Village Capacity in Maintaining Infrastructure
Evidence from Rural Indonesia

Arya Gaduh

November 2010

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Acknowledgements

It took a team to complete this study. Daan Pattinasarany provided input into questionnaire design, while Ali Subandoro managed the early process necessary to get the study going. Data was collected by a team of trained enumerators, who went and interviewed 3840 households in 32 villages every three months for a whole year. The data were entered and cleaned by another team into an elaborate information system that was designed by Nur Cahyadi.

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Executive Summary

Inadequate rural infrastructure creates constraints to economic growth in these areas by limiting productive growth and impeding the development of human capital. Recognition of the rural-poverty-alleviation role of infrastructure development motivated the central government, as well as donor agencies, to direct a significant amount of aid into supporting such projects.[1] Naturally, the poverty-targeting criterion plays an important part in deciding on the location of project activities. As priorities for infrastructure projects are usually given to poorer regions and villages, a problem arises. Currently, infrastructure is often provided under the implicit assumption that local people are able to pay the full maintenance costs. However, there is no systematic evidence that this assumption is justified.

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1 About 76% of almost US$ 700 million-worth of investments channeled through the World Bank's *Kecamatan Development Program* (KDP) were for infrastructure projects, with 23% for economic activities, and 1% for education and health activities (ADB, 2005).

Research Questions and Design

This study examines the assumption that villagers are able to finance the necessary maintenance of infrastructure on their own. More specifically, the study seeks answers to the following questions.

i. Do villagers in poor villages have the resources to maintain their priority infrastructure on their own?

ii. If they do, to what extent are villagers willing to use their resources for infrastructure maintenance?

iii. How do village characteristics affect resource availability and their willingness to pay for infrastructure maintenance?

To this end, we took a purposive sample of 32 relatively poor villages across five provinces in Java, Sumatra, Kalimantan, Sulawesi, and East Nusa Tenggara. To see how our sample fit relative to other villages in the country and in each province, we do some comparative analysis. We find that with some minor exceptions, our sample villages are mainly located in the poorest 40% of *kecamatan* (sub-districts) nationally and provincially. With regard to infrastructure quality, compared to their district averages, these *kecamatan* (sub-districts) have slightly greater shares of villages with a majority of asphalt roads, slightly lesser access to municipal waterworks (PAM) and ground water compared to their district averages.

Once we selected our sample villages, in each village, our team of infrastructure engineers performed measurements of the maintenance costs necessary to ensure the long term sustainability of village infrastructure. We considered three types of infrastructure: roads, bridges, and piped water systems. To estimate the inflow of resources, we collected detailed information on household income and consumption. To account for possible income and consumption fluctuations between seasons, we collected data from four Consecutive Surveys, each three months apart. Using this data, we examine how much of an extra burden maintenance costs would be if they were fully born by these households. We also did a similar calculation assuming that villagers contribute fully the necessary unskilled labor.

Using the contingent valuation method, we also asked households to state their Willingness To Pay (WTP) maintain infrastructure individually and as a bundle. We use these data to estimate resources that would be available in different ways to collect contributions from households. Household data were collected between July 2008 and August 2009.

Results

We find that, with respect to their current welfare, the cost of maintaining village infrastructure was significant in our sample villages. When distributed equally across households in each village, the total costs to maintain village infrastructure in this study—village roads, bridges, and piped water systems when they exist—amount to between 0.1% and 2.8% of households' total consumption, with a median of 1.1% (see Table 25). If we assume that villagers can supply all of the necessary unskilled labor, maintenance costs amount to between 0.1% and 1.4% of their consumption, with a median of 0.5% (see Table 26). The bulk of these costs come from the cost to maintain rural roads.

While these percentages might appear small, this "local tax" for infrastructure is likely to be burdensome, given the low income of many villagers. Moreover, since income and consumption are not easily observable, it may be difficult to create with a mechanism to collect contributions based on household income or consumption share in these villages. If we use villagers' stated willingness to pay instead, we find that the resources collected fell well below what would necessary to fully finance these costs. Table 30 Shows that between 21% (when villagers do not contribute any unskilled labor) and 63% (when villagers contribute all unskilled labor) of sample villages would be able to afford the maintenance of all three types of infrastructure. When looked at separately for each type of infrastructure, the heaviest burden comes from financing roads: only between 21% and 43% of villages would be able to afford road maintenance based on their stated willingness to pay for road maintenance (see Tables 27, 28, and 29 for comparisons).

It is, however, reasonable to think that households may not contribute their full WTP. Our econometric analysis alludes to the presence of the temptation to free ride on other households' contributions. When households did so, total contributions would fall. Under scenarios in which a single-priced monthly household user fee is established through a voting procedure, we find that the number of villages whose contributions would fall short of those necessary to finance proper infrastructure maintenance increases. Using their WTPs as the basis for calculations, we find that only between 10% and 20% of the sample villages' resources collected through these user fees would be adequate to finance the maintenance of all three types of infrastructure (Table 34).

Table 35 presents our empirical analysis of the determinants of household WTP to pay for road maintenance. It shows, as predicted by theory, that household income and opportunity costs from a damaged road were positively correlated with WTP. In addition, we also find that the increase in WTP due to increased opportunity costs only happened when households have suffered actual incidences of failed roads and the coefficient was only significant for monetary opportunity cost. We also find that institutional responsiveness is important: Satisfactory responses to complaints regarding road problems increased WTP. Perceived administrative quality of the various levels of governments did not seem to play a major role in influencing the WTPs. Interestingly enough, a higher perceived trust of fellow villagers and their helpfulness appears to reduce households WTPs.

Policy Recommendations

Based on our results, we recommend the following:

Institutionalize infrastructure maintenance with clearly defined roles and responsibilities for the different levels of administration. Our study finds that there is a significant willingness on the part of villagers to contribute towards infrastructure maintenance. For most villages, there would be adequate resources to conduct routine maintenance. However, villagers may need a significant financial support to ensure that periodic maintenance is conducted properly. This suggests that villagers can take up the responsibility for routine maintenance. At the same time, district governments and outside agencies need also to step up their support of the types of maintenance activities villagers have difficulty affording.

District governments need to gradually reallocate resources towards maintenance instead of upgrades. Table 11 suggests that district governments tend to use their resources to support upgrades and rehabilitation efforts instead of periodic maintenance. One study suggests that the cost ratio between upgrades and maintenance is about 3.5 to 1 (Dongges et. al., 2007). There is a strong case for a gradual shift from construction and rehabilitation or upgrades towards developing the necessary resources and institutions to undertake rural infrastructure maintenance activities.

Newly constructed infrastructure needs to be accompanied with an explicit and detailed maintenance plan that states clearly the resources necessary to implement it. Our data shows that the maintenance costs vary much more than the villagers' willingness to pay. These variations are driven, among other factors, by local conditions as well as the volume and design of the infrastructure. Estimating the maintenance costs long after the fact—which may be necessary in order to estimate the resource gap that will need to be plugged—can be cumbersome, costly, and may not be particularly accurate. On the other hand, these variations are likely to be better understood by the initial implementers of the infrastructure. It is therefore crucial that new projects be accompanied with plans for sustainable maintenance that can be used and understood by the various agencies that may need to be involved in plugging the resource gap.

At the village level, there needs to be a designated institution responsible for maintenance. Our data suggest that villages do implement routine maintenance on their own. However maintenance can be implemented more efficiently if they are implemented at the correct time (Dongges et. al., 2007). Moreover, these activities will require villager contributions and we find that villagers' willingness to contribute are positively and significantly correlated with the responsiveness of an institution in immediately addressing reported infrastructure problems. This designated institution or person can therefore act to coordinate maintenance efforts as well as respond to potential problems in a timely fashion. Having an institution responsible for maintenance—this could well come from an existing village institution—will be instrumental in ensuring the sustainability of the maintenance efforts.

The assignment of maintenance activities to villagers needs to take into account the possibly unequal distribution of burdens towards poorer households. Our data show that maintenance costs can be reduced significantly when villagers are expected to contribute all of the unskilled labor. However having villages supply all unskilled labor may amount to a regressive "informal tax", where poorer households "pay" more (in the form of labor) for public goods.[2] It is important to address this potential issue in the process of institutionalizing maintenance activities at the village level.

Studies need to be undertaken on effective and efficient means to collect and channel resources to ensure that infrastructure is well-maintained in the long term. This study provides insight into the resource gaps faced by villagers in fulfilling the maintenance requirements for their infrastructure. It also suggests a role for outside agencies to support maintenance efforts in villages, including, but not limited to, district governments. However, we still lack a good understanding on effective mechanisms to deliver resources in a manner that ensures that infrastructure is well-maintained in the long term or how effective these mechanisms are in different contexts. Moreover, we also need to understand better the effectiveness of different resource collection strategies for different types of infrastructure to improve the design of the village-level maintenance institutions.

2 For a discussion of this "informal tax", see Olken and Singhal (2009).

Chapter 1

Introduction

The lack of key infrastructure in rural areas is often considered an underlying cause of rural poverty in Indonesia. Inadequate rural infrastructure creates constraints to economic growth in rural areas by limiting productive growth and impeding the development of human capital. This recognition of the rural-poverty-alleviation role of infrastructure development motivated the central government, as well as donor agencies, to direct a significant amount of aid into supporting such projects.[3] Naturally, the poverty-targeting criterion plays an important part in deciding on the location of project activities. As priorities for infrastructure projects are usually given to poorer regions and villages, a problem arises. Currently, infrastructure is provided under the implicit assumption that local people would be able to pay, either for partial contribution to the development or the upkeep of infrastructure. However, there is no systematic evidence that this assumption is justified.

3 About 76% of almost US$ 700 million-worth of investments channeled through the World Bank's *Kecamatan Development Program* (KDP) were for infrastructure projects, with 23% for economic activities, and 1% for education and health activities (ADB, 2005).

This study examines the assumption that villagers would be able to finance the necessary maintenance of their infrastructure on their own. More specifically, the study seeks answers to the following questions:

i. Do villagers in poor villages have the resources to maintain their priority infrastructure on their own?
ii. If they do, to what extent are villagers willing to use their resources for infrastructure maintenance?
iii. How do village characteristics affect resource availability and their willingness to pay for infrastructure?

To this end, we took a purposive sample of 32 relatively poor villages across five provinces in Java, Sumatra, Kalimantan, Sulawesi, and East Nusa Tenggara. In each village, our team of infrastructure engineers performs measurements of the maintenance costs necessary to ensure the long term sustainability of village infrastructure. For this study, we consider three types of infrastructure: roads, bridges, and piped water systems. We then compare this with resources that would be available to villagers. More specifically, we use the income and consumption data to estimate the inflow of resources to households in these villages. Then, we examine how much of an extra burden would maintenance costs be if they were fully born by these households. Using the contingent valuation method, we also asked households to state their willingness to pay to maintain their infrastructure individually and as a group. We use these data to estimate resources that would be available under different ways to collect contributions from households.

Our study finds that these maintenance costs would add a burden of between 0.1% and 4.3% of households' total income, with a median of 1.4%. If we use consumption, which typically is better measured than income, these maintenance costs would amount to between 0.1% and 2.8% of these households' consumption, with a median of 1.1%. Meanwhile, using the willingness to pay (WTP) data, we find that in 21% to 63% of our sample villages the maximum voluntary contributions from these households would be adequate to finance the three types of infrastructure considered in the study, depending on our assumption of the amount of unskilled labor that villagers contribute to infrastructure maintenance. These numbers fell to between 10% and 20% if we consider the more realistic mechanism of using user fees to collect these contributions.

The report is organized as follows. In the next section, we describe the general methodology of the study. It is followed by a discussion on the characteristics of our sample villages in Section 3. Since we have a small sample, this section begins by giving a sense of where our sample villages fit within the context of the country. Section 4 describes the welfare characteristics and willingness to pay of the households in our sample, followed by a discussion of what that would entail for total available resources in the villages in Section 5. Section 6 discusses in detail some of our empirical analysis linking the total maintenance cost to the villagers' willingness and ability to pay for them. More specifically, it discusses the extent to which village contributions can play a role in financing infrastructure maintenance under different scenarios. It also presents our empirical analysis of the determinants of villagers willingness for infrastructure, particularly for roads. Section 7 concludes.

Chapter 2

General Methodology

We conducted our study in 32 villages in five provinces during the period of August 2008 and July 2009. At the beginning of the period, our team of engineers estimated the costs of infrastructure maintenance by sampling different points of three types of infrastructure, namely roads, bridges, and piped water systems, when they exist. Meanwhile, household data were collected every three months during the period. Within each village, we interviewed village officials as well as a sample of 120 households, which were followed by our panel survey throughout the year. We describe the sample and infrastructure selection strategy in more detail below.

2.1 Village and Household Sampling Strategy

In this study, we wanted to focus on villages that are representative of the poorer villages in different topographical locations across Indonesia. Hence, we sampled 32 villages in five island groups: Sumatra, Java, Kalimantan, Sulawesi, and East Nusa Tenggara. To find the poorer villages in these island groups, ideally we would select based on some direct measures of village-level poverty. However, since reliable poverty maps were only available at the *kecamatan* level or higher, we had to approximate. We first limited the sample villages to those located in kecamatan that are among the poorest 40% in each island group based on BPS's 2004 *kecamatan*-level poverty map. To ensure the tractability of the survey, we then limited the sample to rural villages with between 300 and 600 households based on the *Potensi Desa* (Podes) 2005 data.

Once we obtained a list of these villages, we categorized them in terms of their island groups and topography—whether each is located in a coastal, flatland, or hilly/mountainous area. Within each category, we selected 4-8 villages whose poverty characteristics (as provided by the *Podes 2005* data) are around the median in each *kecamatan*.[4] The final list of 32 villages was determined after we consulted with the field team regarding the feasibility of conducting the survey within the allotted time, i.e., one survey wave in each quarter.

Within each village, the survey interviewed village officials and a random sample of households. To construct the sampling frame for households, the survey team conducted a mini-census of households. Based on the household consumption categories collected during the mini-census, 120 households were stratified-random sampled from each village.

4 Unlike the BPS's poverty map which tries to estimate *kecamatan-level* poverty based on its households' consumption level, *Podes* asks its village informant—typically the village head—to estimate how many households fall under the *pra-sejahtera* (or pre-welfare) level. When doing national level comparison, the former is likely to be more accurate; but we had to resort to the latter to choose the villages in the absence of a recent village-level poverty map.

2.2 Infrastructure Maintenance Costs: Definition and Sampling Strategy

Defining Maintenance

Our study focused on two types of infrastructure maintenance activities. The first, *routine maintenance*, refers to infrastructure maintenance work that needs to be performed at least once a year. This includes light maintenance work to ensure that the infrastructure is working properly, such as checking and cleaning the side-road drains after heavy rain. The second, *periodic maintenance,* needs to be done once every few years. The cost calculations in the study assume that periodic maintenance needs to be performed once every five years. Periodic maintenance refers to light or medium structural repairs to village infrastructure. Tables 1, 2, and 3 list the different maintenance activities and their classification as periodic or routine activities that we consider when we estimate the maintenance costs for different types of infrastructure.

Table 1: Periodic (P) and routine (R) maintenance activities: Roads

Work on the main road	
Replace damaged segment of concrete construction	P
Repair damages to asphalt penetration	P
Resurface with asphalt and sands	P
Resurface gravel roads	P
Re-gravel telford roads	P
Rearrange paving stone roads	P
Patch holes in telford roads	R
Patch holes or damaged segments in paving stone roads	R
Add sand and stones covering on telford stones	R
Resurface road tracks on telford roads	R
Shoulder lane	
Repair drainage of the shoulder	P
Reshaping of the shoulder lane	R
Repair the volume of eroded materials	R
Side drainage	
Reshape the soil channel and scour check	P
Repair damaged lining pairs	P
Maintain the side drainage	P
Clean up and light repairs of the drainage	R

Slopes	
Periodic maintenance of trees on the slopes	P
Periodic maintenance of weeds on the slopes	P
Periodic repairs of damaged covering pairs	P
Periodic repairs of gabion	P
Clean and maintain retaining wall, etc	R
Clearing of gabion	R
Routine maintenance of terrace, diversion channel, etc	R
Drainage tunnel	
Repairs of the outside of the drainage tunnel	P
Periodic repairs of damaged pairs on tunnels	P
Periodic repairs of damaged concrete on the tunnels	P
Periodic repairs of damaged gabion on tunnels	P
Clearing of drainage tunnels	R
Other buildings	
Construction-protecting gabion	P
Periodic repairs of damaged pairs on other buildings	P
Periodic repairs of damaged concrete on other buildings	P
Periodic repairs of gabions on other buildings	P
Repairs of the outside of the buildings	P
Clearing of areas around the buildings	R

Table 2: Periodic (P) and routine (R) maintenance activities: Bridges

Bridge's upper structure	
Periodic maintenance of the wood, concrete planks	P
Periodic maintenance of upper structure	P
Periodic maintenance of the metal construction	P
Painting of the metal, wood construction	P
General clean up of bridge, drainage channel, etc	R
Work on the bridge abutment and pillar	
Periodic maintenance of the abutment, pillar	P
Periodic maintenance of the safety rock pairs	P
Periodic maintenance, abutment metal, wood, concrete	P
Periodic painting of wood part of abutment and pillar	R
Periodic painting of the metal part of abutment and pillar	R
Clearing of water under the bridge	R
Maintenance of bridge ramp	R

Road approach	
Periodic maintenance of the ramp covering pair	P
Routine clearing of the road approach	R
River banks around the bridge	
Periodic maintenance of the bridge wing	P
Periodic maintenance of the concrete structure	P
Periodic maintenance of gabion	P
Maintenance of grass on cliff (replanting volume)	P
Clearing of the bridge wing pair (from plants, etc)	R
Vegetation clearing around bridge construction	R

Table 3: Periodic (P) and routine (R) maintenance activities: Piped water systems

Main building for transmission pipes	
Painting of walls for buildings	P
Maintenance/overhaul of the pump set	P
Maintenance/overhaul of the hydrant set	P
Maintenance of stones, bricks, and concretes	P
Maintenance/replacement of building metals etc	P
Maintenance of building pipes	P
Clean-up of the building	R
Clean-up of the building areas and drains	R
Distribution buildings	
Maintenance of public taps	P
Painting of walls, metal constructions	P
Maintenance of stones, bricks, and concretes	P
Periodic maintenance of metal constructions	P
Maintenance of pipes	P
Clean-up of the building areas and drains	R

Piping
Replacement of pipes
Pairs of stones to maintain
Concrete constructions to maintain
Repairs/replacement of metal parts on buildings etc
Painting of metal construction
Checks on the pipelines

There is a third type of maintenance activity, namely *emergency maintenance,* that we do not consider here. Emergency maintenance refers to activities to repair damages due to unforeseen circumstances (Dongges, et. al., 2007). Examples of such emergencies would be damage due to landslides, flood, or major accidents. Provision for this type of maintenance is obviously critical to ensuring that the road or other infrastructure can provide uninterrupted service to villagers. However, due to its unforeseen nature, we cannot incorporate the cost of emergency maintenance in this study.

Infrastructure Sampling Strategy and Extrapolation to Village-Level Costs

To establish maintenance costs, the team sampled different sections of the infrastructure that we will study to allow us to estimate the total cost of maintenance to the villages. For roads, we excluded roads whose maintenance is not the responsibility of the villagers, such as district or provincial roads. We then ranked the roads in terms of the number of beneficiaries and selected those with the largest number. We include only roads with a total length of at least 500 meters. For a homogeneous road, we sample one segment of the road to calculate the cost. Otherwise, we sampled segments that are representative of road types (in terms of its material), morphology (hilly or flat), and use (residential or non-residential). Once the costs for these segments were calculated, we inflated these costs using the total length of the existing village road divided by the segment length to establish a village-level maintenance cost.

Similar to roads, for bridges we prioritized those with the largest beneficiaries. We only included bridges that were considered permanent, these can be one of three types: concrete, steel, or wood. Similarly, for the water system, we picked one piped water system with the largest number of beneficiaries. The cost is calculated for both transmission and distribution systems. Within the sampled water systems, we examine segments of the system with the highest number of users and figure out the costs for these segments. We use the costs for these segments as a basis for extrapolating the costs for the system covering the whole village. However, for water systems, we do not extrapolate based on the total length of the *existing* system. In our sample villages, existing systems only cover between 1.4% to 28.6% of villagers in each of villages with water systems. Instead, we inflate the cost using the total number of villagers divided by the number of users of our sampled segments in each of these villages using data on the number of beneficiaries collected during the infrastructure survey.

Before we proceed, we need qualify what we mean by “village-level costs”. First, our calculations of “village-level costs” applies only to our sampled roads, bridges, and piped water systems. Although we sampled our infrastructure projects such that they are the most heavily used ones, they were often not the only ones that the villages had to maintain. We cannot generalize these costs to all infrastructure available in the villages. Henceforth, *our calculated village-level costs should be interpreted as a lower bound to the cost of maintaining infrastructure in these villages*. Second, we could only calculate costs based on maintenance of *existing* infrastructure. As the result, we do not have costs for bridges and piped water systems in almost half of our sample villages. Moreover, when calculating village-level costs, we assume that the maintenance costs are homogeneous within villages. Obviously, this is a strong assumption. Finally, all cost calculations include both material and labor necessary based on local wages and prices.

Chapter 3
Sample Village Characteristics

3.1 The Broader Context: Where do Our Sample Villages Fit?

The above sample selection process gives us 32 villages located in 29 *kecamatan* in 21 districts across 5 provinces. The following provides a sense of how these sample villages fit within the broader context in terms of welfare and infrastructure. We first look at the welfare indicators. Using the 2004 *kecamatan*-level poverty map, we can examine where these *kecamatan* are in terms of poverty. Table 4 presents the *kecamatan* poverty rate as well as its normalized ranking nationally and within each province. The ranking ranged from 0 to 1, where 0 means it is the poorest, and 1, the richest.

Table 4: Sample kecamatan according to the 2004 Poverty Map

Province	District	*Kecamatan*	% Poor	National rank	Prov. Rank
Central Java	Blora	Japah	30.75	0.18	0.2
	Pati	Margoyoso	21.58	0.38	0.51
	Pemalang	Warungpring	35.13	0.12	0.1
	Rembang	Kragan	28.96	0.21	0.24
	Rembang	Sluke	28.73	0.22	0.25
	Tegal	Bojong	30.53	0.19	0.21
	Wonosobo	Kaliwiro	35.1	0.12	0.1
West Kalimantan	Kubu Raya	Telok Pa'kedai	17.02	0.51	0.37
	Landak	Menyuke	20.66	0.40	0.25
	Pontianak	Toho	14.1	0.61	0.5
	Singkawang	Singkawang Timur	13.8	0.63	0.54
	Singkawang	Singkawang Utara	19.67	0.43	0.28
	Sintang	Kayan Hulu	21.06	0.39	0.23
Lampung	Lampung Selatan	Kalianda	30.86	0.18	0.21
	Lampung Timur	Way Bungur	39.35	0.08	0.09
	Pesawaran	Kedondong	26.48	0.26	0.38
	Pesawaran	Padang Cermin	26.25	0.27	0.4
	Way Kanan	Banjit	38.38	0.09	0.1
	Way Kanan	Baradatu	30.1	0.19	0.26
East Nusa Tenggara	Kupang	Amabi Oefeto	-	-	-
	Kupang	Amarasi	38.01	0.09	0.26
	Kupang	Kupang Timur	36.86	0.1	0.29
	Timor Tengah Selatan	Amanuban Selatan	37.43	0.09	0.27
	Timor Tengah Utara	Noemuti	41.23	0.06	0.18
South Sulawesi	Bone	Amali	21.47	0.38	0.27
	Bone	Lappariaja	34.8	0.12	0.06
	Luwu	Lamasi	23.33	0.33	0.24
	Luwu	Larompong Selatan	21.67	0.38	0.27
	Tana Toraja	Sopai	-	-	-

Source: BPS Poverty Map 2004

Nationally, four *kecamatan* in West Kalimantan were not within the 40% poorest in 2004. Of these, two (namely, Toho and East Singkawang) were within the 40% poorest *kecamatan* in the province. *Kecamatan* Pati in Java did not fall within the 40% poorest *kecamatan* in the province, but is within 40% poorest *kecamatan* nationally. These discrepancies were possibly due the application of the poverty criterion at the island group level, instead of the national or province level. Meanwhile, the 2004 poverty data for two *kecamatan* in East Nusa Tenggara and South Sulawesi (Amabi Oefeto and Sopai) are not available. Overall, except for the two *kecamatan* in West Kalimantan, the poverty rates are higher than the national average of 16.7% in 2004.

Table 5: Share of villages in kecamatan with different road types and conditions, 2008

Province	District	*Kecamatan*	Road type								Accessible by 4+wh. vehicle all year?	
			Ashpalt		Hardened		Earth		Others			
			Dist.	Kec	Dist	Kec	Dist	Kec	Dist	Kec	Dist.	Kec
Lampung	Lampung Selatan	Kalianda	0.62	0.85	0.10	0.04	0.28	0.11	0.00	0.00	0.99	0.96
	Lampung Timur	Way Bungur	0.28	0.75	0.54	0.25	0.18	0.00	0.00	0.00	0.98	1.00
	Way Kanan	Banjit	0.17	0.30	0.60	0.65	0.23	0.05	0.00	0.00	0.96	1.00
	Way Kanan	Baradatu	0.17	0.59	0.60	0.27	0.23	0.14	0.00	0.00	0.96	0.91
	Pesawaran	Padang Cermin	0.62	0.73	0.23	0.27	0.15	0.00	0.00	0.00	0.97	0.86
	Pesawaran	Kedondong	0.62	0.67	0.23	0.14	0.15	0.19	0.00	0.00	0.97	0.95
Central Java	Wonosobo	Kaliwiro	0.63	0.24	0.36	0.76	0.00	0.00	0.00	0.00	1.00	1.00
	Blora	Japah	0.66	0.50	0.33	0.50	0.01	0.00	0.00	0.00	0.98	1.00
	Rembang	Kragan	0.94	1.00	0.06	0.00	0.00	0.00	0.00	0.00	1.00	1.00
	Rembang	Sluke	0.94	1.00	0.06	0.00	0.00	0.00	0.00	0.00	1.00	1.00
	Pati	Margoyoso	0.92	1.00	0.07	0.00	0.01	0.00	0.00	0.00	0.99	1.00
	Pemalang	Warungpring	0.86	0.50	0.11	0.33	0.03	0.17	0.00	0.00	0.96	1.00
	Tegal	Bojong	0.93	0.94	0.07	0.06	0.01	0.00	0.00	0.00	0.99	0.88
East Nusa Tenggara	Kupang	Amarasi	0.18	0.33	0.45	0.56	0.37	0.11	0.00	0.00	0.90	1.00
	Kupang	Kupang Timur	0.18	0.77	0.45	0.15	0.37	0.08	0.00	0.00	0.90	1.00
	Kupang	Amabi Oefeto	0.18	0.00	0.45	0.29	0.37	0.71	0.00	0.00	0.90	0.86
	Timor Tengah Selatan	Amanuban Selatan	0.30	0.20	0.37	0.70	0.34	0.10	0.00	0.00	0.91	1.00
	Timor Tengah Utara	Noemuti	0.30	0.00	0.38	0.82	0.31	0.18	0.00	0.00	0.96	0.91
West Kalimantan	Landak	Menyuke	0.38	0.31	0.13	0.13	0.50	0.56	0.00	0.00	0.65	0.56
	Pontianak	Toho	0.73	1.00	0.05	0.00	0.23	0.00	0.00	0.00	0.84	1.00
	Sintang	Kayan Hulu	0.19	0.14	0.11	0.21	0.69	0.64	0.01	0.00	0.59	0.43
	Kubu Raya	Telok Pa'kedai	0.48	0.00	0.02	0.00	0.51	1.00	0.00	0.00	0.42	0.15
	Singkawang	Singkawang Timur	1.00	1.00	0.00	0.00	0.00	0.00	0.00	0.00	1.00	1.00
	Singkawang	Singkawang Utara	1.00	1.00	0.00	0.00	0.00	0.00	0.00	0.00	1.00	1.00
South Sulawesi	Bone	Lappariaja	0.50	0.22	0.38	0.56	0.12	0.22	0.00	0.00	0.92	0.78
	Bone	Amali	0.50	0.80	0.38	0.20	0.12	0.00	0.00	0.00	0.92	1.00
	Luwu	Larompong Selatan	0.40	0.60	0.38	0.40	0.22	0.00	0.00	0.00	0.84	1.00
	Luwu	Lamasi	0.40	1.00	0.38	0.00	0.22	0.00	0.00	0.00	0.84	1.00
	Tana Toraja	Sopai	0.26	0.50	0.40	0.50	0.34	0.00	0.00	0.00	0.80	1.00

Source: Podes 2008

We next examine the relative quality of the infrastructure in the *kecamatan* where our sample villages reside using *Podes* 2008 (hereafter, *Podes*). Since our study focuses on roads and bridges, and water sources, we employ the Podes questions on road and water sources. *Podes* has questions on the main means of transportation to and from the village, and, if it is by land, the dominant road types in each respondent village. There are three main categories: asphalt, hardened, and earth road, plus an "other" option. In addition, *Podes* includes a question of whether these roads are accessible by 4-or-more wheeled vehicles all year long. For a sense of the relative quality of roads, we calculate the share of villages in each *kecamatan* with the different types of dominant road types and its year-long accessibility for cars and the like. We use district averages of these *kecamatan*-level shares as benchmark of the relative quality of the infrastructure in our sample. Table 5 presents these numbers.

The relative qualities of infrastructure in between our sample *kecamatan* and their district counterparts differ by provinces. In Lampung, *kecamatan* in our sample tend to have better quality roads than their counterparts. Overall, sample *kecamatan* have a higher share of villages with asphalt roads, and a lower share with earth roads. However, in terms of accessibility to vehicles with 4 or more wheels, they are comparable to the district average, except for *Kecamatan* Padang Cermin, which has a lower share of year-long accessible villages than the district average.

Meanwhile, in Central Java, about half of the *kecamatan* have a higher share of villages with asphalt, and the other half, a significantly lower share. Meanwhile, these *kecamatan* have comparable (and fairly small) shares of villages with earth roads to their district counterparts, except for *Kecamatan* Warungpring, with more of the earth roads. Across the province, almost all of the villages have roads that are accessible to four-or-more wheeled vehicles all year long.

In East Nusa Tenggara, more than half of the *kecamatan* have a much smaller share of villages with a majority asphalt road than the district average. Sample *kecamatan* tend to have a higher share of hardened roads, and a lower share of earth roads, except for *Kecamatan* Amabi Oefeto, which has a larger share of villages with earth roads compared to the district average. Only about 90% of the districts where our sample villages reside have year-long accessibility to four-or-more-wheeled vehicles. Our sample *kecamatan* tend to have comparable or slightly higher accessibility, except for *Kecamatan* Amabi Oefeto, which as a much lower accessibility than its district average.

Excluding *kecamatan* located in Singkawang—where all villages have a majority of asphalt roads—the road quality in our West Kalimantan sample *kecamatan* tended to be worse than the district average. There tend to be a lower share of villages with asphalt roads, and a higher share of those with earth roads. Our sample *kecamatan* also tended to have a much lower share of villages with year-long accessibility to four-or-more-wheeled vehicles. The exception in West Kalimantan is *Kecamatan Toho,* which tends to have a higher share of villages with asphalt road, a lower share with earth road, and a higher accessibility than its district average.

In South Sulawesi, our sample *kecamatan* tend to have better road qualities than the district average, with the exception of *Kecamatan* Lappariaja. Except for one *kecamatan,* our sample *kecamatan* have shares of villages with asphalt roads that are higher than the district average, no villages with earth roads, and all villages with year-long access to four-or-more-wheeled vehicles.

On water sources, *Podes* asks village informants for the main source of drinking and cooking water used in the village. Aside from the "other" option, it has six options: PAM (the state-owned water company), electric/manual pump, well, springs, river/lake, and rain. We re-categorized these options into PAM, manually extracted ground water (for the second and third options), and other natural sources (for the remaining three). We implemented the same calculations as before to find the share of villages in the sample *kecamatan* with different types of water sources and that have households that purchase water for drinking and cooking. The results are presented in Table 6.

Table 6: Share of villages in kecamatan with different types of water sources, 2008

Province	District	*Kecamatan*	Water source							
			PAM		Ground		Natural		Others	
			Dist	Kec	Dist	Kec	Dist	Kec	Dist	Kec
Lampung	Lampung Selatan	Kalianda	0.02	0.04	0.83	0.63	0.13	0.30	0.02	0.04
	Lampung Timur	Way Bungur	0.02	0.00	0.96	1.00	0.03	0.00	0.00	0.00
	Way Kanan	Banjit	0.00	0.00	0.93	0.90	0.07	0.10	0.00	0.00
	Way Kanan	Baradatu	0.00	0.00	0.93	1.00	0.07	0.00	0.00	0.00
	Pesawaran	Padang Cermin	0.02	0.14	0.83	0.55	0.13	0.32	0.02	0.00
	Pesawaran	Kedondong	0.02	0.00	0.83	0.71	0.13	0.19	0.02	0.10
Central Java	Wonosobo	Kaliwiro	0.28	0.38	0.00	0.00	0.72	0.62	0.00	0.00
	Blora	Japah	0.04	0.00	0.85	1.00	0.11	0.00	0.00	0.00
	Rembang	Kragan	0.12	0.04	0.63	0.63	0.25	0.33	0.00	0.00
	Rembang	Sluke	0.12	0.00	0.63	0.50	0.25	0.50	0.00	0.00
	Pati	Margoyoso	0.12	0.00	0.72	0.95	0.15	0.05	0.00	0.00
	Pemalang	Warungpring	0.05	0.00	0.69	0.83	0.26	0.17	0.00	0.00
	Tegal	Bojong	0.05	0.06	0.81	0.18	0.14	0.76	0.00	0.00
East Nusa Tenggara	Kupang	Amarasi	0.03	0.00	0.63	0.56	0.33	0.44	0.00	0.00
	Kupang	Kupang Timur	0.03	0.00	0.63	0.85	0.33	0.15	0.00	0.00
	Kupang	Amabi Oefeto	0.03	0.00	0.63	0.57	0.33	0.29	0.00	0.14
	Timor Tengah Selatan	Amanuban Selatan	0.00	0.00	0.13	0.40	0.86	0.60	0.01	0.00
	Timor Tengah Utara	Noemuti	0.11	0.00	0.28	0.45	0.59	0.55	0.02	0.00
West Kalimantan	Landak	Menyuke	0.00	0.00	0.08	0.06	0.90	0.94	0.01	0.00
	Pontianak	Toho	0.00	0.00	0.19	0.63	0.81	0.38	0.00	0.00
	Sintang	Kayan Hulu	0.04	0.00	0.31	0.00	0.65	1.00	0.00	0.00
	Kubu Raya	Telok Pa'kedai	0.00	0.00	0.01	0.07	0.98	0.93	0.01	0.00
	Singkawang	Singkawang Timur	0.32	0.60	0.14	0.20	0.54	0.20	0.00	0.00
	Singkawang	Singkawang Utara	0.32	0.00	0.14	0.00	0.54	1.00	0.00	0.00
South Sulawesi	Bone	Lappariaja	0.09	0.00	0.66	0.89	0.25	0.11	0.00	0.00
	Bone	Amali	0.09	0.00	0.66	0.33	0.25	0.67	0.00	0.00
	Luwu	Larompong Selatan	0.03	0.00	0.72	0.80	0.25	0.20	0.00	0.00
	Luwu	Lamasi	0.03	0.00	0.72	1.00	0.25	0.00	0.00	0.00
	Tana Toraja	Sopai	0.09	0.00	0.27	0.00	0.61	1.00	0.02	0.00

Source: Podes 2008

We can immediately observe that across the five provinces, PAM coverage was very low, even in Java. Except in Wonosobo, Rembang, and Pati in Central Java, and Singkawang in West Kalimantan, the district average for the share of villages with PAM connections in the *kecamatan* was less than 10%. These shares were generally even lower for our sample *kecamatan*: out of 29 sample *kecamatan,* they were only higher in five: Kalianda and Padang Cermin in Lampung, Kaliwiro, and Bojong (barely) in Central Java, and Singkawang Timur in West Kalimantan. In the rest, the coverage is equal to—i.e. at zero—or lower than the district average. Most villagers in our sample *kecamatan* rely on either ground water or other natural sources of water for drinking and cooking.

In Lampung, ground water, accessed through a well or pump, is generally the main source of water. The district average of the share of villages in each *kecamatan* using ground water is between 83% and 96%. Some of our sample *kecamatan,* however, have less reliance on ground water and more on other natural sources than their district averages. *Kecamatan* Kalianda, Padang Cermin, and Kedondong reported shares of 63%, 55%, and 71% respectively, lower than their district averages of 83%.

Meanwhile in Java, though in most districts villages still mainly use ground water as their source for cooking and drinking, there is a larger share of villages that use other natural sources than in Lampung. The exception is in Wonosobo district, where villages do not use ground water for cooking and drinking, and instead either use PAM or other natural sources of water. In about half of our sample, *kecamatan* have a higher share of villages using ground water than the district average. In the other half, more villages in our sample *kecamatan* use other natural sources than ground water compared to the district average.

In East Nusa Tenggara, outside of Kupang district, villagers rely much more on other natural sources of water. Our sample *kecamatan* appear to have greater access to ground water than their district averages. However, even there, less than half can rely on ground water. In Kupang, about two-thirds of villages rely on ground water, and only about one-third have to rely on the other natural sources.

In West Kalimantan, the majority of villages have to rely on natural sources of water other than manually-extracted ground water. Except in Toho and Singkawang Timur, our sample *kecamatan* rely very heavily on natural sources of water. In Toho, a majority of villages make use of ground water, while in the more urban Singkawang Timur, 60% of villages have access to PAM sources.

Meanwhile, half of our sample *kecamatan* in South Sulawesi have more access to manually-extracted ground water than the district average. Except in Tana Toraja, villages in districts where our samples are located mainly use ground water for cooking and drinking. In our sample *kecamatan* Sopai in Tana Toraja, all villages have to rely on other natural sources for water.

In sum, with some minor exceptions, our sample villages are mainly located in the poorest 40% *kecamatan* nationally and provincially. With regards to infrastructure quality, compared to their district averages, these *kecamatan* have slightly greater shares of villages with a majority of asphalt roads, slightly lesser access to PAM and ground water compared to their district averages.

3.2 Village Characteristics

In this study, we considered topographical conditions as one of the criteria for village selection. Within each province, we selected more or less equal numbers of villages that are located either in the coastal, flatland, or hills/mountainous areas. Table 7 below summarizes the sample villages by topography. Overall, the final sample slightly oversampled villages located in flatland areas. The final sample under-sampled villages in coastal area in South Sulawesi, flatland area in West Kalimantan, and hills/mountainous area in Lampung and South Sulawesi.

Table 7: Sample villages by topography

Province	Coast	Flatland	Hills/Mountns	Total
Lampung	2	3	1	6
Central Java	3	2	3	8
East Nusa Tenggara	2	2	2	6
West Kalimantan	2	1	3	6
South Sulawesi	1	4	1	6
Total	**10**	**12**	**10**	**32**

Source: Podes 2008, own calculations

The sample villages have sizes between 230 and 669 households, with almost half (15 villages) with more than 500 households. While the mean number of households in the villages (459.5 households) is much lower than the national average based on *Podes* 2008 data (801.9), the median of the number of households in the sample (479.5 households) is comparable to that at the national level (472 households).[5] We also compare village density, which we calculated as the number of households per hectare. The average village density in our sample (0.87 households per hectare) is much lower than at the national level (3.21 households per hectare). The median density in our sample (0.65 households per hectare) is slightly lower than that nationally (0.76 households per hectare).

Village Maintenance Practices

Next, we examined the maintenance practices of these villages. To this end, we asked village informants (typically the village head) whether there had been any infrastructure activity in the village in the past 12 months. For each type of infrastructure, we then asked what kind of maintenance activities were done and the locations (for up to three locations for each type of infrastructure). We then classified these answers into the different types of maintenance activities. Table 8 summarizes maintenance activities for different types of infrastructure across our sample. It also categorizes the different types of activities as routine maintenance (e.g., light clean-up of roads, removal of weeds, etc.) or periodic maintenance (e.g., asphalting, filling in potholes, replacing water pipes). Otherwise, the maintenance activities might be considered a sustainable upgrade (i.e., a minor or major upgrade of the infrastructure, e.g., concrete reinforcement). Routine maintenance tends to be the least costly, and the upgrades tend to be the most costly.

Table 8 shows that many villages perform their own maintenance activities. As shown above, out of 32 villages, 22 villages performed some activities to maintain their roads. These activities are not limited to the more routine (and least costly) type of maintenance, namely routine maintenance. Three villages performed routine maintenance, 8 performed periodic maintenance and 8 performed sustainable upgrades. In 4 villages, the informant did not elaborate on the types of maintenance

5 Before we implemented the first wave of interviews, we conducted a census of the sample villages. The numbers of households in these villages based on our census are comparable to those of *Podes* 2008.

activities performed, in part because some of these works were either performed by private or some government contractors. Note here that since we asked for three locations for each infrastructure, a village could have performed more than one type of maintenance activities.

Table 8: Number of villages with maintenance activities and upgrades in the last 12 months

Type	Total w/ infrastructure*	Maintenance Activities (last 12 mo)	Upgrade	Periodic	Routine
Roads	32	22	8	8	3
Bridges	21	7	3	3	0
Water systems**	13	7	1	5	0

Source: VRRI Village data;
* VRRI infrastructure survey.
**The total number in this row (based on the VRRI Infrastructure Survey) only accounts for villages with piped water system.

Table 9: Number of villages with maintenance activities in the last 12 months by province

	Total w/ infrastructure*	Maintenance Activities (last 12 mo)	Upgrade	Periodic	Routine
Roads					
Lampung	6	5	2	0	2
Central Java	8	6	0	4	2
East Nusa Tenggara	6	2	0	1	1
West Kalimantan	6	3	1	0	2
South Sulawesi	6	6	0	3	1
Bridges					
Lampung	4	1	0	1	0
Central Java	5	2	0	1	1
East Nusa Tenggara	2	2	0	0	2
West Kalimantan	6	1	0	1	0
South Sulawesi	4	1	0	0	0
Water systems**					
Lampung	2	1	0	1	0
Central Java	5	2	0	2	0
East Nusa Tenggara	3	2	0	1	1
West Kalimantan	1	1	0	1	0
South Sulawesi	2	1	0	0	0

Source: VRRI Village data; * VRRI infrastructure survey.
Note: **The total number in this row (based on the VRRI Infrastructure Survey) only accounts for villages with piped water system.

Meanwhile, out of 21 villages with bridges, only a third (or seven villages) performed some kind of maintenance in the last 12 months. Three villages performed activities that would fall under upgrades (strengthening the concrete), while the other three performed periodic maintenance (e.g., replacement of the bridge planks). For water systems, 7 villages out of 13 with piped systems performed mainly periodic maintenance of pipe replacements.

Table 9 disaggregates the data by province. Most of our sample villages in Lampung, Central Java, and South Sulawesi performed some kind of road maintenance. About half of the sample villages in West Kalimantan did so, and only a third in East Nusa Tenggara. Meanwhile, in the past 12 months, bridges did not get maintained very often—except in East Nusa Tenggara, where two out of two villages with a bridge perform some kind of maintenance, albeit only routine.

Table 10: Implementer of maintenance activities and upgrades

	Upgrade	Periodic	Routine	Sub-total
All				
Villagers only	19	22	9	50
Villagers and government	1	1	0	2
Villagers and an infrastructure organization	1	1	0	2
Infrastructure organization only	0	3	0	3
Government	0	0	0	0
Others	1	3	0	4
Subtotal	22	30	9	61
By Province:				
Lampung				
Villagers only	4	2	6	12
Villagers and an infrastructure organization	1	0	0	1
Infrastructure organization only	0	2	0	2
Central Java				
Villagers only	5	12	0	17
Infrastructure organization only	0	1	0	1
East Nusa Tenggara				
Villagers only	5	1	0	6
Villagers and an infrastructure organization	0	1	0	1
Others	1	0	0	1
West Kalimantan				
Villagers only	5	1	3	9
Government	0	0	0	0
Others	0	3	0	3
South Sulawesi				
Villagers only	0	6	0	6
Villagers and government	1	1	0	2
Total	**22**	**30**	**9**	**61**

Source: VRRI village data

Next, we examine who performed these maintenance activities as well as the source of resources to perform these activities. Table 10 and Table 11 summarize, respectively, the answers of the village informants regarding the implementers of and the source of resources for these activities. We counted all maintenance activities that are listed by the village informants *and* that included explanations of maintenance performed. A glance at Panel A of Table 10 shows that villagers were overwhelmingly responsible for these maintenance activities. In 82% of all maintenance activities, villagers were solely responsible for performing maintenance. In an additional 6.7% of these activities, villagers work together with other institutions to perform maintenance. The pattern is similar across provinces. It is also true for different types of maintenance activities—with 100% of routine maintenance being done by villagers only.

The picture is very different for maintenance resources. Table 11 summarizes the source of maintenance resources, grouped by infrastructure type and provinces. The table suggests that villagers are still the most significant contributors to these activities. For instance, let us look at

Table 11: Sources of resources for infrastructure maintenance, by infrastructure type and province

	Upgrade	Periodic	Routine	Total
By Infrastructure				
Roads				
Villagers only	10	8	6	24
Villagers & district gov.	0	1	0	1
Villagers & private sector	0	0	3	3
Villagers & others	1	1	0	2
Central government	1	0	0	1
District government	3	1	0	4
Donor organization	3	3	0	6
Others	0	2	0	2
Subtotal	**18**	**16**	**9**	**43**
Bridges				
Villagers only	0	4	0	4
District government	3	0	0	3
Subtotal	**3**	**4**	**0**	**7**
Water				
Villagers only	0	4	0	4
Villagers & district gov.	0	4	0	4
Infrastructure organization	0	1	0	1
District government	1	0	0	1
Donor organization	0	1	0	1
Subtotal	**1**	**10**	**0**	**11**

Source: VRRI village data

	Upgrade	Periodic	Routine	Total
By Province				
Lampung				
Villagers only	5	2	3	10
Villagers & district government	0	1	0	1
Villagers & private sector	0	0	3	3
Infrastructure organization	0	1	0	1
Central Java				
Villagers only	0	7	0	7
Villagers & district government	0	1	0	1
Central government	1	0	0	1
District government	1	0	0	1
Donor organization	3	3	0	6
Others	0	2	0	2
East Nusa Tenggara				
Villagers only	3	0	0	3
District government	3	1	0	4
Donor organization	0	1	0	1
West Kalimantan				
Villagers only	2	1	3	6
Villagers & district government	0	3	0	3
District government	3	0	0	3
South Sulawesi				
Villagers only	0	6	0	6
Villagers & others	1	1	0	2
Total all provinces	**22**	**30**	**9**	**61**

the example of road maintenance on Panel A. In 55.8% of these maintenance activities villagers themselves provide the resources. In an additional 14% of the cases villagers bear part of the cost, while either government or private agencies provide the rest. However, in about 30% of the cases, these activities are funded fully by outside sources. As expected, activities that were fully resourced by outside institutions are sustainable and periodic maintenance activities, which can become too costly for these villagers (see Table 27). About 39% of all sustainable maintenance activities and 37.5% of periodic maintenance are fully resourced from outside these villages. Meanwhile, all routine maintenance activities are fully resourced by villagers.

What about the role of district governments? To what extent do they participate in supporting village infrastructure-maintenance efforts, particularly the more expensive periodic type? Table 11 suggests that district governments tend to be more actively involved in supporting upgrades rather than maintenance. Out of 22 upgrade activities, district governments fully financed 7 of them, while it only fully financed 1 out of 30 periodic maintenance activities and provided partial resources for 5 periodic activities. Given that, in the long term, investment in periodic maintenance tends to bring a higher return than upgrades, there appears to be a need for district governments to reallocate some of its resources towards helping villagers with periodic maintenance.

For the maintenance of bridges, all sustainable maintenance are fully resourced from outside, while periodic maintenance—which, in this case, refers *only* to replacing bridge planks—are all fully resourced by villagers. Meanwhile, 27% of maintenance work on water facilities were fully resourced by outside sources.

Meanwhile, Panel B of Table 11 shows how these capabilities to provide for maintenance activities vary across province. There were comparable number of maintenance activities in our sample villages in both Lampung and Central Java; however, those in Lampung were more likely to resource their maintenance activities on their own. These can reflect either financial capabilities, access to outside resources (which are more likely to be available in Central Java), or both. Meanwhile, maintenance activities in South Sulawesi were either fully or partly resourced by villagers. In West Kalimantan, apart from routine resources, about a third of the maintenance activities were fully resourced by villagers, a third were partly resourced by them, and the remaining third were fully funded by outside resources. Our sample villages in East Nusa Tenggara appeared to be the least capable; they have the least number of maintenance activities and these were mostly resourced by outside sources.

Table 12 tabulates the number of villages by the types of contributions villagers make for each of the maintenance activities summarized in the previous two tables. Panel A shows the frequencies of combinations of the different forms of villager contributions. Meanwhile Panel B uses information in Panel A to examine the extent to which villagers provide the different forms of contributions individually. Overall, in 81% of the cases, villagers contribute some labor; in some 43% of the cases, they contribute some money. For sustainable maintenance activities, labor is the main form of contribution from these villagers. Labor is still the most important form of contributions for periodic maintenance, followed by labor and material. In the case of routine maintenance, villagers contribute both money and labor in all cases. Table 13 breaks down the types of contributions by the types of infrastructure projects.

Finally, we also inquired whether villages have community organizations to manage the different types of infrastructure. Only a small number of villages have any kind of infrastructure-management organization: of 32 villages, 4 villages had organizations for water, 1 village for roads, and none for bridges.

Table 12: How villagers contribute by types of maintenance activities

Contributions	Upgrade	Periodic	Routine	Unclassified	Total
Money only	0	4	0	0	4
Money and labor	1	9	6	0	16
Money, labor, material, and snacks	1	2	0	1	4
Money, labor, and snacks	2	0	3	0	5
Money and snacks	0	1	0	0	1
Labor only	13	5	0	0	18
Labor and material	1	3	0	0	4
Labor, material and snacks	0	5	0	0	5
Labor and snacks	3	0	0	2	5
Not applicable	1	1	0	6	8
Subtotal	22	30	9	9	70
Villagers contribute some:					
Money	4	16	9	1	30
Labor	21	24	9	2	56
Material	2	10	0	2	14
Snacks	6	8	3	3	20

Source: VRRI village data

Table 13: How villagers contribute by types of infrastructure

Contributions	Road	Bridge	Water System	Total
Money only	0	0	4	4
Money and labor	10	3	3	16
Money, labor, material, and snacks	3	0	1	4
Money, labor, and snacks	5	0	0	5
Money and snacks	0	1	0	1
Labor only	17	1	0	18
Labor and material	2	0	2	4
Labor, material and snacks	5	0	0	5
Labor and snacks	3	1	1	5
Not applicable	5	2	1	8
Subtotal	**50**	**8**	**12**	**70**
Villagers contribute some:				
Money	18	4	8	30
Labor	45	5	7	57
Material	10	0	3	13
Snacks	16	2	2	20

Source: VRRI village data

Chapter 4

Household Characteristics: Income, Expenditure, and Willingness to Pay

In this section, we examine the three characteristics of the households that are relevant to answering our research questions: income, expenditure, and willingness to pay. We use income as a rough measure of resource inflows into households in these villages. However, in rural areas, fluctuation tends to be high. As such, measured income will include the transitory components, and hence, may not accurately reflect household welfare. We use expenditure as a measure of overall welfare of the households. In addition, we also include a discussion of households' responses to the willingness to pay (WTP) questions at the end of the section.

4.1 Income

Before we begin with our discussion of income, we need to start with a caveat with regard to income measurement. Deaton (1997) has argued that income measurements are rife with problems. In general, recall bias, seasonality, imputations when the prices of goods and services are not readily available, and biases coming from questionnaire design—problems that are associated with expenditure questionnaire—tend to affect the precision and accuracy of income questions more than they do expenditure. In addition, income is a more sensitive subject, and households may have an incentive to bias their answers downward. Also, accurate income measurements require knowledge of the returns of different assets; again, a sensitive subject about which respondents may not have an incentive to answer truthfully.

Furthermore, measurements of self-employment incomes are complicated since households do not necessarily account money inflows and outflows, as well as inventory, carefully enough to allow the researchers to measure the true income precisely. Measurement errors are likely to be significant. The fact that this survey is a quarterly survey may address some of the issues related to seasonality and recall bias, albeit imperfectly. However, there are still a myriad of other issues in measuring income that could not be addressed satisfactorily.[6] Hence, we consider the income measure as a rough estimate that will allow us to study the inflow and fluctuations of resources into these households over the year and across various seasons.

This survey considers four types of income: *non-business income* (i.e., incomes from assets), *salary, agriculture self-employment income, and non-agriculture self-employment income.* For both agriculture and non-agriculture self-employment income, at every survey wave, we asked about their revenue, costs, as well as existing inventory. However, because we are interested mainly in the inflow of resources, we excluded business inventories in our income calculations in this section.

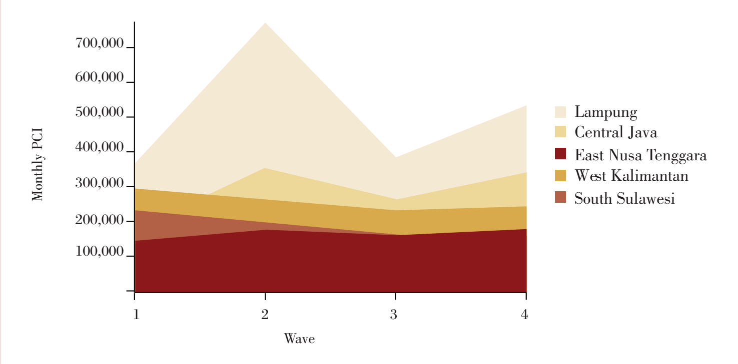
Table 14 shows our calculations of monthly per-capita income of households aggregated at the province level for the sample villages. The average income in our sample was highest in Lampung, followed by Central Java (except in the first survey wave), West Kalimantan, and South Sulawesi. In addition, Figure 1 plots income across the different waves in these provinces. A casual observation of Figure 1 suggests that income fluctuation was strongest in Lampung, the province with the highest income, followed by Central Java. In these provinces, there did not seem to be a clear trend of income. Meanwhile, there were very mild income fluctuations among the remaining three provinces. However, in both West Kalimantan and South Sulawesi, income appeared to trend downward slightly across the four quarters between August 2008 and July 2009. Fluctuations were relatively mild in East Nusa Tenggara, where the average income was lowest among the provinces.

6 A comparison between the (typically more reliable) measurements of per-capita expenditure (Table 17) with income (Table 14) suggests that our income measures may have been somewhat of an underestimate. However, in comparing the two, note that our income measures in Table 14 did not include agriculture and non-agriculture inventories at the end of the fourth wave, net transfers, or loans.

Table 14: Monthly per-capita income by province, Aug 2008-Jul 2009

Province	Wave			
	1	2	3	4
Lampung	363,503	762,912	385,928	530,932
Central Java	156,837	355,085	266,402	335,364
East Nusa Tenggara	148,253	165,488	155,376	157,351
West Kalimantan	291,134	266,955	239,099	245,592
South Sulawesi	225,091	198,827	161,845	159,307

Figure 1: Monthly per-capita income by province, Aug 2008 - Jul 2009

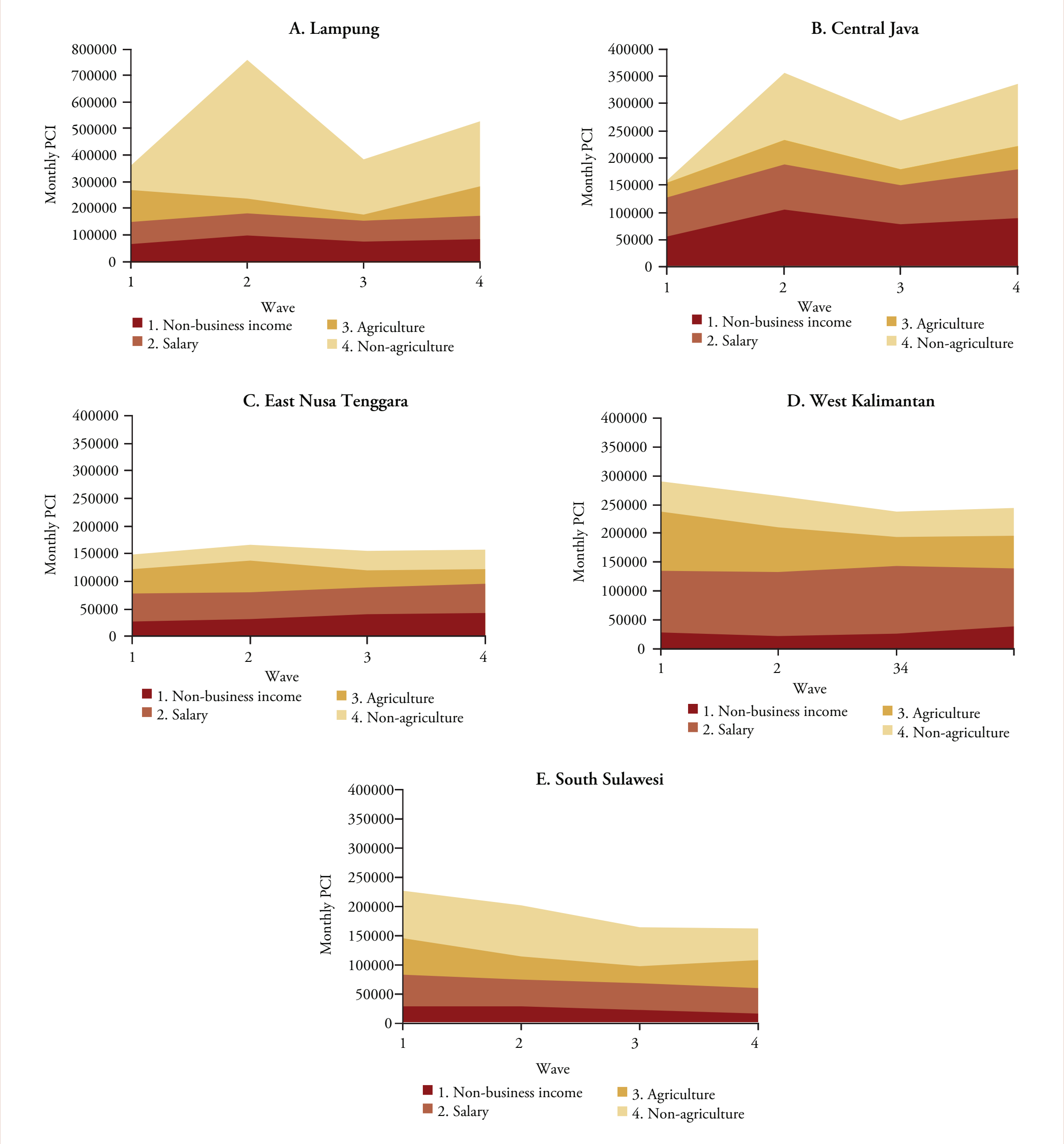


To examine the source of income fluctuations, we decompose incomes in these provinces according to their sources—namely, whether they come from non-business income, salary, agriculture, or non-agriculture self employment. Panels A to E of Figure 2 show the contribution of different sources on income at the province. In general, we observe that salary and non-business income do not significantly contribute to income fluctuations in these provinces; instead, self-employment income appears to be the more important source of fluctuations over the year. In Panel A, we see that non-agriculture income was the main source of income fluctuations in the province. In particular, there was an upward spike of non-agriculture income in the second wave of the survey, corresponding to the beginning of the Idul Fitri holiday, where many traders typically enjoy income boosts, before it stabilized in the following waves. At the same time, agriculture income appeared to have fallen significantly in waves 2 and 3 before picking up in wave 4.

We observe from Panel B above a somewhat similar pattern in Central Java, where non-agriculture income was up between waves 1 and 2, although it tended to be more stable across the last three waves compared to that in Lampung. Non-agriculture self-employment income fell slightly between waves 2 and 3, but picked up in the following wave. However, unlike in Lampung, self-employment agriculture income in Central Java tends to be more stable across the four waves.

Meanwhile, Panel D shows that in West Kalimantan, non-agriculture self-employment income did not play as significant role as the source of income compared to that in Central Java and Lampung. Instead, on average, salary was the dominant source of income in the province. As we have discussed above, there appeared to be a slight downward trend in income in West Kalimantan. This trend came mainly from falling agriculture self-employment income. The trend began in wave 2 and continued in wave 3, and stabilized at that level in wave 4. As we discuss below, a negative shock to commodity prices that began in wave 2 was responsible for the fall in agriculture income in the

Figure 2: Monthly per-capita income flow by income source and province,
Aug 2008 – July 2009



Source: VRRI Household data

province. In Panel E, we observe that non-agriculture income was the largest source of income, followed by salary and agricultural income in South Sulawesi. As in West Kalimantan, there was a slight downward trend in income, which mostly came from fluctuations in agriculture income.

In Panel C, we observe that there was little fluctuation of overall income in East Nusa Tenggara. Of the various sources of income, salary was the most important. Agriculture income was the second most significant source of income in the first two waves, while non-agriculture income became important in the last two waves, compensating for the fall in the agriculture income during the last two waves.

Table 15: Average and CV of monthly per-capita income, by province and income source

	Wave				CV
	1	2	3	4	
Lampung					
Non-business income	69,998	98,739	75,505	87,189	0.15
Salary	81,319	82,810	81,120	88,818	0.04
Agriculture	119,784	58,019	22,635	109,295	0.59
Non-agriculture	92,403	523,344	206,668	245,631	0.68
Central Java					
Non-business income	55,586	104,823	76,548	88,677	0.25
Salary	70,253	81,247	71,560	89,934	0.12
Agriculture	27,110	44,334	29,773	40,684	0.23
Non-agriculture	3,888	124,682	88,521	116,068	0.66
East Nusa Tenggara					
Non-business income	26,180	31,639	39,413	43,156	0.22
Salary	51,820	48,334	49,822	51,303	0.03
Agriculture	42,964	57,613	31,024	26,629	0.35
Non-agriculture	27,289	27,902	35,118	36,263	0.15
West Kalimantan					
Non-business income	29,141	21,554	26,947	38,661	0.25
Salary	105,673	112,161	117,516	101,514	0.06
Agriculture	103,703	78,498	50,197	56,318	0.34
Non-agriculture	52,617	54,742	44,438	49,098	0.09
South Sulawesi					
Non-business income	76,166	78,284	58,050	41,498	0.27
Salary	163,975	139,102	139,292	130,193	0.1
Agriculture	192,648	119,488	86,311	148,366	0.33
Non-agriculture	242,485	259,608	201,881	157,865	0.21

Source: VRRI Household data, author's own calculations

To examine further the role of each of the income sources to total income fluctuation in each of these provinces, Table 15 presents the average and coefficient of variation of these averages across the four interview waves, disaggregated by the different income sources. When we examine the coefficient of variation across these interview waves, we observe that the mean non-agriculture self-employment income has the highest variation in Lampung and Central Java. In the remaining three provinces, agriculture income has the highest variation. Among the provinces, agriculture income fluctuation was highest in Lampung and lowest in Central Java.

Table 16: Number of households reporting experiencing shock by source and province, Aug 2008-Jul 2009

	Wave			
	1	2	3	4
Lampung (n = 670 households)				
Death in the household	6	0	0	0
Illness in the household	21	11	12	8
Loss of employment of HH member(s)	12	7	7	4
Natural disasters	0	0	1	5
Crop failure	114	78	33	33
Product/commodity price shocks	13	42	30	7
Climate-related shocks	49	71	25	3
Others	4	2	3	6
Central Java (n = 939 households)				
Death in the household	9	4	4	4
Illness in the household	31	22	12	21
Loss of employment of HH member(s)	19	4	3	8
Natural disasters	2	0	6	3
Crop failure	71	31	51	82
Product/commodity price shocks	5	2	6	1
Climate-related shocks	20	12	14	10
Others	19	15	23	45
East Nusa Tenggara (n = 698 households)				
Death in the household	5	1	3	4
Illness in the household	5	3	4	2
Loss of employment of HH member(s)	0	2	0	1
Natural disasters	1	1	0	0
Crop failure	7	9	25	30
Climate-related shocks	0	1	11	0
Others	1	0	0	0

	Wave			
	1	2	3	4
West Kalimantan (n = 696 households)				
Death in the household	9	8	6	3
Illness in the household	40	21	15	28
Loss of employment of HH member(s)	22	15	13	10
Natural disasters	1	11	17	5
Crop failure	10	40	55	143
Product/commodity price shocks	5	345	356	54
Climate-related shocks	142	372	243	115
Others	22	5	5	12
South Sulawesi (n = 718 households)				
Death in the household	16	1	4	2
Illness in the household	45	16	4	10
Loss of employment of HH member(s)	15	4	1	1
Crop failure	91	41	96	29
Product/commodity price shocks	14	2	4	4
Climate-related shocks	37	13	35	22
Others	16	10	5	9
ALL (n = 3721 households)				
Death in the household	45	14	17	13
Illness in the household	121	62	35	61
Loss of employment of HH member(s)	68	32	24	24
Natural disasters	4	12	24	13
Crop failure	293	199	260	317
Product/commodity price shocks	37	391	396	66
Climate-related shocks	248	469	328	150
Others	62	32	36	72

Source: VRRI Household data, author's own calculations.

What accounted for income fluctuations in these provinces throughout the year? Table 16 presents parts of the answer. The table summarizes responses to a question that asked respondents whether their households experienced some kind of negative economic shocks during the three months prior to the interview. The most significant negative economic shocks overall are agriculture in nature—which explained how falling agriculture income appeared to contribute to falling income in several of these provinces, mainly in the second and third waves. In the first wave, crop failure and climate-related shocks were the factors most often cited by respondents. Crop failure was cited across provinces, with the highest incidence reported in Lampung, followed by South Sulawesi, and Central Java. Meanwhile, the highest incidence of climate-related shocks were reported by West Kalimantan, followed by Lampung in a distant second.

However, in the second and third wave, there were significant jumps in the incidences of product/commodity price shocks and climate-related shocks. A closer look suggests that a disproportionate share of the former incidences were reported by West Kalimantan households. Enumerators in the province reported that falling world commodity prices, particularly rubber, due to the economic crisis had impacted many households there. A similar plight was experienced by producers of cacao and rubber in Lampung. However, there appeared to be more diversity among agricultural producers in Lampung compared to West Kalimantan. Crop failures played an important role in creating income fluctuations all across the provinces, although their contributions, while not unimportant, were not as dramatic as those of falling commodity prices in West Kalimantan.

4.2 Expenditures

General expenditures

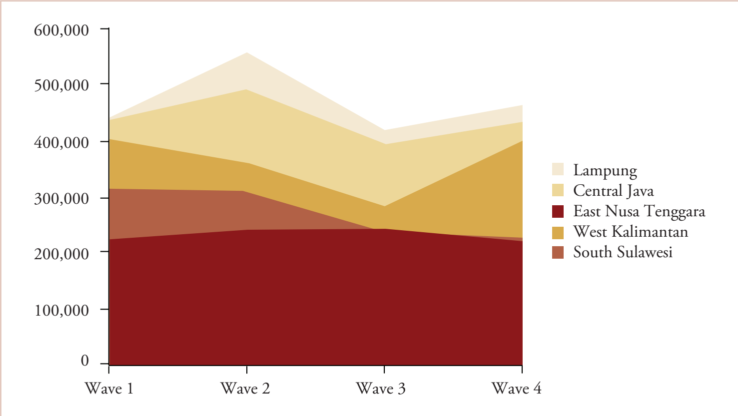
We next examine the average economic welfare of villagers in our sample villages. For our measure of welfare, we use households' monthly per-capita expenditures. Table 17 below summarizes the mean nominal monthly per-capital expenditures in our sample villages across the four survey waves. The data show the different levels of development (and prosperity) between the different regions in our sample, despite the fact that they are mostly located in the 40% poorest *kecamatan* in their respective provinces. Lampung and Central Java were the two most prosperous regions, followed by West Kalimantan. South Sulawesi and East Nusa Tenggara were at the bottom. The ranking was consistent with our income ranking, although when we compare the monthly per-capita expenditure with income, it appears that our measures underestimate the true income in these villages.

Table 17: Monthly nominal per-capita expenditure in sample villages, Aug 2008- Jul 2009

	Wave 1	Wave 2	Wave 3	Wave 4
Lampung	438,853	552,507	418,449	459,663
Central Java	433,802	486,662	393,640	430,832
East Nusa Tenggara	220,280	235,037	242,016	217,383
West Kalimantan	398,863	357,731	282,099	396,957
South Sulawesi	311,596	307,098	237,887	226,432

Source: VRRI household data, own calculations

Figure 3: Monthly nominal per-capita expenditure, Aug 2008-Jul 2009



Throughout the year, the various regions experienced different cycles that affected their consumption. Figure 3 shows how monthly per-capita expenditures fluctuate over the year. In Lampung and Central Java, household per-capita expenditure went up in the second wave of the survey, before falling back to around the level found in the first wave. The second wave of the survey was collected in the three months beginning in November 2008, and since the expenditure questionnaire asked about expenses in the previous month, for households that were interviewed in November, the second wave of survey therefore captured the expenditures of some of the households during the Idul Fitri holiday, which fell on October 1, 2008

However, we did not find a similar pattern in West Kalimantan where per-capita expenditure fell during waves 2 and 3, and in South Sulawesi where per capita consumption fell in waves 2, 3, and 4. As we have mentioned in our discussion on income, the sharp fall in the price of rubber may have significantly affected purchasing power in these villages. Meanwhile, no significant fluctuation was found among the villages in East Nusa Tenggara. The sharpest drop between the first and fourth wave was observed in South Sulawesi. Table 18 provides a more detailed breakdown of per-capita expenditures in each of the sample villages.

Public goods and infrastructure expenditures

In a later section, we will explore the extent to which infrastructure maintenance costs may act as an additional tax burden to villagers. However, before we consider how those costs become an *additional* burden, it may be useful to look at the extent to which villagers are paying local taxes. We ask respondents about their expenditures on local public goods, such as trash, road, bridge, and water system maintenance, and neighborhood collections (*iuran RT).* Table 19 summarizes the average monthly expenditure on these local taxes, as well as their share as a percentage of consumption. Overall, they are insignificant, amounting to less than 0.1% of our sample households' consumption in all bar one village (Village 24).

Table 18: Monthly nominal per-capita expenditure, Aug 2008-Jul 2009

Province/Village ID	Wave 1	Wave 2	Wave 3	Wave 4
Lampung				
1	481,274	478,804	401,906	443,012
2	510,060	730,220	574,854	536,276
3	386,450	470,135	340,528	334,671
4	443,642	469,835	472,248	743,339
5	368,266	595,676	311,696	339,855
6	457,056	579,847	415,409	360,824
Central Java				
7	344,925	384,245	315,429	337,970
8	381,873	386,746	353,016	322,305
9	363,906	380,551	337,895	295,574
10	468,015	550,348	403,622	509,002
11	483,269	629,412	478,694	583,137
12	463,749	427,612	358,757	463,171
13	534,568	767,181	528,376	549,621
14	431,972	373,111	373,031	385,880
East Nusa Tenggara				
15	225,036	235,357	265,048	204,870
16	212,897	262,554	235,085	235,938
17	212,708	210,642	233,546	194,411
18	206,097	226,708	239,968	215,299
19	195,340	222,129	215,554	197,687
20	269,812	253,096	262,864	256,093
West Kalimantan				
21	393,647	224,177	198,791	319,073
22	458,663	455,969	323,629	496,006
23	313,270	282,856	272,574	331,748
24	439,124	536,371	348,736	445,609
25	398,677	278,674	239,005	383,879
26	392,620	374,200	311,288	405,429
South Sulawesi				
27	311,888	233,508	230,946	216,611
28	319,889	423,963	254,243	273,565
29	257,508	416,826	276,342	253,050
30	297,559	349,692	254,605	258,345
31	321,000	218,069	211,780	178,087
32	361,802	200,888	199,541	178,932

Source: VRRI data, author's own calculations

Table 19: Monthly per-household local tax and consumption

Province	vid	HH consumption	Local tax	% of HH Cons.
Lampung	1	1,915,696	7	0.00%
	2	2,670,972	820	0.03%
	3	1,700,188	166	0.01%
	4	2,507,650	460	0.02%
	5	1,437,218	14	0.00%
	6	1,677,492	1,492	0.09%
Central Java	7	1,338,415	222	0.02%
	8	1,297,386	1,122	0.09%
	9	1,168,903	796	0.07%
	10	1,568,555	468	0.03%
	11	1,946,179	13	0.00%
	12	1,465,667	219	0.01%
	13	1,979,672	506	0.03%
	14	1,314,921	608	0.05%
East Nusa Tenggara	15	887,094	19	0.00%
	16	1,185,005	0	0.00%
	17	1,007,547	8	0.00%
	18	883,098	0	0.00%
	19	992,353	7	0.00%
	20	1,099,967	66	0.01%
West Kalimantan	21	1,246,733	0	0.00%
	22	1,975,047	0	0.00%
	23	1,289,781	58	0.00%
	24	1,829,268	2,858	0.16%
	25	1,559,003	114	0.01%
	26	1,486,823	275	0.02%
South Sulawesi	27	1,045,858	0	0.00%
	28	1,365,275	0	0.00%
	29	1,206,702	160	0.01%
	30	1,272,316	0	0.00%
	31	1,005,602	0	0.00%
	32	1,019,723	0	0.00%

Source: VRRI household data, all waves.

Another expenditure that is relevant to the infrastructure studied here is households' current water consumption. Table 20 looks at the monthly per-household water consumption. There is a wide variation in the amount that households spent for water. On average, households spent about Rp2158 to obtain water, with a median of Rp594. In a quarter of the villages, households had no expenditure to obtain water. On average, water expenditure accounts for 0.14% of total households expenditure, with the median at 0.04%.

Table 20: Monthly per-household water expenditure and consumption

Province	vid	HH consumption	Water exp.	% of hh cons
Lampung	1	1,915,696	4,592	0.24%
	2	2,670,972	2,271	0.09%
	3	1,700,188	4,696	0.28%
	4	2,507,650	4,779	0.19%
	5	1,437,218	0	0.00%
	6	1,677,492	0	0.00%
Central Java	7	1,338,415	288	0.02%
	8	1,297,386	2,529	0.19%
	9	1,168,903	5,500	0.47%
	10	1,568,555	458	0.03%
	11	1,946,179	10,408	0.53%
	12	1,465,667	3,546	0.24%
	13	1,979,672	5,788	0.29%
	14	1,314,921	729	0.06%
East Nusa Tenggara	15	887,094	46	0.01%
	16	1,185,005	83	0.01%
	17	1,007,547	4,785	0.47%
	18	883,098	58	0.01%
	19	992,353	0	0.00%
	20	1,099,967	0	0.00%
West Kalimantan	21	1,246,733	2,208	0.18%
	22	1,975,047	71	0.00%
	23	1,289,781	0	0.00%
	24	1,829,268	2,583	0.14%
	25	1,559,003	0	0.00%
	26	1,486,823	8	0.00%
South Sulawesi	27	1,045,858	0	0.00%
	28	1,365,275	0	0.00%
	29	1,206,702	7,696	0.64%
	30	1,272,316	3,717	0.29%
	31	1,005,602	1,917	0.19%
	32	1,019,723	292	0.03%

Source: VRRI household data, all waves.

4.3 Willingness to pay

Above, we have described the income and expenditure, which together reflect resources that are available to households in these villages. However, in order to answer the question of whether villagers can pay for maintaining the infrastructure in their villages, we need to measure not only resources that are available to households, but also whether villagers would be willing to contribute some of these resources for maintaining their infrastructure. Our study directly addresses this question by asking our survey respondents their willingness to pay for maintaining their infrastructure. Using information elicited by this question, we come up with a profile of villagers' willingness—and, implicit in that, ability—to pay for maintaining the roads, bridges, and piped water systems in their respective village.

To elicit respondents' willingness to pay, we used an iterative bidding procedure with a randomized starting value. The interviewer begins by describing the quality of a village infrastructure to the respondent. Following a description of the quality of the infrastructure, the interviewer described a hypothetical village meeting in which a decision about contributions to maintain the infrastructure is to be decided. In the case of roads and bridges, villagers may still be asked to provide some labor contributions. Meanwhile, in the question for water system, villagers will not have to contribute additional labor. The interviewer then asks the respondent whether the respondent will be willing to pay a certain amount to maintain the infrastructure. If the respondent answers "Yes", the interviewer asks the same question using a higher value $X + \varepsilon$; otherwise, the interviewer uses a lower value $X - \varepsilon$. If the highest value provided in the survey is reached, the interviewer asks the respondent to name a value that he or she is willing to pay to maintain the infrastructure.

We used this approach to minimize anchoring bias. Anchoring is the tendency of respondents to answer close to the first value introduced at the start of the question. To minimize this, we randomized the starting value, X, across the respondents. By randomizing the starting points, we expect that the anchoring bias will cancel each other out when we calculate the village averages. We use a value of Rp.1,000 for the increment e, and Rp.15,000 for the maximum value before the interviewer asks the respondent to name his or her willingness to pay.

Table 21: Villagers' average willingness to pay by province

Province	Road	Bridge	Water	All
Lampung	6,061	4,894	5,587	9,797
Central Java	5,497	3,705	4,546	8,379
East Nusa Tenggara	4,558	3,945	5,333	10,319
West Kalimantan	6,399	4,499	9,483	12,911
South Sulawesi	3,562	2,300	4,240	4,794

Source: VRRI data (Wave 2), own calculations

Table 22: Mean and median household willingness to pay for infrastructure maintenance (Rp/month)

	Road		Bridge		Water		All	
	Mean	Median	Mean	Median	Mean	Median	Mean	Median
Lampung								
1	5,892	5,000	5,058	3,000	5,617	5,000	9,415	6,000
2	7,420	5,000	5,790	5,000	6,458	5,000	12,283	10,000
3	5,992	5,000	5,083	5,000	6,250	5,000	9,208	8,000
4	5,782	5,000	5,000	3,000	5,800	5,000	10,350	7,000
5	4,714	4,000	3,642	2,000	3,580	3,000	7,538	5,000
6	6,567	5,000	4,800	5,000	5,815	5,000	9,966	8,000
Central Java								
7	3,842	3,000	2,408	2,000	3,533	3,000	4,683	4,000
8	5,667	5,000	4,458	3,000	4,600	4,000	7,975	5,000
9	4,217	4,000	2,958	2,000	3,975	3,000	7,483	5,000
10	4,667	3,000	3,383	2,000	3,908	3,000	7,575	5,000
11	6,000	5,000	3,613	2,000	4,286	3,000	8,102	5,000
12	5,758	5,000	3,567	2,000	4,842	4,000	9,025	5,000
13	7,492	5,000	4,933	3,500	6,233	5,000	11,782	10,000
14	6,342	5,000	4,317	3,000	4,983	5,000	10,433	10,000
East Nusa Tenggara								
15	5,361	5,000	4,708	5,000	6,125	5,000	10,800	10,000
16	4,895	5,000	3,957	2,000	5,474	5,000	11,145	5,500
17	4,717	2,500	3,975	2,000	4,658	3,000	9,375	5,000
18	4,133	2,000	3,158	2,000	6,117	3,000	12,345	5,000
19	3,975	2,000	3,723	2,000	4,840	2,000	8,699	5,000
20	4,283	2,000	4,150	2,000	4,783	2,000	9,542	5,000
West Kalimantan								
21	3,942	3,000	2,202	2,000	7,417	5,000	9,242	7,000
22	8,158	5,000	3,429	3,000	10,575	10,000	14,267	10,000
23	3,042	2,000	2,583	2,000	7,025	5,000	8,658	5,000
24	4,825	3,000	2,750	2,000	10,508	10,000	13,250	11,000
25	10,092	10,000	8,433	7,000	10,563	10,000	14,850	13,500
26	8,333	7,000	7,567	5,000	10,839	10,000	17,235	15,000
South Sulawesi								
27	3,333	2,500	2,342	1,000	3,825	3,000	4,175	3,000
28	5,706	5,000	3,292	1,000	5,521	3,000	7,261	5,000
29	2,383	1,000	1,592	1,000	3,899	3,000	4,185	3,000
30	3,500	2,000	2,479	1,000	4,367	3,000	4,733	4,000
31	3,067	2,000	1,625	1,000	3,445	3,000	4,033	3,000
32	3,400	2,000	2,475	1,000	4,383	3,000	4,392	3,000

Table 21 summarizes the average (or mean) households' WTP to maintain different types of infrastructure, broken down by province. For respondents who chose values above Rp.15.000, we included their answer if they answered the open question following the maximum value in our iterative bidding procedure, or Rp.15,000 if the answer was missing. This procedure has the unfortunate effect of underestimating the mean WTPs, and therefore throughout the analysis, we sometimes make use of the median instead of the mean WTPs. The WTP questions were asked to villagers irrespective of the availability of the infrastructure in their village. The first three columns summarize the WTP for each individual infrastructure. Meanwhile, the fourth column lists the WTP if they were to pay a single fee to maintain all kinds of infrastructure.

Different provinces exhibit different priorities. In Lampung and Central Java, villagers are most willing to pay for road maintenance followed by water systems. In comparison, in East Nusa Tenggara, West Kalimantan and South Sulawesi, the WTPs were higher for water than for roads. The willingness to pay for maintaining a good water system was very high in West Kalimantan compared to the rest of the provinces, even though its per-capita expenditure was third among the provinces. Our data cannot explain why there was a higher relative WTP for maintaining roads relative to piped water system in Lampung and Central Java, but not in the other three provinces. However, since these two provinces are the ones more integrated to the wider market, one plausible explanation is that the economic returns from roads in these provinces are higher than in the rest of provinces.

Generally, villagers are least willing to pay for bridge maintenance—perhaps because in our sample there were more villagers benefiting from roads and water systems. In addition, one thing that was true across the provinces is that the average WTP to finance maintenance of all three maintenance is much lower than the sum of the averages for individual infrastructure. A more detailed breakdown that included both the mean and median household WTP by village is provided in Table 22.

The previous tables show us the centered values of the distribution of the households' WTP for infrastructure maintenance. However, we may want to see the distribution of the WTPs across different values. Panels A, B, C, and D of Table 23 present these values grouped in Rp 5,000 increments. For roads, we can observe in Panel A that overall 10.3% of households had zero WTP. The share of respondents with zero WTP was highest in South Sulawesi and lowest in Lampung. It is interesting to note that even though East Nusa Tenggara is the province with the lowest per-capita expenditure in our sample, the share of households with zero WTP was the second lowest after Lampung. On the other hand, households in Central Java, which is the province with the second highest per-capita expenditure, have a second highest share of households with zero willingness to pay for road maintenance.

About 63.1% of the respondents are willing to pay between Rp.1,000-5,000, with Rp.5000 as the mode of the distribution of the WTPs (i.e., the value with the highest number of responses). Hence, almost three-fourths of the respondents overall were not be willing to pay more than Rp.5,000 for road maintenance. The share of households willing to pay up to Rp.5,000 only was highest in South Sulawesi, followed by East Nusa Tenggara, Lampung, Central Java, and West Kalimantan. Meanwhile, about 3.5% of the overall households were willing to pay more than Rp.15,000 a month for road maintenance. Lampung, which is the province with the highest per-capita expenditure in our sample, led with 5.7%, followed, surprisingly, by East Nusa Tenggara. South Sulawesi has the smallest share of households willing to pay more than Rp.15,000.

Table 23: Distribution of willingness to pay per household per month in all villages, by province and infrastructure

Roads	Lampung		Central Java		East Nusa Tenggara		West Kalimantan		South Sulawesi		All	
Nothing	19	2.6%	119	12.4%	68	9.5%	82	11.4%	108	15.0%	396	10.3%
Rp.1000-5000	485	67.4%	547	57.0%	512	71.2%	377	52.4%	499	69.4%	2420	63.1%
Rp.6000-10000	142	19.7%	194	20.2%	82	11.4%	152	21.1%	79	11.0%	649	16.9%
Rp.11000-15000	33	4.6%	69	7.2%	25	3.5%	85	11.8%	26	3.6%	238	6.2%
>15000	41	5.7%	31	3.2%	32	4.5%	24	3.3%	7	1.0%	135	3.5%
Total	720	100.0%	960	100.0%	719	100.0%	720	100.0%	719	100.0%	3838	100.0%

Bridges	Lampung		Central Java		East Nusa Tenggara		West Kalimantan		South Sulawesi		All	
Nothing	66	9.2%	278	29.0%	84	11.7%	148	20.6%	179	24.9%	755	19.7%
Rp.1000-5000	505	70.2%	503	52.4%	527	73.2%	410	57.1%	488	67.9%	2433	63.4%
Rp.6000-10000	91	12.7%	128	13.3%	64	8.9%	113	15.7%	38	5.3%	434	11.3%
Rp.11000-15000	33	4.6%	32	3.3%	23	3.2%	36	5.0%	11	1.5%	135	3.5%
>15000	24	3.3%	19	2.0%	22	3.1%	11	1.5%	3	0.4%	79	2.1%
Total	719	100.0%	960	100.0%	720	100.0%	718	100.0%	719	100.0%	3836	100.0%

Piped Water	Lampung		Central Java		East Nusa Tenggara		West Kalimantan		South Sulawesi		All	
Nothing	77	10.7%	257	26.8%	47	6.5%	7	1.0%	91	12.7%	479	12.5%
Rp.1000-5000	439	61.0%	454	47.3%	501	69.6%	245	34.1%	489	68.2%	2128	55.5%
Rp.6000-10000	124	17.2%	160	16.7%	100	13.9%	264	36.7%	89	12.4%	737	19.2%
Rp.11000-15000	42	5.8%	60	6.3%	36	5.0%	164	22.8%	34	4.7%	336	8.8%
>15000	38	5.3%	29	3.0%	36	5.0%	39	5.4%	14	2.0%	156	4.1%
Total	720	100.0%	960	100.0%	720	100.0%	719	100.0%	717	100.0%	3836	100.0%

All Infrastructure	Lampung		Central Java		East Nusa Tenggara		West Kalimantan		South Sulawesi		All	
Nothing	19	2.6%	93	9.7%	40	5.6%	7	1.0%	77	10.7%	236	6.2%
Rp.1000-5000	285	39.6%	422	44.0%	352	48.9%	181	25.2%	486	67.7%	1726	45.0%
Rp.6000-10000	234	32.5%	233	24.3%	161	22.4%	215	29.9%	102	14.2%	945	24.6%
Rp.11000-15000	78	10.8%	97	10.1%	57	7.9%	158	22.0%	31	4.3%	421	11.0%
>15000	104	14.4%	115	12.0%	110	15.3%	158	22.0%	22	3.1%	509	13.3%
Total	720	100.0%	960	100.0%	720	100.0%	719	100.0%	718	100.0%	3837	100.0%

Panel B shows the distribution of households' WTP for bridges. Close to one-fifth of the households have zero WTPs—almost double the number with zero WTPs for roads. This is not surprising, since for most respondents, roads are likely to be more relevant to their livelihoods than bridges. About 63.4% were willing to pay between Rp.1,000 and Rp.5,000 for bridge maintenance. Overall, less than 20% of households would be willing to pay more than Rp.5,000 to maintain bridges in their villages.

As mentioned above, the survey asked the WTP question irrespective of whether the infrastructure referred to in the questions were present in these villages. While this presents no problem with regards to the WTP measures for roads (which are present in all of the villages), it may skew these measures for bridges and water systems if the distribution of responses of households in villages without these types of infrastructure are systematically different from those with the infrastructure. Since our interest is in studying the willingness to pay for maintenance, we are more interested in the latter type of villages.

Table 24 presents the distribution of responses from villages with the infrastructure for bridges and water systems. For bridges, there was a higher share of households in villages with these infrastructure who have zero WTP, although there was a slightly lower share with WTP up to Rp.5,000. For water systems, there was a higher share at the lower ends of WTP distribution overall: there was a larger share of households with zero WTPs and with WTPs between Rp.1,000 and Rp.5,000. This seems to suggest that households in villages with the infrastructure tend to state a lower willingness to pay compared to those who were asked to state their WTP based on hypothetical infrastructure. However, this casual observation does not control for the different characteristics between villages with and without bridges or water systems. These characteristics may have been responsible for the difference in the willingness to pay for maintenance between the two groups of villages.

Table 24: Willingness to pay per household per month for villages with bridges and water systems

Bridges	Lampung		Central Java		E. Nusa Tenggara		West Kalimantan		S. Sulawesi		All	
Nothing	35	7.3%	176	29.3%	30	12.5%	148	20.6%	153	25.5%	542	20.5%
Rp.1000-5000	342	71.3%	310	51.7%	170	70.8%	410	56.9%	409	68.2%	1641	62.2%
Rp.6000-10000	65	13.5%	81	13.5%	26	10.8%	113	15.7%	28	4.7%	313	11.9%
Rp.11000-15000	21	4.4%	18	3.0%	5	2.1%	36	5.0%	8	1.3%	88	3.3%
>15000	17	3.5%	15	2.5%	9	3.8%	13	1.8%	2	0.3%	56	2.1%
Total	480	100.0%	600	100.0%	240	100.0%	720	100.0%	600	100.0%	2640	100.0%

Piped Water	Lampung		Central Java		E. Nusa Tenggara		West Kalimantan		S. Sulawesi		All	
Nothing	34	9.4%	126	21.0%	28	7.8%	2	1.7%	31	13.0%	221	13.2%
Rp.1000-5000	214	59.4%	334	55.7%	264	73.3%	26	21.7%	171	71.6%	1,009	60.1%
Rp.6000-10000	67	18.6%	81	13.5%	36	10.0%	49	40.8%	27	11.3%	260	15.5%
Rp.11000-15000	24	6.7%	42	7.0%	17	4.7%	35	29.2%	7	2.9%	125	7.4%
>15000	21	5.8%	17	2.8%	15	4.2%	8	6.7%	3	1.3%	64	3.8%
Total	360	100.0%	600	100.0%	360	100.0%	120	100.0%	239	100.0%	1,679	100.0%

Chapter 5

Village Resources

In this section, we try to answer the first of our research questions, namely whether villagers have the resources to finance their own infrastructure. One way to approach this question is to examine how much of an additional burden would transferring the full cost of infrastructure maintenance be to these villagers in terms of the income that they generated. The first and second columns of Table 25 present the annual income and consumption from our household data for these villages. Meanwhile, Panel C of the table presents the annualized periodic and routine costs that were necessary to maintain these villages' infrastructure properly.

Table 25: Annual income, consumption, and total maintenance cost

Province	vid	A. Income	B. Consumption	C. Annual periodic and routine cost		
				Rupiah	% of income	% of cons
Lampung	1	6,694,273,024	5,080,425,472	60,211,418	0.90%	1.19%
	2	14,465,620,992	12,179,630,080	143,965,178	1.00%	1.18%
	3	5,315,733,504	6,814,352,896	120,697,529	2.27%	1.77%
	4	4,259,000,832	7,402,582,016	49,806,373	1.17%	0.67%
	5	7,615,383,552	7,640,249,856	108,729,166	1.43%	1.42%
	6	11,645,253,632	5,354,554,368	32,233,364	0.28%	0.60%
Central Java	7	2,391,934,976	5,476,795,392	36,307,074	1.52%	0.66%
	8	3,029,536,768	6,943,611,392	91,190,771	3.01%	1.31%
	9	6,436,700,160	6,802,330,112	113,896,246	1.77%	1.67%
	10	5,337,646,080	7,472,593,920	78,715,472	1.47%	1.05%
	11	7,118,802,944	9,365,013,504	171,380,245	2.41%	1.83%
	12	5,672,835,584	7,158,316,544	60,141,497	1.06%	0.84%
	13	11,614,415,872	11,355,395,072	39,645,959	0.34%	0.35%
	14	1,612,817,920	2,713,996,800	51,522,781	3.19%	1.90%
East Nusa Tenggara	15	3,663,342,592	4,886,112,256	26,060,619	0.71%	0.53%
	16	6,076,235,776	6,285,267,968	38,904,618	0.64%	0.62%
	17	3,740,581,376	5,211,032,576	74,525,178	1.99%	1.43%
	18	2,222,495,744	2,458,543,616	2,517,202	0.11%	0.10%
	19	2,346,012,416	2,536,454,656	24,110,973	1.03%	0.95%
	20	4,879,995,904	5,148,011,520	59,649,605	1.22%	1.16%
West Kalimantan	21	3,382,002,432	4,592,963,072	42,841,475	1.27%	0.93%
	22	7,094,712,320	9,314,318,336	111,422,409	1.57%	1.20%
	23	5,741,086,208	6,825,518,592	144,811,262	2.52%	2.12%
	24	8,371,660,288	8,034,143,744	71,338,695	0.85%	0.89%
	25	5,302,328,832	6,790,970,368	26,142,682	0.49%	0.38%
	26	2,602,045,440	3,318,588,416	34,300,763	1.32%	1.03%
South Sulawesi	27	2,062,812,672	3,175,225,856	88,218,479	4.28%	2.78%
	28	8,451,226,624	7,454,402,048	31,067,303	0.37%	0.42%
	29	7,706,818,560	7,225,728,512	44,131,120	0.57%	0.61%
	30	5,869,850,624	8,687,370,240	22,778,165	0.39%	0.26%
	31	3,414,336,000	5,695,731,200	63,002,107	1.85%	1.11%
	32	4,482,786,304	5,249,534,464	126,302,889	2.82%	2.41%

Source: VRRI data, own calculations.

Table 26: Annual income, consumption, and maintenance cost excluding unskilled labor

Province	vid	A. Income	B. Consumption	C. Annual periodic and routine cost		
				Rupiah	% of income	% of cons
Lampung	1	6,694,273,024	5,080,425,472	41,323,041	0.62%	0.81%
	2	14,465,620,992	12,179,630,080	82,940,534	0.57%	0.68%
	3	5,315,733,504	6,814,352,896	75,281,538	1.42%	1.10%
	4	4,259,000,832	7,402,582,016	36,184,727	0.85%	0.49%
	5	7,615,383,552	7,640,249,856	24,683,489	0.32%	0.32%
	6	11,645,253,632	5,354,554,368	10,431,949	0.09%	0.19%
Central Java	7	2,391,934,976	5,476,795,392	26,833,625	1.12%	0.49%
	8	3,029,536,768	6,943,611,392	67,339,257	2.22%	0.97%
	9*	6,436,700,160	6,802,330,112			
	10	5,337,646,080	7,472,593,920	62,245,934	1.17%	0.83%
	11*	7,118,802,944	9,365,013,504			
	12	5,672,835,584	7,158,316,544	34,898,724	0.62%	0.49%
	13	11,614,415,872	11,355,395,072	29,111,188	0.25%	0.26%
	14	1,612,817,920	2,713,996,800	19,616,898	1.22%	0.72%
East Nusa Tenggara	15	3,663,342,592	4,886,112,256	12,062,782	0.33%	0.25%
	16	6,076,235,776	6,285,267,968	24,392,409	0.40%	0.39%
	17	3,740,581,376	5,211,032,576	38,579,555	1.03%	0.74%
	18	2,222,495,744	2,458,543,616	1,639,789	0.07%	0.07%
	19	2,346,012,416	2,536,454,656	2,117,122	0.09%	0.08%
	20	4,879,995,904	5,148,011,520	15,326,924	0.31%	0.30%
West Kalimantan	21	3,382,002,432	4,592,963,072	21,698,687	0.64%	0.47%
	22	7,094,712,320	9,314,318,336	46,463,799	0.65%	0.50%
	23	5,741,086,208	6,825,518,592	98,339,135	1.71%	1.44%
	24	8,371,660,288	8,034,143,744	47,479,863	0.57%	0.59%
	25	5,302,328,832	6,790,970,368	11,663,339	0.22%	0.17%
	26	2,602,045,440	3,318,588,416	21,882,611	0.84%	0.66%
South Sulawesi	27	2,062,812,672	3,175,225,856	43,240,819	2.10%	1.36%
	28	8,451,226,624	7,454,402,048	16,021,501	0.19%	0.21%
	29	7,706,818,560	7,225,728,512	15,592,006	0.20%	0.22%
	30	5,869,850,624	8,687,370,240	14,803,946	0.25%	0.17%
	31	3,414,336,000	5,695,731,200	33,013,723	0.97%	0.58%
	32	4,482,786,304	5,249,534,464	74,036,783	1.65%	1.41%

Source: VRRI data, own calculations. * Labor cost data were missing for these villages.

Table 25 shows that, if we distribute the cost of maintaining infrastructure equally across households in these villages, it would amount to 0.1% (Village 18) to 4.3% (Village 27) of extra burden—or a “tax” if you will—to these villagers relative to their income, with a median of 1.4%. However, as discussed above in the introduction of the income section, there are problems with the measurement of income. In particular, income reporting tends to be systematically downward biased.[7] Since consumption tends to be measured with less bias, we may want to consider examining the additional tax from paying for maintenance cost using our consumption measures. Based on the consumption measures, paying for the full cost of periodic and routine maintenance amounts to a tax of between 0.1% (Village 18) to 2.8% (Village 14) relative to their consumption, with a median of 1.1%.

The maintenance costs presented above included costs for both labor and material. One could argue that this would overestimate the true maintenance costs, since as we observe before, in many of the villages with maintenance activities, their main contributions are in the form of labor, especially for routine maintenance activities. Table 26 addresses this issue by excluding unskilled-labor costs from our calculations of the total maintenance costs. If we assume that all unskilled labor are provided by villagers, we find that the cost of infrastructure maintenance will create an additional tax burden of 0.1% (0.1%) to 2.2%(1.4%) with respect to their income (consumption). The median tax from maintenance with respect to their income (consumption) will be 0.6%(0.5%).

7 This problem is clearly illustrated by Table 25, where consumption exceeds income in 25 out of 32 villages by between 0.3% and 129%, with a median of 31.3%.

Chapter 6

Empirical Analysis

6.1 Paying for Maintenance: Assessing Different Scenarios

With data on maintenance costs and villagers' willingness to pay, we can now begin to answer the extent to which these villages can maintain their own infrastructure. The answer to this question varies depending on what we assume about the mechanism that we will use to collect the contributions that these villagers claim they are willing to pay.

We shall consider two scenarios. *First*, we shall consider the simplest case where villagers can somehow be induced to voluntarily contribute the full value of their stated willingness to pay. Note, however, that theoretically we do not have a credible resource collection mechanism to allow us to induce households to contribute the full value of their willingness to pay. Therefore, this should be considered the best-case (and hypothetical) scenario amongst voluntary mechanisms. We will examine, under this scenario, the extent to which households are able to pay for maintaining infrastructure.

Second, we shall consider the more realistic mechanism of charging a single user fees to all households. Because the survey only collected monthly per-household WTP, our user fees scenario would be based on a monthly collection of user fees for the right to use the infrastructure. We assume that households that do not pay this fee would be cut off from access to the infrastructure. Obviously, this second scenario is a mere analytical tool to get at a more realistic amount that can be collected from villagers. We do not, in any way, suggest that this would be the proper user-fee policy to implement for the various types of infrastructure considered here. For instance, user fees for piped water may be better collected based on usage (instead of a flat fee) depending on the local context. At any rate, we use this scenario to examine two questions. First, how much financial resources would be generated by this scenario? Second, how many households in each village would be excluded from the use of the different types of infrastructure?

Scenario 1: Villagers Pay Their Full Willingness to Pay

Suppose that villagers pay their stated willingness to pay. How much resources would be available to finance the maintenance of infrastructure? Would these resources be adequate to fund the necessary maintenance to ensure the sustainability of their infrastructure? To answer this question, we use our estimates of the periodic and routine maintenance costs for each village to find the amount that each household would need to contribute on average to maintain the quality of their infrastructure. We then compare this number with the average that each head of household stated he or she was willing to contribute for the infrastructure. Since our sample is representative of the village population, if this willingness to pay is more than the average maintenance cost, it implies that contributions of villagers would be adequate to finance the maintenance costs.

Tables 27, 28, and 29 present the average costs that households need to contribute for maintenance and households' willingness to pay for roads, bridges, and piped water, respectively, across all villages. We consider both the costs that include and exclude those of unskilled labors. We begin with comparing the costs with the separate WTPs for each infrastructure, starting with roads. Based on total maintenance costs, Table 27 shows that the maximum voluntary contributions of villagers would cover costs in only 7 out of the 32 villages surveyed—less then 25% of the villages sampled. However, since we ask respondents their WTPs assuming that they may still be asked to contribute some (unskilled) labor, we need to compare their WTPs with the total cost excluding unskilled labor. In this case, 13 out of 30 villages—or 43% of our sample villages—would be able to finance the material, equipment rental, and skilled labor cost necessary to maintain their roads.

Before we proceed, it is important to clarify how we would interpret the results here. Since our WTP question did not include a question on their willingness to supply unskilled labor, it would seem that the cost estimates that exclude unskilled-labor cost would be the more accurate ones. However, this may not be true, since for some types of roads, such as telford or macadam roads, periodic maintenance is a very labor-intensive process. For villages with these types of roads, excluding the cost of unskilled labor may reduce the maintenance costs significantly. However, at the same time, excluding all of the unskilled-labor cost, we assume that villagers would be able to supply *all* of the unskilled labor necessary for this purpose. Our data, however, cannot say whether this assumption is justified. As such, we take the number of villages that are able to self-finance when we compare villager WTPs with the *total* costs as the lower bound, while that compared to the costs that exclude unskilled-labor costs as the upper bound. In other words, our results show that between about a quarter and slightly more than two-fifths of our sample would be able to finance road maintenance if each household contributes their maximum willingness to pay for road maintenance.

Looking across different provinces, we find that when we consider total costs, none of the villages in Lampung, one in eight villages in Central Java and two in six villages each in East Nusa Tenggara, West Kalimantan, and South Sulawesi would have adequate resources to finance road maintenance from their own contributions. However, when we exclude unskilled labor from the total cost, five out of six villages in East Nusa Tenggara would now be able to finance the maintenance of their road from contributions alone. From the data, we find that the majority of villages in East Nusa Tenggara are able to finance road maintenance through the villagers' own contributions because of the generally lower cost of road maintenance there, due to a combination of lower volume, local prices, and need for a given road type. In addition, two villages in Lampung, and an additional village in South Sulawesi are now able to finance their road maintenance from contributions alone.

In the above analysis, we use the average (or mean) of willingness to pay (WTP). Instead of using the mean, we can use the median, which gives us central values that are less sensitive to the effects of outliers. Except for Village 9, the median WTP is lower than its mean. When we use the median, only 4 out of the 32 villages—a mere 13%—would be able to afford the total costs of maintenance, and only 9 out of 30 villages—or 30% of the villages—would be able to afford the cost of maintenance, even if they supplied all of the unskilled labor themselves.

Table 28 below presents our results for bridges. In our sample of 32 villages, only 21 villages have permanent bridges that are maintained by the village. Total maintenance costs per households for the bridges in our sample were relatively low compared to roads. As such, using the average WTPs, in 17 out of 21 villages, the voluntary contributions from villagers would be adequate to finance their maintenance. The number of villages able to self-finance their bridge maintenance does not change when we exclude the cost of unskilled labor. Meanwhile, as shown in Table 29, we find that in 11 out of 14 villages with piped water systems, in all bar one villages, voluntary contributions based on the mean WTP would be adequate to finance the total cost of maintenance. When we exclude unskilled-labor costs, in all villages bar one (Village 27), the maximum possible contributions based on the WTPs would be adequate to finance the maintenance of the water systems.

Table 27: Maintenance costs and willingness to pay per-household: Roads

Province	vid	All costs			Costs excluding unskilled labor			Willingness to pay**	
		Periodic	Routine	Periodic +Routine	Periodic	Routine	Periodic +Routine	Mean	Median
Lampung	1	14,922	1,297	16,220	12,960	344	13,305	5,892	5,000
	2	16,641	1,400	18,041	13,934	108	14,042	7,420	5,000
	3	20,300	4,640	24,940	14,483	1,160	15,644	5,992	5,000
	4	7,346	6,432	13,778	6,525	3,036	9,561	5,782	5,000
	5	10,584	9,869	20,453	2,158	2,485	4,643	4,714	4,000
	6	5,418	3,658	9,076	1,673	919	2,592	6,567	5,000
Central Java	7	6,856	518	7,374	5,953	50	6,003	3,842	3,000
	8	13,968	2,436	16,405	11,685	472	12,158	5,667	5,000
	9*	10,157	6,827	16,984				4,217	4,000
	10	15,126	1,117	16,243	12,857	97	12,954	4,667	3,000
	11*	34,338	1,277	35,615				6,000	5,000
	12	6,148	4,589	10,737	4,992	1,320	6,312	5,758	5,000
	13	5,683	512	6,195	4,708	41	4,749	7,492	5,000
	14	15,606	9,357	24,963	7,136	2,369	9,504	6,342	5,000
East Nusa Tenggara	15	1,847	2,884	4,731	1,469	721	2,190	5,361	5,000
	16	3,890	2,804	6,693	3,445	762	4,207	4,895	5,000
	17	6,948	4,448	11,396	5,156	1,097	6,253	4,717	2,500
	18	709	195	904	569	20	589	4,133	2,000
	19	351	5,717	6,068	155	20	175	3,975	2,000
	20	186	9,503	9,689	117	2,119	2,236	4,283	2,000
West Kalimantan	21	1,321	1,305	2,627	822	62	884	3,942	3,000
	22	16,357	6,937	23,293	8,793	802	9,595	8,158	5,000
	23	21,603	4,820	26,423	17,030	760	17,791	3,042	2,000
	24	7,366	4,323	11,689	6,446	993	7,439	4,825	3,000
	25	2,520	2,472	4,992	1,803	177	1,981	10,092	10000
	26	8,146	6,817	14,963	4,494	5,064	9,557	8,333	7,000
South Sulawesi	27	5,096	11,532	16,628	3,871	2,770	6,641	3,333	2,500
	28	3,387	2,303	5,690	2,049	885	2,934	5,706	5,000
	29	1,879	2,111	3,990	603	935	1,539	2,383	1,000
	30	1,894	1,442	3,336	1,463	706	2,168	3,500	2,000
	31	7,437	2,661	10,098	4,894	291	5,184	3,067	2,000
	32	11,059	4,029	15,088	7,403	462	7,865	3,400	2,000

Source: VRRI data, own calculations. Note: * Labor cost data missing for these villages. **Based on wave 2 data.

Table 28: Maintenance costs and willingness to pay per-household: Bridges

Province	vid	All costs			Costs excluding unskilled labor			Willingness to pay**	
		Periodic	Routine	Periodic +Routine	Periodic	Routine	Periodic +Routine	Mean	Median
Lampung	1	155	133	288	97	114	211	5,058	3,000
	3	2,413	153	2,567	2,288	28	2,316	5,083	5,000
	4	471	2,623	3,094	342	2,355	2,697	5,000	3,000
	6	316	707	1,023	185	491	677	4,800	5,000
Central Java	8	163	415	578	115	284	399	4,458	3,000
	9*	243	271	515				2,958	2,000
	10	177	103	280	100	12	112	3,383	2,000
	12	83	71	155	51	38	89	3,567	2,000
	13	137	73	210	77	8	85	4,933	3,500
East Nusa Tenggara	16	300	342	642	162	231	392	3,957	2,000
	17	780	372	1,152	514	183	696	3,975	2,000
West Kalimantan	21	4,388	4,615	9,003	4,205	802	5,006	2,202	2,000
	22	169	164	333	163	94	258	3,429	3,000
	23	644	297	942	623	169	792	2,583	2,000
	24	734	2,050	2,784	711	1,630	2,341	2,750	2,000
	25	663	347	1,009	636	61	697	8,433	7,000
	26	173	232	405	165	82	246	7,567	5,000
South Sulawesi	27	457	4,039	4,497	254	3,031	3,285	2,342	1,000
	29	243	21	264	80	3	83	1,592	1,000
	31	409	617	1,026	269	375	644	1,625	1,000
	32	78	9,369	9,446	55	6,462	6,517	2,475	1,000

Source: VRRI data, own calculations. Note: * *Labor cost data missing for these villages* **Based on wave 2 data.

Table 29: Maintenance costs and willingness to pay per-household: Piped water

Province	vid	All costs			Costs excluding unskilled labor			Willingness to pay**	
		Periodic	Routine	Periodic +Routine	Periodic	Routine	Periodic +Routine	Mean	Median
Lampung	1	1,698	4,500	6,197	1,398	669	2,067	5,617	5,000
	2	3,876	9,654	13,530	3,056	1,091	4,147	6,458	5,000
	3	675	1,933	2,608	571	253	824	6,250	5,000
Central Java	7	514	985	1,499	432	123	554	3,533	3,000
	8	30	26	56	24	2	26	4,600	4,000
	9*	1,054	1,017	2,071				3,975	3,000
	12	702	720	1,422	626	118	744	4,842	4,000
	13	285	222	507	217	24	242	6,233	5,000
East Nusa Tenggara	17	396	1,465	1,861	309	201	510	4,658	3,000
	19	367	2,998	3,365	230	424	653	4,840	2,000
	20	737	2,255	2,992	593	429	1,023	4,783	2,000
West Kalimantan	24	1,172	598	1,770	925	105	1,030	10,508	10,000
South Sulawesi	27	4,327	3,606	7,932	3,851	465	4,316	3,825	3,000
	29	928	2,188	3,115	709	273	982	3,899	3,000

Source: VRRI data, own calculations. Note: * *Labor cost data missing for these villages* **Based on wave 2 data.

Finally, Table 30 shows comparisons between the per-household annualized maintenance costs for all of the infrastructure in each village and the average and median household WTP for the maintenance of all infrastructure. Mean WTPs would cover the total costs of maintenance in only 7 out of 32 villages, while they would cover the costs excluding the unskilled-labor costs in 19 out of 30 villages—or between 22% to 63% of the sample villages. Meanwhile, if villagers are to focus on fully financing routine maintenance, 25 out of 32 villages would be able to do so if they all contribute their full WTP.

Table 30: Maintenance costs and willingness to pay: all infrastructure

Province	vid	Periodic	Routine	P+R costs	P+R costs w/o unskilled	Willingness to pay**	
						Mean	Median
Lampung	1	16,774	5,930	22,704	15,582	9,252	9,000
	2	20,517	11,054	31,571	18,189	10,713	10,000
	3	23,388	6,726	30,114	18,783	8,942	8,000
	4	7,817	9,055	16,872	12,258	9,271	7,000
	5	10,584	9,869	20,453	4,643	7,456	5,000
	6	5,734	4,365	10,098	3,268	9,515	10,000
Central Java	7	7,370	1,503	8,873	6,558	4,996	4,000
	8	14,161	2,877	17,039	12,582	7,171	5,000
	9	11,454	8,115	19,570		6,833	5,000
	10	15,303	1,220	16,523	13,066	6,938	5,000
	11	34,338	1,277	35,615		7,824	5,000
	12	6,933	5,381	12,314	7,145	8,563	5,500
	13	6,105	806	6,912	5,075	10,238	10,000
	14	15,606	9,357	24,963	9,504	9,913	10,000
East Nusa Tenggara	15	1,847	2,884	4,731	2,190	8,550	5,000
	16	4,190	3,145	7,335	4,599	9,048	5,000
	17	8,125	6,285	14,409	7,459	7,471	5,000
	18	709	195	904	589	9,310	5,000
	19	719	8,714	9,433	828	6,910	5,000
	20	923	11,758	12,681	3,258	8,092	5,000
West Kalimantan	21	5,709	5,920	11,629	5,890	8,911	7,000
	22	16,526	7,100	23,626	9,852	11,924	10,000
	23	22,247	5,117	27,364	18,583	8,158	5,000
	24	9,272	6,971	16,243	10,810	10,924	10,000
	25	3,182	2,819	6,002	2,678	11,912	10,000
	26	8,319	7,049	15,368	9,804	14,167	15,000
South Sulawesi	27	9,880	19,177	29,057	14,243	4,067	3,000
	28	3,387	2,303	5,690	2,934	6,858	5,000
	29	3,050	4,320	7,370	2,604	4,757	5,000
	30	1,894	1,442	3,336	2,168	5,158	5,000
	31	7,846	3,278	11,123	5,829	3,892	3,000
	32	11,137	13,398	24,534	14,382	4,347	3,000

Source: VRRI data, own calculations. Note: * *Labor cost data missing for these villages* **Based on wave 2 data.

Scenario 2: User fees

As we have argued before, it may not be realistic to consider the total WTPs as the resources available for infrastructure maintenance. When households are asked to voluntarily contribute to maintain infrastructure there is the temptation to free-ride on the contributions of others and contribute much less that their WTP values. We do not have a mechanism to collect each households' true WTPs. As such, we should consider these WTP values as the maximum that villagers are willing to contribute.

A more realistic approach would be to consider common mechanisms of resource collections, and consider the amount of resources that would be available for maintenance given the distribution of households' WTPs in each village. One such mechanism is user fees. Given how the WTP values were collected, we consider a scenario where households would be required to pay a flat monthly fee that will grant them access the infrastructure. Hence, this calculation may not be applicable to other, more sophisticated, forms of user fees, such as those based on usage. Furthermore, we only focus the analysis on single-price user fees—namely that all households face the same monthly fee. That is, we do not consider the possibility of price discrimination among different households because it is not clear how such a price discrimination would be implemented in villages. As we discussed in the beginning of this section, this user fee scenario is a mere analytical tool to add a bit of realism into the amount of resources that can be collected voluntarily by and from villagers.

We calculate the available resources under the assumption that households will refuse to pay user fees above their WTPs. We consider two different user fee scenarios: the resource-maximizing (or "optimal") user fee, or the "politically feasible" (or "median") user fee. The former refers to the level of single-price user fee that would maximize the total amount of resources collected in the village given the distribution of WTPs in the village. An increase in user fees will increase the revenue collected per household, but will decrease the number of households willing to pay this fee. Using our discrete WTP data, we can therefore find the optimal level of user fee that maximizes the total resources collected.

While this level of user fee maximizes the total resources collected, in a democratic setting where the user fee is decided through a one-household one-vote mechanism, the optimal user fee may not be politically feasible if it is rejected by the majority of the households in the village. Alternatively, we consider a scenario if which each household representative will vote for a particular level of user fee insofar that it is below his or her WTPs. Under a majority rule decision rule, this implies that the "politically feasible" user fee will be somewhere around or below the median WTP.[8] Under this decision rule, the optimal user fee will be politically feasible if and only if it is less or equal to this "median" user fee.

Tables 31, 32, and 33 present the optimal and median user fee for each of the village and summarize the amount of resources that would be available under the median and optimal fees for roads, bridges, and piped water systems respectively. They also calculated the financing gaps

8 More specifically, suppose we have a village with 100 households and we sort their WTPs from the lowest to the highest. Under this decision rule, the fee that is politically feasible will be one less or equal to the WTP of the 49th household from the bottom.

in these villages in both cases where villagers do and do not fully contribute their unskilled labor for maintenance. In general, with the user fees, naturally the number of villages that are able to self-finance their maintenance falls. For roads, Table 31 below shows that in 18 out of 32 villages, we have optimal fee levels that are be different from the median level. In one of these 18 villages, Village 26, the optimal user fee is lower than the median user fee, while it is higher in the remaining 17 villages. Implementing the optimal user fee in these 17 villages would exclude between 50.9% to 79.2% of households from access to the village roads (see column D). Meanwhile, implementing the median user fee will exclude between 5.3% to 49.6% of the households in these villages.

With the median user fees, the number of villages that would be able to collect enough resources to finance the total cost of road maintenance falls from 7 villages above to a mere 2 out of 32 villages. If villagers fully contribute the necessary unskilled labor, 4 out of 30 villages would have adequate resources to finance road maintenance. The financing gaps among the villages that are unable to finance the total costs of road maintenance range from Rp4.0 million to Rp156.1 million annually. The financing gaps if villagers provide all of the unskilled labor ranges from Rp.0.7million to Rp88.1 million annually. For the most part, the median fee varies between Rp.2000 and Rp.5,000 (with two exceptions of Rp.7,000 in Village 26 and Rp.10,000 in Village 25).

Meanwhile, under the optimal user fees, only 2 out of 32 villages will be able to finance the total cost of maintenance. If villagers contribute all of the necessary unskilled labor, 6 out of 30 villages would have the resources to finance road maintenance. The financing gap ranges from Rp3.7 million to Rp156.1 million annually, with a median of Rp37.4 million. Meanwhile, the financing gap when villagers contribute all of the necessary unskilled labor ranges from Rp0.7 million to Rp87.0 million, with a median of Rp13.6 million. For almost all villages, the optimal fee for road maintenance is Rp.5,000.

Table 32 shows that for bridges, 14 out of 21 villages would be able to self-finance the total cost of bridge maintenance in their villages with the median user fees. If villagers are to supply all of the unskilled labor, 15 out of 20 villages would be able to self-finance the cost to maintain bridge. Hence, between two-thirds and three-forth of the villages would be able to afford the cost of maintenance with the median user fee scenario. The financing gaps among the seven villages that are unable to finance the total cost range from Rp0.1 million (Village 17) to Rp44.8 million (Village 32) annually. Meanwhile, the financing gaps when villages contribute all of the unskilled labor range from Rp2.6 million (Village 4) to Rp29.7 million (Village 32) annually. The median user fees mainly vary between Rp.1,000 and Rp.3,000 per household. With the median user fee, between 10.3% to 48.3% of households in these villages would be unwilling to pay the fee and therefore not have access to them.

Meanwhile, with the optimal user fees, villagers in 16 out of 21 villages would be able to finance the total cost of bridge maintenance. When we exclude the unskilled-labor cost, 15 in 20 villages would be able to do so—hence, roughly, three-fourths of the sample with bridges would have adequate resources with the optimal user fees. When the cost includes the unskilled-labor cost, the financing gaps range from Rp2 million (Village 4) to Rp44.8 million (Village 32), while without it, the financing gaps range from Rp.0.8 million (Village 4) to Rp29.7 million (Village 32). In more than 75% of these villages, the optimal fee for bridges is Rp.5,000. With the optimal fee, between 3.4% to 85% of households in these villages would be would be unwilling to pay the fee and therefore not have access to them.

Table 31: Resource collection under median and optimal user fees: Roads

Province	Vid	Maintenance costs		B. User fees**		C. Ann. resource collected		D. % HHs excluded		E. Resources – Cost w/ median fee		F. Resources – Cost w/ optimal fee	
		All	w/o unskilled	Median	Optimal	Median	Optimal	Median	Optimal	Total cost	Cost w/o unskilled	Total	Cost w/o unskilled
Lampung	1	43,014,214	35,283,548	5,000	5,000	7,577,143	7,577,143	42.9%	42.9%	-35,437,071	-27,706,405	-35,437,071	-27,706,405
	2	82,268,483	64,031,887	5,000	5,000	17,040,000	17,040,000	25.3%	25.3%	-65,228,483	-46,991,887	-65,228,483	-46,991,887
	3	99,957,775	62,699,539	5,000	5,000	14,045,128	14,045,128	29.9%	29.9%	-85,912,647	-48,654,411	-85,912,647	-48,654,411
	4	40,673,164	28,224,642	5,000	5,000	8,270,690	8,270,690	44.0%	44.0%	-32,402,474	-19,953,952	-32,402,474	-19,953,952
	5	108,729,166	24,683,489	4,000	5,000	11,191,579	13,056,842	47.4%	50.9%	-97,537,587	-13,491,910	-95,672,324	-11,626,647
	6	28,969,415	8,272,205	5,000	5,000	10,731,724	10,731,724	32.8%	32.8%	-18,237,691	2,459,519	-18,237,691	2,459,519
Central Java	7	30,174,640	24,565,370	3,000	5,000	6,866,238	7,629,153	44.1%	62.7%	-23,308,402	-17,699,132	-22,545,487	-16,936,217
	8	87,798,031	65,066,944	5,000	5,000	15,194,237	15,194,237	43.2%	43.2%	-72,603,794	-49,872,707	-72,603,794	-49,872,707
	9*	98,848,786		4,000	5,000	11,938,462	12,933,333	48.7%	55.6%	-86,910,324		-85,915,453	
	10	77,381,689	61,712,314	3,000	5,000	8,994,103	11,499,310	37.1%	51.7%	-68,387,586	-52,718,211	-65,882,379	-50,213,004
	11*	171,380,245		5,000	5,000	15,272,870	15,272,870	36.5%	36.5%	-156,107,375		-156,107,375	
	12	52,440,777	30,826,435	5,000	5,000	14,980,336	14,980,336	38.7%	38.7%	-37,460,441	-15,846,099	-37,460,441	-15,846,099
	13	35,536,104	27,239,893	5,000	9,000	17,158,974	17,208,000	40.2%	66.7%	-18,377,130	-10,080,919	-18,328,104	-10,031,893
	14	51,522,781	19,616,898	5,000	5,000	6,996,610	6,996,610	32.2%	32.2%	-44,526,171	-12,620,288	-44,526,171	-12,620,288
East Nusa Tenggara	15	26,060,619	12,062,782	5,000	5,000	15,461,053	15,461,053	43.9%	43.9%	-10,599,566	3,398,271	-10,599,566	3,398,271
	16	35,501,028	22,312,209	5,000	5,000	14,383,729	14,383,729	45.8%	45.8%	-21,117,299	-7,928,480	-21,117,299	-7,928,480
	17	58,940,495	32,341,722	2,000	5,000	6,277,128	10,609,231	39.3%	59.0%	-52,663,367	-26,064,594	-48,331,264	-21,732,491
	18	2,517,202	1,639,789	2,000	5,000	3,602,824	4,094,118	35.3%	70.6%	1,085,622	1,963,035	1,576,916	2,454,329
	19	15,510,262	446,809	2,000	5,000	3,228,632	3,699,474	36.8%	71.1%	-12,281,630	2,781,823	-11,810,788	3,252,665
	20	45,575,470	10,517,004	2,000	5,000	5,758,345	8,313,104	38.8%	64.7%	-39,817,125	-4,758,659	-37,262,366	-2,203,900
West Kalimantan	21	9,675,877	3,256,550	3,000	5,000	5,719,895	5,978,421	48.3%	67.5%	-3,955,982	2,463,345	-3,697,456	2,721,871
	22	109,850,652	45,249,266	5,000	5,000	22,338,948	22,338,948	5.3%	5.3%	-87,511,704	-22,910,318	-87,511,704	-22,910,318
	23	139,828,492	94,147,722	2,000	5,000	6,009,560	7,175,593	43.2%	72.9%	-133,818,932	-88,138,162	-132,652,899	-86,972,129
	24	51,339,082	32,674,086	3,000	5,000	8,478,470	10,120,696	35.7%	53.9%	-42,860,612	-24,195,616	-41,218,386	-22,553,390
	25	21,745,462	8,627,638	10,000	10,000	24,364,068	24,364,068	44.1%	44.1%	2,618,606	15,736,430	2,618,606	15,736,430
	26	33,397,583	21,332,516	7,000	5,000	8,145,846	10,396,923	47.9%	6.8%	-25,251,737	-13,186,670	-23,000,660	-10,935,593
South Sulawesi	27	50,484,078	20,163,436	3,000	5,000	4,592,269	5,485,210	49.6%	63.9%	-45,891,809	-15,571,167	-44,998,868	-14,678,226
	28	31,067,303	16,021,501	5,000	5,000	15,370,588	15,370,588	43.7%	43.7%	-15,696,715	-650,913	-15,696,715	-650,913
	29	23,892,967	9,214,475	1,000	5,000	4,391,200	6,237,500	26.7%	79.2%	-19,501,767	-4,823,275	-17,655,467	-2,976,975
	30	22,778,165	14,803,946	2,000	5,000	7,510,800	12,802,500	45.0%	62.5%	-15,267,365	-7,293,146	-9,975,665	-2,001,446
	31	57,193,445	29,363,870	2,000	5,000	6,136,000	8,260,000	45.8%	70.8%	-51,057,445	-23,227,870	-48,933,445	-21,103,870
	32	77,672,236	40,487,708	2,000	5,000	5,748,600	7,936,500	44.2%	69.2%	-71,923,636	-34,739,108	-69,735,736	-32,551,208

Source: VRRI data, own calculations. Note: *Labor cost missing **Based on wave 2 data.

Table 32: Resource collection under median and optimal user fees: Bridges

Province	vid	Maintenance costs		B. User fees		C. Ann. resource collected		D. % HHs excluded		E. Resources – Cost w/ median fee		F. Resources – Cost w/ optimal fee	
		All	w/o unskilled	Median	Optimal	Median	Optimal	Median	Optimal	Total cost	Cost w/o unskilled	Total cost	Cost w/o unskilled
Lampung	1	762,623	558,846	3,000	5,000	4,546,286	6,156,429	42.9%	53.6%	3,783,663	3,987,440	5,393,806	5,597,583
	3	10,286,561	9,280,504	5,000	5,000	11,647,179	11,647,179	41.9%	41.9%	1,360,618	2,366,675	1,360,618	2,366,675
	4	9,133,209	7,960,085	3,000	5,000	5,344,138	7,125,517	39.7%	51.7%	-3,789,071	-2,615,947	-2,007,692	-834,568
	6	3,263,949	2,159,744	5,000	5,000	8,530,345	8,530,345	46.6%	46.6%	5,266,396	6,370,601	5,266,396	6,370,601
Central Java	8	3,092,691	2,135,423	3,000	5,000	9,660,814	12,019,322	39.8%	55.1%	6,568,123	7,525,391	8,926,631	9,883,899
	9*	2,995,143		2,000	5,000	6,964,103	8,705,128	40.2%	70.1%	3,968,960		5,709,985	
	10	1,333,783	533,620	2,000	5,000	5,667,517	8,419,138	40.5%	64.7%	4,333,734	5,133,897	7,085,355	7,885,518
	12	756,232	436,225	2,000	5,000	5,663,799	8,824,034	42.0%	63.9%	4,907,567	5,227,574	8,067,802	8,387,809
	13	1,202,016	485,511	3,000	5,000	9,118,769	13,482,051	47.0%	53.0%	7,916,753	8,633,258	12,280,035	12,996,540
East Nusa Tenggara	16	3,403,591	2,080,199	2,000	5,000	7,101,966	12,136,271	33.1%	54.2%	3,698,375	5,021,767	8,732,680	10,056,072
	17	5,958,757	3,601,623	2,000	5,000	5,835,077	9,946,154	43.6%	61.5%	-123,680	2,233,454	3,987,397	6,344,531
West Kalimantan	21	33,165,598	18,442,137	2,000	2,000	4,588,842	4,588,842	37.7%	37.7%	-28,576,756	-13,853,295	-28,576,756	-13,853,295
	22	1,571,756	1,214,534	3,000	5,000	7,694,527	11,376,316	45.6%	51.8%	6,122,771	6,479,993	9,804,560	10,161,782
	23	4,982,770	4,191,413	2,000	3,000	5,830,170	6,323,492	44.9%	60.2%	847,400	1,638,757	1,340,722	2,132,079
	24	12,226,590	10,282,872	2,000	3,000	5,499,548	5,499,548	37.4%	58.3%	-6,727,042	-4,783,324	-6,727,042	-4,783,324
	25	4,397,220	3,035,701	7,000	5,000	15,762,814	21,041,694	48.3%	3.4%	11,365,594	12,727,113	16,644,474	18,005,993
	26	903,180	550,095	5,000	5,000	10,015,385	10,015,385	10.3%	10.3%	9,112,205	9,465,290	9,112,205	9,465,290
South Sulawesi	27	13,651,783	9,974,084	1,000	3,000	2,500,235	2,908,437	17.6%	68.1%	-11,151,548	-7,473,849	-10,743,346	-7,065,647
	29	1,583,364	497,536	1,000	5,000	3,642,700	4,491,000	39.2%	85.0%	2,059,336	3,145,164	2,907,636	3,993,464
	31	5,808,662	3,649,852	1,000	5,000	5,519,300	8,250,500	19.2%	75.8%	-289,362	1,869,448	2,441,838	4,600,648
	32	48,630,654	33,549,076	1,000	1,000	3,823,200	3,823,200	32.5%	32.5%	-44,807,454	-29,725,876	-44,807,454	-29,725,876

Source: VRRI data, own calculations. Note: *Labor cost missing **Based on wave 2 data.

Table 33: Resource collection under median and optimal user fees: Piped water system

Province	vid	Maintenance costs		B. User fees		C. Ann. resource collected		D. % HHs excluded		E. Resources – Cost w/ median fee		F. Resources – Cost w/ optimal fee	
		All	w/o unskilled	Median	Optimal	Median	Optimal	Median	Optimal	Total cost	Cost w/o unskilled	Total cost	Cost w/o unskilled
Lampung	1	16,434,581	5,480,647	5,000	5,000	7,695,536	7,695,536	42.0%	42.0%	-8,739,045	2,214,889	-8,739,045	2,214,889
	2	61,696,695	18,908,646	5,000	5,000	13,920,000	13,920,000	38.9%	38.9%	-47,776,695	-4,988,646	-47,776,695	-4,988,646
	3	10,453,193	3,301,495	5,000	5,000	13,017,436	13,017,436	35.0%	35.0%	2,564,243	9,715,941	2,564,243	9,715,941
Central Java	7	6,132,434	2,268,254	3,000	3,000	6,554,136	6,554,136	46.6%	46.6%	421,702	4,285,882	421,702	4,285,882
	8	300,050	136,890	4,000	5,000	10,885,424	12,699,661	49.2%	52.5%	10,585,374	10,748,534	12,399,611	12,562,771
	9*	12,052,317		3,000	5,000	9,849,231	12,435,897	43.6%	57.3%	-2,203,086	9,849,231	383,580	12,435,897
	12	6,944,488	3,636,064	4,000	5,000	10,014,252	12,107,395	48.7%	50.4%	3,069,764	6,378,188	5,162,907	8,471,331
	13	2,907,839	1,385,785	5,000	10,000	17,158,974	20,590,770	40.2%	64.1%	14,251,135	15,773,189	17,682,931	19,204,985
East Nusa Tenggara	17	9,625,926	2,636,209	3,000	5,000	8,089,539	10,609,231	47.9%	59.0%	-1,536,387	5,453,330	983,305	7,973,022
	19	8,600,711	1,670,313	2,000	5,000	3,587,369	4,596,316	29.8%	64.0%	-5,013,342	1,917,056	-4,004,395	2,926,003
	20	14,074,135	4,809,920	2,000	5,000	6,569,380	9,326,897	30.2%	60.3%	-7,504,755	1,759,460	-4,747,238	4,516,977
West Kalimantan	24	7,773,023	4,522,905	10,000	10,000	29,025,392	29,025,392	33.9%	33.9%	21,252,369	24,502,487	21,252,369	24,502,487
South Sulawesi	27	24,082,617	13,103,299	3,000	5,000	4,898,420	6,378,152	46.2%	58.0%	-19,184,197	-8,204,879	-17,704,465	-6,725,147
	29	18,654,788	5,879,996	3,000	5,000	9,281,400	13,223,500	48.3%	55.8%	-9,373,388	3,401,404	-5,431,288	7,343,504

Source: VRRI data, own calculations. Note: *Labor cost missing **Based on wave 2 data.

Table 34: Resource collection under median and optimal user fees: all infrastructure

Province	vid	Maintenance costs		B. User fees**		C. Ann. resource collected		D. % HHs excluded		E. Resources – Cost w/ median vote		F. Resources – Cost w/ optimal fee	
		All	w/o unskilled	Median	Optimal	Median	Optimal	Median	Optimal	Total	Cost w/o unskilled	Total	Cost w/o unskilled
Lampung	1	60,211,418	41,323,041	6,000	10,000	8,666,357	11,839,286	46.0%	55.0%	-51,545,061	-32,656,684	-48,372,132	-29,483,755
	2	143,965,178	82,940,534	10,000	10,000	23,040,000	23,040,000	49.0%	49.0%	-120,925,178	-59,900,534	-120,925,178	-59,900,534
	3	120,697,529	75,281,538	8,000	10,000	16,443,077	18,155,898	49.0%	55.0%	-104,254,452	-58,838,461	-102,541,631	-57,125,640
	4	49,806,373	36,184,727	7,000	10,000	10,866,414	12,215,172	47.0%	59.0%	-38,939,959	-25,318,313	-37,591,201	-23,969,555
	5	108,729,166	24,683,489	5,000	5,000	17,953,158	17,953,158	32.0%	32.0%	-90,776,008	-6,730,331	-90,776,008	-6,730,331
	6	32,233,364	10,431,949	8,500	10,000	12,988,138	15,409,655	49.0%	52.0%	-19,245,226	2,556,189	-16,823,709	4,977,706
Central Java	7	36,307,074	26,833,625	4,000	5,000	8,738,847	9,883,220	47.0%	52.0%	-27,568,227	-18,094,778	-26,423,854	-16,950,405
	8	91,190,771	67,339,257	5,000	5,000	18,369,152	18,369,152	31.0%	31.0%	-72,821,619	-48,970,105	-72,821,619	-48,970,105
	9*	113,896,246		5,000	10,000	16,912,820	18,405,128	42.0%	68.0%	-96,983,426		-95,491,118	
	10	78,715,472	62,245,934	5,000	10,000	13,758,103	16,016,897	42.0%	66.0%	-64,957,369	-48,487,831	-62,698,575	-46,229,037
	11*	171,380,245		5,000	10,000	17,155,826	17,155,826	29.0%	64.0%	-154,224,419		-154,224,419	
	12	60,141,497	34,898,724	5,000	10,000	18,468,908	19,289,748	24.0%	61.0%	-41,672,589	-16,429,816	-40,851,749	-15,608,976
	13	39,645,959	29,111,188	10,000	10,000	33,337,436	33,337,436	42.0%	42.0%	-6,308,523	4,226,248	-6,308,523	4,226,248
	14	51,522,781	19,616,898	10,000	10,000	11,019,661	11,019,661	47.0%	47.0%	-40,503,120	-8,597,237	-40,503,120	-8,597,237
East Nusa Tenggara	15	26,060,619	12,062,782	10,000	10,000	29,472,632	29,472,632	46.0%	46.0%	3,412,013	17,409,850	3,412,013	17,409,850
	16	38,904,618	24,392,409	6,500	10,000	17,530,170	23,373,560	45.0%	56.0%	-21,374,448	-6,862,239	-15,531,058	-1,018,849
	17	74,525,178	38,579,555	5,000	10,000	15,250,769	16,797,948	41.0%	68.0%	-59,274,409	-23,328,786	-57,727,230	-21,781,607
	18	2,517,202	1,639,789	5,000	10,000	9,825,882	10,059,832	29.0%	64.0%	7,308,680	8,186,093	7,542,630	8,420,043
	19	24,110,973	2,117,122	5,000	5,000	6,838,421	6,838,421	46.0%	46.0%	-17,272,552	4,721,299	-17,272,552	4,721,299
	20	59,649,605	15,326,924	5,000	10,000	13,584,828	13,787,586	42.0%	71.0%	-46,064,777	-1,742,096	-45,862,019	-1,539,338
West Kalimantan	21	42,841,475	21,698,687	6,500	5,000	12,021,474	15,350,000	46.0%	17.0%	-30,820,001	-9,677,213	-27,491,475	-6,348,687
	22	111,422,409	46,463,799	10,000	10,000	35,990,528	35,990,528	24.0%	24.0%	-75,431,881	-10,473,271	-75,431,881	-10,473,271
	23	144,811,262	98,339,135	5,000	10,000	19,732,882	22,423,728	25.0%	58.0%	-125,078,380	-78,606,253	-122,387,534	-75,915,407
	24	71,338,695	47,479,863	12,000	10,000	26,581,148	30,171,130	50.0%	31.0%	-44,757,547	-20,898,715	-41,167,565	-17,308,733
	25	26,142,682	11,663,339	13,500	10,000	28,314,000	37,284,408	50.0%	14.0%	2,171,318	16,650,661	11,141,726	25,621,069
	26	34,300,763	21,882,611	15,000	15,000	19,458,462	19,458,462	42.0%	42.0%	-14,842,301	-2,424,149	-14,842,301	-2,424,149
South Sulawesi	27	88,218,479	43,240,819	3,000	5,000	5,357,647	6,760,841	41.0%	55.0%	-82,860,832	-37,883,172	-81,457,638	-36,479,978
	28	31,067,303	16,021,501	5,000	10,000	15,600,000	18,811,764	43.0%	66.0%	-15,467,303	-421,501	-12,255,539	2,790,263
	29	44,131,120	15,592,006	3,000	5,000	9,580,800	13,473,000	47.0%	55.0%	-34,550,320	-6,011,206	-30,658,120	-2,119,006
	30	22,778,165	14,803,946	4,000	5,000	13,883,600	16,785,500	49.0%	51.0%	-8,894,565	-920,346	-5,992,665	1,981,554
	31	63,002,107	33,013,723	3,000	5,000	9,204,000	12,272,000	46.0%	57.0%	-53,798,107	-23,809,723	-50,730,107	-20,741,723
	32	126,302,889	74,036,783	3,000	5,000	9,266,400	10,725,000	40.0%	58.0%	-117,036,489	-64,770,383	-115,577,889	-63,311,783

For piped water systems, Table 33 shows that under the median user fee, 6 out of 14 villages would be able to afford the total cost of maintenance. If villagers contribute all unskilled labor, the number increases to 12 villages. The median fee was more varied between Rp.2,000-5,000 with Rp.3,000 being the most frequent median fee, found in 5 out of the 14 villages. Meanwhile, under the optimal fee, 8 out of 14 villages would be afford the total cost of maintenance, while 12 would be able to afford the cost if all unskilled labor are provided by villagers. The optimal fee was Rp.5,000 in 11 villages, Rp.10,000 in 2 villages, and Rp.3,000 in one village. With the median user fee, between 29.8% and 49.2% of households in these villages would not be willing to pay the fee and not have access to the water system. Meanwhile, with the optimal fee, between 33.9% and 64.1% of households would not pay the fee and lose access to the water system.

Table 34 considers these fee scenarios when the WTPs are asked for all infrastructure as a bundle. As we have discussed above, the WTPs for the overall infrastructure tends to be lower than the sum of the WTPs for individual infrastructure. Under the median user fee, only 3 out of 32 villages would have adequate resources to finance the total costs for all three types of infrastructure. If villagers contribute all of the necessary unskilled labor, the number increases to 6 (out of 30 villages). Hence, roughly 10-20% of our sample villages would be able to afford the cost of maintenance under the median user fees. Under the optimal user fee, 3 out of 32 villages could afford the total costs of maintenance for all infrastructure. If we assume that villagers provide the unskilled labor, 8 out of 30 villages would be able to afford the full maintenance under the optimal fee scenario. Therefore, under the optimal user fee scenario, only about 10–25% of villages would be able to afford the cost of maintaining these three types of infrastructure in their villages.

6.2 Determinants of villagers' willingness to pay

We next use a simple econometric model to explore the question of the determinants of respondents' willingness to pay. In theory, we expect that respondents' income and the opportunity cost from poorly maintained roads to be important determinants of the willingness to pay. However, we are also interested in looking at the role of institutional quality, as well as villagers' knowledge about village administration and perception of social trust in the village in determining their willingness to pay.

As explained before, the iterative bidding procedure used to elicit respondents' WTP gives us WTP responses that are in the form of discrete values from Rp.0 up to Rp.15,000. If the respondent was willing to pay up to Rp.15,000, he or she would be asked to state the maximum value that she would be willing to pay. However, many respondents did not state specific maximum values of their willingness to pay, creating missing observations at values greater than Rp.15,000. In additions, respondents are, naturally, not allowed to state negative WTPs, although this is theoretically possible.[9] Because of the discrete nature of the data, and the fact that WTP values above Rp.15,000 and below Rp.0 are "missing", we specified the regression using an interval model that are censored from above and below.

9 An example of a negative WTP would be when a high-traffic use of the well-maintained infrastructure creates negative costs to the respondents beyond the benefits that they obtain from good quality infrastructure.

We estimate the following simple model:

$$WTP_i = \alpha + \beta_1 STARTBID_i + \beta_2 INC_i + \beta_3 OC_i + \beta_4 INST_i + \beta_5 OTH + \delta . D_p + \varepsilon_i$$

where *WTP* is the respondents' willingness to pay, *INC* is the log of respondent income, *OC* is the opportunity costs (in time and monetary terms) of a well-maintained infrastructure, *INST* is respondent perception of the quality of the institutions (including that of social trust), *OTH* is other control variables, such as the respondent's mode of transport, and D_p is the province dummy to control for province-level effects. In addition, we also include *STARTBID,* which is the random starting bid for the contingent valuation questions, to control for the anchoring bias. The subscript *i* refers to respondent *i.* To estimate this model, we use data from Wave 4 of the VRRI survey, which contains information on all of the relevant variables above.

Before we proceed with the estimation, we need to be clear about what we mean by "opportunity cost" (i.e., the variable *OC).* The WTP question elicits the maximum value that respondents are willing to pay to ensure that they have a smoothly working village infrastructure, be that a road, bridge, or piped water system. The opportunity cost of having improper maintenance would, therefore, be the cost from having village infrastructure that would occasionally fail to work smoothly. We measure this by taking the difference in the costs—in terms of both monetary and time values—of using the (main) village infrastructure and an alternative infrastructure when the main infrastructure failed. As an example, for roads, this would be the difference in the costs to reach the place of their main employment using the main road versus the alternative road that the respondents would use when the main road became damaged.

In the past two years, some respondents in our sample experienced a breakdown in the main village infrastructure that they use, and therefore, could state the real cost of having to use an alternate. However, not all respondents had ever experienced such breakdowns. For these respondents, we hence asked a "what-if" question, i.e., what would the costs of using an alternative infrastructure be *if* the main infrastructure had broken down. The costs of an alternate we obtained from these respondents are, therefore, hypothetical. As we shall see, whether respondents' answer is based on real experiences or not changes the results in important ways.

Meanwhile, for *INST,* we made use of several variables. We used the respondent satisfaction level with regard to the quality of the village administration. We also asked the question: "What do you think about the statement that villagers trust their […] officials?", where the blank was filled with either "village" and "sub-district" and the respondent was asked whether he or she strongly disagrees, disagrees, agrees, or strongly agrees. To gauge the effect of social trust on WTP, we use two questions, namely, "What do you think of the statement that villagers here are trustworthy?" and "What do you think of the statement that villagers here are helpful to each other?" where the respondent was again asked to express their level of agreement. We recode the answers such that a low number implies a low level of trust. In addition, we also asked if the respondent knows about the use of the village development funds as a measure of respondent knowledge of village finances.

The survey also asked whether the respondent has ever lodged a complaint regarding an infrastructure. Having lodged a complaint can be construed as placing a high value on the particular infrastructure. Conditional on having lodged a complaint, the survey followed up by asking the respondent whether the complaint was responded to satisfactorily. We use both of these two variables to see how satisfactory responses to complaints may have affected WTP. We also included dummy variables for the different economic sectors in which family members were employed or have businesses. Finally, we included the village dummy variable to control for fixed effects at the village level and a dummy variable indicating whether a village received the village allocation fund (or *alokasi dana desa,* ADD) during the survey period.

In principle, we would have liked to do this estimation on all three types of infrastructure—the road, bridge, and piped water systems. However, since only a subset of the whole sample were actually users of the bridge and piped water system, the sample sizes available to do estimations for the bridges and piped water systems were much lower than that for roads. The low sample sizes for actual users, combined with the relatively large number of variables that we are interested in, resulted in the low power of the estimates. On the other hand, we can try running the estimates on the overall sample, irrespective of whether they used the infrastructure in question—i.e., estimating the effects of these variables on the WTP for hypothetical infrastructure. However, as we will show below, this could be misleading. As such, we decide to focus on estimating the model for roads only.

Table 35 presents the interval regression of the various indicators on the WTP for roads. Meanwhile, the signs for the main variables are as expected from theory: a higher income is positively associated with a higher WTP, suggesting that road maintenance is a normal good that rises with income. Statistically, the estimate is highly significant. However, the coefficient for income is miniscule.

Meanwhile, we find that there were differential impacts between the "hypothetical" versus real opportunity costs of a damaged road on WTP. For those who stated hypothetical costs of using the alternate road because they had never experienced damages to their main road to work in the past two years, the increase in the relative time cost has no significant effect on the WTP, and the increase in the relative monetary cost has a negative, although not statistically significant, effect on the WTP. On the other hand, respondents who were impacted by road damages in the past two years, the increase in the time and money opportunity costs from *actually* having to go through an alternative road are positive, although the coefficient for the time opportunity cost is not statistically significant. For these respondents, there is almost a one-to-one increase in WTP with respect to the increase in the additional transportation cost due to the breakdown in roads.

We also examine the role of the respondents' mode of transportation on their WTPs. For each respondent, we asked them of their mode of transport to go to work—whether they walk, use a bicycle, motorcycle, car, or other. All things equal, it appears that respondents using motorcycles as their main mode of transport have the highest willingness to pay for well-maintained road compared to those using other modes of transportation. Respondents who use cars also have a slightly higher WTP when compared to the benchmark "Other" category, although the difference is not statistically significant.

Table 35: Interval regression on the willingness to pay for roads+

Variables	Coefficients (std dev)
Starting bid for CV questionnaire	0.2425***
	(0.03)
Monthly income	0.0001**
	(0.00)
Opportunity cost of poor maintenance	
Resp. did not experience road failure	
Time (minute)	14.8441
	(15.63)
Money (Rp.)	-0.6943
	(0.48)
Resp. experienced road failure	
Time (minute) experienced damage	53.9326
	(37.97)
Money if experienced damage (Rp.)	1.0034*
	(0.55)
Mode of transport	
Foot	319.1193
	(469.89)
Bike	-149.3376
	(703.63)
Motorbike	1434.5177***
	(486.52)
Car	670.0737
	(564.09)
Satisfaction with regards to	
The quality of the village administration	101.4066
	(160.22)
The quality of the road	-241.1105
	(264.40)
Trust of	
Fellow villagers	-956.8074***
	(293.63)
Helpfulness of villagers	-11.1474
	(342.83)
Village officials	-131.6200
	(402.94)
Sub-district officials	650.5856
	(456.77)

Variables	Coefficients (std dev)
Complained about poor road quality	-173.6632
	(355.26)
Is satisfied with response to complaints	1466.6899***
	(549.57)
Knowledge of use of village funds	1118.4932***
	(413.27)
Village dummy variables:	
Receives village allocation fund (ADD)	4095.4534***
	(1210.44)
Topography: Mountains/hills	594.1091
	(1020.95)
Topography: Flatland	2442.6942**
	(1019.56)
Province: Central Java	-
Province: East Nusa Tenggara	-
Province: West Kalimantan	-
Province: South Sulawesi	-
Other dummy variables not shown	
Sectors family members work in	Included
Sectors family members own business in	Included
Village ID dummies	Included
Constant	-1305.2213
	(2380.67)
Regression statistics:	
lnsigma	
_cons	8.4408***
	(0.02)
sigma	4632.26
ll	-4594.64
chi2	464.10
McKelvey & Zavoina's R2:	0.163
Number of observations	1859

In terms of institutional quality, we did not find an effect of respondents' perception of the quality and trustworthiness of the various levels of government and government officials on their WTP. For village level governments, the quality of the village administration and the trustworthiness of village officials do not significantly affect respondents WTP. Meanwhile, the coefficient on the trustworthiness of sub-district officials was positive, although this is not significant at the 10 percent level.

With regards to social trust we find, somewhat surprisingly, negative coefficients on both trust variables towards fellow villagers. All else the same, the more the respondent agrees to the statement that "villagers are trustworthy" and "villagers are helpful to each other", the lower is the respondent's WTP. The coefficient is only significant at the 10% level for the former.[10] One plausible interpretation is to see this as evidence for strategic free-riding among villagers; the belief that one's fellow villagers are trustworthy means that one does not need to contribute as much. If this interpretation is correct, it highlights the difficulties of relying solely on voluntary contributions to finance these types of public goods. However, more evidence is needed to see the extent to which this interpretation is correct.

Meanwhile, three other variables have significant and positive correlation with WTP in this sample. The first variable is having made a complaint about road quality, and having that complaint resolved satisfactorily. Those who make complaints are likely to be individuals who value the benefit of road use more than the cost of making the complaint. It is, hence, plausible to think that those who complained would state a higher WTP. However, our analysis shows that those who complain translates to a higher stated WTPs *only when their complaints are satisfactorily resolved.* All else the same, having had a complaint satisfactorily resolved increased WTP by around Rp.1,450. Otherwise, having made a complaint had a zero effect on the WTP.

Table 36: Complaints and satisfaction rates, by province

	Observations			% of observations		Satisfaction rate
	Total	Complained	Satisfied	Complained	Satisfied	
Lampung	392	54	27	13.8%	6.9%	50.0%
Central Java	450	64	18	14.2%	4.0%	28.1%
East Nusa Tenggara	456	90	12	19.7%	2.6%	13.3%
West Kalimantan	328	83	34	25.3%	10.4%	41.0%
South Sulawesi	234	78	33	33.3%	14.1%	42.3%

Table 36 presents the breakdown of where these results come from. Overall, we found that about 19.8% of respondents included in our regressions have lodged a complaint about roads. About a third of them received satisfactory responses to their complaints. The province with highest share of respondents complaining is South Sulawesi, while the lowest is Lampung. In West Kalimantan, South Sulawesi and Lampung, about 40-50% of those complaints were responded satisfactorily. The lowest satisfaction rate is found in East Nusa Tenggara, where only 13.3% of complaints were responded satisfactorily.

10 The coefficient for the response to "villagers are helpful to each other" becomes significant (and remains negative) when we remove the variable containing the responses for the "villagers are trustworthy" question.

We also asked each respondent: "To whom do you report your infrastructure problem?" and the respondent can list more than one recipients of their complaints. Table 37 lists the different parties that receive respondents' complaints regarding the roads problems. The top four recipients of respondents' complaints are village officials, followed by the village heads, hamlet head, and head of the neighborhood administration (RT). Among these four, the satisfaction rate was highest for those reporting to the hamlet head, followed by the village head. However, when we see beyond the top four, the highest satisfaction rate was obtained by respondents who lodged their complaints to the infrastructure management group. Since such groups are rarely present in these villages, and the sample size of those reporting to them are admittedly very small.

Table 37: Recipients of respondents' complaints

	Complained	Satisfied	Satisfaction Rate
Village officials	139	43	30.9%
Village head	137	49	35.8%
RW head	95	38	40.0%
RT head	85	20	23.5%
Family and relatives	16	2	12.5%
Gov admin other than vil admin	13	5	38.5%
Project management (e.g., KDP)	10	4	40.0%
Infrastructure management group	7	4	57.1%
Community group/NGO	6	2	33.3%
Regional parliament	3	0	0.0%
Others	3	1	33.3%

The second variable that is associated with a higher WTP is knowledge of how the village allocation fund is used. Those who claim to know how village funds are used, all else the same, have WTPs that are on average around Rp.1,100 higher than those who do not. This finding needs to be interpreted carefully. On the one hand, this may be seen as evidence for the value of greater transparency in increasing people's WTP for public goods. On the other hand, it is also plausible that people who know how village funds are used may have been individuals who have a higher propensity to care about public welfare, and therefore, are more likely to have a higher WTP for public goods irrespective of the level of transparency of village funds.

Finally, the dummy variable indicating that a village receives the village allocation fund (*ADD*) is also positive and significant. Having received the village allocation fund does not reduce one's willingness to contribute for maintenance. At the same time, one needs to be careful not to interpret this as saying that higher village allocation fund levels cause higher WTP. As before, it may well be that factors associated with higher WTPs (such as a higher political awareness) may also be conducive to their villages' receipt of village allocation funds.

Chapter 7

Conclusion

Our study provides an insight into the implicit assumption that villagers are able to finance proper maintenance of rural infrastructure. We found that, with respect to their current welfare, the costs to maintain their infrastructure are significant in our sample villages. When distributed equally across households in each village, the total costs to maintain the village infrastructure in this study—to wit, village roads, bridges, and piped water systems when they exist—amount to between 0.1% and 2.8% of households' total consumption, with a median of 1.1%. If we assume that villagers can supply all of the necessary unskilled labor, maintenance costs amount to between 0.1% and 1.4% of their consumption, with a median of 0.5%. The bulk of these costs come from the cost to maintain rural roads.

While these percentages might appear small, this "local tax" for infrastructure is likely to be burdensome, given the low income of many villagers. Moreover, since income and consumption are not easily observable, it may be difficult to create a mechanism to collect contributions based on household income or consumption share in the village. If we use villagers' stated willingness to pay instead, we find that the resources collected fell well below what would necessary to fully finance these costs. Between 21% (when villagers do not contribute any unskilled labor) and 63% (when villagers contribute *all* unskilled labor) of sample villages would be able to afford the maintenance of all three types of infrastructure. When looked at separately for each infrastructure, the heaviest burden comes from financing roads. Only 21% to 43% of villages would be able to afford road maintenance based on their stated willingness to pay for it.

It is, however, reasonable to think that households may not contribute their full WTP. Our econometric analysis alludes to the presence of the temptation to free ride on other households' contributions. As households did so, total contributions would fall. Under scenarios in which a single-priced monthly per-household user fee are established through a voting procedure, we find the number of villages whose contributions would fell short of those necessary to finance proper infrastructure maintenance increases. Using their WTPs as the basis for calculations, we find that only between 10% and 20% of the sample villages resources collected through these user fees would be adequate to finance the maintenance of all three infrastructures.

Meanwhile, our examination of the determinants of households' WTP to pay for road maintenance shows, as predicted by theory, household income and opportunity costs from a damaged road were positively correlated with WTP. In addition, we also find that the increase in WTP due to increased opportunity costs only happened when households have suffered actual incidences of failed roads and the coefficient was only significant for monetary opportunity cost. We also find that satisfactory responses to complaints regarding road problems increased WTP. Perceived administrative quality of the various levels of governments did not seem to play a major role in influencing WTPs. Interestingly enough, a higher perceived trust of fellow villagers and their helpfulness appears to *reduce* households WTPs.

Chapter 8

Policy Recommendations

Based on these results, we have the following recommendations.

Institutionalize infrastructure maintenance with clearly defined roles and responsibilities for the different levels of administration. Our study finds that there is a significant willingness on the part of villagers to contribute towards infrastructure maintenance, even though their contributions are not adequate to fully finance the all of the necessary maintenance for all of the infrastructure in their villages. For most of the villages, there would be adequate resources to conduct routine maintenance. However, villagers may need significant financial support to ensure that periodic maintenance is conducted properly. This suggests that villagers can take up the responsibility for routine maintenance, especially in the presence of an institution responsible for maintenance (see below). At the same time, district governments and outside agencies need also to step up their support of the types of maintenance activities that villages are unlikely to be able to afford.

District governments need to gradually reallocate resources towards maintenance instead of upgrades. Table 11 suggests that district governments tend to use their resources to support upgrades and rehabilitation efforts instead of periodic maintenance. However, one study suggests that the cost ratio between upgrades and maintenance is about 3.5 to 1 (Dongges et. al., 2007). There is a strong case for a gradual shift from construction and rehabilitation or upgrades towards developing the necessary resources and institutions to undertake rural infrastructure maintenance activities. To quote Dongges et. al. in their discussion of rural roads, policymakers should consider maintenance as "an essential part of the investments in the transport sector, and not as an afterthought only considered when the demands for trunk roads have been taken care of". The same can be said of rural infrastructure generally.

Newly constructed infrastructure needs to be accompanied with a clear maintenance plan, which states clearly the resources necessary to implement it. Our data show that the maintenance costs vary much more than the villagers' willingness to pay. These variations are driven, among others, by local conditions as well as the volume and design of the infrastructure. Accounting for the maintenance costs long after the fact, which may be necessary to estimate the resource gap that needs to be plugged, can be cumbersome, costly, and may not be particularly accurate. On the other hand, these variations are likely to be better understood by the initial implementers of the infrastructure. It is therefore crucial that new projects be accompanied with plans for sustainable maintenance that can be used and understood by the various agencies that may want to be involved in plugging the resource gap.

At the village level, there needs to be a designated institution responsible for maintenance. Our data suggest that villages do implement routine maintenance on their own. However, as suggested by Dongges et. al. (2007, p.19), these routine maintenance can be implemented more efficiently if they are implemented at the correct time. This is likely to apply in the case of periodic maintenance. Moreover, these activities will require villager contributions—which are likely to be forthcoming only if these villagers recognize the value of participating in maintenance activities. Our study finds villagers' willingness to contribute is positively and significantly correlated with the responsiveness of an institution in immediately addressing reported infrastructure problems. This designated institution (or person) can therefore act to coordinate maintenance efforts as well as respond to potential problems. Having an institution responsible for maintenance—which may well come from an existing village institution—will be instrumental in ensuring the sustainability of the maintenance efforts.

The assignment of maintenance activities to villagers needs to take into account the possibly unequal distribution of burdens towards poorer households. Our data show that maintenance costs can be reduced significantly when villagers are expected to contribute all of the unskilled labor. However having villages supply all unskilled labor may amount to a regressive "informal tax", where poorer households "pay" more (in the form of labor) for public goods.[11] It is important to address this potential issue in the process of institutionalizing maintenance activities at the village level.

11 For a discussion of this "informal tax", see Olken and Singhal (2009).

There needs to be further study of effective and efficient means to collect and channel resources to ensure that village infrastructure is well-maintained in the long term. This study provides an insight into the resource gaps faced by villagers in fulfilling the maintenance requirements for their infrastructure. It also suggests a role for outside agencies, including but not limited to district governments, to support maintenance efforts in villages. However, we still lack a good understanding on effective mechanisms to deliver resources in a manner that ensures that infrastructure is well-maintained in the long term or whether different mechanisms work better for certain types of infrastructure and communities, but not on others. Moreover, we also need to understand more the effectiveness of different resource collection strategies for different types of infrastructure to improve the design of the village-level maintenance institutions.

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