

An Indian-Australian research partnership

Project Title:	Modelling the water use efficiency of orange orchards	
Project Number	IMURA1014	
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Research Clusters:

Research Themes:

Highlight which of the Academy's CLUSTERS this project will address? <i>(Please nominate JUST one. For more information, see www.iitbmonash.org)</i>		Highlight which of the Academy's Theme(s) this project will address? <i>(Feel free to nominate more than one. For more information, see www.iitbmonash.org)</i>	
1	Material Science/Engineering (including Nano, Metallurgy)	1	Artificial Intelligence and Advanced Computational Modelling
2	Energy, Green Chem, Chemistry, Catalysis, Reaction Eng	2	Circular Economy
3	Math, CFD, Modelling, Manufacturing	3	Clean Energy
4	CSE, IT, Optimisation, Data, Sensors, Systems, Signal Processing, Control	4	Health Sciences
5	Earth Sciences and Civil Engineering (Geo, Water, Climate)	5	Smart Materials
6	Bio, Stem Cells, Bio Chem, Pharma, Food	6	Sustainable Societies
7	Semi-Conductors, Optics, Photonics, Networks, Telecomm, Power Eng		
8	HSS, Design, Management		

The research problem

The critical zone is defined as the layer of the Earth from the top of trees down to the bedrock; it is the zone that supports life with the interaction of processes involving water, air, soil and ecosystems. Critical Zone Observatories (CZO) have been established across the world to explore the relationships of processes above and below ground. These processes are especially important in catchments for agricultural production, where above ground productivity relies on soil quality and water.

India is a large producer of oranges, with orchards often located in semiarid areas with distinct wet and dry seasons during the year, thereby requiring irrigation to support production. Because orange orchards are water intensive, their sustainable management requires the understanding of the soil water pools accessed by the tree roots.

The project will focus on an orchard located within the Narkhed-Pandhurna CZO in Central India. This is a heavily managed catchment with approximately 60% of its surface area used for agricultural and horticultural production. Irrigation heavily relies on groundwater resources, which are increasingly under pressure because of the changing climatic trends with more frequent droughts.

The project thus addresses the problem of a sustainable water use for agricultural production in a semiarid area.

Project aims

The main aims of the project are to quantify the water use efficiency (i.e., the ratio of carbon assimilated for tree and fruit growth with the water evapotranspired by the trees) in an orange orchard in Nagpur and identify the key environmental drivers of the water and carbon balance in a catchment mainly used for orange production.

How skills/experience of the IITB and the Monash supervisor(s) support the proposed project

The two supervisors at IITB have experience in water resources management and estimation of water fluxes from satellite observations. The supervisor at Monash has experience in monitoring and modelling water and carbon fluxes between land and atmosphere.

The expertise of the supervisors complements each other, with the first part of the project entailing data collection being planned in India, and the data analysis and modelling being done in Australia.

What is expected of the student when at IITB and when at Monash?

At IITB, the student is expected to plan the experimental part of the project and conduct measurements at the Narkhed-Pandhurna CZO, with the support of the colleagues at the National Environmental Engineering Research Institute (NEERI).

After the data collection, it is envisioned that the student will spend at least 1 year at Monash University to process and analyse the data and develop conceptual and mathematical models of the water and carbon fluxes in the orchard.

Expected outcomes

The expected outcome of the project is to improve the irrigation to maximize the water use efficiency of the orchard based on the understanding of the water sources (soil water and groundwater) accessed by the roots of the trees.

How will the project address the Goals of the above Themes?

The project addresses the theme Sustainable Societies. With its focus on a more efficient use of water for agricultural production, the project is looking at making the production of oranges more resilient to climate change and droughts. This will provide benefits to the environment, with a lower exploitation of water resources, with consequent economic profits for farmers.

The project will also contribute to the global effort in understanding the links among the natural processes occurring within the critical zone.

Potential RPCs from IITB and Monash

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Capabilities and Degrees Required

The project requires field work for the installation of equipment and collection of data; the candidate will be expected to spend some time at the Narkhed-Pandhurna CZO, especially in the first 2 years of the project. The candidate should be willing to spend time in the field to collect environmental data.

The project also entails data analysis and modelling, which might require the use of specialized software and programming skills (e.g, Python, R, or Matlab). These are common in candidates with degrees in civil or environmental engineering.

Necessary Courses

- Ecohydroclimatology
- Hydrogeomorphology
- Remote Sensing and GIS in Water Resources Monitoring
- Remote Sensing Technology

Potential Collaborators

The project is in collaboration with Dr Parikshit Verma and Dr Paras Pujari at NEERI, who are managing the Narkhed-Pandhurna CZO. They will be involved in the supervision of the students as well as data collection and analysis.

Select up to **(4)** keywords from the Academy's approved keyword list (**available at <http://www.iitbmonash.org/becoming-a-research-supervisor/>**) relating to this project to make it easier for the students to apply.

Water, climate change (Carbon Capture and Sequestration)
Modelling and Simulation