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NH9.6 Advancing the integration of citizen and stakeholders' knowledge in disaster risk assessment, reduction and governance

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The rising of city-regional therapeutic resilience mechanisms in river basins impacted by climate change and their compounding disasters: A case study of the Wuxi river basin in central Taiwan

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The rising of city-regional therapeutic resilience mechanisms in river basins impacted by climate change and their compounding disasters: A case study of the Wuxi river basin in central Taiwan

>Phenomenon and Research purposes

This study: 1). explores compound disaster risks in Taiwan's Wu River Basin, focusing on how towns and communities respond to overlapping climate stressors—such as extreme rainfall, air pollution, and industrial expansion. 2).It introduces the concept of therapeutic resilience, emphasizing bottom-up recovery actions and community-based adaptation in the face of institutional gaps.

>Research Methods

Grounded in the framework of social capital, the research integrates PM2.5 data, disaster exposure, land use, and industrial patterns through **GIS-based spatial analysis**. This is complemented by **fieldwork and stakeholder interview**s in disaster-prone communities to capture lived experiences and local coping mechanisms.

The rising of city-regional therapeutic resilience mechanisms in river basins impacted by climate change and their compounding disasters: A case study of the Wuxi river basin in central Taiwan

>>Findings

Findings reveal spatially differentiated vulnerabilities across the basin: upstream areas are prone to landslides, while midstream and downstream towns face increased flood risk and water pollution due to urbanization and industrial activity.

1). In **Puli Township, residents formed a PM2.5 self-help group, installed air quality sensors, and shared real-time data—demonstrating a grassroots model of therapeutic resilience and civic engagement.**

2). The study positions **therapeutic resilience** as a critical lens for understanding local recovery, linking **environmental health, community participation, and adaptive governance**.

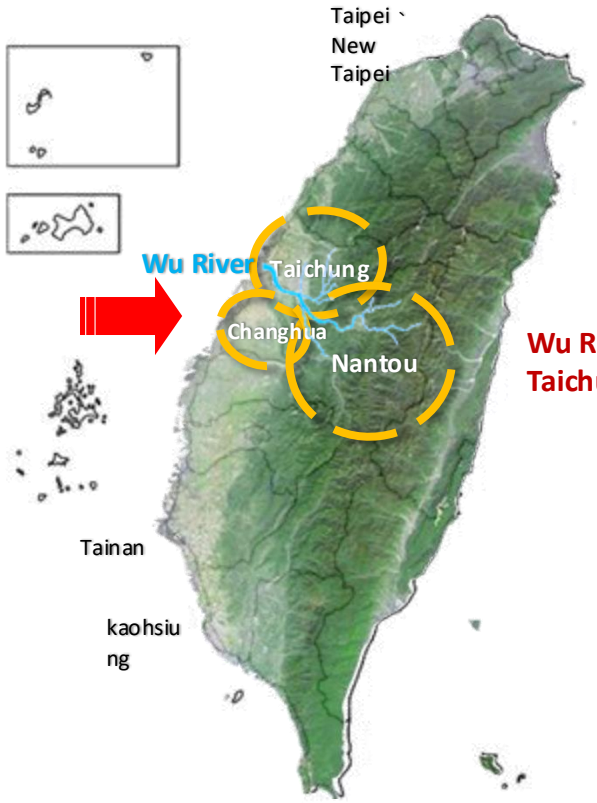
Keywords: adaptation strategies, climate change, social capital, compound disasters, Wu River Basin, therapeutic resilience

CONTENTS

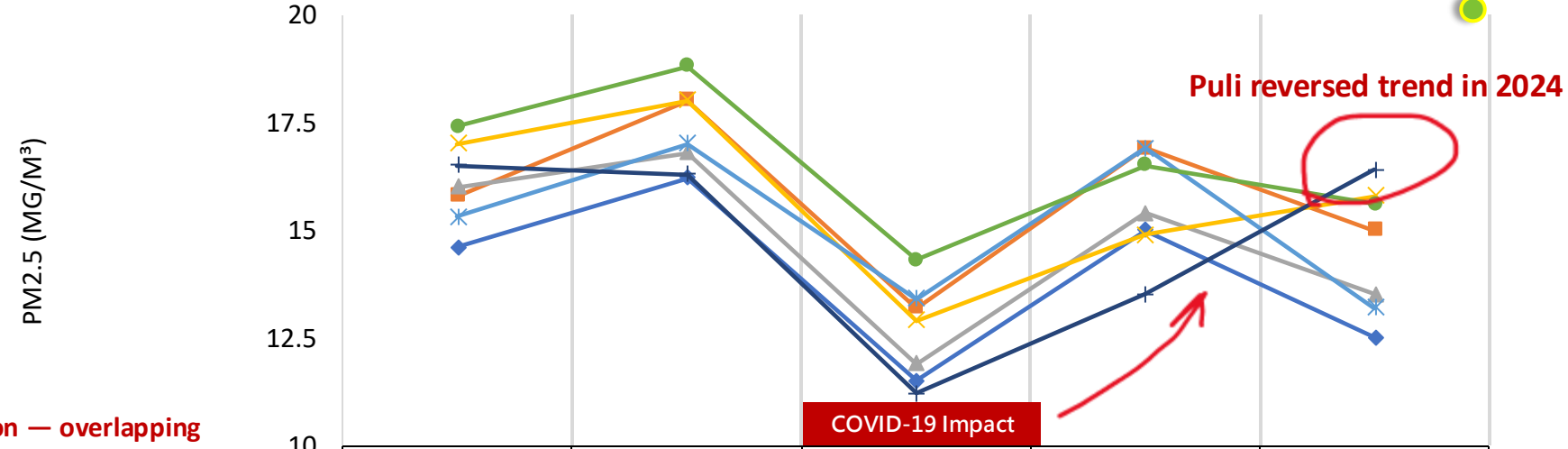
1. Research Background and Motivation

This study looks at how communities in Taiwan's Wu River Basin respond to compound disasters under climate change .
— including extreme rainfall, air pollution, and industrial pressure .
— and how they build what we call "therapeutic resilience."

How Urban Pollution Has Shifted Over Time in the Wu River Basin?



Wu River Basin region — overlapping Taichung, Changhua, and Nantou



	2020	2021	2022	2023	2024
Fengyuan(Taichung)	14.6	16.2	11.5	15	12.5
Xitun(Taichung)	15.8	18	13.2	16.9	15
Zhongming(Taichung)	16	16.8	11.9	15.4	13.5
Dali(Taichung)	17	18	12.9	14.9	15.8
Changhua(Changhua)	15.3	17	13.4	16.9	13.2
Nantou(Nantou)	17.4	18.8	14.3	16.5	15.6
Puli(Nantou)	16.5	16.3	11.2	13.5 ↑	16.4 ↑

PM2.5 Trends Across Taichung, Changhua, and Nantou (2020–2024)

2. Research Question and Objectives

1 Changes in Urban Pollution Across the Wu River Basin: What's Happening and What's Causing It ?

2 Environmental Pressure and Climate Shocks —How Communities Build Therapeutic Resilience?

Air pollution in central Taiwan is largely driven by emissions from the Taichung thermal power plant and the Central Taiwan Science Park.

The northeast monsoon contributes to the long-range transport of air pollutants, affecting downwind areas.

Factory air emissions in the industrial areas of Changhua County

Because it's a basin, there's no strong coastal wind to clear the air, so pollution tends to build up easily.

Fengyuan District
Tanzi District
Longjing District
Xitun District
Shengang Township
Dadu District
Nantun District
Hemei Township
Dali District
Changhua City
Wuri District
Guoxing Township
Fenyuan Township
Caotun Township
Puli Township
Nantou City

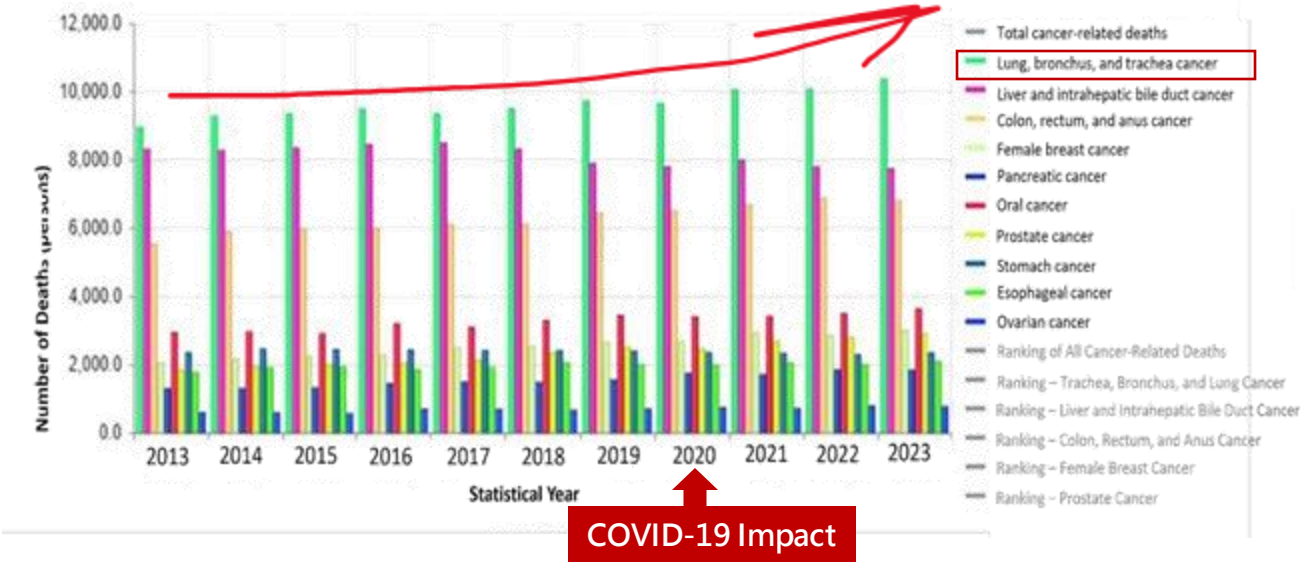
Air Quality Monitoring Station
Thermal power plant
Industrial Area
Wu River Basin
Wu River Basin Towns
0 5 10 Kilometers

> Air Pollution and Lung Cancer: Mortality Trends from 2013 to 2023

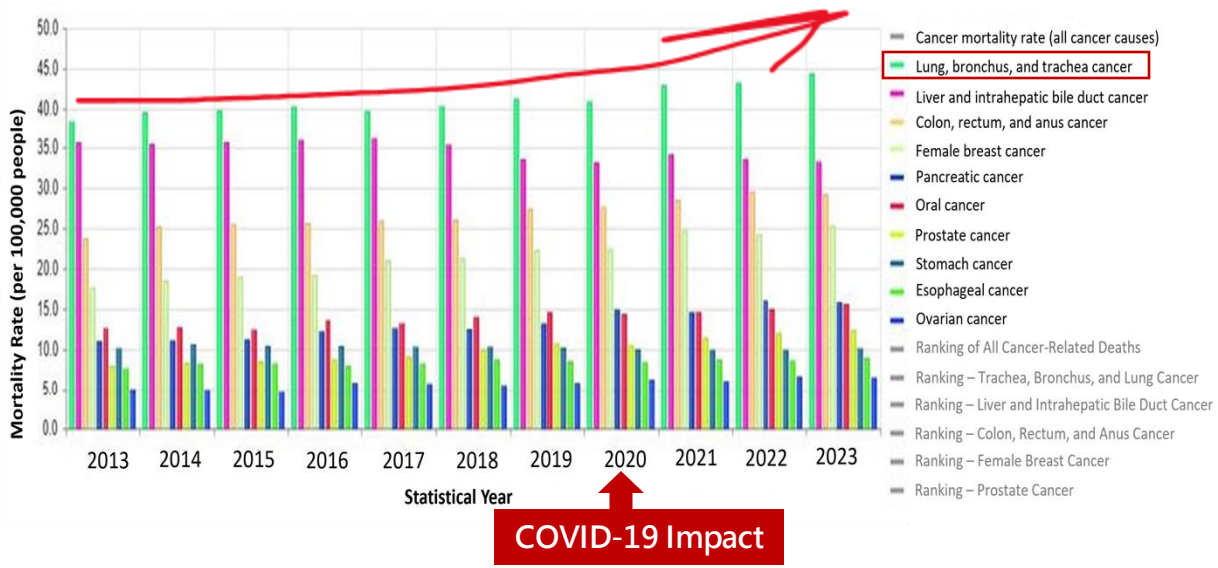
According to Taiwan's Ministry of Health and Welfare (2024), Lung cancer has remained the top cancer killer from 2013 to 2023, with over 2,500 deaths each year.

1.Overall cancer mortality has slightly declined, but lung cancer shows little improvement.

2.Pollution-related cancers like lung and nasopharyngeal cancer have not improved much — suggesting current air pollution control efforts need to be strengthened.



Trends in Cancer Mortality in Taiwan, 2013–2023



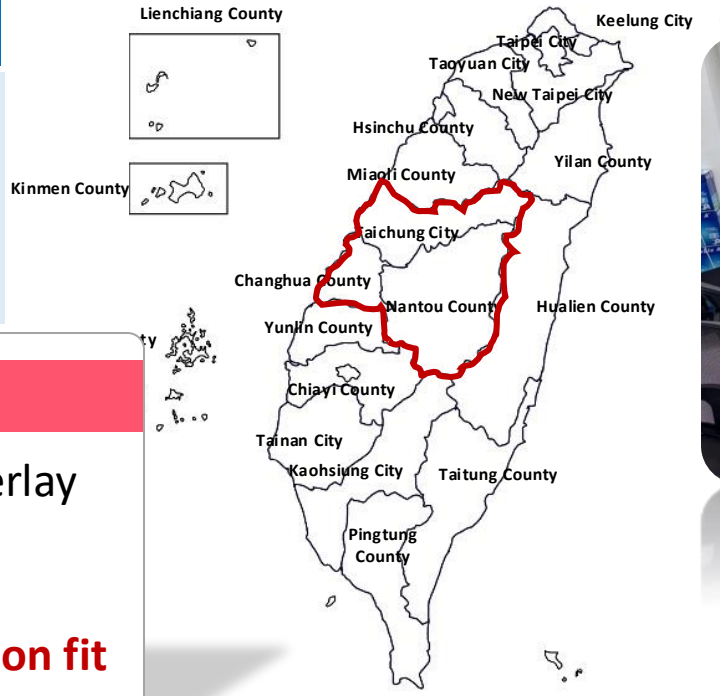
Cancer Mortality Rate per 100,000 Population in Taiwan (2013–2023)

1) According to Dr. Chia-Ying Lee, Vice Superintendent of Show Chwan Memorial Hospital (2024),data from Taiwan's Health Promotion Administration shows that central Taiwan has some of the worst air quality in the country, and its lung cancer incidence is significantly higher than in northern and southern regions.
2) Dr. Lee further noted that:"**Air pollution and lung cancer are highly correlated.**"
3) This suggests the need for further analysis and policy action **from an environmental health risk perspective**.(Source: Show Chwan Memorial Hospital, 2024)

4. Framework and Research Method

1. Research Design and Fieldwork Approach

This study looks at **urban areas in the Wu River Basin**, focusing on how communities respond to compound risks
— like climate change, air pollution, and governance gaps
— through bottom-up actions.



Secondary Data, GIS Overlay

1) We gathered and analyzed:
- ☑ **PM2.5 monitoring data**
- ☑ **Climate models (TCCIP)**
- ☑ **Land use maps & disaster datasets**

2) We used GIS spatial overlay to:
- ➤ Visualize **risk patterns**
- ➤ Assess **urban adaptation fit**

Field Survey and In-depth interview

1) March 6–7, 2025: Fieldwork in Taichung, Nantou, Changhua
2) Interviewed:
- Local government officials
- Urban planners
- Village leaders & residents
- NGOs and community groups

Government response

Fieldwork and stakeholder interviews – Nantou County Government (Construction Department)

Planning expertise

Fieldwork and interviews – Long-Yi Engineering Consultants (Taichung)

Local lived experience

Fieldwork – Beishi Community, Caotun, Nantou

Environmental context (MOEA)

Fieldwork – Niaozuitan Artificial Lake Management Center, MOEA Water Resources Agency (Central Office)

2. Post-Disaster Recovery Mechanisms of Therapeutic Resilience

1) This revised framework illustrates how therapeutic resilience begins with personal and collective recovery, as communities engage in healing and cultural actions under climate and social stress.
2) Over time, this process helps build social capital, which enables institutional engagement and policy advocacy — shaping a local feedback loop from healing to governance, as seen in the Puli case.

Conceptual Illustration of the Relationship Between Healing and Resilience

Source: ACWS. (2024). The healing brain: Supporting children from trauma to resilience. Retrieved December 20, 2024, from https://acws.ca/courses/acws-the-healing-brain-supporting-children-from-trauma-to-resilience/

Post-Disaster Recovery Mechanisms of Therapeutic Resilience

Climate change, air pollution, and shifts in social structure

Psychological Resilience

1. Collective trauma healing
2. Recovery of rituals and cultural traditions
3. Strengthening emotional bonds and group support

Economic Resilience

1. Financial compensation mechanisms
2. Social enterprise models
3. Support for small businesses
4. Resilient infrastructure development

Social Resilience

1. Strengthening social connections
2. Inclusive participation
3. Ensuring the involvement of vulnerable groups

Social Capital Building

1. Government capacity in post-disaster governance
2. Integration of community resources
3. Mechanisms for cultural and economic capital

Pre-Disaster Preparation and Post-Disaster Recovery

1. Diagnosing socio-economic vulnerabilities
2. Government policy response and adaptive strategies
3. Post-disaster reconstruction and economic compensation

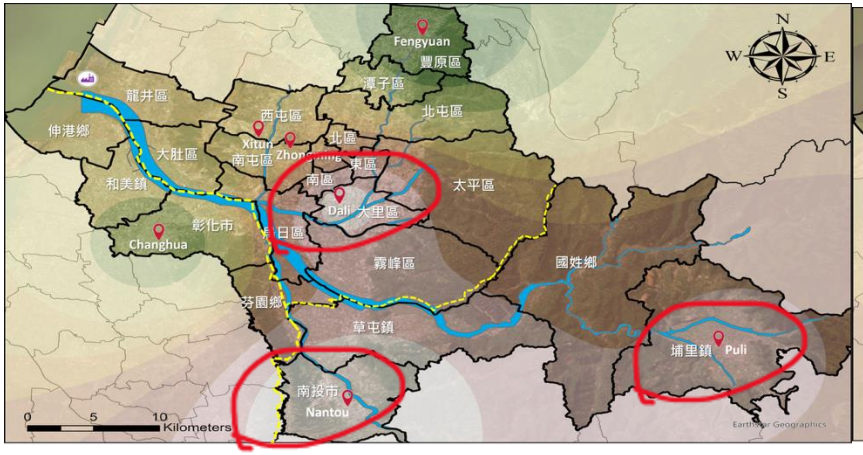
Practical Application of Therapeutic Resilience in Case Studies

Community monitoring, NGO help, and self-help groups (like Puli PM2.5 group)

5. Research Content

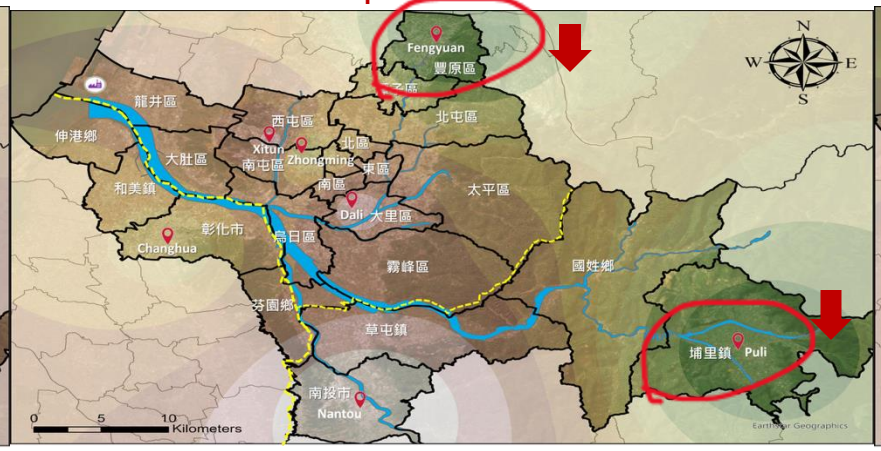
> Spreading Trends of PM2.5 Hotspots in the Wu River Basin's Urban Areas (2020–2024)

2020 – Seasonal Pollution Effects



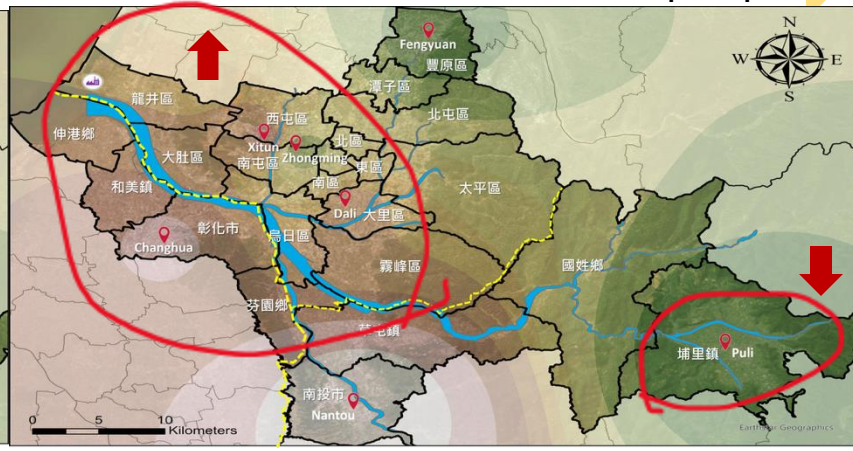
1. Northeast monsoon brought in outside pollution, and the basin trapped it.
2. Caotun, Nantou, and Dali had higher PM2.5 levels — over 16 μg/m³.

2021 – COVID-19 Impact



1. PM2.5 dropped by over 25% in 2021, thanks to COVID-19 measures.
2. Puli and Fengyuan showed the biggest improvements.

2022 – Post-Pandemic Rebound and Rapid Spread



1. Pollution spiked and spread fast across the central plains post-COVID.
2. But Puli stood out — showing signs of resilience and local recovery capacity.

2023 – Normalization of High PM2.5 Values

1. Pollution went up in many areas, likely from tourism plus regional inflow.
2. But Puli didn’ t follow — its levels stayed stable.

2024 – Regional Fluctuation and Partial Decline

1. While areas like Changhua and Hemei improved, Puli stayed hi
2. Local policies or climate conditions may explain these regional differences.

Key Takeaways–Puli Township as an Example

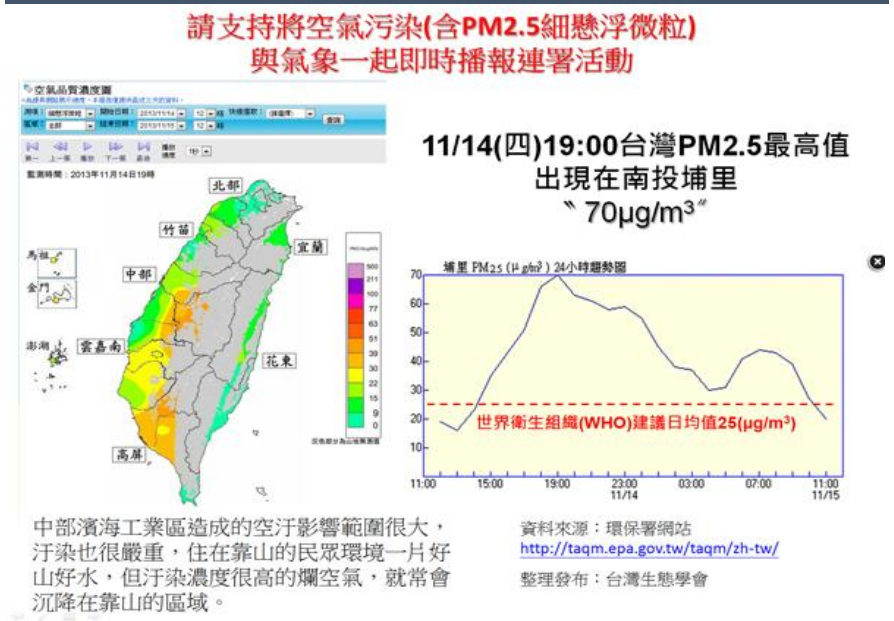
1. In 2020, we started to see serious PM2.5 pollution in Puli. This was likely caused by the local basin terrain, less sunlight, and traffic buildup — all combining to trap polluted air.
2. By 2022–2023, pollution levels dropped. This might be related to community-level monitoring, reduced human mobility, and better local awareness.
3. In 2024, the numbers went back up again. This could be due to regional pollution inflow, seasonal weather effects, and the need for stronger mobile monitoring and localized response strategies.

6. Conclusions and Policy Implications

1. Grassroots Practices of Therapeutic Resilience

1) In **Puli Township**, locals **set up their own air sensors** and shared the data online — building a grassroots network to monitor air quality.
2) **They teamed up with NGOs** to push for better air pollution policies, and eventually got the local government to take notice.
3) Through **training and outreach, these bottom-up efforts showed** how a community can respond to long-term environmental risks — even when official systems fall short.
4) It's a powerful example of **therapeutic resilience** in action — turning care, connection, and action into real change.

They monitored air quality using affordable tools like AirBox and LASS, and shared real-time data online.



They formed a grassroots PM2.5 self-help group to push for cleaner air.

They even designed an educational board game about air pollution, turning public education into a fun, engaging activity.

Sources: (1) https://www.facebook.com/pulipm2.5?locale=zh_TW.(2) Compiled by this study.

6. Conclusions and Policy Implications

2. The Puli Case: Practicing Therapeutic Resilience Through Bottom-Up Governance

1) In Puli Township, residents took action by setting up their own sensors, sharing air quality data, and forming the **PM2.5 Self-Help Group**.
2) This is a real-world example of **therapeutic resilience** in practice, influencing even local policy responses.
3) **However, these actions face bigger structural challenges — not just pollution, but climate change, resource inequality, and broken governance trust, especially for vulnerable communities.**

Challenges of Air Pollution under Climate Change and Vulnerability

Climate Change and Pollution

1) Unstable weather traps pollutants (e.g. inversion spreads PM2.5)
2) Wind patterns + weather events = bigger health risks

Social-Economy Vulnerability

1) Long-term exposure = slow-onset disaster
2) Pollution hotspots near city edges + traffic zones (like Nantou)
3) Weak groups hit harder due to uneven access to resources and broken trust。

Local social capital (community monitoring, NGO support)

1) Community monitoring
2) NGO help, and self-help groups (like Puli PM2.5 group)

Therapeutic Resilience in Practice

1) Air quality sensors & open data sharing
2) PM2.5 Self-Help Group
3) Public education and policy advocacy（Puli as example）

Policy Recommendations

Enhance Planning Capacity

Integrate slow-onset risk assessments into spatial and disaster planning.

Address Air Pollution

Improve coordination across levels of government and make better use of local data to support cross-regional air quality efforts.

Support Local Resilience

Provide funding and participation opportunities so communities can lead their own resilience-building actions.

From climate pressure to policy change, therapeutic resilience offers a grounded path through local healing, participation, and institutional feedback.

Thanks for listening.

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