



Effect of Packaging on Tomatoes in Local and Regional Supply Chains

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Background-the issues

Tomatoes are a high-value crop - production of 130,000 t/y = over 50% of vegetable production, sold in neighboring countries.

Waste is high - poorly harvested, left in the hot sun for many hours, and transported for long distances on bumpy roads using inappropriate transport means...

Packing practices are poor - overpacked in crates, left in the sun, and transported on bumpy roads.



Issues with packaging

- Mostly used wooden crates are made of rough inner surfaces, inflicting damage on tomatoes.
- Filling is done by strongly compressing tomatoes against each other in crates to allow in more tomatoes
- Many tomatoes are crushed against the sharp edges
- Crates are lifted and allowed to hit the hard ground to create space for more extra tomatoes
- Top tomatoes are secured by a paper box held firmly in place with ropes
- The weight of tomato crates when full is abnormally high, with the heaviest reaching nearly 60kg.
- Approximately 15kg of tomatoes/above 30% of the total, are added through overpacking



Initial studies of tomato losses

1

Smooth, firm,
unblemished



2

Slight damage,
still acceptable,
no price
change



3

Significant
damage or very
slight rot,
saleable but
price reduced



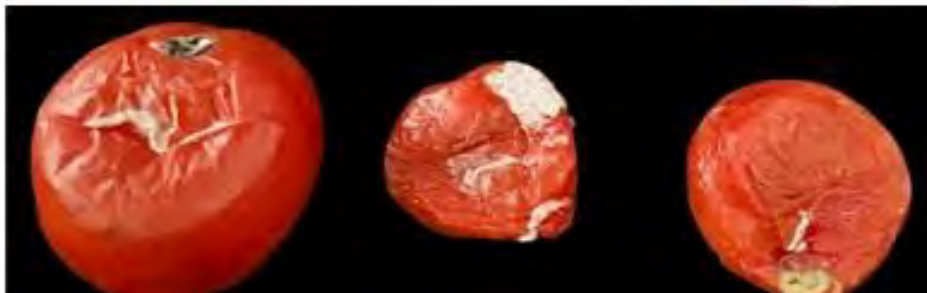
4

Damage up to
50% and / or
significant rot,
not normally
saleable, only
partly edible



5

Major rot or
bruise affecting
>50%, not
edible



Crates purchased from the markets for
assessment



Initial studies on the level of damages

Tomatoes were left at ambient conditions for two days to simulate purchase and then resale by a small retailer

Tomatoes from each crate were sorted into groups by their position in the crate:

- ▶ Top
- ▶ Side
- ▶ Middle
- ▶ Base

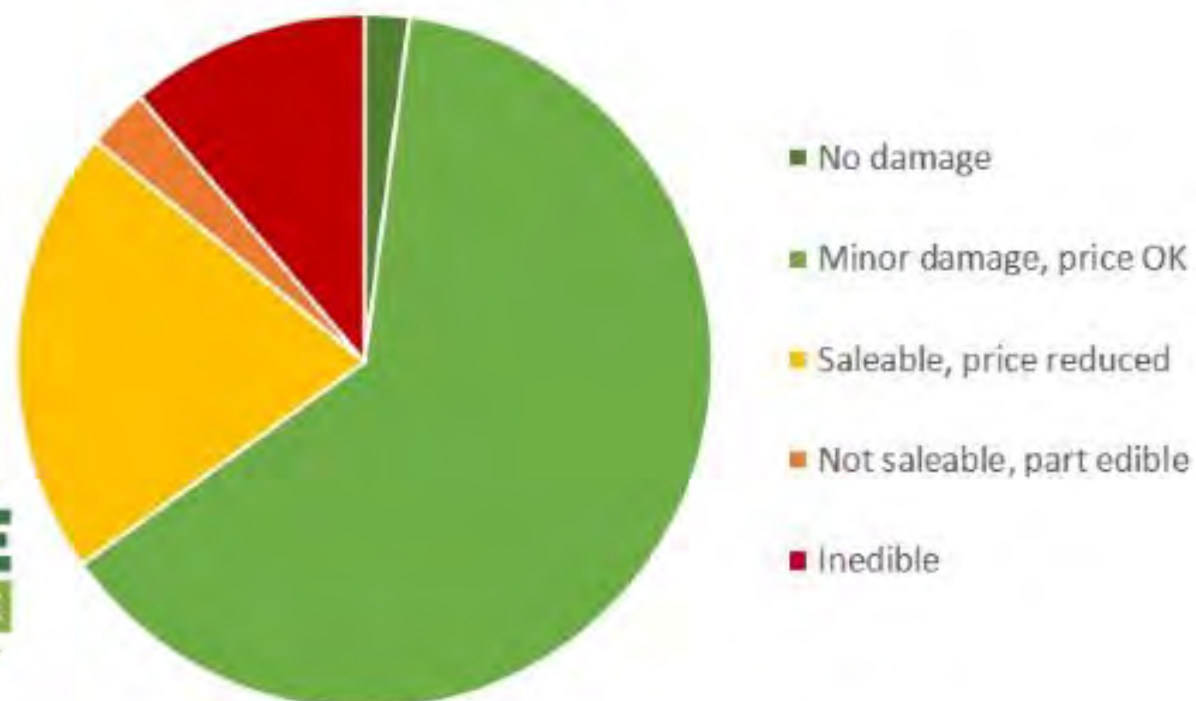
Each group was then divided into grades 1 to 5, each grade was counted and weighed



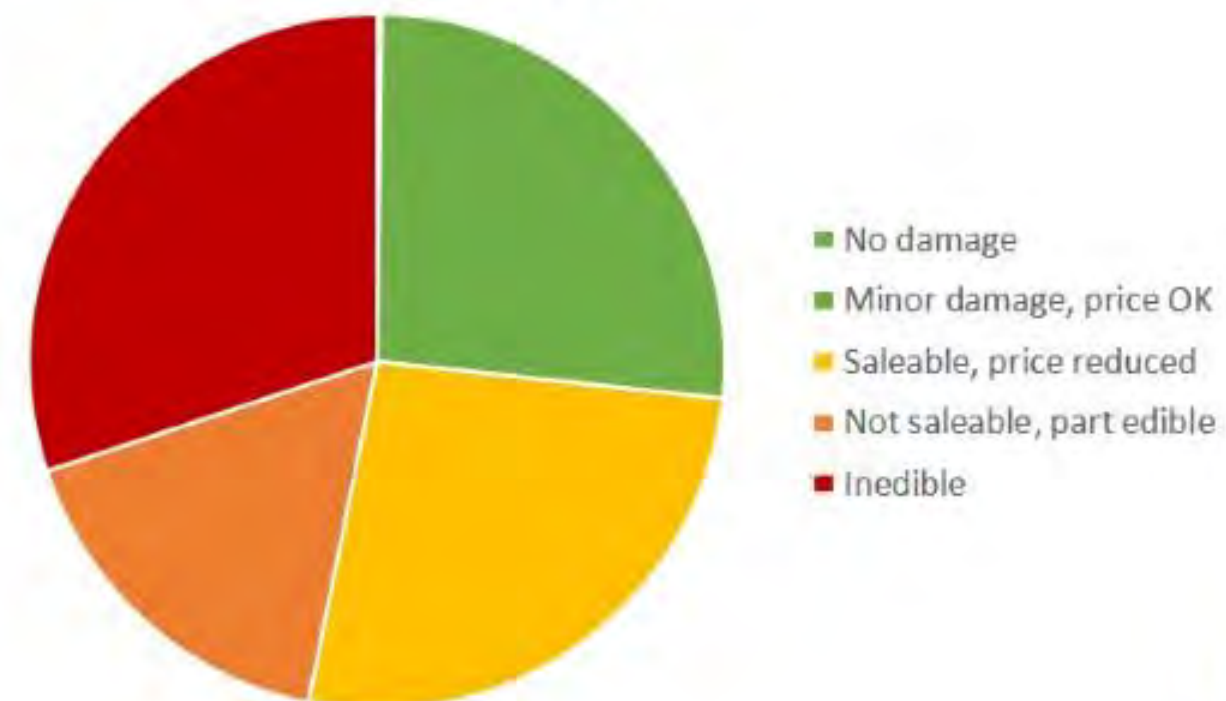
Damage levels

- Not many tomatoes were available, and prices were high
- Damage was significantly worse when tomatoes were already very ripe at purchase
 - ▶ More than 30% of all tomatoes purchased were unsaleable (grade 4 or 5)
 - ▶ Only 44.5% of all tomatoes purchased could be sold at their normal/existing price (grade 1 or 2)

Purchased partly ripe, assessed after 2 days

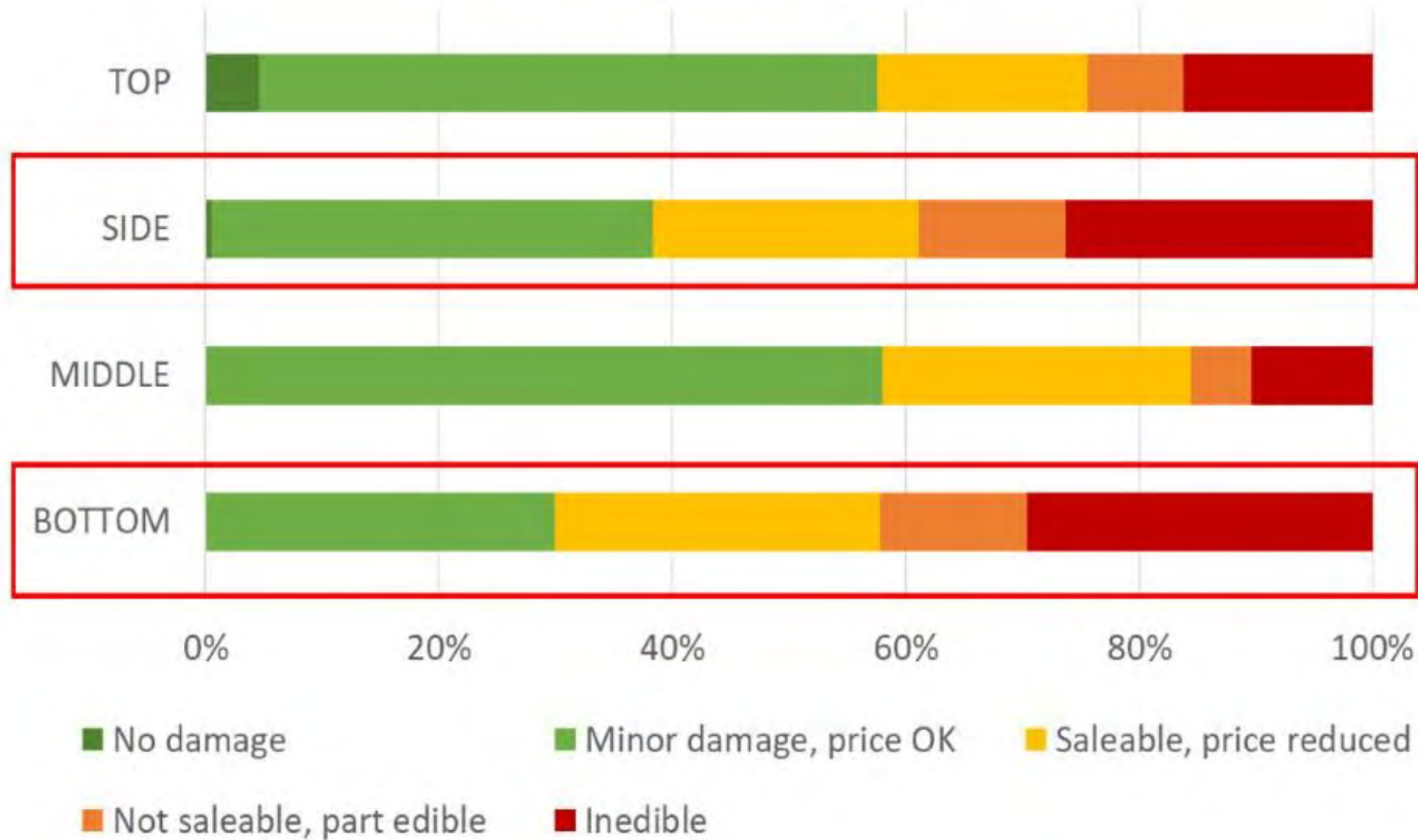


Purchased fully ripe, assessed after 2 days



Damage levels

Damage by location in the crate
(% of fruit in each grade)



Initiatives for damage reduction

Reduce damage by:

- ▶ Not overpacking
- ▶ Lining the crate
- ▶ Using a plastic crate

❑ Initial trial September 2023 – Nduruma to Kilombero

❑ Scaled up with multiple value chains from January to February 2024

Ngarenayuki to Kilombero x 2 (67km)

Manyire to Kilombero (27km)

Mbuguni to Kilombero (40km)

Mabogini to Mbuyuni (15km)

Miwaleni to Mbuyuni (27km)

Kibosho to Mbuyuni (50km)

Kibosho to Mbuyuni (35km)

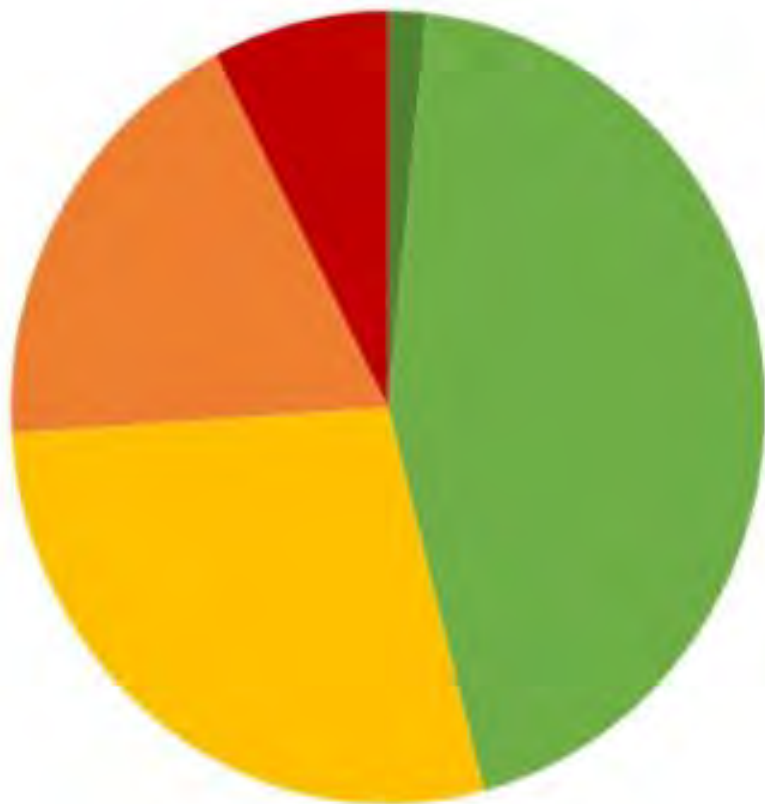
❑ Trial from Arusha to Dar es salaam May 2024 (630km)



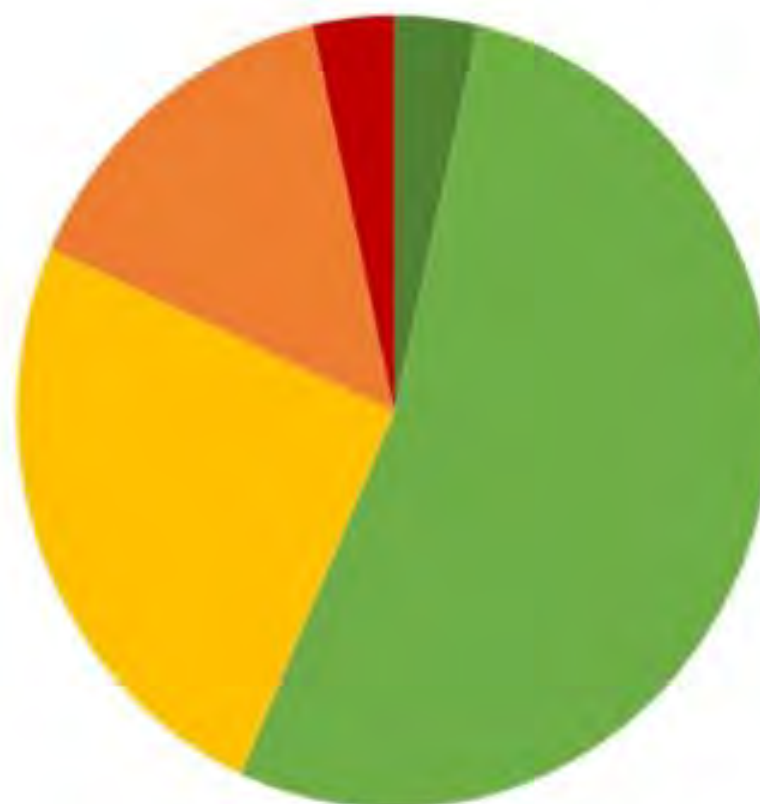
Results – Differences between packing methods

- Traditional packing had the worst outcome
- Adding a paper lining provided a significant improvement
- Plastic crates significantly reduced damage compared to the other methods

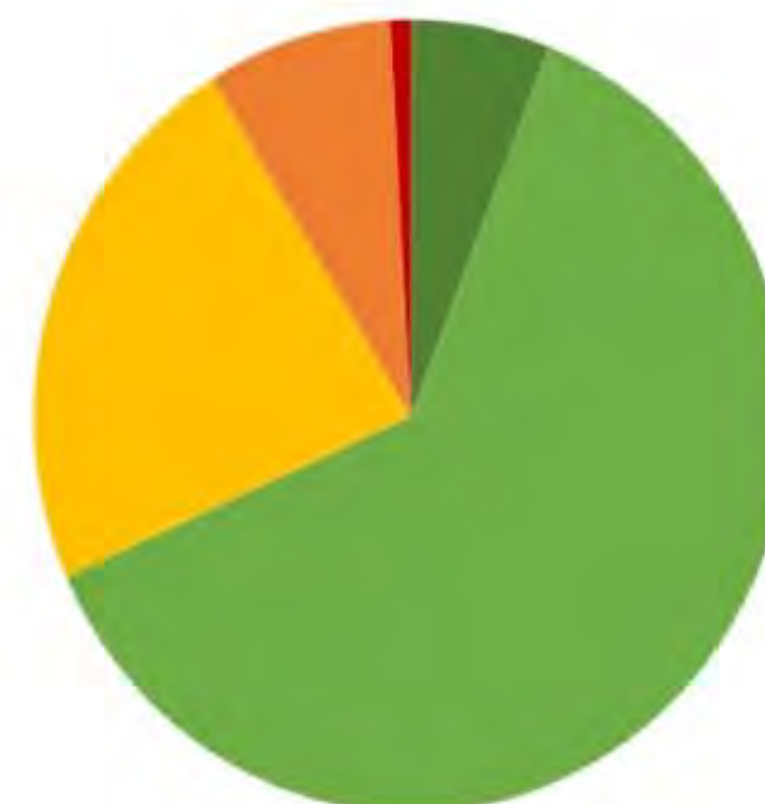
Traditional packing



Paper lined crate

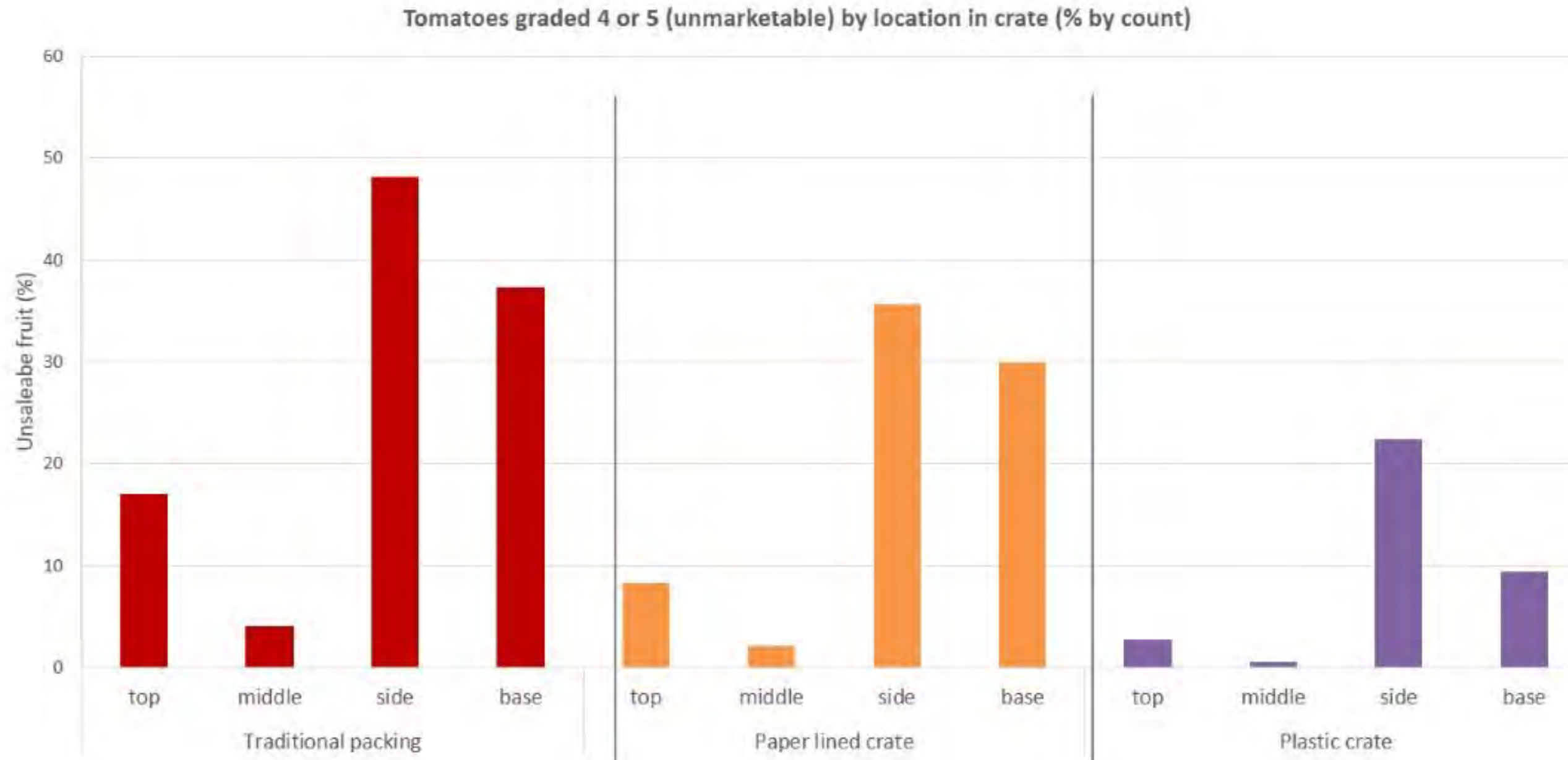


Plastic crate



Results – Differences between packing methods

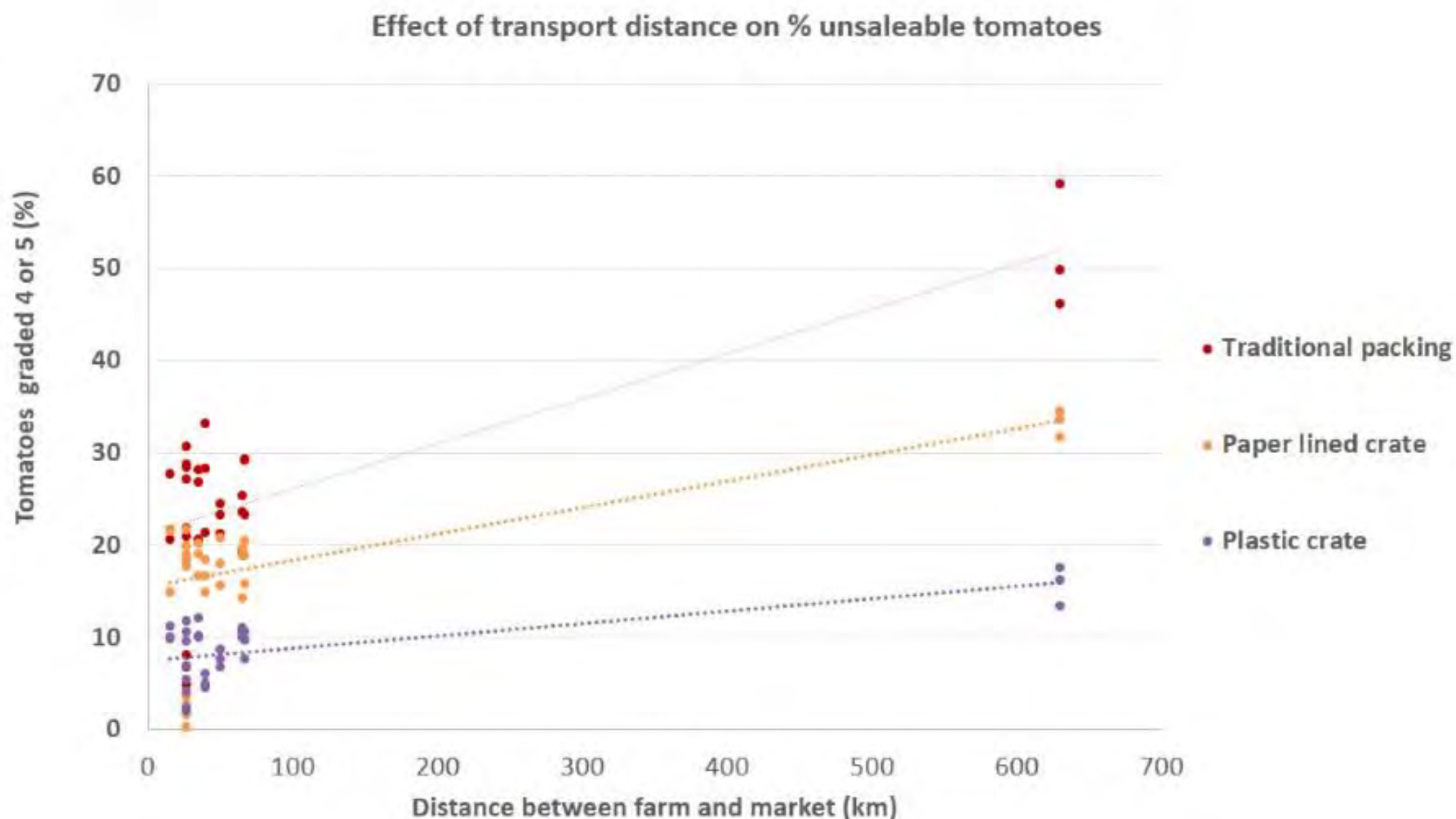
- Avoiding overpacking reduced damage in the top layer of the crate
- Lining the crate with paper reduced damage caused by the sharp edges of the side slats
- The plastic crate reduced damage in all areas, but the biggest improvement was at the base of the crate



Results – effect of transport distance

Transport had most effect on end quality when tomatoes were traditionally packed

- ▶ The percentage of unsaleable fruit increased by 0.049% for every kilometer travelled in traditional crates
- ▶ There was NO significant effect of transport distance in plastic crates



There was no difference between Kilombero and Mbuyuni markets. Damage was significantly higher in Dar es Salaam but both transport distance and days since packing were greatly increased.

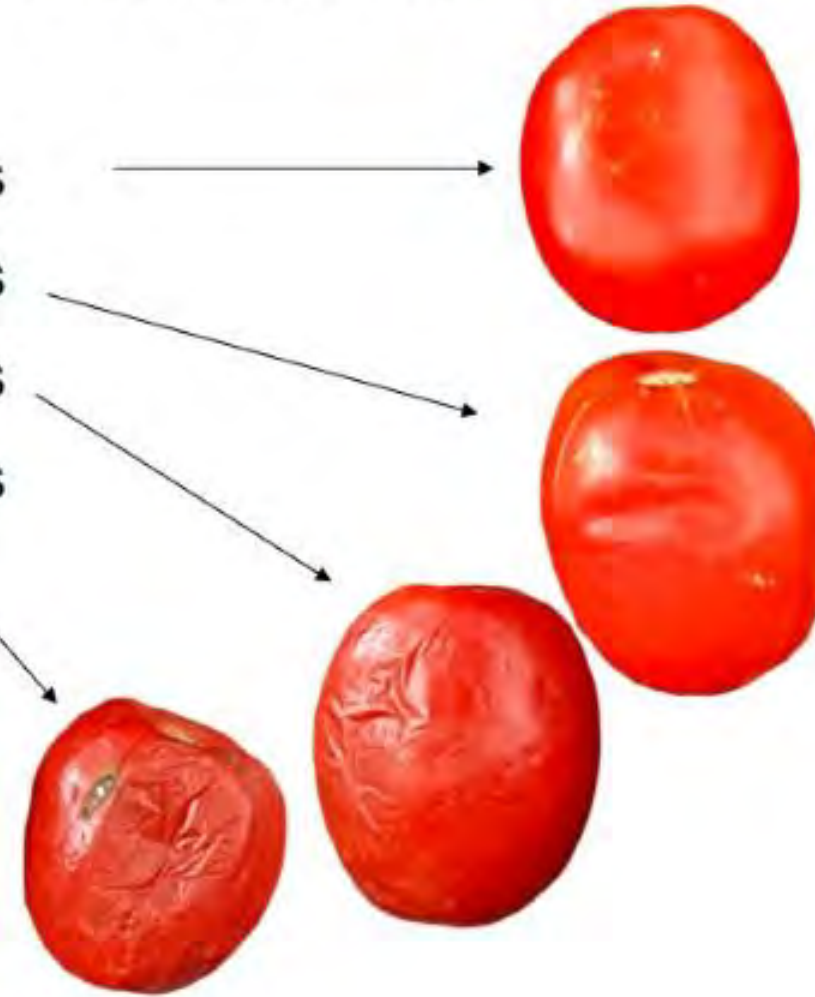
How much does this damage cost?

Depends on many factors

- ▶ Are tomatoes in short supply, or are there plenty to choose from?
- ▶ How much are people willing/able to pay?
- ▶ How important is quality? In Dar es salaam vs Arusha?

• BUT if we assume

- ▶ Grade 1 – 450 Sh. per 6 fruits
- ▶ Grade 2 – 400 Sh. per 6 fruits
- ▶ Grade 3 – 250 Sh. per 6 fruits
- ▶ Grade 4 – 100 Sh. per 6 fruits



How much does this damage cost?

	Total fruit counted					Total fruit	Potential estimated value (all grade 2)	Actual estimated value (\$)
	1	2	3	4	5			
Traditional pack	230	6,242	3,892	2,538	1,039	13,941	929,400	597,242
Paper lined crate	452	7,005	3,423	2,022	471	13,373	891,533	645,217
Plastic crate	815	8,667	3,166	1,105	121	13,874	924,933	772,534

Barriers to use of plastic crates

All costs are PER CRATE not PER KILO

- ▶ Common, stackable plastic crate designs hold less than wooden crates
- ▶ Packing, transport, carrying, market fees would all increase as normal plastic crates carry a smaller volume
- ▶ Larger plastic crates are available (and used in this trial) but do not stack, so difficult to transport

Plastic crates are expensive and need to be returned

- ▶ Who buys / owns them
- ▶ How do they get back to the farm from the small retailer (another cost)
- ▶ How to stop 'leakage' (as crates are very useful for many things)
- ▶ Need to be cleaned in between uses – who will do this?

People are not used to them

Conclusion

- The study concludes that plastic crates are the most appropriate containers for tomato packaging during transportation
- Market fees, transportation, and other associated costs are still calculated crates-wise in many places. Unless estimates are done in weight, plastic crates, which do not contain the weight of the wooden crates may face challenges. The study recommends that plastic crates match the weight of wooden crates or find a solution for over-packed wooden crates to harmonize the situation.
- The study also recommends that further experiments be tried on a bigger scale with actual traders to gauge the perception of uses for the technology and collect further information.
- For the technology to be quickly adopted, a few issues need to be considered;
 - Plastic crates cost more than four times the cost of a wooden box. Without a sound system to return the crates, transaction costs may increase.
 - Returning plastic crates to owners could be tedious and extra costs for collection and transportation. The study recommends using collapsable crates, which occupy less space during transportation when empty.



Thank You



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