Performance of locally made low-cost evaporation cooling pad alternative to commercial pad

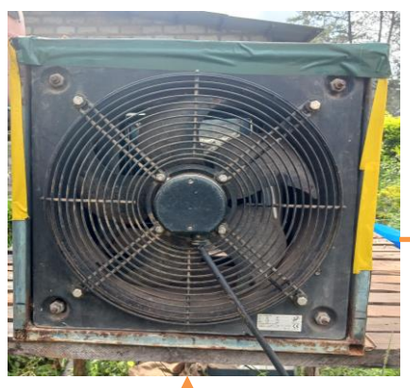
Yetenayet B. Tola[1], Tolcha Techane[1] , Hayat Mohammed[1,] Franz Roman[2], Oliver Hensel[2], Werner Hofacker[3]

[1]Jimma University, Ethiopia; [2]University of Kassel, Agricultural and Biosystems Engineering, Germany; [3]University of Applied Sciences Konstanz Germany

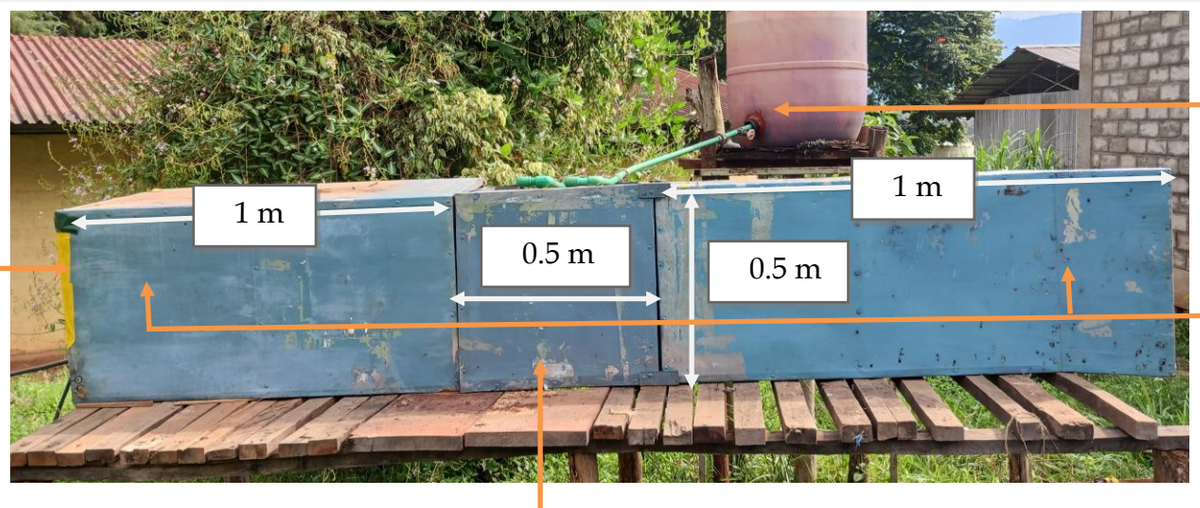
Introduction

- Rift valley of Ethiopia is a production belt of fruits and vegetables
- Its dry and hot climate has negative impacts on postharvest life of perishable crops
- Commercial mechanical refrigerators are expensive to afford by supply chain actors
- The dry and hot climate is an opportunity to apply low cost evaporative cooling (EC) system, however the wet pad not locally available and expensive
- This work attempted to develop a low-cost EC pad as a component of a low-cost EC system

Materials and methods



Fan with control system of air speed (1.1 and 2.6 m.s)



Water supply tank with water flow rate control system (flow rate 0.12 to 0.23 l/s)

Multiple data loggers to record temperature and RH before and after the wet pad

Wet pad made from galvanized sheet, + square steel + Cellulose pad made from False Banana fiber at different thickness (12 - 32 cm) and fiber orientation (Vertical vs Horizontal)

Results

$$\eta = \frac{T_{db-o} - T_{cond.}}{T_{db-o} - T_{wb-o}} \times 100$$

Table 1. Tem. reduction, RH increase and EC efficiency of wet pad in vertical and horizontal orientation of cellulose fiber

Fiber Orient.	Air Velo (m/s)	Thick.of pad (cm)	Water flow rate (l/s)	Temp. ambient ±SE	Temp after the pad ± SE	RH ambient ± SE	RH after the pad± SE	WET BULB Temp	EC± SE
	1.1	12	0.12	28.2	22	38.8	62.4	18.7	65.3
	1.1	18	0.15	27.4	23.1	57	86.8	21.2	69.4
	1.1	24	0.18	28.8	23.1	51.7	87.1	21.6	79.2
	1.1	32	0.23	27.6	22.3	54.4	83.8	21	80.3
	2.6	12	0.12	30.3	24.2	36.9	69.6	20.1	59.8
	2.6	18	0.15	27.6	22.7	57.6	86.4	21.5	80.3
	2.6	**24**	**0.18**	**28**	**22.6**	**55.9**	**85.4**	**21.5**	**83.1**
Verti	**2.6**	**32**	**0.23**	**26.2**	**21.3**	**59.4**	**87.1**	**20.5**	**86.0**
			Average	**28.0±0.4**	**22.0±0.3**	**51.5±3.1**	**81.1±3.4**		**75.4±3.3**
	1.1	12	0.12	29.6	22.8	42.5	70	20.6	75.6
	1.1	18	0.15	27.8	23.3	58.1	79.7	21.7	73.8
	1.1	24	0.18	27.7	23.1	57.4	84.9	21.5	74.2
	1.1	32	0.23	27.4	22.4	56.2	82.3	21	78.1
	2.6	12	0.12	28.5	22.9	52.7	72.3	21.5	80.0
	2.6	18	0.15	27.4	22.3	56.4	85.8	21.1	81.0
	2.6	**24**	**0.18**	**27.9**	**21.9**	**52.3**	**72.2**	**20.9**	**85.7**
Hori	**2.6**	**32**	**0.23**	**28.2**	**22.2**	**57.2**	**86.5**	**21.3**	**87.0**
			Average	**28.1±0.3**	**22.6±0.2**	**54.1±1.8**	**79.2±2.4**		**79.4±1.8**

Conclusion

- Air velocity, water flow rate and fiber orientation have effects on Evaporative Cooling efficiency
- The higher the air velocity, water flow rate and fiber thickness results in better Evaporative Cooling efficiency
- Both orientation of fiber results in better efficiency
- The study demonstrated possibility to develop low cost wetting pad from locally available materials
- Results of this study need to be validated under scale up condition

Acknowledgments

VolkswagenStiftung

Jimma University

UNIKASSEL VERSITÄT

HTWG Hochschule Konstanz Technik, Wirtschaft und Gestaltung