0	0	0	0	0
13	8	200	3	3	90	0	0	1	0	0	0	1	1
13	9	201	1	0	30	3	50	0	0	0	1	0	0
13	9	201	2	1	60	0	100	1	0	0	0	0	0
13	9	201	3	3	90	0	0	1	0	0	0	1	1
13	10	202	1	3	90	2	50	0	0	1	0	0	0
13	10	202	2	0	120	3	100	0	0	0	1	0	0
13	10	202	3	3	90	0	0	1	0	0	0	1	1
13	11	203	1	1	90	3	200	0	0	0	1	0	0
13	11	203	2	2	120	0	0	1	0	0	0	0	1
13	11	203	3	3	90	0	0	1	0	0	0	1	0
13	12	204	1	1	30	1	100	0	1	0	0	0	0
13	12	204	2	2	60	2	200	0	0	1	0	0	0
13	12	204	3	3	90	0	0	1	0	0	0	1	1
13	13	205	1	2	30	2	200	0	0	1	0	0	0
13	13	205	2	3	60	3	0	0	0	0	1	1	1
13	13	205	3	3	90	0	0	1	0	0	0	0	0
13	14	206	1	2	120	1	50	0	1	0	0	0	0
13	14	206	2	3	30	2	100	0	0	1	0	0	0
13	14	206	3	3	90	0	0	1	0	0	0	1	1
13	15	207	1	0	60	2	100	0	0	1	0	0	0
13	15	207	2	1	90	3	200	0	0	0	1	0	0
13	15	207	3	3	90	0	0	1	0	0	0	1	1
13	16	208	1	3	60	1	200	0	1	0	0	0	0
13	16	208	2	0	90	2	0	0	0	1	0	1	1
13	16	208	3	3	90	0	0	1	0	0	0	0	0

Id	Card_id	Case_id	Alternative	Death	Time	Road	Tax	Earth	Gravel	Cape seal	Asphalt	R1S2	R2S2
14	1	209	1	3	30	0	0	1	0	0	0	0	0
14	1	209	2	0	60	1	50	0	1	0	0	1	0
14	1	209	3	3	90	0	0	1	0	0	0	0	1
14	2	210	1	2	90	0	100	1	0	0	0	0	0
14	2	210	2	3	120	1	200	0	1	0	0	0	0
14	2	210	3	3	90	0	0	1	0	0	0	1	1
14	3	211	1	0	120	0	200	1	0	0	0	0	0
14	3	211	2	1	30	1	0	0	1	0	0	1	0
14	3	211	3	3	90	0	0	1	0	0	0	0	1
14	4	212	1	1	60	0	50	1	0	0	0	0	0
14	4	212	2	2	90	1	100	0	1	0	0	0	0
14	4	212	3	3	90	0	0	1	0	0	0	1	1
14	5	213	1	1	120	2	0	0	0	1	0	0	1
14	5	213	2	2	30	3	50	0	0	0	1	0	0
14	5	213	3	3	90	0	0	1	0	0	0	1	0
14	6	214	1	0	90	1	0	0	1	0	0	1	0
14	6	214	2	1	120	2	50	0	0	1	0	0	1
14	6	214	3	3	90	0	0	1	0	0	0	0	0
14	7	215	1	2	60	3	0	0	0	0	1	1	1
14	7	215	2	3	90	0	50	1	0	0	0	0	0
14	7	215	3	3	90	0	0	1	0	0	0	0	0
14	8	216	1	3	120	3	100	0	0	0	1	0	0
14	8	216	2	0	30	0	200	1	0	0	0	0	0
14	8	216	3	3	90	0	0	1	0	0	0	1	1
14	9	217	1	0	30	3	50	0	0	0	1	0	0
14	9	217	2	1	60	0	100	1	0	0	0	0	0
14	9	217	3	3	90	0	0	1	0	0	0	1	1
14	10	218	1	3	90	2	50	0	0	1	0	0	0
14	10	218	2	0	120	3	100	0	0	0	1	0	0
14	10	218	3	3	90	0	0	1	0	0	0	1	1
14	11	219	1	1	90	3	200	0	0	0	1	0	0
14	11	219	2	2	120	0	0	1	0	0	0	0	1
14	11	219	3	3	90	0	0	1	0	0	0	1	0
14	12	220	1	1	30	1	100	0	1	0	0	0	0
14	12	220	2	2	60	2	200	0	0	1	0	0	0
14	12	220	3	3	90	0	0	1	0	0	0	1	1
14	13	221	1	2	30	2	200	0	0	1	0	0	0
14	13	221	2	3	60	3	0	0	0	0	1	1	1
14	13	221	3	3	90	0	0	1	0	0	0	0	0
14	14	222	1	2	120	1	50	0	1	0	0	0	0
14	14	222	2	3	30	2	100	0	0	1	0	0	0
14	14	222	3	3	90	0	0	1	0	0	0	1	1
14	15	223	1	0	60	2	100	0	0	1	0	0	0
14	15	223	2	1	90	3	200	0	0	0	1	0	0
14	15	223	3	3	90	0	0	1	0	0	0	1	1
14	16	224	1	3	60	1	200	0	1	0	0	0	0
14	16	224	2	0	90	2	0	0	0	1	0	1	1
14	16	224	3	3	90	0	0	1	0	0	0	0	0

Id	Card_id	Case_id	Alternative	Death	Time	Road	Tax	Earth	Gravel	Cape seal	Asphalt	R1S2	R2S2
15	1	225	1	3	30	0	0	1	0	0	0	0	0
15	1	225	2	0	60	1	50	0	1	0	0	1	0
15	1	225	3	3	90	0	0	1	0	0	0	0	1
15	2	226	1	2	90	0	100	1	0	0	0	0	0
15	2	226	2	3	120	1	200	0	1	0	0	0	0
15	2	226	3	3	90	0	0	1	0	0	0	1	1
15	3	227	1	0	120	0	200	1	0	0	0	0	0
15	3	227	2	1	30	1	0	0	1	0	0	1	0
15	3	227	3	3	90	0	0	1	0	0	0	0	1
15	4	228	1	1	60	0	50	1	0	0	0	0	0
15	4	228	2	2	90	1	100	0	1	0	0	0	0
15	4	228	3	3	90	0	0	1	0	0	0	1	1
15	5	229	1	1	120	2	0	0	0	1	0	0	1
15	5	229	2	2	30	3	50	0	0	0	1	0	0
15	5	229	3	3	90	0	0	1	0	0	0	1	0
15	6	230	1	0	90	1	0	0	1	0	0	1	0
15	6	230	2	1	120	2	50	0	0	1	0	0	1
15	6	230	3	3	90	0	0	1	0	0	0	0	0
15	7	231	1	2	60	3	0	0	0	0	1	1	1
15	7	231	2	3	90	0	50	1	0	0	0	0	0
15	7	231	3	3	90	0	0	1	0	0	0	0	0
15	8	232	1	3	120	3	100	0	0	0	1	0	0
15	8	232	2	0	30	0	200	1	0	0	0	0	0
15	8	232	3	3	90	0	0	1	0	0	0	1	1
15	9	233	1	0	30	3	50	0	0	0	1	0	0
15	9	233	2	1	60	0	100	1	0	0	0	0	0
15	9	233	3	3	90	0	0	1	0	0	0	1	1
15	10	234	1	3	90	2	50	0	0	1	0	0	0
15	10	234	2	0	120	3	100	0	0	0	1	0	0
15	10	234	3	3	90	0	0	1	0	0	0	1	1
15	11	235	1	1	90	3	200	0	0	0	1	0	0
15	11	235	2	2	120	0	0	1	0	0	0	0	1
15	11	235	3	3	90	0	0	1	0	0	0	1	0
15	12	236	1	1	30	1	100	0	1	0	0	0	0
15	12	236	2	2	60	2	200	0	0	1	0	0	0
15	12	236	3	3	90	0	0	1	0	0	0	1	1
15	13	237	1	2	30	2	200	0	0	1	0	0	0
15	13	237	2	3	60	3	0	0	0	0	1	1	1
15	13	237	3	3	90	0	0	1	0	0	0	0	0
15	14	238	1	2	120	1	50	0	1	0	0	0	0
15	14	238	2	3	30	2	100	0	0	1	0	0	0
15	14	238	3	3	90	0	0	1	0	0	0	1	1
15	15	239	1	0	60	2	100	0	0	1	0	0	0
15	15	239	2	1	90	3	200	0	0	0	1	0	0
15	15	239	3	3	90	0	0	1	0	0	0	1	1
15	16	240	1	3	60	1	200	0	1	0	0	0	0
15	16	240	2	0	90	2	0	0	0	1	0	1	1
15	16	240	3	3	90	0	0	1	0	0	0	0	0

Id	Card_id	Case_id	Alternative	Death	Time	Road	Tax	Earth	Gravel	Cape seal	Asphalt	R1S2	R2S2
16	1	241	1	3	30	0	0	1	0	0	0	0	0
16	1	241	2	0	60	1	50	0	1	0	0	1	1
16	1	241	3	3	90	0	0	1	0	0	0	0	0
16	2	242	1	2	90	0	100	1	0	0	0	1	1
16	2	242	2	3	120	1	200	0	1	0	0	0	0
16	2	242	3	3	90	0	0	1	0	0	0	0	0
16	3	243	1	0	120	0	200	1	0	0	0	1	0
16	3	243	2	1	30	1	0	0	1	0	0	0	0
16	3	243	3	3	90	0	0	1	0	0	0	0	1
16	4	244	1	1	60	0	50	1	0	0	0	0	1
16	4	244	2	2	90	1	100	0	1	0	0	1	0
16	4	244	3	3	90	0	0	1	0	0	0	0	0
16	5	245	1	1	120	2	0	0	0	1	0	1	1
16	5	245	2	2	30	3	50	0	0	0	1	0	0
16	5	245	3	3	90	0	0	1	0	0	0	0	0
16	6	246	1	0	90	1	0	0	1	0	0	1	0
16	6	246	2	1	120	2	50	0	0	1	0	0	0
16	6	246	3	3	90	0	0	1	0	0	0	0	1
16	7	247	1	2	60	3	0	0	0	0	1	0	1
16	7	247	2	3	90	0	50	1	0	0	0	1	0
16	7	247	3	3	90	0	0	1	0	0	0	0	0
16	8	248	1	3	120	3	100	0	0	0	1	0	0
16	8	248	2	0	30	0	200	1	0	0	0	1	1
16	8	248	3	3	90	0	0	1	0	0	0	0	0
16	9	249	1	0	30	3	50	0	0	0	1	1	0
16	9	249	2	1	60	0	100	1	0	0	0	0	0
16	9	249	3	3	90	0	0	1	0	0	0	0	1
16	10	250	1	3	90	2	50	0	0	1	0	0	0
16	10	250	2	0	120	3	100	0	0	0	1	1	1
16	10	250	3	3	90	0	0	1	0	0	0	0	0
16	11	251	1	1	90	3	200	0	0	0	1	0	1
16	11	251	2	2	120	0	0	1	0	0	0	1	0
16	11	251	3	3	90	0	0	1	0	0	0	0	0
16	12	252	1	1	30	1	100	0	1	0	0	1	1
16	12	252	2	2	60	2	200	0	0	1	0	0	0
16	12	252	3	3	90	0	0	1	0	0	0	0	0
16	13	253	1	2	30	2	200	0	0	1	0	0	1
16	13	253	2	3	60	3	0	0	0	0	1	1	0
16	13	253	3	3	90	0	0	1	0	0	0	0	0
16	14	254	1	2	120	1	50	0	1	0	0	0	1
16	14	254	2	3	30	2	100	0	0	1	0	1	0
16	14	254	3	3	90	0	0	1	0	0	0	0	0
16	15	255	1	0	60	2	100	0	0	1	0	1	0
16	15	255	2	1	90	3	200	0	0	0	1	0	0
16	15	255	3	3	90	0	0	1	0	0	0	0	1
16	16	256	1	3	60	1	200	0	1	0	0	0	0
16	16	256	2	0	90	2	0	0	0	1	0	1	1
16	16	256	3	3	90	0	0	1	0	0	0	0	0

Id	Card_id	Case_id	Alternative	Death	Time	Road	Tax	Earth	Gravel	Cape seal	Asphalt	R1S2	R2S2
17	1	257	1	3	30	0	0	1	0	0	0	0	0
17	1	257	2	0	60	1	50	0	1	0	0	1	0
17	1	257	3	3	90	0	0	1	0	0	0	0	1
17	2	258	1	2	90	0	100	1	0	0	0	1	0
17	2	258	2	3	120	1	200	0	1	0	0	0	0
17	2	258	3	3	90	0	0	1	0	0	0	0	1
17	3	259	1	0	120	0	200	1	0	0	0	1	0
17	3	259	2	1	30	1	0	0	1	0	0	0	0
17	3	259	3	3	90	0	0	1	0	0	0	0	1
17	4	260	1	1	60	0	50	1	0	0	0	0	0
17	4	260	2	2	90	1	100	0	1	0	0	1	0
17	4	260	3	3	90	0	0	1	0	0	0	0	1
17	5	261	1	1	120	2	0	0	0	1	0	1	1
17	5	261	2	2	30	3	50	0	0	0	1	0	0
17	5	261	3	3	90	0	0	1	0	0	0	0	0
17	6	262	1	0	90	1	0	0	1	0	0	1	0
17	6	262	2	1	120	2	50	0	0	1	0	0	1
17	6	262	3	3	90	0	0	1	0	0	0	0	0
17	7	263	1	2	60	3	0	0	0	0	1	0	1
17	7	263	2	3	90	0	50	1	0	0	0	1	0
17	7	263	3	3	90	0	0	1	0	0	0	0	0
17	8	264	1	3	120	3	100	0	0	0	1	0	0
17	8	264	2	0	30	0	200	1	0	0	0	1	0
17	8	264	3	3	90	0	0	1	0	0	0	0	1
17	9	265	1	0	30	3	50	0	0	0	1	1	0
17	9	265	2	1	60	0	100	1	0	0	0	0	0
17	9	265	3	3	90	0	0	1	0	0	0	0	1
17	10	266	1	3	90	2	50	0	0	1	0	0	0
17	10	266	2	0	120	3	100	0	0	0	1	1	0
17	10	266	3	3	90	0	0	1	0	0	0	0	1
17	11	267	1	1	90	3	200	0	0	0	1	0	0
17	11	267	2	2	120	0	0	1	0	0	0	1	1
17	11	267	3	3	90	0	0	1	0	0	0	0	0
17	12	268	1	1	30	1	100	0	1	0	0	1	0
17	12	268	2	2	60	2	200	0	0	1	0	0	0
17	12	268	3	3	90	0	0	1	0	0	0	0	1
17	13	269	1	2	30	2	200	0	0	1	0	0	0
17	13	269	2	3	60	3	0	0	0	0	1	1	1
17	13	269	3	3	90	0	0	1	0	0	0	0	0
17	14	270	1	2	120	1	50	0	1	0	0	0	0
17	14	270	2	3	30	2	100	0	0	1	0	1	0
17	14	270	3	3	90	0	0	1	0	0	0	0	1
17	15	271	1	0	60	2	100	0	0	1	0	1	0
17	15	271	2	1	90	3	200	0	0	0	1	0	0
17	15	271	3	3	90	0	0	1	0	0	0	0	1
17	16	272	1	3	60	1	200	0	1	0	0	0	0
17	16	272	2	0	90	2	0	0	0	1	0	1	1
17	16	272	3	3	90	0	0	1	0	0	0	0	0

Id	Card_id	Case_id	Alternative	Death	Time	Road	Tax	Earth	Gravel	Cape seal	Asphalt	R1S2	R2S2
18	1	273	1	3	30	0	0	1	0	0	0	0	0
18	1	273	2	0	60	1	50	0	1	0	0	1	0
18	1	273	3	3	90	0	0	1	0	0	0	0	1
18	2	274	1	2	90	0	100	1	0	0	0	1	0
18	2	274	2	3	120	1	200	0	1	0	0	0	0
18	2	274	3	3	90	0	0	1	0	0	0	0	1
18	3	275	1	0	120	0	200	1	0	0	0	1	0
18	3	275	2	1	30	1	0	0	1	0	0	0	0
18	3	275	3	3	90	0	0	1	0	0	0	0	1
18	4	276	1	1	60	0	50	1	0	0	0	0	0
18	4	276	2	2	90	1	100	0	1	0	0	1	0
18	4	276	3	3	90	0	0	1	0	0	0	0	1
18	5	277	1	1	120	2	0	0	0	1	0	1	1
18	5	277	2	2	30	3	50	0	0	0	1	0	0
18	5	277	3	3	90	0	0	1	0	0	0	0	0
18	6	278	1	0	90	1	0	0	1	0	0	1	0
18	6	278	2	1	120	2	50	0	0	1	0	0	1
18	6	278	3	3	90	0	0	1	0	0	0	0	0
18	7	279	1	2	60	3	0	0	0	0	1	0	1
18	7	279	2	3	90	0	50	1	0	0	0	1	0
18	7	279	3	3	90	0	0	1	0	0	0	0	0
18	8	280	1	3	120	3	100	0	0	0	1	0	0
18	8	280	2	0	30	0	200	1	0	0	0	1	0
18	8	280	3	3	90	0	0	1	0	0	0	0	1
18	9	281	1	0	30	3	50	0	0	0	1	1	0
18	9	281	2	1	60	0	100	1	0	0	0	0	0
18	9	281	3	3	90	0	0	1	0	0	0	0	1
18	10	282	1	3	90	2	50	0	0	1	0	0	0
18	10	282	2	0	120	3	100	0	0	0	1	1	0
18	10	282	3	3	90	0	0	1	0	0	0	0	1
18	11	283	1	1	90	3	200	0	0	0	1	0	0
18	11	283	2	2	120	0	0	1	0	0	0	1	1
18	11	283	3	3	90	0	0	1	0	0	0	0	0
18	12	284	1	1	30	1	100	0	1	0	0	1	0
18	12	284	2	2	60	2	200	0	0	1	0	0	0
18	12	284	3	3	90	0	0	1	0	0	0	0	1
18	13	285	1	2	30	2	200	0	0	1	0	0	0
18	13	285	2	3	60	3	0	0	0	0	1	1	1
18	13	285	3	3	90	0	0	1	0	0	0	0	0
18	14	286	1	2	120	1	50	0	1	0	0	0	0
18	14	286	2	3	30	2	100	0	0	1	0	1	0
18	14	286	3	3	90	0	0	1	0	0	0	0	1
18	15	287	1	0	60	2	100	0	0	1	0	1	0
18	15	287	2	1	90	3	200	0	0	0	1	0	0
18	15	287	3	3	90	0	0	1	0	0	0	0	1
18	16	288	1	3	60	1	200	0	1	0	0	0	0
18	16	288	2	0	90	2	0	0	0	1	0	1	1
18	16	288	3	3	90	0	0	1	0	0	0	0	0

Id	Card_id	Case_id	Alternative	Death	Time	Road	Tax	Earth	Gravel	Cape seal	Asphalt	R1S2	R2S2
19	1	289	1	3	30	0	0	1	0	0	0	1	0
19	1	289	2	0	60	1	50	0	1	0	0	0	1
19	1	289	3	3	90	0	0	1	0	0	0	0	0
19	2	290	1	2	90	0	100	1	0	0	0	0	0
19	2	290	2	3	120	1	200	0	1	0	0	0	1
19	2	290	3	3	90	0	0	1	0	0	0	1	0
19	3	291	1	0	120	0	200	1	0	0	0	0	1
19	3	291	2	1	30	1	0	0	1	0	0	1	0
19	3	291	3	3	90	0	0	1	0	0	0	0	0
19	4	292	1	1	60	0	50	1	0	0	0	0	0
19	4	292	2	2	90	1	100	0	1	0	0	0	1
19	4	292	3	3	90	0	0	1	0	0	0	1	0
19	5	293	1	1	120	2	0	0	0	1	0	0	0
19	5	293	2	2	30	3	50	0	0	0	1	0	1
19	5	293	3	3	90	0	0	1	0	0	0	1	0
19	6	294	1	0	90	1	0	0	1	0	0	1	1
19	6	294	2	1	120	2	50	0	0	1	0	0	0
19	6	294	3	3	90	0	0	1	0	0	0	0	0
19	7	295	1	2	60	3	0	0	0	0	1	1	0
19	7	295	2	3	90	0	50	1	0	0	0	0	1
19	7	295	3	3	90	0	0	1	0	0	0	0	0
19	8	296	1	3	120	3	100	0	0	0	1	0	0
19	8	296	2	0	30	0	200	1	0	0	0	0	1
19	8	296	3	3	90	0	0	1	0	0	0	1	0
19	9	297	1	0	30	3	50	0	0	0	1	0	1
19	9	297	2	1	60	0	100	1	0	0	0	0	0
19	9	297	3	3	90	0	0	1	0	0	0	1	0
19	10	298	1	3	90	2	50	0	0	1	0	0	0
19	10	298	2	0	120	3	100	0	0	0	1	0	1
19	10	298	3	3	90	0	0	1	0	0	0	1	0
19	11	299	1	1	90	3	200	0	0	0	1	0	1
19	11	299	2	2	120	0	0	1	0	0	0	0	0
19	11	299	3	3	90	0	0	1	0	0	0	1	0
19	12	300	1	1	30	1	100	0	1	0	0	0	1
19	12	300	2	2	60	2	200	0	0	1	0	0	0
19	12	300	3	3	90	0	0	1	0	0	0	1	0
19	13	301	1	2	30	2	200	0	0	1	0	0	0
19	13	301	2	3	60	3	0	0	0	0	1	1	0
19	13	301	3	3	90	0	0	1	0	0	0	0	1
19	14	302	1	2	120	1	50	0	1	0	0	1	0
19	14	302	2	3	30	2	100	0	0	1	0	0	1
19	14	302	3	3	90	0	0	1	0	0	0	0	0
19	15	303	1	0	60	2	100	0	0	1	0	0	1
19	15	303	2	1	90	3	200	0	0	0	1	0	0
19	15	303	3	3	90	0	0	1	0	0	0	1	0
19	16	304	1	3	60	1	200	0	1	0	0	0	0
19	16	304	2	0	90	2	0	0	0	1	0	1	1
19	16	304	3	3	90	0	0	1	0	0	0	0	0

Id	Card_id	Case_id	Alternative	Death	Time	Road	Tax	Earth	Gravel	Cape seal	Asphalt	R1S2	R2S2
20	1	305	1	3	30	0	0	1	0	0	0	1	0
20	1	305	2	0	60	1	50	0	1	0	0	0	0
20	1	305	3	3	90	0	0	1	0	0	0	0	1
20	2	306	1	2	90	0	100	1	0	0	0	0	0
20	2	306	2	3	120	1	200	0	1	0	0	0	0
20	2	306	3	3	90	0	0	1	0	0	0	1	1
20	3	307	1	0	120	0	200	1	0	0	0	0	0
20	3	307	2	1	30	1	0	0	1	0	0	1	0
20	3	307	3	3	90	0	0	1	0	0	0	0	1
20	4	308	1	1	60	0	50	1	0	0	0	0	0
20	4	308	2	2	90	1	100	0	1	0	0	0	0
20	4	308	3	3	90	0	0	1	0	0	0	1	1
20	5	309	1	1	120	2	0	0	0	1	0	0	1
20	5	309	2	2	30	3	50	0	0	0	1	0	0
20	5	309	3	3	90	0	0	1	0	0	0	1	0
20	6	310	1	0	90	1	0	0	1	0	0	1	0
20	6	310	2	1	120	2	50	0	0	1	0	0	1
20	6	310	3	3	90	0	0	1	0	0	0	0	0
20	7	311	1	2	60	3	0	0	0	0	1	1	1
20	7	311	2	3	90	0	50	1	0	0	0	0	0
20	7	311	3	3	90	0	0	1	0	0	0	0	0
20	8	312	1	3	120	3	100	0	0	0	1	0	0
20	8	312	2	0	30	0	200	1	0	0	0	0	0
20	8	312	3	3	90	0	0	1	0	0	0	1	1
20	9	313	1	0	30	3	50	0	0	0	1	0	0
20	9	313	2	1	60	0	100	1	0	0	0	0	0
20	9	313	3	3	90	0	0	1	0	0	0	1	1
20	10	314	1	3	90	2	50	0	0	1	0	0	0
20	10	314	2	0	120	3	100	0	0	0	1	0	0
20	10	314	3	3	90	0	0	1	0	0	0	1	1
20	11	315	1	1	90	3	200	0	0	0	1	0	0
20	11	315	2	2	120	0	0	1	0	0	0	0	1
20	11	315	3	3	90	0	0	1	0	0	0	1	0
20	12	316	1	1	30	1	100	0	1	0	0	0	0
20	12	316	2	2	60	2	200	0	0	1	0	0	0
20	12	316	3	3	90	0	0	1	0	0	0	1	1
20	13	317	1	2	30	2	200	0	0	1	0	0	0
20	13	317	2	3	60	3	0	0	0	0	1	1	1
20	13	317	3	3	90	0	0	1	0	0	0	0	0
20	14	318	1	2	120	1	50	0	1	0	0	0	0
20	14	318	2	3	30	2	100	0	0	1	0	0	0
20	14	318	3	3	90	0	0	1	0	0	0	1	1
20	15	319	1	0	60	2	100	0	0	1	0	0	0
20	15	319	2	1	90	3	200	0	0	0	1	0	0
20	15	319	3	3	90	0	0	1	0	0	0	1	1
20	16	320	1	3	60	1	200	0	1	0	0	0	0
20	16	320	2	0	90	2	0	0	0	1	0	1	1
20	16	320	3	3	90	0	0	1	0	0	0	0	0

Id	Card_id	Case_id	Alternative	Death	Time	Road	Tax	Earth	Gravel	Cape seal	Asphalt	R1S2	R2S2
21	1	321	1	3	30	0	0	1	0	0	0	1	0
21	1	321	2	0	60	1	50	0	1	0	0	0	1
21	1	321	3	3	90	0	0	1	0	0	0	0	0
21	2	322	1	2	90	0	100	1	0	0	0	0	1
21	2	322	2	3	120	1	200	0	1	0	0	0	0
21	2	322	3	3	90	0	0	1	0	0	0	1	0
21	3	323	1	0	120	0	200	1	0	0	0	0	0
21	3	323	2	1	30	1	0	0	1	0	0	1	0
21	3	323	3	3	90	0	0	1	0	0	0	0	1
21	4	324	1	1	60	0	50	1	0	0	0	0	1
21	4	324	2	2	90	1	100	0	1	0	0	0	0
21	4	324	3	3	90	0	0	1	0	0	0	1	0
21	5	325	1	1	120	2	0	0	0	1	0	0	1
21	5	325	2	2	30	3	50	0	0	0	1	0	0
21	5	325	3	3	90	0	0	1	0	0	0	1	0
21	6	326	1	0	90	1	0	0	1	0	0	1	0
21	6	326	2	1	120	2	50	0	0	1	0	0	0
21	6	326	3	3	90	0	0	1	0	0	0	0	1
21	7	327	1	2	60	3	0	0	0	0	1	1	1
21	7	327	2	3	90	0	50	1	0	0	0	0	0
21	7	327	3	3	90	0	0	1	0	0	0	0	0
21	8	328	1	3	120	3	100	0	0	0	1	0	0
21	8	328	2	0	30	0	200	1	0	0	0	0	1
21	8	328	3	3	90	0	0	1	0	0	0	1	0
21	9	329	1	0	30	3	50	0	0	0	1	0	0
21	9	329	2	1	60	0	100	1	0	0	0	0	0
21	9	329	3	3	90	0	0	1	0	0	0	1	1
21	10	330	1	3	90	2	50	0	0	1	0	0	0
21	10	330	2	0	120	3	100	0	0	0	1	0	1
21	10	330	3	3	90	0	0	1	0	0	0	1	0
21	11	331	1	1	90	3	200	0	0	0	1	0	1
21	11	331	2	2	120	0	0	1	0	0	0	0	0
21	11	331	3	3	90	0	0	1	0	0	0	1	0
21	12	332	1	1	30	1	100	0	1	0	0	0	1
21	12	332	2	2	60	2	200	0	0	1	0	0	0
21	12	332	3	3	90	0	0	1	0	0	0	1	0
21	13	333	1	2	30	2	200	0	0	1	0	0	1
21	13	333	2	3	60	3	0	0	0	0	1	1	0
21	13	333	3	3	90	0	0	1	0	0	0	0	0
21	14	334	1	2	120	1	50	0	1	0	0	0	1
21	14	334	2	3	30	2	100	0	0	1	0	0	0
21	14	334	3	3	90	0	0	1	0	0	0	1	0
21	15	335	1	0	60	2	100	0	0	1	0	0	0
21	15	335	2	1	90	3	200	0	0	0	1	0	0
21	15	335	3	3	90	0	0	1	0	0	0	1	1
21	16	336	1	3	60	1	200	0	1	0	0	0	0
21	16	336	2	0	90	2	0	0	0	1	0	1	1
21	16	336	3	3	90	0	0	1	0	0	0	0	0

Id	Card_id	Case_id	Alternative	Death	Time	Road	Tax	Earth	Gravel	Cape seal	Asphalt	R1S2	R2S2
22	1	337	1	3	30	0	0	1	0	0	0	1	0
22	1	337	2	0	60	1	50	0	1	0	0	0	0
22	1	337	3	3	90	0	0	1	0	0	0	0	1
22	2	338	1	2	90	0	100	1	0	0	0	0	0
22	2	338	2	3	120	1	200	0	1	0	0	0	0
22	2	338	3	3	90	0	0	1	0	0	0	1	1
22	3	339	1	0	120	0	200	1	0	0	0	0	0
22	3	339	2	1	30	1	0	0	1	0	0	1	0
22	3	339	3	3	90	0	0	1	0	0	0	0	1
22	4	340	1	1	60	0	50	1	0	0	0	0	0
22	4	340	2	2	90	1	100	0	1	0	0	0	0
22	4	340	3	3	90	0	0	1	0	0	0	1	1
22	5	341	1	1	120	2	0	0	0	1	0	0	1
22	5	341	2	2	30	3	50	0	0	0	1	0	0
22	5	341	3	3	90	0	0	1	0	0	0	1	0
22	6	342	1	0	90	1	0	0	1	0	0	1	0
22	6	342	2	1	120	2	50	0	0	1	0	0	1
22	6	342	3	3	90	0	0	1	0	0	0	0	0
22	7	343	1	2	60	3	0	0	0	0	1	1	1
22	7	343	2	3	90	0	50	1	0	0	0	0	0
22	7	343	3	3	90	0	0	1	0	0	0	0	0
22	8	344	1	3	120	3	100	0	0	0	1	0	0
22	8	344	2	0	30	0	200	1	0	0	0	0	0
22	8	344	3	3	90	0	0	1	0	0	0	1	1
22	9	345	1	0	30	3	50	0	0	0	1	0	0
22	9	345	2	1	60	0	100	1	0	0	0	0	0
22	9	345	3	3	90	0	0	1	0	0	0	1	1
22	10	346	1	3	90	2	50	0	0	1	0	0	0
22	10	346	2	0	120	3	100	0	0	0	1	0	0
22	10	346	3	3	90	0	0	1	0	0	0	1	1
22	11	347	1	1	90	3	200	0	0	0	1	0	0
22	11	347	2	2	120	0	0	1	0	0	0	0	1
22	11	347	3	3	90	0	0	1	0	0	0	1	0
22	12	348	1	1	30	1	100	0	1	0	0	0	0
22	12	348	2	2	60	2	200	0	0	1	0	0	0
22	12	348	3	3	90	0	0	1	0	0	0	1	1
22	13	349	1	2	30	2	200	0	0	1	0	0	0
22	13	349	2	3	60	3	0	0	0	0	1	1	1
22	13	349	3	3	90	0	0	1	0	0	0	0	0
22	14	350	1	2	120	1	50	0	1	0	0	0	0
22	14	350	2	3	30	2	100	0	0	1	0	0	0
22	14	350	3	3	90	0	0	1	0	0	0	1	1
22	15	351	1	0	60	2	100	0	0	1	0	0	0
22	15	351	2	1	90	3	200	0	0	0	1	0	0
22	15	351	3	3	90	0	0	1	0	0	0	1	1
22	16	352	1	3	60	1	200	0	1	0	0	0	0
22	16	352	2	0	90	2	0	0	0	1	0	1	1
22	16	352	3	3	90	0	0	1	0	0	0	0	0

Id	Card_id	Case_id	Alternative	Death	Time	Road	Tax	Earth	Gravel	Cape seal	Asphalt	R1S2	R2S2
23	1	353	1	3	30	0	0	1	0	0	0	0	0
23	1	353	2	0	60	1	50	0	1	0	0	1	1
23	1	353	3	3	90	0	0	1	0	0	0	0	0
23	2	354	1	2	90	0	100	1	0	0	0	0	1
23	2	354	2	3	120	1	200	0	1	0	0	0	0
23	2	354	3	3	90	0	0	1	0	0	0	1	0
23	3	355	1	0	120	0	200	1	0	0	0	0	0
23	3	355	2	1	30	1	0	0	1	0	0	1	0
23	3	355	3	3	90	0	0	1	0	0	0	0	1
23	4	356	1	1	60	0	50	1	0	0	0	1	1
23	4	356	2	2	90	1	100	0	1	0	0	0	0
23	4	356	3	3	90	0	0	1	0	0	0	0	0
23	5	357	1	1	120	2	0	0	0	1	0	0	1
23	5	357	2	2	30	3	50	0	0	0	1	1	0
23	5	357	3	3	90	0	0	1	0	0	0	0	0
23	6	358	1	0	90	1	0	0	1	0	0	0	0
23	6	358	2	1	120	2	50	0	0	1	0	1	0
23	6	358	3	3	90	0	0	1	0	0	0	0	1
23	7	359	1	2	60	3	0	0	0	0	1	1	1
23	7	359	2	3	90	0	50	1	0	0	0	0	0
23	7	359	3	3	90	0	0	1	0	0	0	0	0
23	8	360	1	3	120	3	100	0	0	0	1	1	0
23	8	360	2	0	30	0	200	1	0	0	0	0	1
23	8	360	3	3	90	0	0	1	0	0	0	0	0
23	9	361	1	0	30	3	50	0	0	0	1	1	0
23	9	361	2	1	60	0	100	1	0	0	0	0	0
23	9	361	3	3	90	0	0	1	0	0	0	0	1
23	10	362	1	3	90	2	50	0	0	1	0	1	0
23	10	362	2	0	120	3	100	0	0	0	1	0	1
23	10	362	3	3	90	0	0	1	0	0	0	0	0
23	11	363	1	1	90	3	200	0	0	0	1	1	1
23	11	363	2	2	120	0	0	1	0	0	0	0	0
23	11	363	3	3	90	0	0	1	0	0	0	0	0
23	12	364	1	1	30	1	100	0	1	0	0	0	1
23	12	364	2	2	60	2	200	0	0	1	0	1	0
23	12	364	3	3	90	0	0	1	0	0	0	0	0
23	13	365	1	2	30	2	200	0	0	1	0	0	1
23	13	365	2	3	60	3	0	0	0	0	1	1	0
23	13	365	3	3	90	0	0	1	0	0	0	0	0
23	14	366	1	2	120	1	50	0	1	0	0	0	1
23	14	366	2	3	30	2	100	0	0	1	0	1	0
23	14	366	3	3	90	0	0	1	0	0	0	0	0
23	15	367	1	0	60	2	100	0	0	1	0	1	0
23	15	367	2	1	90	3	200	0	0	0	1	0	0
23	15	367	3	3	90	0	0	1	0	0	0	0	1
23	16	368	1	3	60	1	200	0	1	0	0	0	0
23	16	368	2	0	90	2	0	0	0	1	0	1	1
23	16	368	3	3	90	0	0	1	0	0	0	0	0

Id	Card_id	Case_id	Alternative	Death	Time	Road	Tax	Earth	Gravel	Cape seal	Asphalt	R1S2	R2S2
24	1	369	1	3	30	0	0	1	0	0	0	0	0
24	1	369	2	0	60	1	50	0	1	0	0	1	0
24	1	369	3	3	90	0	0	1	0	0	0	0	1
24	2	370	1	2	90	0	100	1	0	0	0	0	0
24	2	370	2	3	120	1	200	0	1	0	0	0	0
24	2	370	3	3	90	0	0	1	0	0	0	1	1
24	3	371	1	0	120	0	200	1	0	0	0	0	0
24	3	371	2	1	30	1	0	0	1	0	0	1	0
24	3	371	3	3	90	0	0	1	0	0	0	0	1
24	4	372	1	1	60	0	50	1	0	0	0	1	0
24	4	372	2	2	90	1	100	0	1	0	0	0	0
24	4	372	3	3	90	0	0	1	0	0	0	0	1
24	5	373	1	1	120	2	0	0	0	1	0	0	1
24	5	373	2	2	30	3	50	0	0	0	1	1	0
24	5	373	3	3	90	0	0	1	0	0	0	0	0
24	6	374	1	0	90	1	0	0	1	0	0	0	0
24	6	374	2	1	120	2	50	0	0	1	0	1	1
24	6	374	3	3	90	0	0	1	0	0	0	0	0
24	7	375	1	2	60	3	0	0	0	0	1	1	1
24	7	375	2	3	90	0	50	1	0	0	0	0	0
24	7	375	3	3	90	0	0	1	0	0	0	0	0
24	8	376	1	3	120	3	100	0	0	0	1	1	0
24	8	376	2	0	30	0	200	1	0	0	0	0	0
24	8	376	3	3	90	0	0	1	0	0	0	0	1
24	9	377	1	0	30	3	50	0	0	0	1	1	0
24	9	377	2	1	60	0	100	1	0	0	0	0	0
24	9	377	3	3	90	0	0	1	0	0	0	0	1
24	10	378	1	3	90	2	50	0	0	1	0	1	0
24	10	378	2	0	120	3	100	0	0	0	1	0	0
24	10	378	3	3	90	0	0	1	0	0	0	0	1
24	11	379	1	1	90	3	200	0	0	0	1	1	0
24	11	379	2	2	120	0	0	1	0	0	0	0	1
24	11	379	3	3	90	0	0	1	0	0	0	0	0
24	12	380	1	1	30	1	100	0	1	0	0	0	0
24	12	380	2	2	60	2	200	0	0	1	0	1	0
24	12	380	3	3	90	0	0	1	0	0	0	0	1
24	13	381	1	2	30	2	200	0	0	1	0	0	0
24	13	381	2	3	60	3	0	0	0	0	1	1	1
24	13	381	3	3	90	0	0	1	0	0	0	0	0
24	14	382	1	2	120	1	50	0	1	0	0	0	0
24	14	382	2	3	30	2	100	0	0	1	0	1	0
24	14	382	3	3	90	0	0	1	0	0	0	0	1
24	15	383	1	0	60	2	100	0	0	1	0	1	0
24	15	383	2	1	90	3	200	0	0	0	1	0	0
24	15	383	3	3	90	0	0	1	0	0	0	0	1
24	16	384	1	3	60	1	200	0	1	0	0	0	0
24	16	384	2	0	90	2	0	0	0	1	0	1	1
24	16	384	3	3	90	0	0	1	0	0	0	0	0

Id	Card_id	Case_id	Alternative	Death	Time	Road	Tax	Earth	Gravel	Cape seal	Asphalt	R1S2	R2S2
25	1	385	1	3	30	0	0	1	0	0	0	0	0
25	1	385	2	0	60	1	50	0	1	0	0	1	1
25	1	385	3	3	90	0	0	1	0	0	0	0	0
25	2	386	1	2	90	0	100	1	0	0	0	0	1
25	2	386	2	3	120	1	200	0	1	0	0	0	0
25	2	386	3	3	90	0	0	1	0	0	0	1	0
25	3	387	1	0	120	0	200	1	0	0	0	0	0
25	3	387	2	1	30	1	0	0	1	0	0	1	1
25	3	387	3	3	90	0	0	1	0	0	0	0	0
25	4	388	1	1	60	0	50	1	0	0	0	1	0
25	4	388	2	2	90	1	100	0	1	0	0	0	1
25	4	388	3	3	90	0	0	1	0	0	0	0	0
25	5	389	1	1	120	2	0	0	0	1	0	0	1
25	5	389	2	2	30	3	50	0	0	0	1	1	0
25	5	389	3	3	90	0	0	1	0	0	0	0	0
25	6	390	1	0	90	1	0	0	1	0	0	0	0
25	6	390	2	1	120	2	50	0	0	1	0	1	1
25	6	390	3	3	90	0	0	1	0	0	0	0	0
25	7	391	1	2	60	3	0	0	0	0	1	1	1
25	7	391	2	3	90	0	50	1	0	0	0	0	0
25	7	391	3	3	90	0	0	1	0	0	0	0	0
25	8	392	1	3	120	3	100	0	0	0	1	1	1
25	8	392	2	0	30	0	200	1	0	0	0	0	0
25	8	392	3	3	90	0	0	1	0	0	0	0	0
25	9	393	1	0	30	3	50	0	0	0	1	1	0
25	9	393	2	1	60	0	100	1	0	0	0	0	0
25	9	393	3	3	90	0	0	1	0	0	0	0	1
25	10	394	1	3	90	2	50	0	0	1	0	0	1
25	10	394	2	0	120	3	100	0	0	0	1	1	0
25	10	394	3	3	90	0	0	1	0	0	0	0	0
25	11	395	1	1	90	3	200	0	0	0	1	1	0
25	11	395	2	2	120	0	0	1	0	0	0	0	1
25	11	395	3	3	90	0	0	1	0	0	0	0	0
25	12	396	1	1	30	1	100	0	1	0	0	0	1
25	12	396	2	2	60	2	200	0	0	1	0	1	0
25	12	396	3	3	90	0	0	1	0	0	0	0	0
25	13	397	1	2	30	2	200	0	0	1	0	0	1
25	13	397	2	3	60	3	0	0	0	0	1	1	0
25	13	397	3	3	90	0	0	1	0	0	0	0	0
25	14	398	1	2	120	1	50	0	1	0	0	0	1
25	14	398	2	3	30	2	100	0	0	1	0	1	0
25	14	398	3	3	90	0	0	1	0	0	0	0	0
25	15	399	1	0	60	2	100	0	0	1	0	1	0
25	15	399	2	1	90	3	200	0	0	0	1	0	1
25	15	399	3	3	90	0	0	1	0	0	0	0	0
25	16	400	1	3	60	1	200	0	1	0	0	0	1
25	16	400	2	0	90	2	0	0	0	1	0	1	0
25	16	400	3	3	90	0	0	1	0	0	0	0	0

Id	Card_id	Case_id	Alternative	Death	Time	Road	Tax	Earth	Gravel	Cape seal	Asphalt	R1S2	R2S2
26	1	401	1	3	30	0	0	1	0	0	0	0	0
26	1	401	2	0	60	1	50	0	1	0	0	1	0
26	1	401	3	3	90	0	0	1	0	0	0	0	1
26	2	402	1	2	90	0	100	1	0	0	0	0	0
26	2	402	2	3	120	1	200	0	1	0	0	0	0
26	2	402	3	3	90	0	0	1	0	0	0	1	1
26	3	403	1	0	120	0	200	1	0	0	0	0	0
26	3	403	2	1	30	1	0	0	1	0	0	1	0
26	3	403	3	3	90	0	0	1	0	0	0	0	1
26	4	404	1	1	60	0	50	1	0	0	0	1	0
26	4	404	2	2	90	1	100	0	1	0	0	0	0
26	4	404	3	3	90	0	0	1	0	0	0	0	1
26	5	405	1	1	120	2	0	0	0	1	0	0	1
26	5	405	2	2	30	3	50	0	0	0	1	1	0
26	5	405	3	3	90	0	0	1	0	0	0	0	0
26	6	406	1	0	90	1	0	0	1	0	0	0	0
26	6	406	2	1	120	2	50	0	0	1	0	1	1
26	6	406	3	3	90	0	0	1	0	0	0	0	0
26	7	407	1	2	60	3	0	0	0	0	1	1	1
26	7	407	2	3	90	0	50	1	0	0	0	0	0
26	7	407	3	3	90	0	0	1	0	0	0	0	0
26	8	408	1	3	120	3	100	0	0	0	1	1	0
26	8	408	2	0	30	0	200	1	0	0	0	0	0
26	8	408	3	3	90	0	0	1	0	0	0	0	1
26	9	409	1	0	30	3	50	0	0	0	1	1	0
26	9	409	2	1	60	0	100	1	0	0	0	0	0
26	9	409	3	3	90	0	0	1	0	0	0	0	1
26	10	410	1	3	90	2	50	0	0	1	0	1	0
26	10	410	2	0	120	3	100	0	0	0	1	0	0
26	10	410	3	3	90	0	0	1	0	0	0	0	1
26	11	411	1	1	90	3	200	0	0	0	1	1	0
26	11	411	2	2	120	0	0	1	0	0	0	0	1
26	11	411	3	3	90	0	0	1	0	0	0	0	0
26	12	412	1	1	30	1	100	0	1	0	0	1	0
26	12	412	2	2	60	2	200	0	0	1	0	0	0
26	12	412	3	3	90	0	0	1	0	0	0	0	1
26	13	413	1	2	30	2	200	0	0	1	0	0	0
26	13	413	2	3	60	3	0	0	0	0	1	1	1
26	13	413	3	3	90	0	0	1	0	0	0	0	0
26	14	414	1	2	120	1	50	0	1	0	0	1	0
26	14	414	2	3	30	2	100	0	0	1	0	0	0
26	14	414	3	3	90	0	0	1	0	0	0	0	1
26	15	415	1	0	60	2	100	0	0	1	0	1	0
26	15	415	2	1	90	3	200	0	0	0	1	0	0
26	15	415	3	3	90	0	0	1	0	0	0	0	1
26	16	416	1	3	60	1	200	0	1	0	0	0	0
26	16	416	2	0	90	2	0	0	0	1	0	1	1
26	16	416	3	3	90	0	0	1	0	0	0	0	0

Id	Card_id	Case_id	Alternative	Death	Time	Road	Tax	Earth	Gravel	Cape seal	Asphalt	R1S2	R2S2
27	1	417	1	3	30	0	0	1	0	0	0	1	0
27	1	417	2	0	60	1	50	0	1	0	0	0	1
27	1	417	3	3	90	0	0	1	0	0	0	0	0
27	2	418	1	2	90	0	100	1	0	0	0	0	1
27	2	418	2	3	120	1	200	0	1	0	0	0	0
27	2	418	3	3	90	0	0	1	0	0	0	1	0
27	3	419	1	0	120	0	200	1	0	0	0	0	0
27	3	419	2	1	30	1	0	0	1	0	0	1	0
27	3	419	3	3	90	0	0	1	0	0	0	0	1
27	4	420	1	1	60	0	50	1	0	0	0	0	1
27	4	420	2	2	90	1	100	0	1	0	0	0	0
27	4	420	3	3	90	0	0	1	0	0	0	1	0
27	5	421	1	1	120	2	0	0	0	1	0	0	1
27	5	421	2	2	30	3	50	0	0	0	1	0	0
27	5	421	3	3	90	0	0	1	0	0	0	1	0
27	6	422	1	0	90	1	0	0	1	0	0	1	0
27	6	422	2	1	120	2	50	0	0	1	0	0	0
27	6	422	3	3	90	0	0	1	0	0	0	0	1
27	7	423	1	2	60	3	0	0	0	0	1	1	1
27	7	423	2	3	90	0	50	1	0	0	0	0	0
27	7	423	3	3	90	0	0	1	0	0	0	0	0
27	8	424	1	3	120	3	100	0	0	0	1	0	0
27	8	424	2	0	30	0	200	1	0	0	0	0	1
27	8	424	3	3	90	0	0	1	0	0	0	1	0
27	9	425	1	0	30	3	50	0	0	0	1	0	0
27	9	425	2	1	60	0	100	1	0	0	0	0	0
27	9	425	3	3	90	0	0	1	0	0	0	1	1
27	10	426	1	3	90	2	50	0	0	1	0	0	0
27	10	426	2	0	120	3	100	0	0	0	1	0	1
27	10	426	3	3	90	0	0	1	0	0	0	1	0
27	11	427	1	1	90	3	200	0	0	0	1	0	1
27	11	427	2	2	120	0	0	1	0	0	0	0	0
27	11	427	3	3	90	0	0	1	0	0	0	1	0
27	12	428	1	1	30	1	100	0	1	0	0	0	1
27	12	428	2	2	60	2	200	0	0	1	0	0	0
27	12	428	3	3	90	0	0	1	0	0	0	1	0
27	13	429	1	2	30	2	200	0	0	1	0	0	1
27	13	429	2	3	60	3	0	0	0	0	1	1	0
27	13	429	3	3	90	0	0	1	0	0	0	0	0
27	14	430	1	2	120	1	50	0	1	0	0	1	1
27	14	430	2	3	30	2	100	0	0	1	0	0	0
27	14	430	3	3	90	0	0	1	0	0	0	0	0
27	15	431	1	0	60	2	100	0	0	1	0	0	0
27	15	431	2	1	90	3	200	0	0	0	1	0	0
27	15	431	3	3	90	0	0	1	0	0	0	1	1
27	16	432	1	3	60	1	200	0	1	0	0	0	0
27	16	432	2	0	90	2	0	0	0	1	0	1	1
27	16	432	3	3	90	0	0	1	0	0	0	0	0

Id	Card_id	Case_id	Alternative	Death	Time	Road	Tax	Earth	Gravel	Cape seal	Asphalt	R1S2	R2S2
28	1	433	1	3	30	0	0	1	0	0	0	1	0
28	1	433	2	0	60	1	50	0	1	0	0	0	1
28	1	433	3	3	90	0	0	1	0	0	0	0	0
28	2	434	1	2	90	0	100	1	0	0	0	0	1
28	2	434	2	3	120	1	200	0	1	0	0	0	0
28	2	434	3	3	90	0	0	1	0	0	0	1	0
28	3	435	1	0	120	0	200	1	0	0	0	0	0
28	3	435	2	1	30	1	0	0	1	0	0	1	1
28	3	435	3	3	90	0	0	1	0	0	0	0	0
28	4	436	1	1	60	0	50	1	0	0	0	0	0
28	4	436	2	2	90	1	100	0	1	0	0	0	1
28	4	436	3	3	90	0	0	1	0	0	0	1	0
28	5	437	1	1	120	2	0	0	0	1	0	0	1
28	5	437	2	2	30	3	50	0	0	0	1	0	0
28	5	437	3	3	90	0	0	1	0	0	0	1	0
28	6	438	1	0	90	1	0	0	1	0	0	1	0
28	6	438	2	1	120	2	50	0	0	1	0	0	1
28	6	438	3	3	90	0	0	1	0	0	0	0	0
28	7	439	1	2	60	3	0	0	0	0	1	1	1
28	7	439	2	3	90	0	50	1	0	0	0	0	0
28	7	439	3	3	90	0	0	1	0	0	0	0	0
28	8	440	1	3	120	3	100	0	0	0	1	0	1
28	8	440	2	0	30	0	200	1	0	0	0	0	0
28	8	440	3	3	90	0	0	1	0	0	0	1	0
28	9	441	1	0	30	3	50	0	0	0	1	0	0
28	9	441	2	1	60	0	100	1	0	0	0	0	0
28	9	441	3	3	90	0	0	1	0	0	0	1	1
28	10	442	1	3	90	2	50	0	0	1	0	0	1
28	10	442	2	0	120	3	100	0	0	0	1	0	0
28	10	442	3	3	90	0	0	1	0	0	0	1	0
28	11	443	1	1	90	3	200	0	0	0	1	0	0
28	11	443	2	2	120	0	0	1	0	0	0	0	1
28	11	443	3	3	90	0	0	1	0	0	0	1	0
28	12	444	1	1	30	1	100	0	1	0	0	0	1
28	12	444	2	2	60	2	200	0	0	1	0	0	0
28	12	444	3	3	90	0	0	1	0	0	0	1	0
28	13	445	1	2	30	2	200	0	0	1	0	0	1
28	13	445	2	3	60	3	0	0	0	0	1	1	0
28	13	445	3	3	90	0	0	1	0	0	0	0	0
28	14	446	1	2	120	1	50	0	1	0	0	0	1
28	14	446	2	3	30	2	100	0	0	1	0	0	0
28	14	446	3	3	90	0	0	1	0	0	0	1	0
28	15	447	1	0	60	2	100	0	0	1	0	0	0
28	15	447	2	1	90	3	200	0	0	0	1	0	1
28	15	447	3	3	90	0	0	1	0	0	0	1	0
28	16	448	1	3	60	1	200	0	1	0	0	0	1
28	16	448	2	0	90	2	0	0	0	1	0	1	0
28	16	448	3	3	90	0	0	1	0	0	0	0	0

Id	Card_id	Case_id	Alternative	Death	Time	Road	Tax	Earth	Gravel	Cape seal	Asphalt	R1S2	R2S2
29	1	449	1	3	30	0	0	1	0	0	0	1	0
29	1	449	2	0	60	1	50	0	1	0	0	0	0
29	1	449	3	3	90	0	0	1	0	0	0	0	1
29	2	450	1	2	90	0	100	1	0	0	0	0	0
29	2	450	2	3	120	1	200	0	1	0	0	0	0
29	2	450	3	3	90	0	0	1	0	0	0	1	1
29	3	451	1	0	120	0	200	1	0	0	0	0	0
29	3	451	2	1	30	1	0	0	1	0	0	1	0
29	3	451	3	3	90	0	0	1	0	0	0	0	1
29	4	452	1	1	60	0	50	1	0	0	0	0	0
29	4	452	2	2	90	1	100	0	1	0	0	0	0
29	4	452	3	3	90	0	0	1	0	0	0	1	1
29	5	453	1	1	120	2	0	0	0	1	0	0	1
29	5	453	2	2	30	3	50	0	0	0	1	0	0
29	5	453	3	3	90	0	0	1	0	0	0	1	0
29	6	454	1	0	90	1	0	0	1	0	0	1	0
29	6	454	2	1	120	2	50	0	0	1	0	0	1
29	6	454	3	3	90	0	0	1	0	0	0	0	0
29	7	455	1	2	60	3	0	0	0	0	1	1	1
29	7	455	2	3	90	0	50	1	0	0	0	0	0
29	7	455	3	3	90	0	0	1	0	0	0	0	0
29	8	456	1	3	120	3	100	0	0	0	1	0	0
29	8	456	2	0	30	0	200	1	0	0	0	0	0
29	8	456	3	3	90	0	0	1	0	0	0	1	1
29	9	457	1	0	30	3	50	0	0	0	1	0	0
29	9	457	2	1	60	0	100	1	0	0	0	0	0
29	9	457	3	3	90	0	0	1	0	0	0	1	1
29	10	458	1	3	90	2	50	0	0	1	0	0	0
29	10	458	2	0	120	3	100	0	0	0	1	0	0
29	10	458	3	3	90	0	0	1	0	0	0	1	1
29	11	459	1	1	90	3	200	0	0	0	1	0	0
29	11	459	2	2	120	0	0	1	0	0	0	0	1
29	11	459	3	3	90	0	0	1	0	0	0	1	0
29	12	460	1	1	30	1	100	0	1	0	0	0	0
29	12	460	2	2	60	2	200	0	0	1	0	0	0
29	12	460	3	3	90	0	0	1	0	0	0	1	1
29	13	461	1	2	30	2	200	0	0	1	0	0	0
29	13	461	2	3	60	3	0	0	0	0	1	1	1
29	13	461	3	3	90	0	0	1	0	0	0	0	0
29	14	462	1	2	120	1	50	0	1	0	0	1	0
29	14	462	2	3	30	2	100	0	0	1	0	0	0
29	14	462	3	3	90	0	0	1	0	0	0	0	1
29	15	463	1	0	60	2	100	0	0	1	0	0	0
29	15	463	2	1	90	3	200	0	0	0	1	0	0
29	15	463	3	3	90	0	0	1	0	0	0	1	1
29	16	464	1	3	60	1	200	0	1	0	0	0	0
29	16	464	2	0	90	2	0	0	0	1	0	1	1
29	16	464	3	3	90	0	0	1	0	0	0	0	0

Id	Card_id	Case_id	Alternative	Death	Time	Road	Tax	Earth	Gravel	Cape seal	Asphalt	R1S2	R2S2
30	1	465	1	3	30	0	0	1	0	0	0	1	0
30	1	465	2	0	60	1	50	0	1	0	0	0	0
30	1	465	3	3	90	0	0	1	0	0	0	0	1
30	2	466	1	2	90	0	100	1	0	0	0	0	0
30	2	466	2	3	120	1	200	0	1	0	0	0	0
30	2	466	3	3	90	0	0	1	0	0	0	1	1
30	3	467	1	0	120	0	200	1	0	0	0	0	0
30	3	467	2	1	30	1	0	0	1	0	0	1	0
30	3	467	3	3	90	0	0	1	0	0	0	0	1
30	4	468	1	1	60	0	50	1	0	0	0	0	0
30	4	468	2	2	90	1	100	0	1	0	0	0	0
30	4	468	3	3	90	0	0	1	0	0	0	1	1
30	5	469	1	1	120	2	0	0	0	1	0	0	1
30	5	469	2	2	30	3	50	0	0	0	1	0	0
30	5	469	3	3	90	0	0	1	0	0	0	1	0
30	6	470	1	0	90	1	0	0	1	0	0	1	0
30	6	470	2	1	120	2	50	0	0	1	0	0	1
30	6	470	3	3	90	0	0	1	0	0	0	0	0
30	7	471	1	2	60	3	0	0	0	0	1	1	1
30	7	471	2	3	90	0	50	1	0	0	0	0	0
30	7	471	3	3	90	0	0	1	0	0	0	0	0
30	8	472	1	3	120	3	100	0	0	0	1	0	0
30	8	472	2	0	30	0	200	1	0	0	0	0	0
30	8	472	3	3	90	0	0	1	0	0	0	1	1
30	9	473	1	0	30	3	50	0	0	0	1	0	0
30	9	473	2	1	60	0	100	1	0	0	0	0	0
30	9	473	3	3	90	0	0	1	0	0	0	1	1
30	10	474	1	3	90	2	50	0	0	1	0	0	0
30	10	474	2	0	120	3	100	0	0	0	1	0	0
30	10	474	3	3	90	0	0	1	0	0	0	1	1
30	11	475	1	1	90	3	200	0	0	0	1	0	0
30	11	475	2	2	120	0	0	1	0	0	0	0	1
30	11	475	3	3	90	0	0	1	0	0	0	1	0
30	12	476	1	1	30	1	100	0	1	0	0	0	0
30	12	476	2	2	60	2	200	0	0	1	0	0	0
30	12	476	3	3	90	0	0	1	0	0	0	1	1
30	13	477	1	2	30	2	200	0	0	1	0	0	0
30	13	477	2	3	60	3	0	0	0	0	1	1	1
30	13	477	3	3	90	0	0	1	0	0	0	0	0
30	14	478	1	2	120	1	50	0	1	0	0	1	0
30	14	478	2	3	30	2	100	0	0	1	0	0	0
30	14	478	3	3	90	0	0	1	0	0	0	0	1
30	15	479	1	0	60	2	100	0	0	1	0	0	0
30	15	479	2	1	90	3	200	0	0	0	1	0	0
30	15	479	3	3	90	0	0	1	0	0	0	1	1
30	16	480	1	3	60	1	200	0	1	0	0	0	0
30	16	480	2	0	90	2	0	0	0	1	0	1	1
30	16	480	3	3	90	0	0	1	0	0	0	0	0

Appendix C
Agriculture data

HH_ID	Respondent number
Area	Farm area (Rai)
Crop Type	Crop types i.e. casava corn
Crop volume	Crop volume (Ton/Rai)
Vehicle Type	Vehicle Type i.e. Truck, car
Load	Vehicle lading capacity
Revenue	Revenue for famers' household (THB/year)
Cost	Agriculture transport cost for famers' household (THB/year)
R1S1	Data for Hin Ngon villagers
R2S1	Data for Pao Thai villagers
R1S2	Data for Sak Nga villagers
R2S2	Data for Rom Klao villagers

Table C1 Agriculture data for R1S1

HH_Id	Area	Crop_type	Crop(Ton/rai)	Veh_Type	Load	Revenue	Cost
1	3	Corn	0.75	Middle truck	4000	22500	249
2	4	Corn	0.82	Middle truck	4000	32800	363
3	7	Corn	0.65	Middle truck	4000	45500	504
4	11	Corn	0.8	Middle truck	4000	88000	974
5	4	Corn	0.78	Middle truck	4000	31200	345
6	5	Corn	0.75	Middle truck	4000	37500	415
7	7	Casava	1.7	Middle truck	4000	59500	1317
8	16	Corn	0.68	Middle truck	4000	108800	1204
9	16	Corn	0.7	Middle truck	4000	112000	1240
10	3	Corn	0.72	Middle truck	4000	21600	239
11	5	Casava	1.7	Middle truck	4000	42500	941
12	4	Corn	0.78	Middle truck	4000	31200	345
13	8	Corn	0.79	Middle truck	4000	63200	700
14	11	Corn	0.76	Middle truck	4000	83600	925
15	13	Corn	0.8	Middle truck	4000	104000	1151
16	9	Corn	0.65	Middle truck	4000	58500	648
17	5	Corn	0.65	Middle truck	4000	32500	360
18	4	Corn	0.64	Middle truck	4000	25600	283
19	13	Corn	0.75	Middle truck	4000	97500	1079
20	16	Corn	0.79	Middle truck	4000	126400	1399

Table C2 Agriculture data for R1S2

HH_Id	Area	Crop_type	Crop(Ton/rai)	Veh_Type	Load	Revenue	Cost
1	4	Corn	0.7	E-Tak	1000	28000	775.6
2	3	Corn	0.66	E-Tak	1000	19800	548.46
3	2	Corn	0.73	E-Tak	1000	14600	404.42
4	4	Corn	0.6	E-Tak	1000	24000	664.8
5	2	Corn	0.7	E-Tak	1000	14000	387.8
6	2	Corn	0.6	E-Tak	1000	12000	332.4
7	3	Corn	0.75	E-Tak	1000	22500	623.25
8	3	Corn	0.65	E-Tak	1000	19500	540.15
9	3	Corn	0.68	E-Tak	1000	20400	565.08
10	3	Corn	0.6	E-Tak	1000	18000	498.6
11	2	Corn	0.52	E-Tak	1000	10400	288.08
12	3	Corn	0.6	E-Tak	1000	18000	498.6
13	2	Corn	0.63	E-Tak	1000	12600	349.02
14	3	Corn	0.7	E-Tak	1000	21000	581.7
15	3	Corn	0.75	E-Tak	1000	22500	623.25
16	3	Corn	0.6	E-Tak	1000	18000	498.6
17	2	Corn	0.59	E-Tak	1000	11800	326.86
18	4	Corn	0.8	E-Tak	1000	32000	886.4
19	2	Corn	0.8	E-Tak	1000	16000	443.2
20	3	Corn	0.65	Pick Up	1000	19500	540.15
21	3	Corn	0.62	Pick Up	1000	18600	515.22
22	12	Corn	0.66	Pick Up	1000	79200	2193.84

Table C3 Agriculture data for R2S1

HH_Id	Area	Crop_type	Crop(Ton/rai)	Veh_Type	Load	Revenue	Cost
1	8	Corn	0.85	Middle truck	4000	68000	753
2	10	Corn	0.72	Middle truck	4000	72000	797
3	8	Corn	0.85	Middle truck	4000	68000	753
4	13	Corn	0.78	Middle truck	4000	101400	1122
5	10	Corn	0.78	Middle truck	4000	78000	863
6	10	Corn	0.82	Middle truck	4000	82000	908
7	7	Corn	0.86	Middle truck	4000	60200	666
8	6	Corn	0.74	Middle truck	4000	44400	492
9	11	Corn	0.75	Middle truck	4000	82500	913
10	6	Corn	0.82	Middle truck	4000	49200	545
11	10	Corn	0.79	Middle truck	4000	79000	875
12	8	Corn	0.76	Middle truck	4000	60800	673
13	9	Corn	0.86	Middle truck	4000	77400	857
14	8	Corn	0.84	Middle truck	4000	67200	744
15	8	Corn	0.79	Middle truck	4000	63200	700
16	10	Corn	0.79	Middle truck	4000	79000	875
17	9	Corn	0.75	Middle truck	4000	67500	747
18	4	Casava	1.68	Middle truck	4000	33600	744
19	7.5	Casava	1.7	Middle truck	4000	63750	1411
20	6	Casava	1.6	Middle truck	4000	48000	1063
21	4	Casava	1.8	Middle truck	4000	36000	797

Table C4 Agriculture data for R2S2

HH_Id	Area	Crop_type	Crop(Ton/rai)	Veh_Type	Load	Revenue	Cost
1	7	2	0.78	Middle Truck	4000	54600	717
2	7	2	0.68	Middle Truck	4000	47600	625
3	8	2	0.64	Middle Truck	4000	51200	673
4	9	2	0.8	Middle Truck	4000	72000	946
5	9	2	0.69	Middle Truck	4000	62100	816
6	5	2	0.67	Middle Truck	4000	33500	440
7	10	2	0.85	Middle Truck	4000	85000	1117
8	9	2	0.86	Middle Truck	4000	77400	1017
9	7	2	0.67	Middle Truck	4000	46900	616
10	6	2	0.69	Middle Truck	4000	41400	544
11	9	2	0.72	Middle Truck	4000	64800	851
12	6	2	0.74	Middle Truck	4000	44400	583
13	7	2	0.75	Middle Truck	4000	52500	690
14	10	2	0.74	Middle Truck	4000	74000	972
15	8	1	1.68	Middle Truck	4000	67200	1766
16	7	1	1.6	Middle Truck	4000	56000	1472
17	8	2	0.65	Middle Truck	4000	52000	683
18	7	2	0.73	Middle Truck	4000	51100	671
19	13	2	0.85	Middle Truck	4000	110500	1452
20	11	2	0.72	Middle Truck	4000	79200	1041

Appendix D
Vehicle data

- **Vehicle fleet calibration**

In the appraisal, it is necessary to calibrate vehicles to local conditions. The RED provides the spreadsheet called 'HDM4RUCModelVer501' to make the calibration. Table D1 illustrates the representative vehicles that were used in this appraisal for Thailand. Those vehicle parameters, excluding farmers' vehicles, were derived from previous research studying vehicle operation costs on Thailand's road network (Suvunkong, 2008; Department of Highways, 2018), which were prepared for the appraisal using HDM-4. Certain parameters of farmers' vehicles were adopted from the study of using farm vehicles in cultivation, which considered engine power and fuel depletion relative to vehicle speed to calculate the RPM of coefficient (Chaloemthoi and Bumrungkeeree, 2016). Overall, the certain parameters calibrated to Thailand's conditions were very similar to the recommended data by HDM-4. Required by the RED, vehicle fleet data are described in Table D2 and Table D3 and D4 illustrate the data input into the RED model.

Table D1 Representative vehicle

Vehicle description	Representative vehicle
Motorcycle	Honda Wave
Car small	Toyota Vios
Car medium	Toyota Commuter
Pick up	Toyota Vego
Four-wheel drive	Toyota Vego 4×4
Truck light	Isuzu NLR130
Truck medium	Isuzu NPR 150
E-tak	Kubota ET 85
E-Tan	Kubota ET 85

Table D2 Vehicle fleet and data country

Data	Description
	Economic and financial unit cost ($).
New vehicle cost	New vehicle price ($).
New tyre	New tyre price ($/tyre).
Fuel	Fuel price ($/litre).
Lubricating oil	Lubricating oil ($/litre).
Maintenance Labour	Labour cost ($/hour) is estimated from minimum wage per day (320 THB).
Crew wage	Crew wage ($/hour) is estimated from minimum wage per day (320 THB).
Annual overheads	Overhead cost = running cost × coefficient Running cost = fuel cost + oil cost + tyre cost Coefficient = 0.1 for car small; 0.25 for middle truck (Dickey, 1984).
Annual interest	Annual interest is considered to be about 12% per year.
Passenger working time	Passenger working time ($/hour) is estimated from minimum wage per day (320 THB).
Non-passenger working time	Non-passenger working time ($/hour) is estimated from minimum wage per day (320 THB).
Cargo holding time	For local agriculture transport, it was estimated at 9.6 USD/hour ((Insomtao and Kasikitwiwat, 2020).
	Basic vehicle fleet characteristics
Annual kilometre driven (km)	Annual kilometres driven was estimated for different road types, farmers' vehicles—E-tak and E-Tan were expected to be used only for agricultural purposes. This research expected that farmers have a trip per day travelling from their farm to the point that is approximately 20 km distance as a round trip. Thus, the annual kilometres driven are approximately 7300 km (365×20). Other vehicles were expected to be used for various purposes, where the distance from the village to the district centre is

Data	Description
	about 100 km on a round trip. Thus, the estimate of the annual kilometres driven is approximately 36,500 (365×100).
Annual working hours	It is expected that farmers' vehicles, motorcycles and cars are used for 2 hours/day as transport within local subdistrict areas, for example from home to farm and from farm to a local pickup point. Thus, annual working hours should be about 730 per year. Light and middle trucks are expected to use longer hours, as much as 7 hours per day. Thus, the annual working hours should not be over 2555 hours/year (7×365). However, this research decided to use the default value.
Service life	Life service is expected to be about 10 years for all vehicles.
Private use	Cars are expected to be for 100% personal purposes. Pickups are expected to be used for 50%. Others are expected to be 0% use for personal purposes.
Number of passengers	Cars and pickups are expected to carry 2 people. For the others, there are no passengers.
Work-related passenger trips	Cars and pickups are expected to be used 75% for working trips. For the other vehicles, it is 100%.
Gross vehicle weight	Gross vehicle weight (tonne)
Life method	The life method is set to be constant for all vehicle types.
Physical	Set as previous researches.
Tyres	Set as previous researches.
Aerodynamics	Set as previous researches.
Rolling resistance	Set as default value.
Power	Set as previous researches.
Speed desired	Set as previous researches.
Speed parameter	Set as previous researches.
Fuel	The coefficient of RPM is set as in previous research.
Lubricants	Set as default value.

Data	Description
Acceleration noise	Set as default value.
Tyres	Set as default value.
Maintenance parts	Set as default value.
Maintenance labour	Set as default value.
Optimal life	Set as default value.
Residual value	Set as default value.

Table D3 Vehicle fleet in HDM-4

Vehicle Description	Economic or Financial Unit Costs ($) New Vehicle ($/vehicle)	New Tire ($/tire)	Fuel ($/liter)	Lubricating Oil ($/liter)	Maintenance Labor ($/hour)	Crew Wages ($/hour)	Annual Overhead ($/year)	Annual Interest (%)	Passenger Working Time ($/hour)	Passenger Non-Working Time ($/hour)	Cargo Time ($/hour)	Basic Vehicle Fleet Characteristics Annual km Driven (km)	Annual Working Hours (hours)	Service Life (years)	Private Use (%)	Numbe of Passengers (#)	Work Related Passengers Trips (%)	Gross Vehicle Weight (t)
Motorcycle	1,783	6.67	0.87	3.83	1.33	1.33	511.0	12.0	1.33	0.53	0.00	7,300	400	10	100	1	75	0.2
Car Small	18,567	53.33	0.87	8.33	1.33	1.33	511.0	12.0	1.33	0.53	0.00	36,500	600	10	100	2	75	1.0
Car Medium	29,133	66.67	0.87	8.33	1.33	1.33	511.0	12.0	1.33	0.53	0.00	36,500	500	10	100	7	75	1.2
Pickup	19,967	66.67	0.67	12.33	1.33	1.33	511.0	12.0	1.33	0.53	0.00	36,500	1,100	10	0	1	75	2.0
Four-Wheel Drive	23,564	66.67	0.67	12.33	1.33	1.33	511.0	12.0	1.33	0.53	0.00	36,500	800	10	0	1	75	2.0
Truck Light	30,233	150.00	0.67	12.33	1.33	1.33	511.0	12.0	1.33	0.53	0.00	36,500	1,300	10	0	1	0	6.0
Truck Medium	40,800	150.00	0.67	12.33	1.33	1.33	511.0	12.0	1.33	0.53	0.00	36,500	1,800	10	0	1	0	12.0
E-Tak	12,167	66.67	0.67	3.00	1.33	1.33	102.0	12.0	1.33	0.53	0.00	7,300	400	10	0	1	0	1.0
E-Tan	3,030	83.33	0.67	3.00	1.33	1.33	102.0	12.0	1.33	0.53	0.00	7,300	400	10	0	1	0	0.5

Table D4 Vehicle fleet data in HDM-4

Vehicle Description (text)	Life: Life Method (0-Constant, 1-Optimal)	Physical: Passenger Car Equivalent (#)	Physical: Number of Wheels (#)	Tires: Tire Type (0-Radial-ply, 1 - Bias-ply)	Tires: Base Number of Recaps (#)	Tires: Retreat Cost (%)	Power: Used Driving Power (kW)	Power: Not Used	Power: Used Braking Power (kW)	Power: Not Used	Power: Rated Engine power (kW)	Power: Not Used	Power: Rolling Resistance Not Used
Motorcycle	0	0.50	2.00	1.00	1.30	15.00	12.00	1	5.00	1	15.00	1	1
Car Small	0	1.00	4.00	0.00	1.30	15.00	26.00	1	20.00	1	60.00	1	1
Car Medium	0	1.00	4.00	0.00	1.30	15.00	33.00	1	20.00	1	70.00	1	1
Delivery Vehicle	0	1.00	4.00	0.00	1.30	15.00	40.00	1	25.00	1	60.00	1	1
Four-Wheel Drive	0	1.00	4.00	1.00	1.30	15.00	45.00	1	25.00	1	60.00	1	1
Truck Light	0	1.30	4.00	1.00	1.30	15.00	50.00	1	45.00	1	75.00	1	1
Truck Medium	0	1.40	6.00	1.00	1.30	15.00	87.00	1	70.00	1	100.00	1	1
E-Tak	0	1.00	2.00	1.00	1.30	15.00	5.20	1	10.00	1	10.00	1	1
E-Tan	0	1.00	6.00	1.00	1.30	15.00	5.20	1	10.00	1	10.00	1	1

Vehicle Description (text)	Fuel: Engine Speed RPM_A0 (rpm)	Engine Speed RPM_A1 (rpm/(m/s))	Engine Speed RPM_A2 (rpm/(m/s)2)	Engine Speed RPM_A3 (m/s)	Idle Engine Speed RPM_IDLE (rpm)	Idle Fuel Rate IDLE_FUEL (ml/s)	Base Fuel Efficiency ZETAB (ml/kW/s)	Decrease Efficiency EHP (#)	Efficiency Drivetrain EDT (#)	Engine & Accessories PACCS_A0 (#)	Engine & Accessories PCTPENG (%)
Motorcycle	-165.00	298.86	-4.6700	0.0055	800.00	0.12	0.067	0.25	0.95	0.20	80.00
Car Small	750.00	52.22	-0.7792	0.0046	750.00	0.25	0.067	0.25	0.90	0.20	80.00
Car Medium	860.00	0.00	0.3064	-0.0015	800.00	0.36	0.067	0.25	0.90	0.20	80.00
Delivery Vehicle	860.00	50.00	-0.9960	0.0055	800.00	0.48	0.067	0.25	0.90	0.20	80.00
Four-Wheel Drive	860.00	50.00	-0.9960	0.0055	800.00	0.48	0.057	0.10	0.90	0.20	80.00
Truck Light	860.00	50.00	-1.0000	0.0055	500.00	0.37	0.057	0.10	0.86	0.20	80.00
Truck Medium	500.00	400.00	-8.4960	0.0446	500.00	0.37	0.057	0.10	0.86	0.20	80.00
E-Tak	1190.00	181.00	0.00	0.00	500.00	1.12	0.067	0.10	0.86	0.20	80.00
E-Tan	1190.00	181.00	0.00	0.00	500.00	1.12	0.067	0.10	0.86	0.20	80.00