SALUD URBANA EN AMÉRICA LATINA

Diversity in urban health collaborations in Latin America

A temporal multilayer network analysis of the SALURBAL Project

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wellcome

SALURBAL
Salud Urbana en América Latina

LAC-URBAN HEALTH
Urban Health Network for Latin America and the Caribbean

Universidad de los Andes

SOCIAL & HEALTH COMPLEXITY CENTER

Objectives

1. Characterize the evolving collaboration network of the SALURBAL Project and network cohesion.

2. Assess the diversity within and between different project activities with a specific focus on participants' attributes.

3. Assess the growth and sustainability of the collaborations among SALURBAL participants over time.

Diversity

Interdisciplinarity creates opportunities for innovation and learning from other disciplines' approaches to problem solving (Page, 2014).

Intersectoral can promote problem solving and the translation of research into actionable policy by clarifying the perspectives and priorities of stakeholders (WHO, 2018).

Seniority diversity supports mentorship and capacity building allowing individual performance to improve, positively impacting the project performance (Emmerik, 2008).

Geographic diversity bring diverse viewpoints to the discussion and balances the participation of high, low and middle income countries (Siemens & Burr, 2013).

Gender Diversity can drive scientific discovery and innovation (Nielsen *et al.* 2018).

1. Design the collaboration network of SALURBAL, relating the project activities to the network layers.

- Data collection
- Temporal multilayer network approach
- Network cohesion

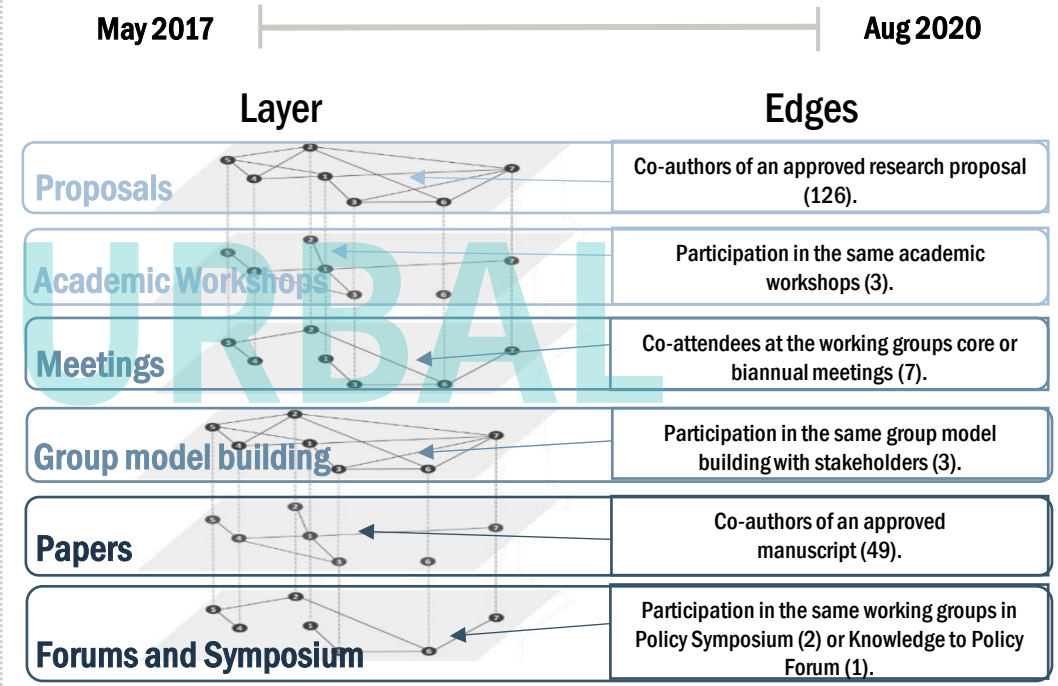
SALURBAL Network

Project Cycle

Research Process
- Group model building
- Core Meetings
- Biannual Meeting

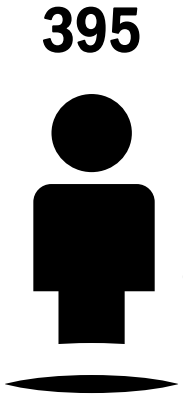
Inputs
- Proposals
- Academic Workshops

Outputs
- Approved Manuscripts
- Policy Symposium
- Knowledge to Policy Forum



Edges are created in the smallest possible grouping. e.g working groups.

Network nodes



SALURBAL Participants

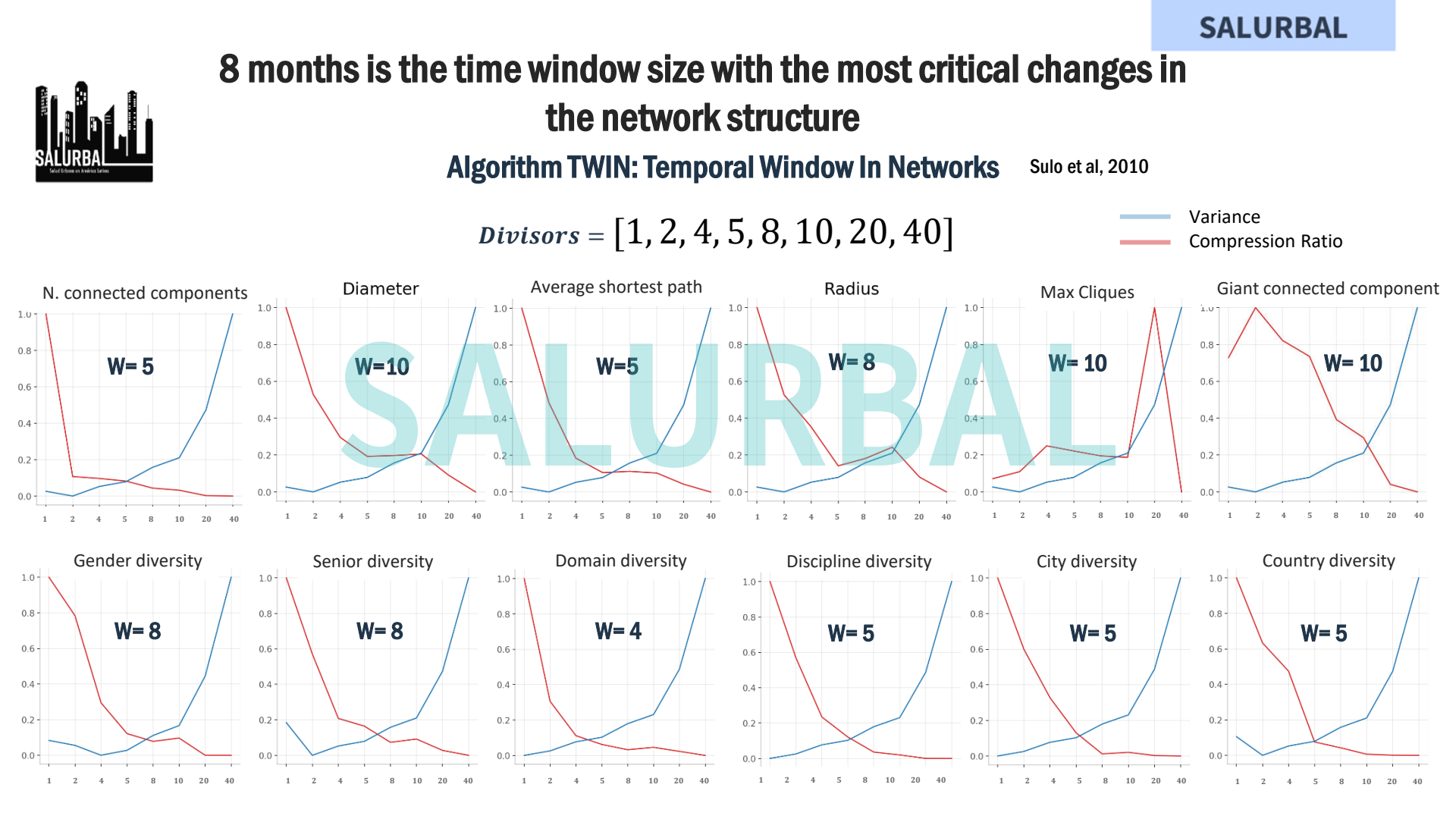
Attribute	Range	Values
Discipline	24	{Public health, Epidemiology, Geography, etc}
Domain	51	{Nutrition, Health disparities, Transport, etc}
Sector	5	{Academia, Public and government, Private sector, Civic society, Intersectoral}
Seniority	2	{Senior, Junior}
Gender	2	{Female, Male}
Country	26	{USA, Brasil, Colombia, Mexico, Peru, etc}
City	73	{Bogotá, Philadelphia, Belo Horizonte, Lima, Santiago de Chile, Cuernavaca, etc}

8 months is the time window size with the most critical changes in the network structure

Algorithm TWIN: Temporal Window In Networks

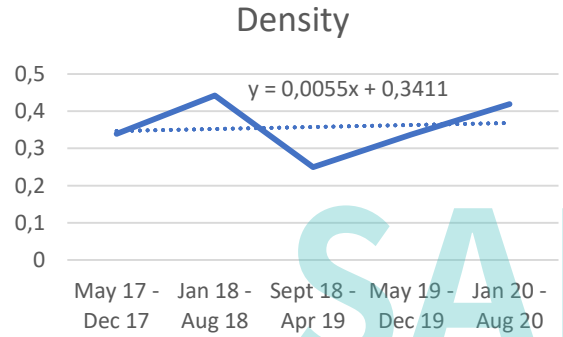
Sulo et al, 2010

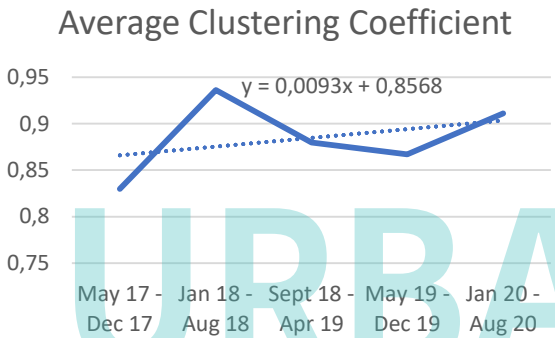
$$Divisors = [1, 2, 4, 5, 8, 10, 20, 40]$$

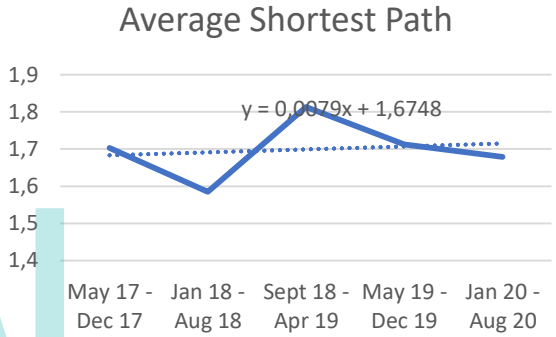


Network cohesion

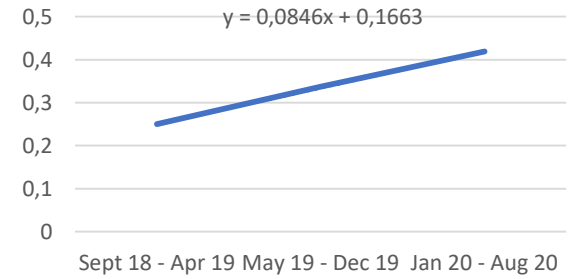
Trought the project

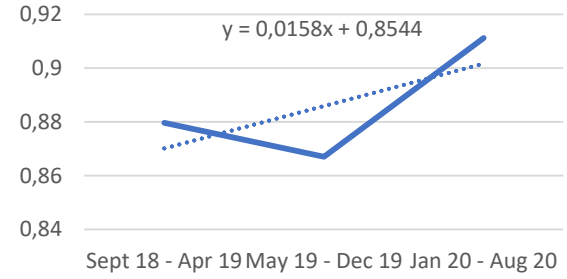


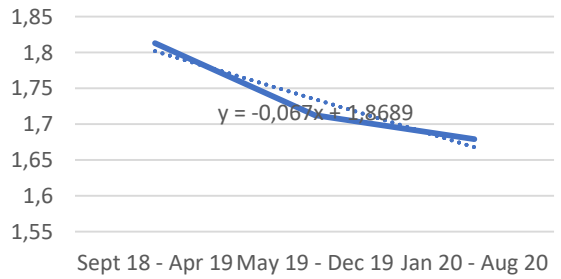




In the last two year





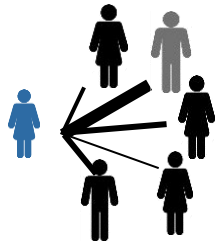


2. Calculate the diversity of the SALURBAL project using indicators related to collaborations between its participants.

- Diversity within layers
- Correlation analysis
- Diversity between layer
- Layer reduction method
- Organizational diagnosis

Diversity within layers

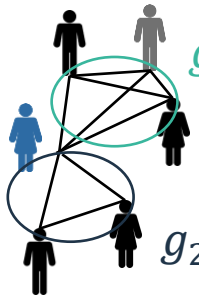
1



$$HD_i^{o,l} = \beta * \left(\frac{1}{\sum w_i^l} \sum_{j \in v_i} w_{i,j} \left(1 - \delta(x_i, x_j)^{o,l}\right) \right)$$

$$+ (1-\beta) * \frac{1}{|p_i^l|} \sum_{g_m \in p_i} \left(\frac{1}{n_{g_m}^l \left(n_{g_m}^l - 1\right)} \sum_{j,k \in g_m} \left(1 - \delta(x_j, x_k)^{o,l}\right) \right)$$

0.75



0.83

0.67

0.875

- The diversity HD_l^o of each layer l, is the average of $HD_i^{o,l}$ over all the nodes.
- v_i is the neighborhood of node i, $v_i = \{j, k, \ldots, n\}$ n is the number of nodes.
- x_i are the attribute values of the node i, $w_{i,j}$ is the weight of the edge(i,j).
- $\delta(x_i, x_j)^{o,l}$ is a Kronecker delta that is equal to 1 if $x_i = x_j$ and 0 otherwise.
- o be the set of outcomes where the diversity will be measured in each layer l.
- g_m is the team m where participate the node i.

[0, 1]

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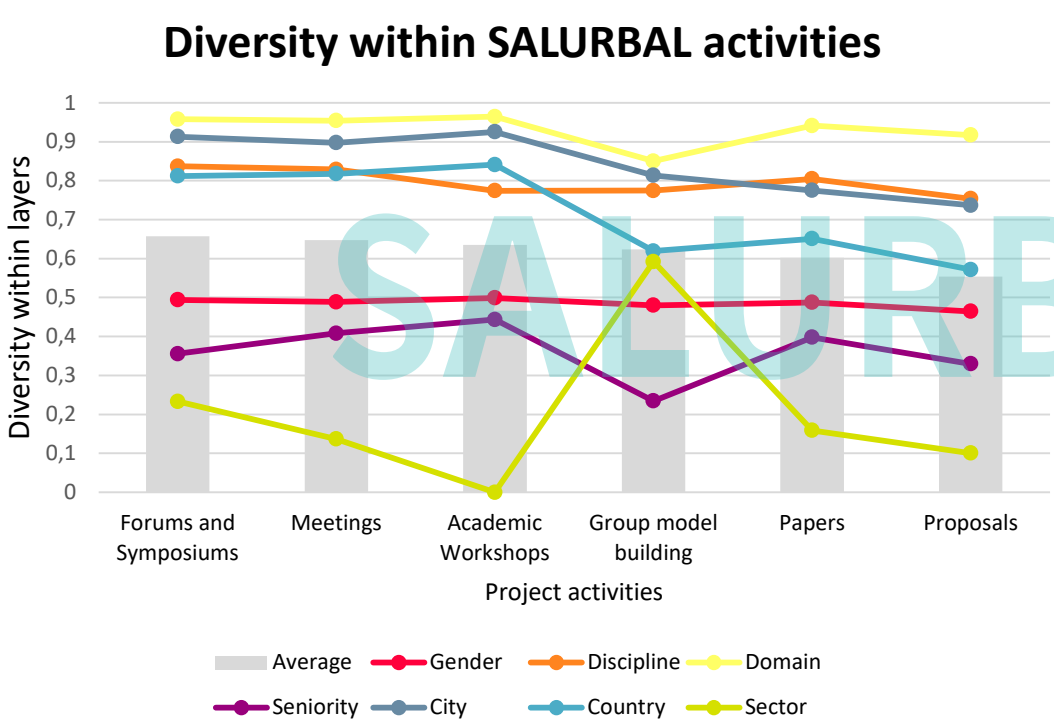
Urban Health in Latin America

Each activity was designed to have a strength in some attributes' diversity, finding a balance in the activity's general diversity



- Discipline and gender diversity is quite constant across the project activities.
- There is a greater geographical diversity in the Forums, Simposiums, Academic Workshops and Meetings.
- In the group model building there is greater sectoral diversity.
- There is a high domain diversity close to one.
- The most seniority diversity is in the academic workshops.

Diversity between layers

$$A(i,j) = 1 - \delta(x_i, x_j)^{o,\bar{p}}$$

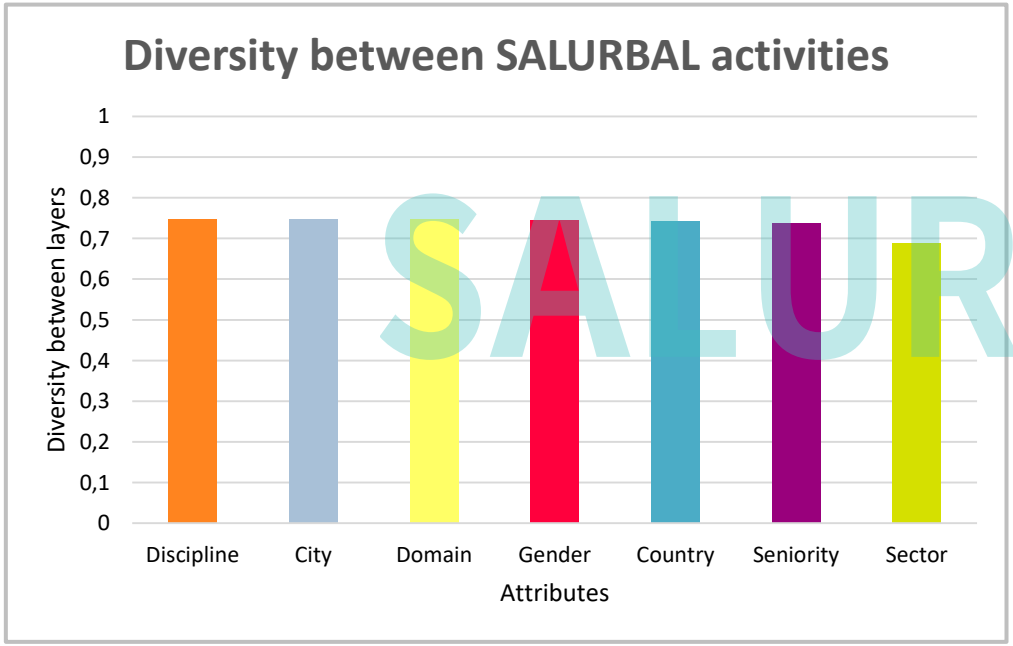
$$D_i(\bar{p},\bar{q}) = min \frac{\sqrt{J(N_i^{\bar{p}}, N_i^{\bar{q}})} + \sqrt{J(T_i^{\bar{p}}, T_i^{\bar{q}})}}{2\sqrt{log(2)}}$$

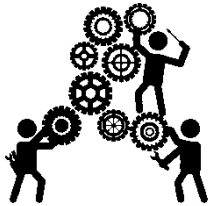
Carpi, et al, 2019

- The LD measure is the average of $D_i(\bar{p},\bar{q})$ over all the nodes.
- Where, J is the Jensen-Shannon (JS) divergence that measures the distance between two probability distributions.
- $N_i^{\bar{p}}$ is the Node Distance Distribution (NDD) of node i in layer $\bar{p}$
- $T^{\bar{p}}$ is the Transition Matrix of layer $\bar{p}$; $T_i^{\bar{p}}(j)$ is the probability that node j in the layer $\bar{p}$, is reached by a random walker located at node i in $\bar{p}$.
- The global diversity is defined recursively and has a range of 0 to the number of layers minus one. This is standardized.

Identical **[0, 1]** Balance

The SALURBAL participants have been forming new collaborations and strengthening others between different disciplines, countries, seniority levels and sectors.





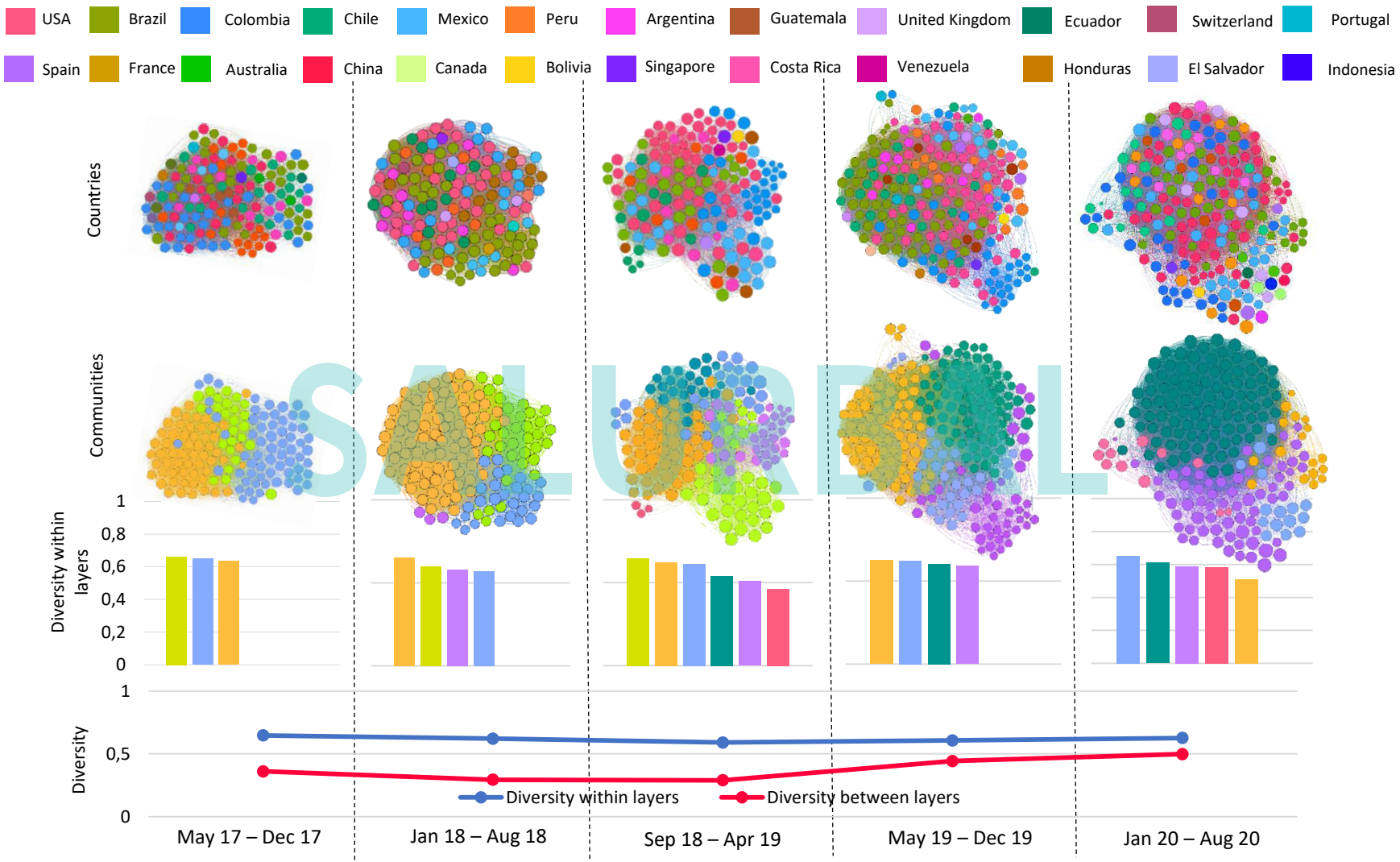
Discipline is where most new diverse collaborations provide the activities

Few activities bring new intersectoral collaborations

There is a stability of mentors through the different activities

3. Assess the growth and sustainability of collaborations among SALURBAL participants over time.

- Time Windows in Networks algorithm
- Diversity between time window
- Louvain community detection algorithm
- Linear regression


USA
Brazil
Colombia
Chile
Mexico
Peru
Argentina
Guatemala
United Kingdom
Ecuador
Switzerland
Portugal
Spain
France
Australia
China
Canada
Bolivia
Singapore
Costa Rica
Venezuela
Honduras
El Salvador
Indonesia
Countries
Communities
Diversity within layers
1
0,8
0,6
0,4
0,2
0
Diversity
1
0,5
0
Diversity within layers
Diversity between layers
May 17 – Dec 17
Jan 18 – Aug 18
Sep 18 – Apr 19
May 19 – Dec 19
Jan 20 – Aug 20

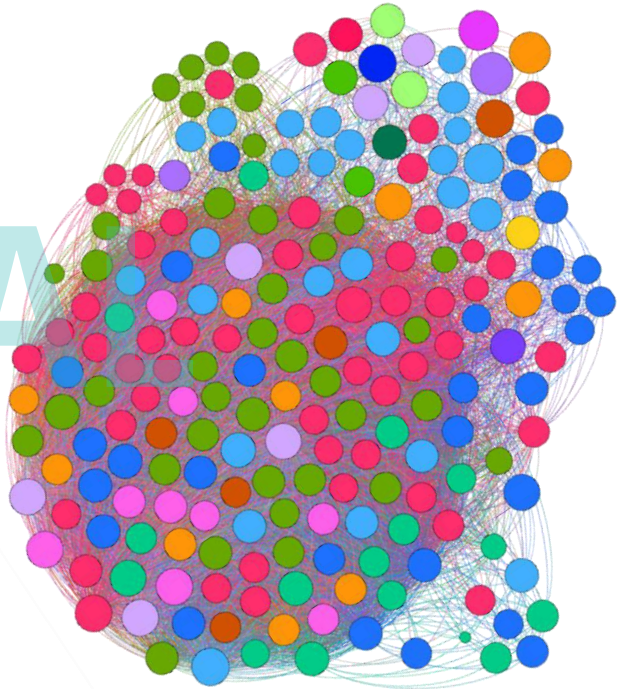
Conclusions

➤ Diversity and cohesion among participants has increased throughout the project. **SALURBAL's structure and flexibility fostered opportunities for collaboration.**

➤ The project has found **balance in the amount of diversity**, allowing it to obtain the diversity' benefits and preventing inefficiency.

➤ The project has understood how to leverage diversity to achieve better performance by **giving each activity a strength in a diversity attribute.**

➤The project's structure is in a **midpoint between some diverse relationships that are maintained and new ones that are generated** between the activities, leaving behind a strong and well-connected collaborative network focus on innovation, research, and development in Latin America and the Caribbean.



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