Postharvest horticultural losses along a commercial tomato supply chain in Fiji

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Pacific Agribusiness Research for Development Initiative (PARDI)

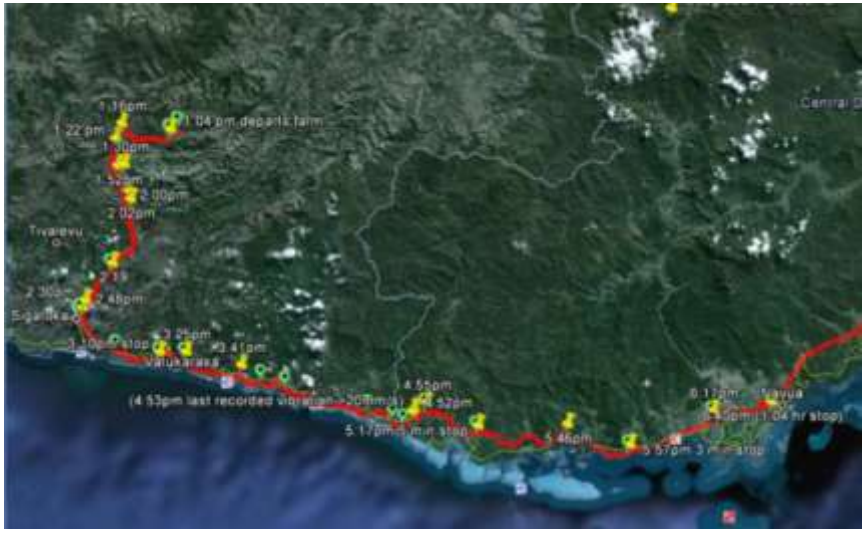
Background

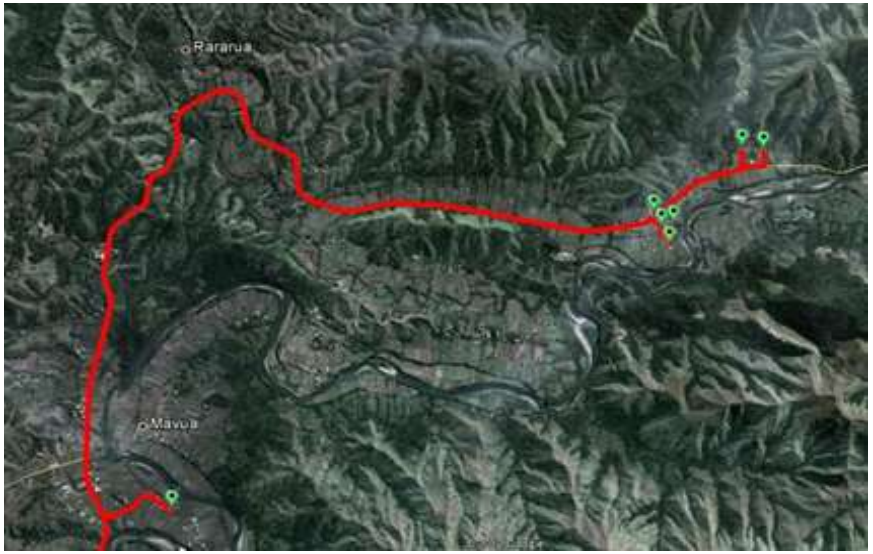
Problem: Fiji growers currently have limited access to high-value domestic market due to consistency of supply and product quality constraints

Our approach: Develop a participatory guarantee scheme between growers and hotels based on agreed quality and supply. Support this with relationship with grower collaborative network assistance and improved postharvest handling protocols.

Postharvest handling element:
Analyse pre-existing postharvest vegetable supply chains in terms of risk, quality and wastage. Then develop tailored low-cost solution specific to local conditions.


Western Division
Fiji
Nadi
Fiji
Central Division
Suva


1.04 pm departs Tavua
Tvarevu
Tavua


Rararua
Mavua

Day 0 – pre-harvest in the field

Day 1 to 4 ambient ripening

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Day 5 – packing in plastic boxes

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Day 6 (3pm)– departs farm

Day 0 – pre-harvest in the field

Day 1 to 4 ambient ripening

Day 5 – packing in plastic boxes

Day 6 (9pm) arrives at Suva markets

Day 6 (3pm)– departs farm

Day 0 – pre-harvest in the field

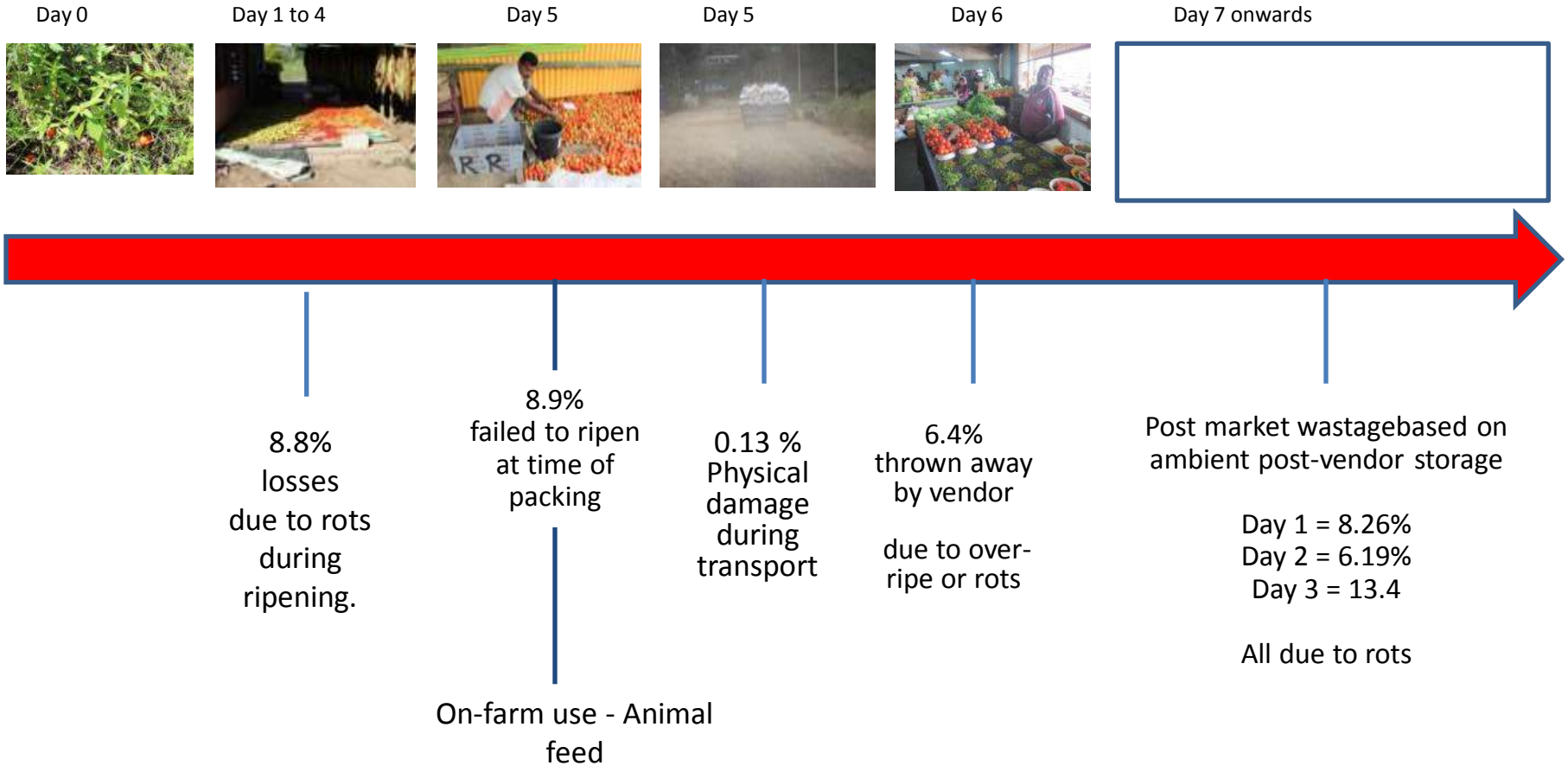
Day 1 to 4 ambient ripening

Day 7 Fruit for sale at the Suva municipal markets

Day 5 – packing in plastic boxes

Day 6 (3pm)– departs farm

Day 6 (9pm) arrives at Suva



Commercial postharvest wastage = 32.93% (farm to vendor)
Projected further 14.45 % loss post-vendor if fruit not consumed within 48hours

If there was a 1 day delay/break in the chain loses (and a 48hr post-vendor consumption) total postharvest wastage = 60.78%.

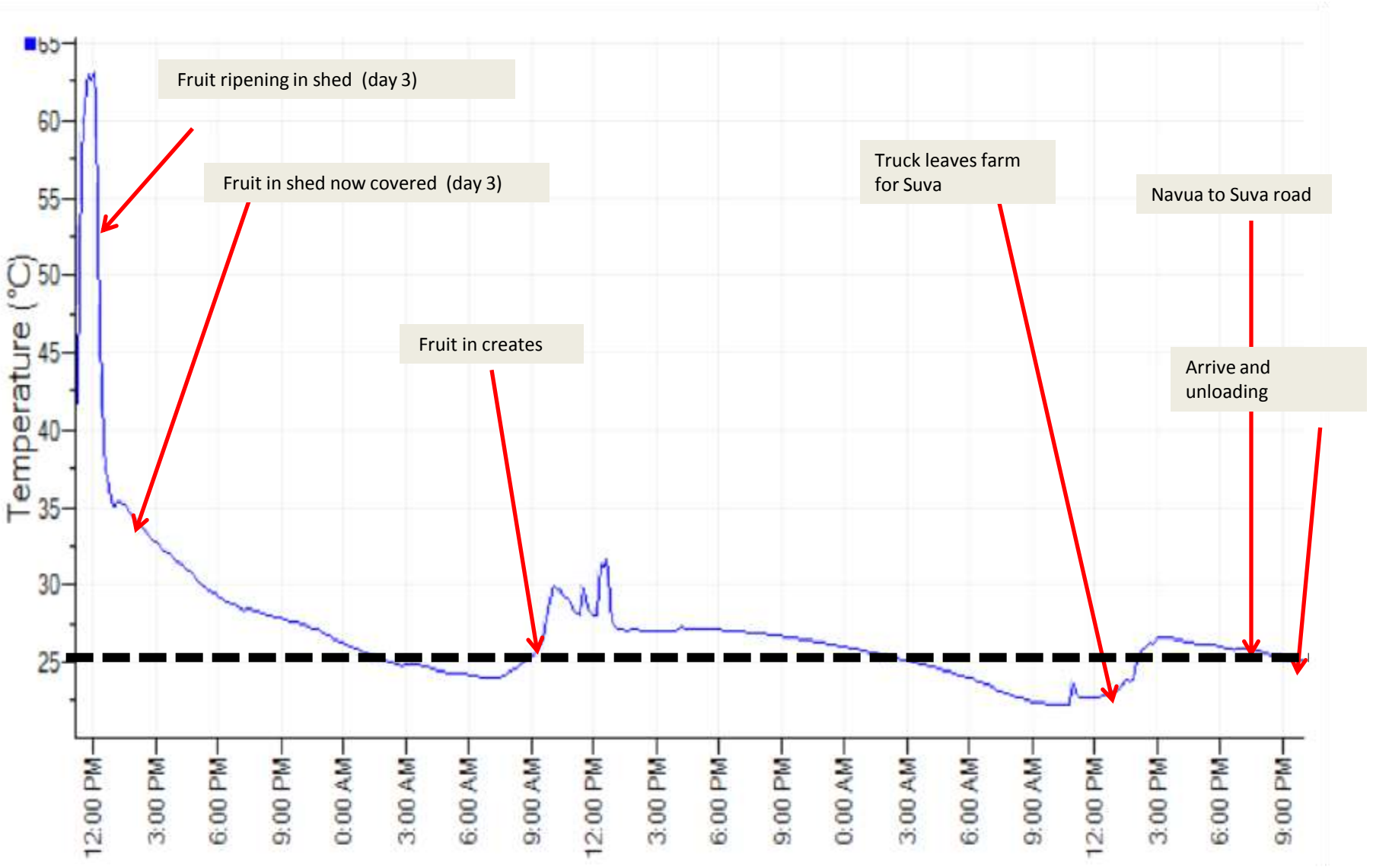
All the postharvest wastage was due to pathogen based spoilage associated with yeasty rot (*Geotrichum candidum),* Anthracnose (*Colletotrichum coccodes)* and Penicillium rot

Table 2: What happens to tomatoes removed from the commercial supply chain

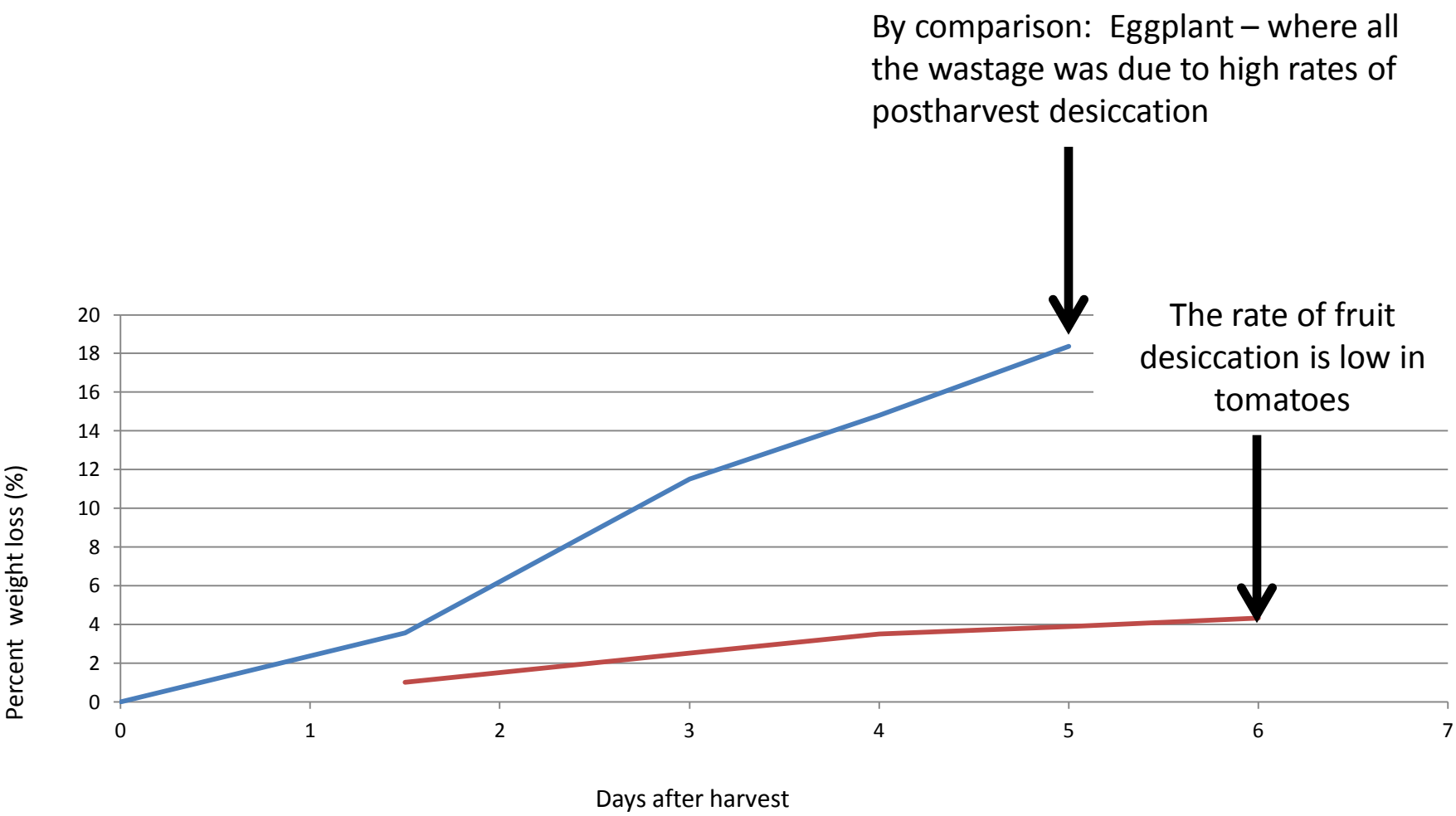
End use of non-commercially traded product	Crop wastage (percentage)*
Home use and intra-community traded	11.0
Feed to domestic livestock (pigs and chickens)	6.34
On-farm and municipal refuse (non-composted)	14.69
Product end use not identified	0.9
Total product removed from the chain	**32.93**

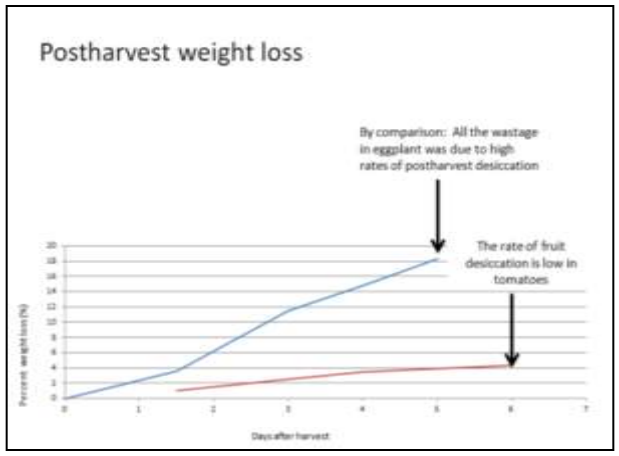
* Value expressed as a percentage of total crop harvested

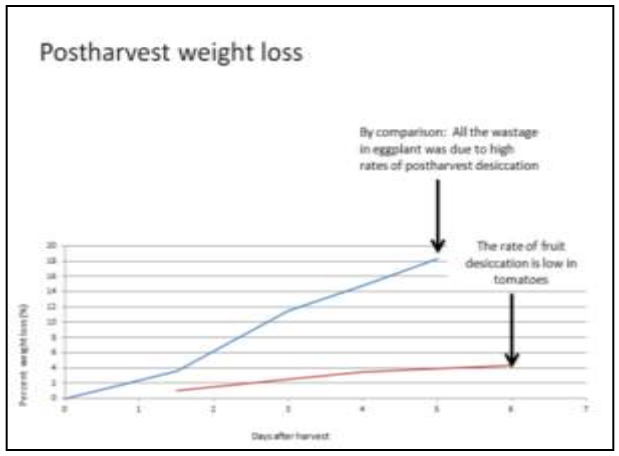
Fruit storage temperature on-farm and during transport to Suva markets



Postharvest weight loss




Postharvest weight loss
By comparison: All the wastage in eggplant was due to high rates of postharvest desiccation
The rate of fruit desiccation is low in tomatoes
Percent weight loss (%)
Days after harvest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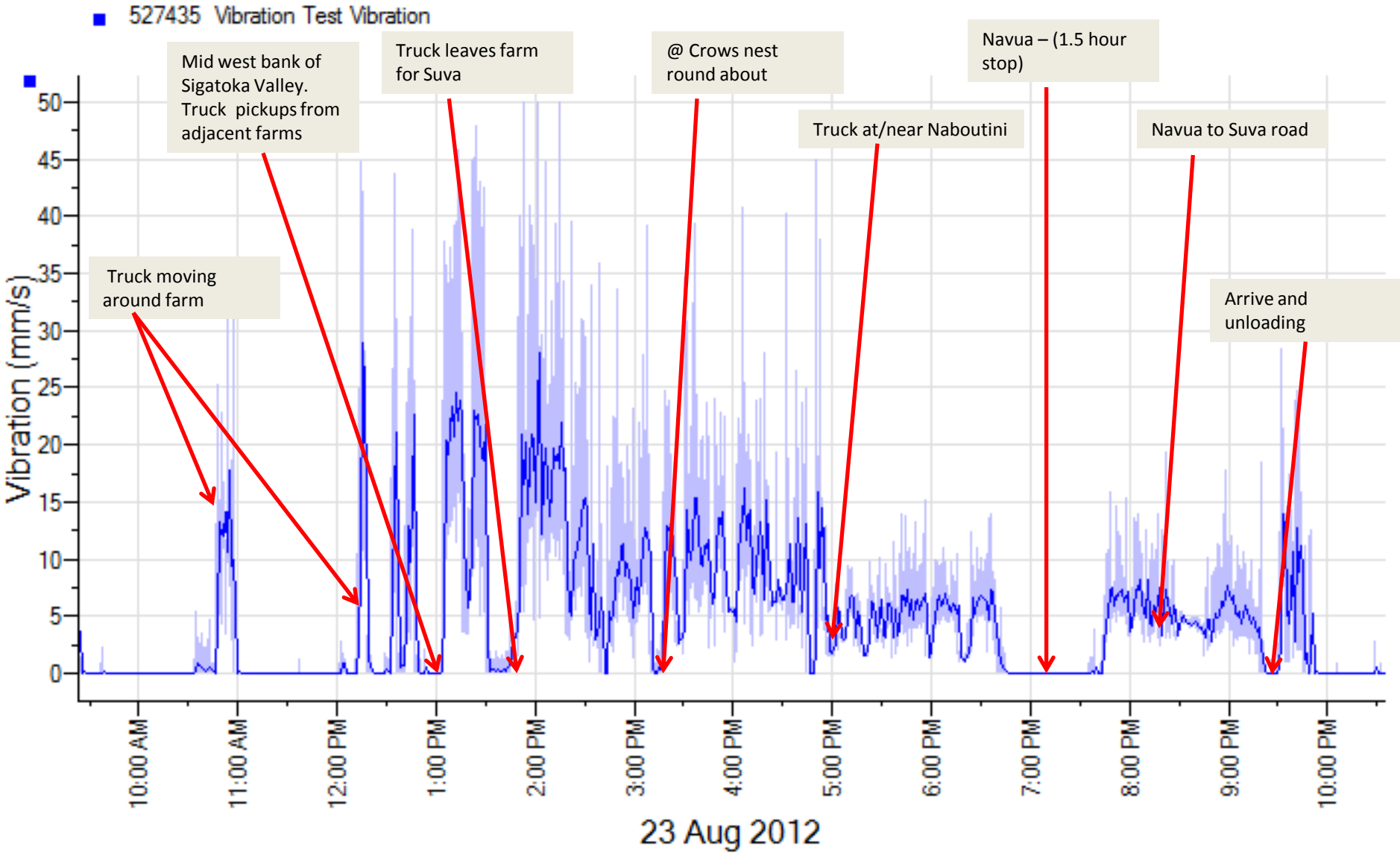
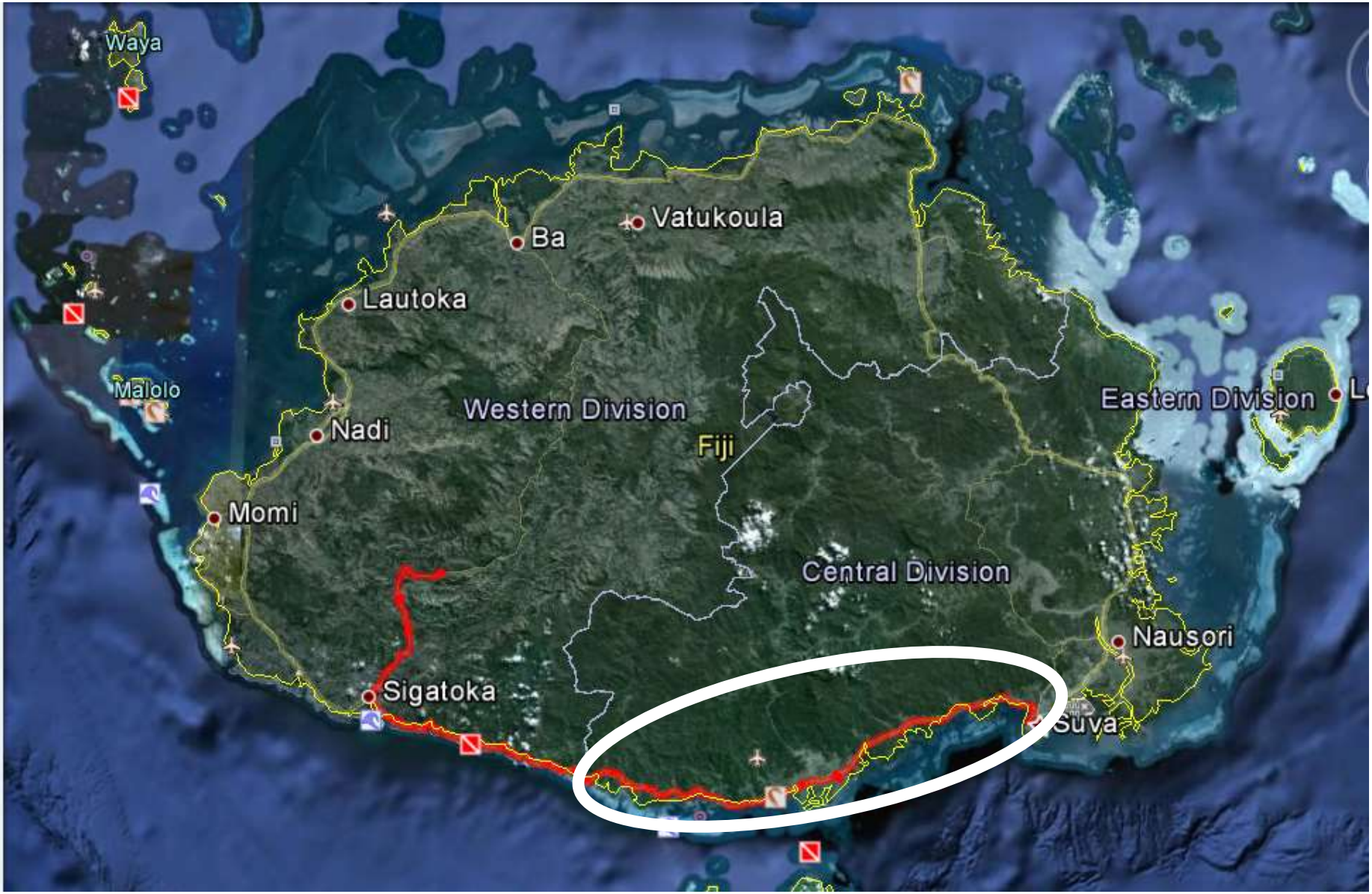
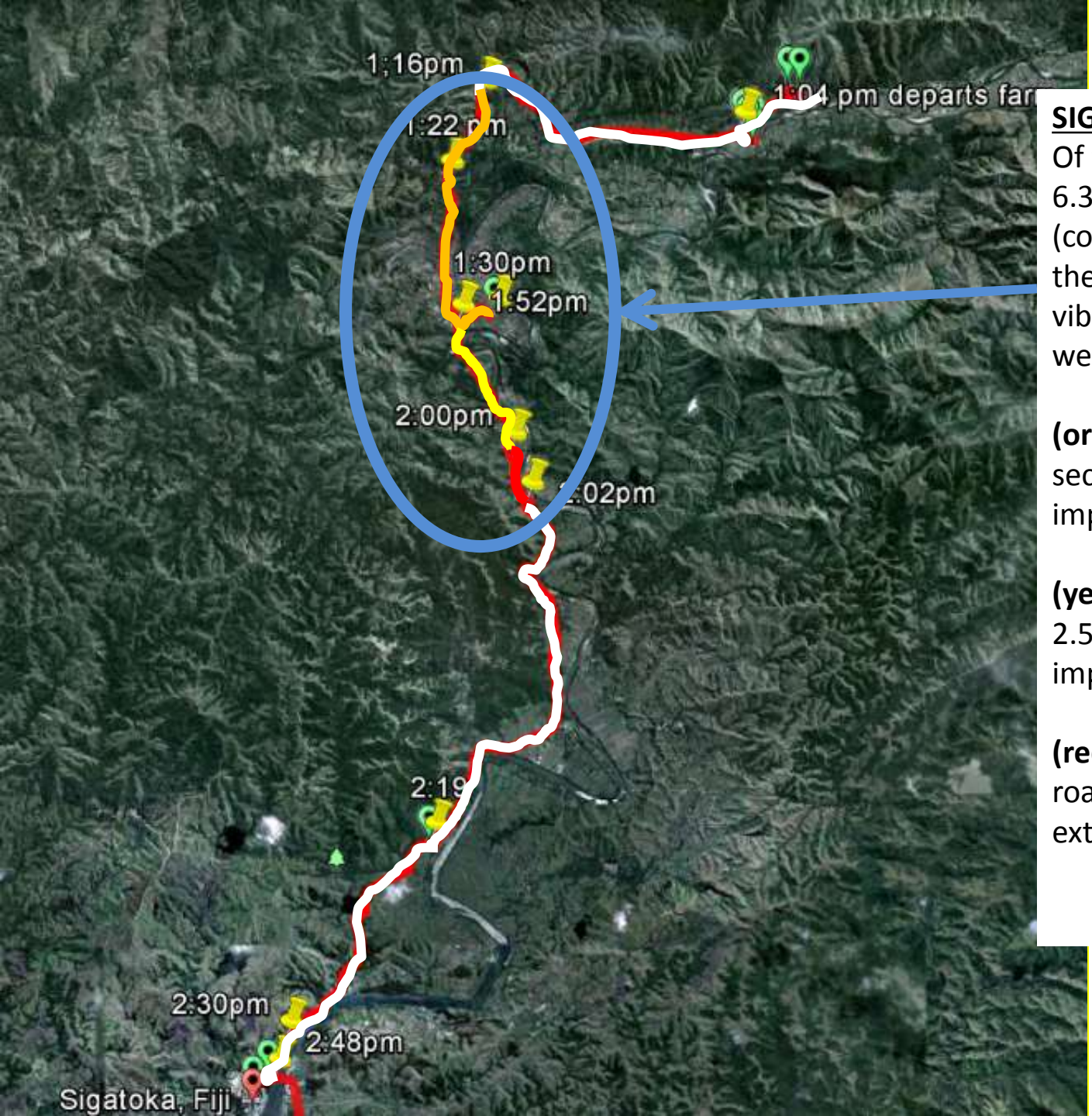
Incidence of vibration/impact loading during transport




Waya
Ba
Vatukoula
Lautoka
Malolo
Western Division
Nadi
Fiji
Eastern Division
Momi
Central Division
Nausori
Sigatoka
Suva



SIGATOKA VALLEY ROAD

Of the total trip there was a 6.33 km section (commencing 6.08 km from the farm) where most of the vibration and impact events were observed

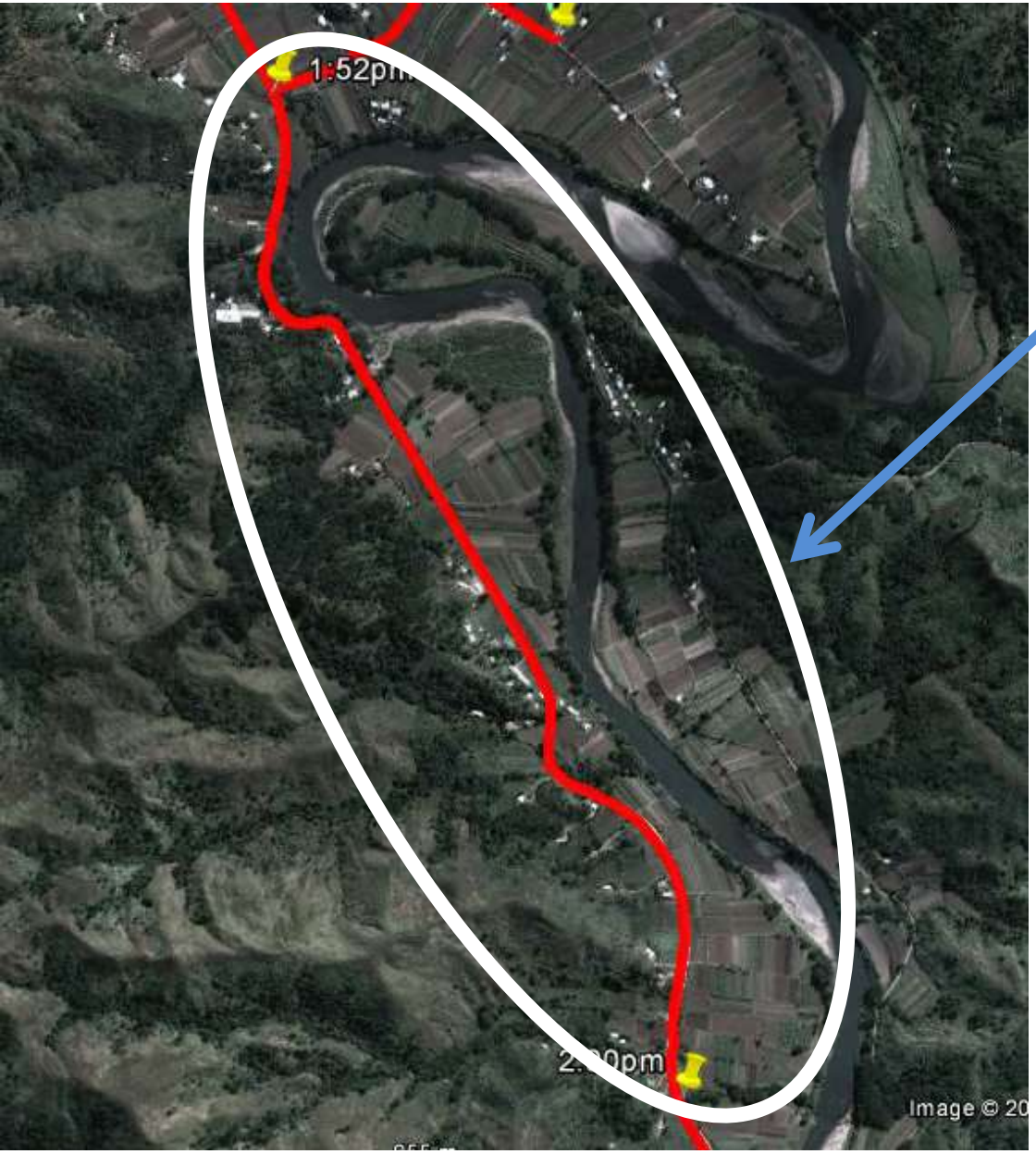
(orange) First 2.74Km section had 2.55 extreme impact events /km

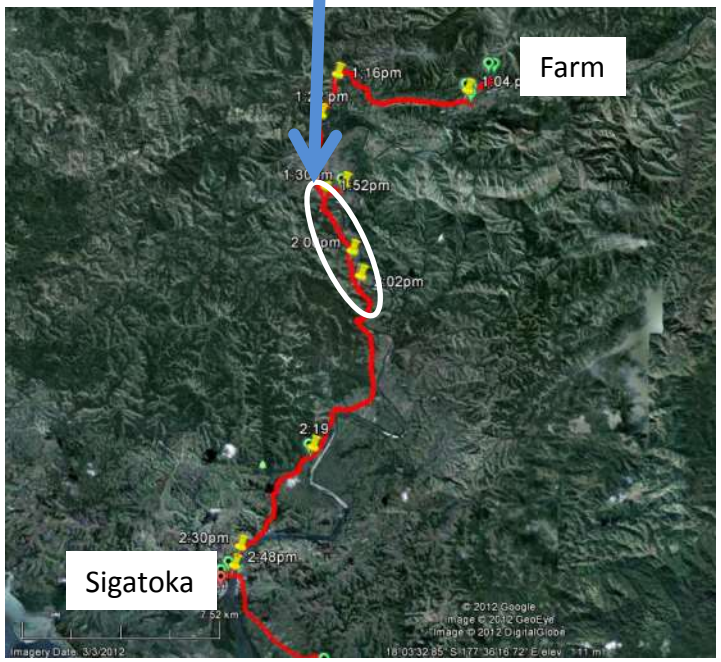
(yellow) The second section 2.58 km had 2.33 extreme impacts events/km

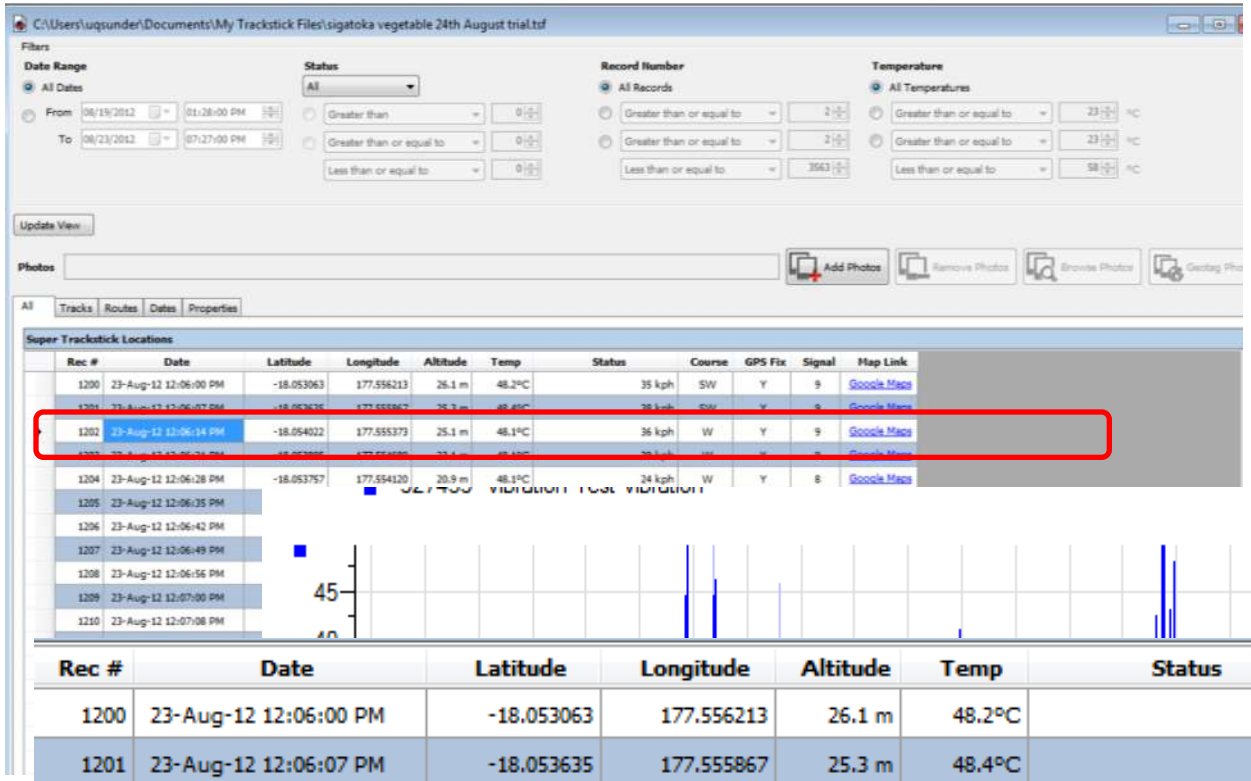
(red) the third section of road 1.01km had 3.96 extreme impacts events/km

Highest number of medium to high vibration events
19.37 (>20mm/s/km)

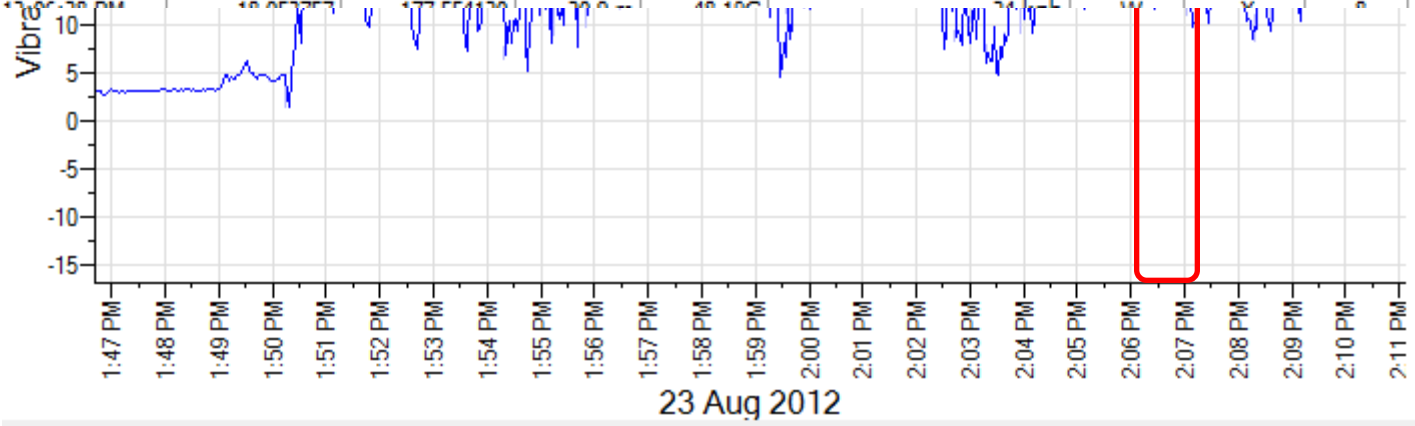
Third worst part for the trip for impacts
3.96 events (>40mm/s/km)







Rec #	Date	Latitude	Longitude	Altitude	Temp	Status	Course	GPS Fix	Signal	Map Link
1200	23-Aug-12 12:06:00 PM	-18.053063	177.556213	26.1 m	48.2°C	35 kph	SW	Y	9	Google Maps
1201	23-Aug-12 12:06:07 PM	-18.053635	177.555867	25.3 m	48.4°C	38 kph	SW	Y	9	Google Maps
1202	23-Aug-12 12:06:14 PM	-18.054022	177.555373	25.1 m	48.1°C	36 kph	W	Y	9	Google Maps
1203	23-Aug-12 12:06:21 PM	-18.053895	177.554680	23.1 m	48.1°C	39 kph	W	Y	9	Google Maps



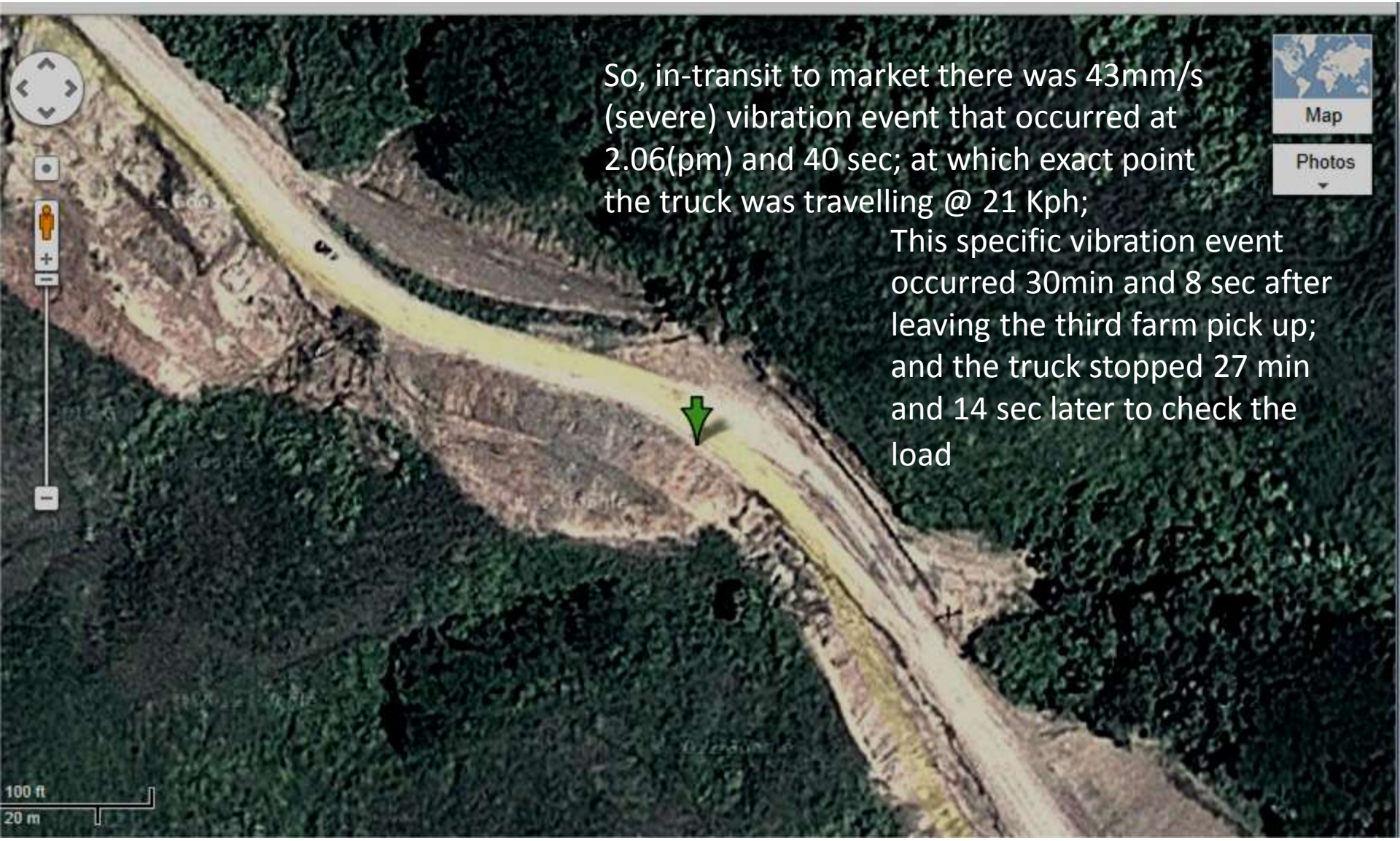

So, in-transit to market there was 43mm/s (severe) vibration event that occurred at 2.06(pm) and 40 sec; at which exact point the truck was travelling @ 21 Kph;
This specific vibration event occurred 30min and 8 sec after leaving the third farm pick up; and the truck stopped 27 min and 14 sec later to check the load
Map
Photos
100 ft
20 m

Table 3. The incidence of truck load vibration associated with commercial road transport from a farm in the middle sigotoka valley to the central municipal markets in Suva, Fiji.

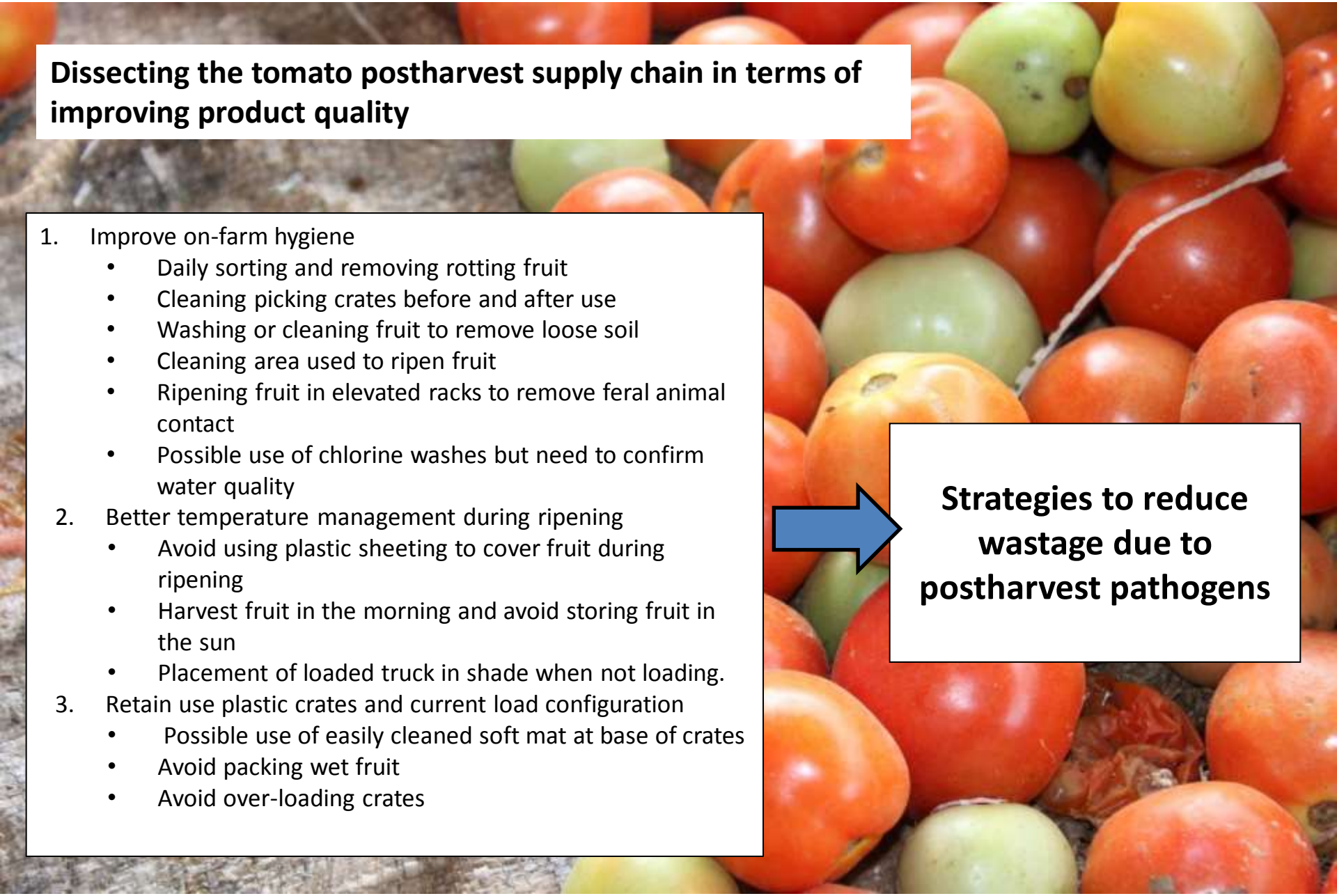
Sections of the transport	Road type	Distance (km)	Average speed (km/hr)	Total number of vibration events (>20mms/km)	Number of high intensity vibration events (>40mms/km)
Farm (Tonga) to Quanasau Ck	unsealed*	5.13	21.28	12.09	0.78
Quanasau creek to Nawalcoba	sealed	0.95	24.13	1.05	0.00
Nawalcoba to lower Bilalevu	unsealed*	2.74	26.75	18.25	2.55
lower Bilalevu to Vulo	unsealed	2.58	23.37	19.38	2.33
Vulo road works (VRW)	unsealed†	1.01	31.18	14.85	3.96
VRW to Nacocolevu	unsealed†	5.47	30.76	10.42	0.73
Nacocolevu to Sigatoka town	unsealed‡	3.45	27.60	3.77	0.00
Sigatoka to Vatukarasa	sealed§	11.28	32.09	1.15	0.00
Vatukarasa to Tagaqo	sealed§	5.71	35.89	2.80	0.00
Tagaqo to Komare	sealed§	12.04	34.43	1.33	0.00
Komare to Naboutini	sealed §	5.97	25.59	2.68	0.34
Naboutini to Suva	sealed	64.86	32.60	0.02	0.00
Totals		**121.19**		**87.79**	**10.69**

*dirt road in poor condition

†dirt road undergoing extensive road works

‡dirt road that has been graded

§sealed bitumen road with a large number of speed bumps associated with adjacent community settlements



Dissecting the tomato postharvest supply chain in terms of improving product quality

1. Improve on-farm hygiene
   - Daily sorting and removing rotting fruit
   - Cleaning picking crates before and after use
   - Washing or cleaning fruit to remove loose soil
   - Cleaning area used to ripen fruit
   - Ripening fruit in elevated racks to remove feral animal contact
   - Possible use of chlorine washes but need to confirm water quality
2. Better temperature management during ripening
   - Avoid using plastic sheeting to cover fruit during ripening
   - Harvest fruit in the morning and avoid storing fruit in the sun
   - Placement of loaded truck in shade when not loading.
3. Retain use plastic crates and current load configuration
   - Possible use of easily cleaned soft mat at base of crates
   - Avoid packing wet fruit
   - Avoid over-loading crates

Strategies to reduce wastage due to postharvest pathogens

Dissecting the postharvest supply chain in terms of improving product quality

BUT the assumption here is that grower postharvest behaviour is based on limited knowledge of good postharvest handling practices

Postharvest behavioural contributors

<u>Positive inadvertent behavioural</u>

1. Packing and pre-loading tomato crates first – **lowers risk of vibration and impact loading stress.**
2. Use of recycled plastic crates (to reduce cost) – **better in-transit protection.**
3. Slow truck speed due to level of loading and vehicle age – **reduction of impact loading**
4. On-farm ripened fruit (while market-based) **– less prone to vibration loading**

<u>Negative behavioural detractors</u>

1. Stage of ripeness at harvest - **inconsistent with time available to harvest**
2. No sorting and removing rotten fruit during – **compounding pathogen losses**

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Postharvest behavioural contributors

Fruit picked hard green
why - *reduce bird damage? weekly picking cycle* ? Normally practice ?

Harvesting hard green makes it *more difficult to identify/achieve uniform maturity and stage of ripen*

Consequence
8.9% of the harvested crop failed to ripen at time of packing – wastage

To speed up the on-farm ripening, unripe fruit separated

To speed up the on-farm ripening, grower places under plastic sheeting or left in the sun.

Consequence
8.8% of the harvested crop rotten at time of packaging due to high ripening temp /humidity – wastage

Fruit not sorted daily during to remove rotten fruit .**- Why?**

Consequence
6.4% of the harvested crop rotten on first day of trading at the Suva markets AND a further 14% rotten if not consumed with 48hr of purchase.

Postharvest behavioural contributors

Harvest breaker-stage tomatoes
which will ripen in 25C in 5 days

1. *Negates need to warm fruit to ripen in time – reducing pathogen risk*
2. *Reduced losses due failing to ripen*
3. *Reduced on-farm*

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While improving on-farm hygiene and better storage temperature management are important, some of these problems could be avoided by improving harvesting practices.

Final Key message – While there are numerous postharvest factors contributing to high rates of wastage – before we seek to remediate postharvest chain efficiency we need to fully identify the **KEY rate determinant factor(s) as well as any inadvertent supportive behaviour.**

Road and transit conditions have the potential to cause damage, but in this case did not – short and quick transport distances, used of plastic crates, load configuration and possible ripeness/partial desiccation contributors.

Thank-you