Design and scale-up of climate resilient waste management and energy capture technologie in small and medium livestock farms - ECUADOR

CTCN Case Study: National biogas program for Ecuador

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https://www.ctc-n.org/technical-assistance/projects/design-and-scale-climate-resilient-waste-management-and-energy-capture

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The objective of this TA is to provide a **plan** for the development of **a national program of biodigesters in Ecuador**, identifying actors, activities, goals, budget and challenges

Focus on small and medium farms in Ecuador

Low cost digesters

Low technological requirement digesters

Just right technology

Which are the low cost digesters?

Low technological input digester

Low technological input digester

Low investment

Installed where the waste is

No transport of waste

Local use of effluent and biogas (heating)

Low technological input digester

China 43.000.000 units (2014)

India 4.750.000 units (2014)

Nepal 330.000 units (2015)

VietNam 183.000 units (2014)

Kenya 16,419 units (2017)

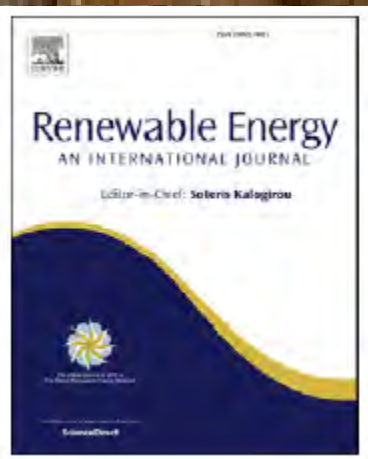
Ethiopia 13,585 units (2017)

Tanzania 13,037 units (2017)

Burkina Faso 7,518 units (2017)

Uganda 6,504 units (2017)

What about Latín America?



Biogas: Developments and perspectives in Europe

Nicolae Scarlat*, Jean-François Dallemand, Fernando Fahl

N. Scarlat et al. / Renewable Energy 129 (2018) 457–472

Low technological input digester

"Just right technology"

Tubular/plastic/balloom digester

No active heating or mixing
Needs more wáter (1:3)
Semi-buried

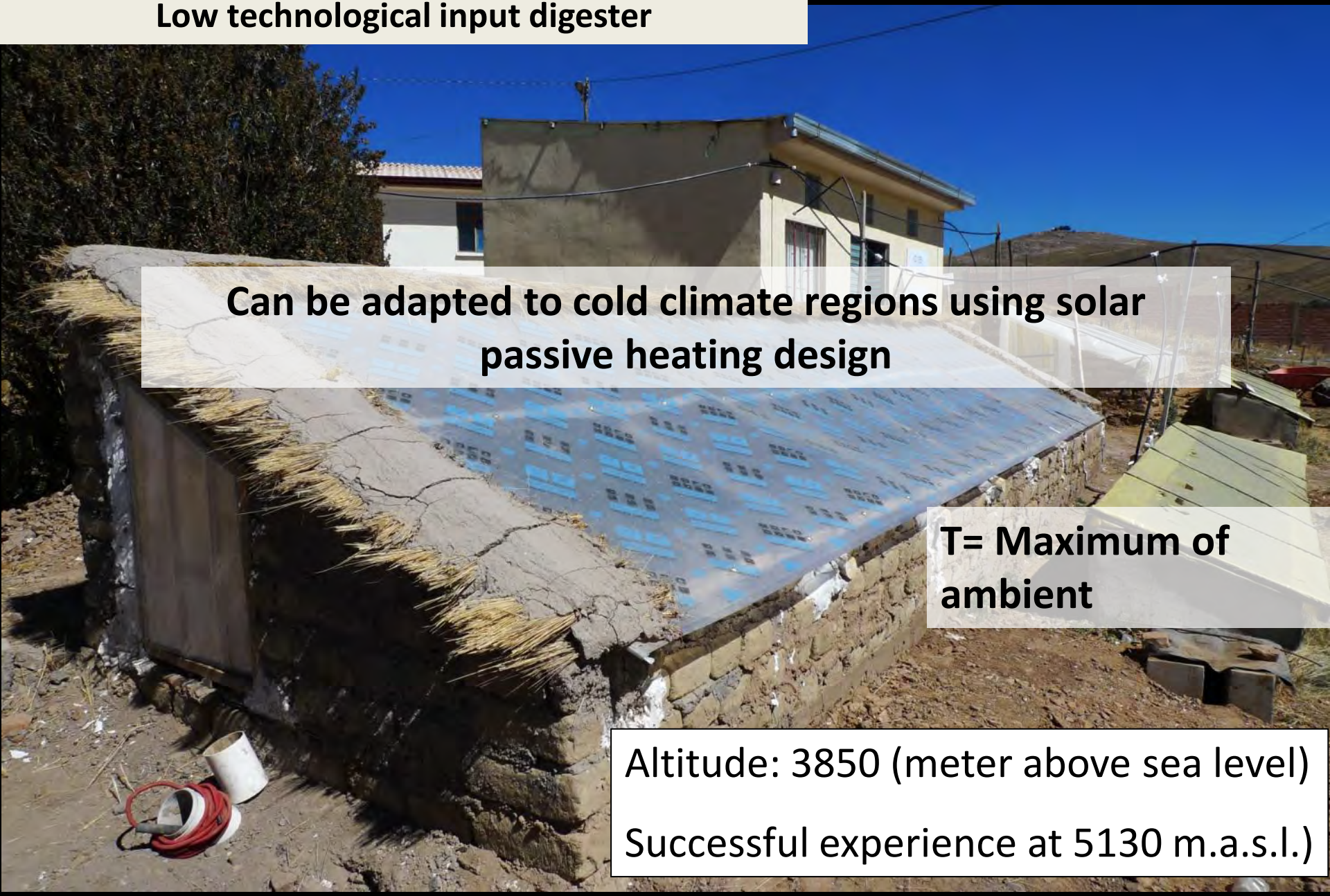
Low cost tubular digesters as appropriate technology for widespread application: Results and lessons learned from Bolivia

Jaime Martí-Herrero [a, *], Maria Chipana [b], Carlos Cuevas [b], Gabriel Paco [c], Victor Serrano [d], Bernhard Zymla [e], Klas Heising [e], Jaime Sologuren [b], Alba Gamarra [f]

J. Martí-Herrero et al. / Renewable Energy 71 (2014) 156–165


Tubular digester
Esay to learn how to install
Materials are able in local markets
Biogas and effluent use to be used locally

Low technological input digester



Can be adapted to cold climate regions using solar passive heating design

T= Maximum of ambient

Altitude: 3850 (meter above sea level)

Successful experience at 5130 m.a.s.l.)

CIB3, La Paz, UMSA-HIVOS-CIMNE Bolivia, 2015

Low technological input digester

With -13ºC mínimum night temperatures, the slurry inside the digester keeps 16-17 ºC

Towards thermal design optimization of tubular digesters in cold climates: A heat transfer model

Thibault Perrigault [a], Vergil Weatherford [b], Jaime Martí-Herrero [a,*], Davide Poggio [c]

T. Perrigault et al. / Bioresource Technology 124 (2012) 259–268

Bioresource Technology 167 (2014) 87–93

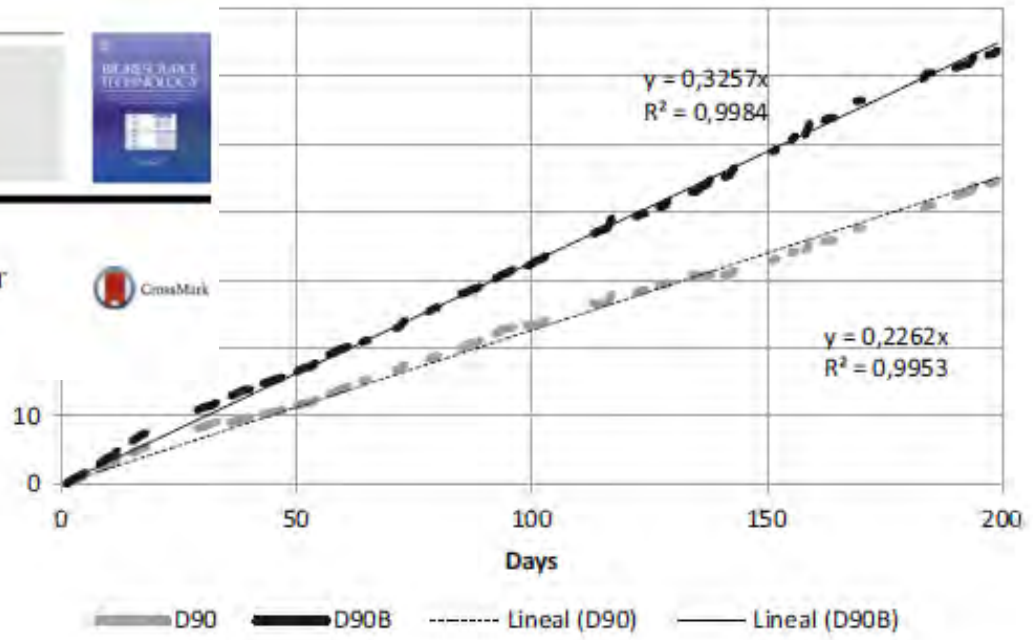
Contents lists available at ScienceDirect

Bioresource Technology

journal homepage: www.elsevier.com/locate/biortech

Improvement through low cost biofilm carrier in anaerobic tubular digestion in cold climate regions

J. Martí-Herrero [a,*], R. Alvarez [b], M.R. Rojas [b], L. Aliaga [c], R. Céspedes [d], J. Carbonell [a]



Bolivia, CIB3

- Cow manure: water(1:3)
- 124 d HRT

•Biofilm (+50% biogas)

Contents lists available at ScienceDirect

Journal of Cleaner Production

journal homepage: www.elsevier.com/locate/jclepro

Evaluation of the low technology tubular digesters in the production of biogas from slaughterhouse wastewater treatment

J. Martí-Herrero [a, b, *], R. Alvarez [c], T. Flores [d]

Three digesters in series

The first digester with chopped up bottles

Fig. 1. The three tubular digesters in series, monitored in the Cochabamba slaughterhouse, at 2572 m above sea level (Martí-Herrero et al., 2016).

Tubular digester


Cidelsa in Perú


Costalgroup in Perú


Biobolsa in Mexico (+LAC)


Terrazonet in Colombia


VIOGAZ in Costa Rica


Biosinergia in Costa Rica


Disambiental in Colombia


Ecuador
Biodigestores Ecuador


BiodigestoresMudoIntag

Tubular digester

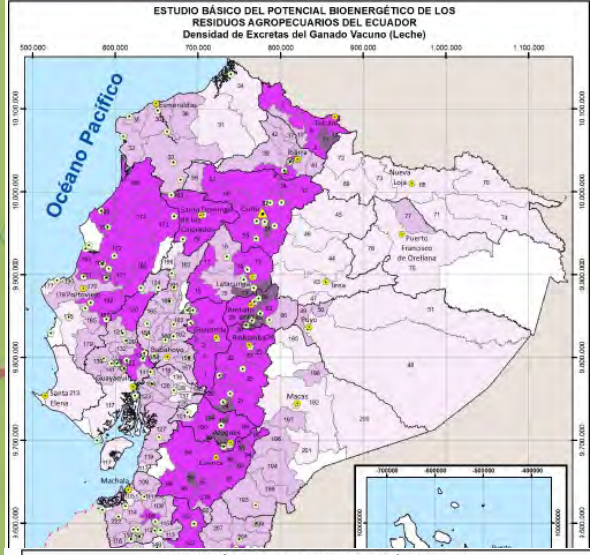
Also big digesters, Colombia

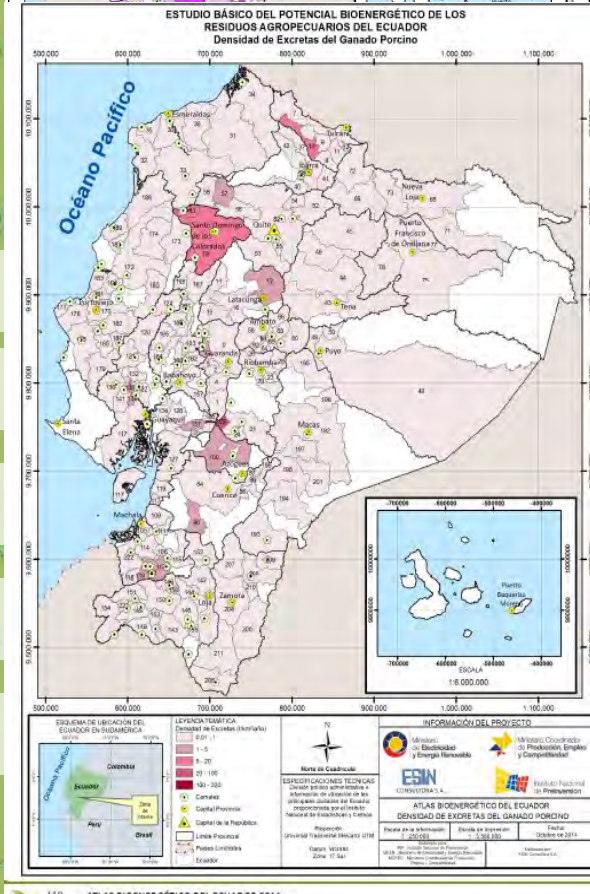
http://redbiolac.org

RedBioLAC

Red de Biodigestores para Latino América y el Caribe

We have determined the **technical potential of small and medium-scale biodigesters in Ecuador** (also agricultural sectors, regions, biogas appropriate technologies, input-output analysis, etc.)





More than 200.000 potential biogas units

Focus con Coast and Andes

Pig and dairy sector

Local productive biogas (heating, cooking)

Nutrient reciclyng by bioslurry use

www.freeworldmaps.net

We developed **protocols:**

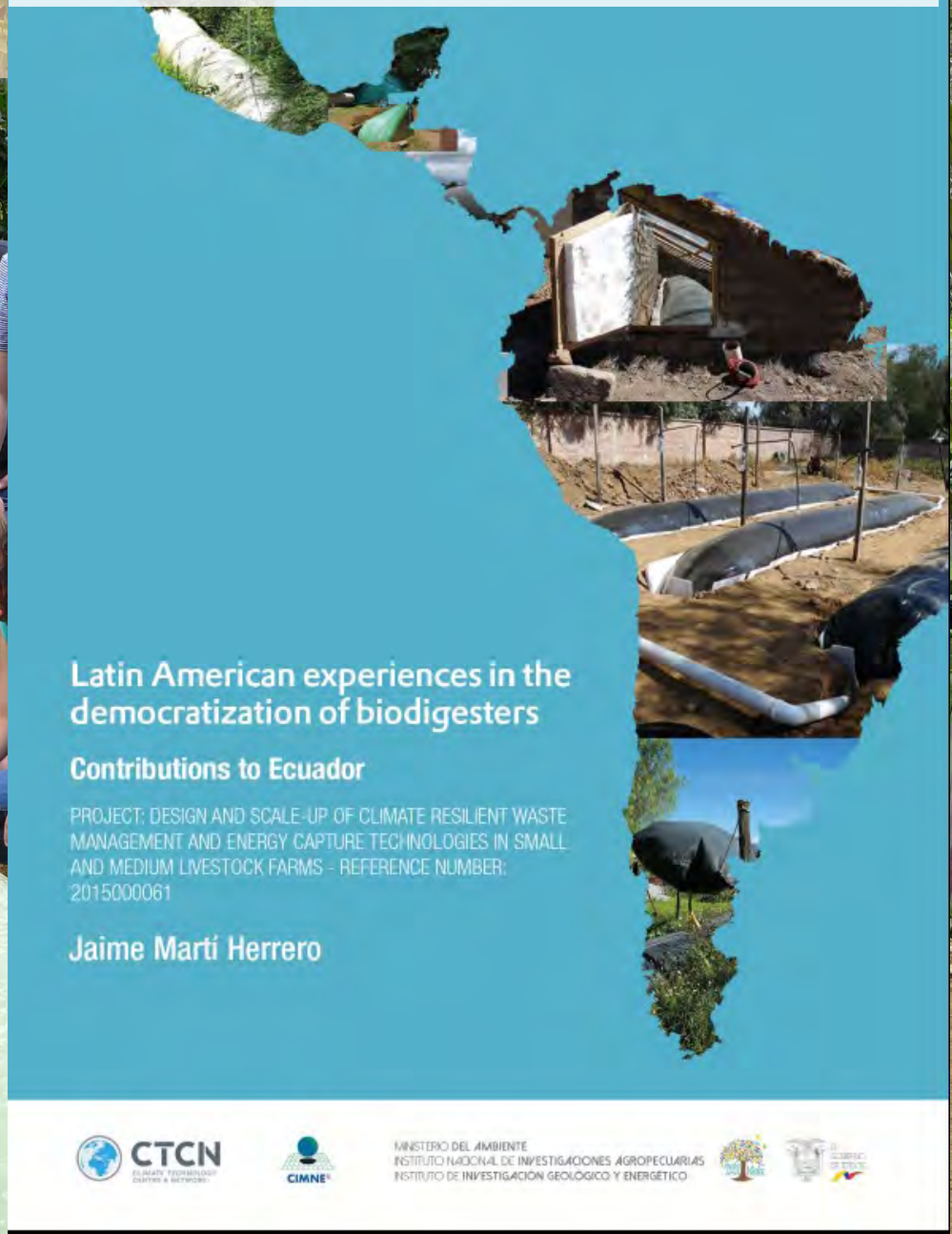
- **Quality control of biodigesters installed**
- **Monitoring and performance characterization of biodigesters.**

We did a **public call for tenders** to install 8 digesters:

- **Four technology providers** installed 2 digesters each
- **8 digesters where evaluated, monitored and characterized**.
- The **technology and service** or four technology providers were **evaluated.**

We realized **local capacity building** through workshops for technicians, farmers and stakeholders about **biodigesters and their contribution to the adaptation to and mitigation of climate change**.

Book (open access): **Latin American experiences in the democratization of biodigesters: Contributions to Ecuador**



We realized an input-output analysis of the farms.

- Energy and fertilizer use and cost, base line
- CO2 emission base line
- Installations cost of a digesters

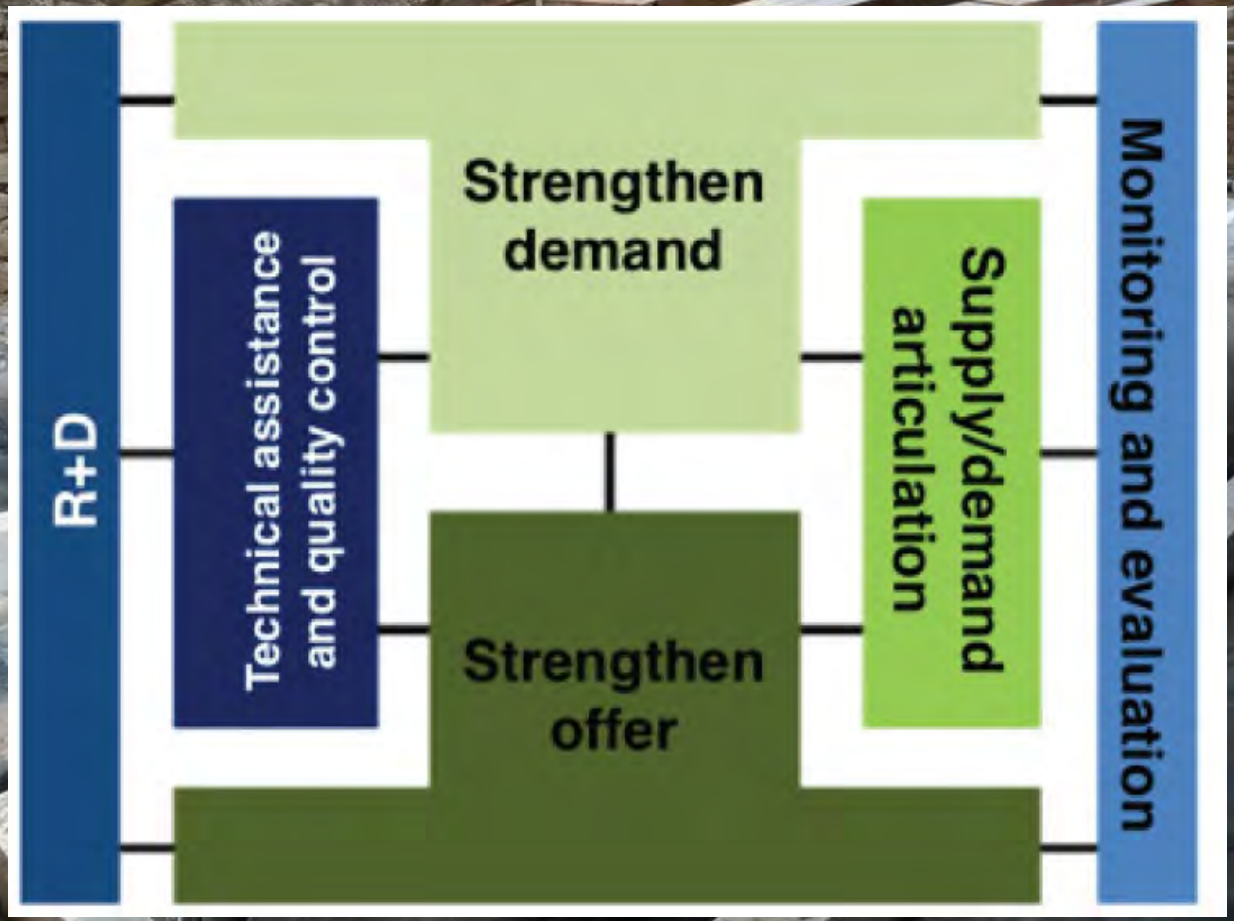
Impact of digester in the farm (economic and CO2)

Plan for a National Biodigesters Program for Ecuador

The objective of the national biogas programs is to generate a sustainable biodigester market for small and medium-sized farmers.

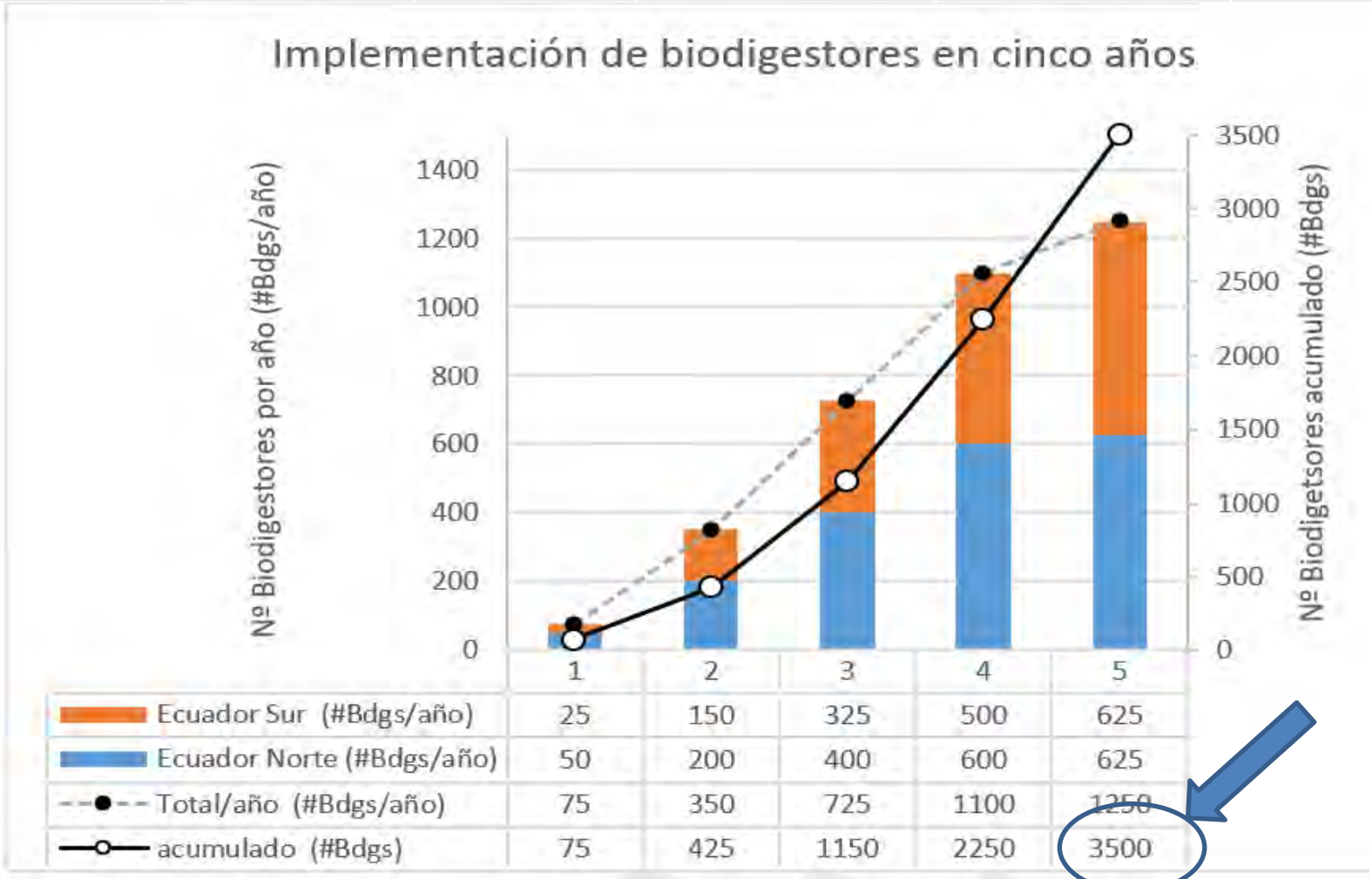
- Market focus in which the clients themselves assume the majority of the investment costs.
- Participation of multiple participants in the program, each with their defined roles.
- Strengthen capacities of existing local participants.
- The development of a sector as such, going beyond the project rationale.
- Competition regulated by the supply side, ensuring the benefit of customers.
- Quality control system, designed and applied to protect the interests of families and gender equality.
- Medium to large timescale, since it takes at least 5-10 years to develop a sustainable and economically viable sector.

Plan for a National Biodigesters Program for Ecuador

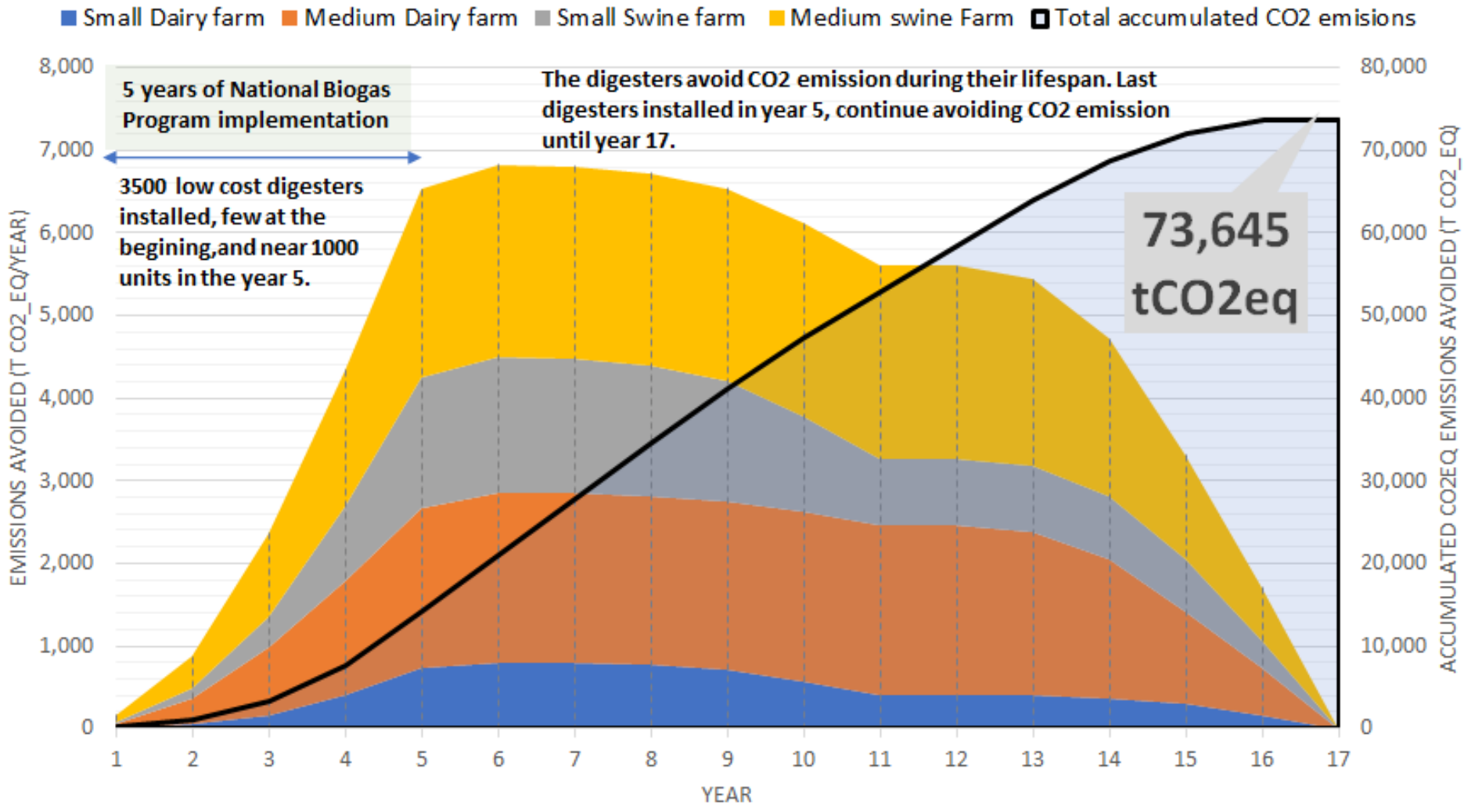


Estimation of Co2eq avoided by the implementation od figesters, respect size and type of farm

	+CO2 Installlation (kgCO2/digester)	-CO2 by biogas use instead LPG (kgCO2/y)	-CO2 by effluent use instead syntethic fertilizers (kgCO2/y)	-CO2 by better manure management (kgCO2/y)	**-CO2 Total emissions per digester (kgCO2/y)**
Small Dairy farm	150	510.1	223.3	29.4	**762.7**
Medium Dairy farm	600	2142.4	673.1	117.4	**2932.9**
Small Swine farm	150	765.1	300.3	494.1	**1559.5**
Medium swine Farm	300	1785.3	558.3	988.1	**3331.8**



CO2eq emissions avoided by the National Biogas Program in Ecuador



Results to 5 years of NBP

- **3500 farmers with biodigesters** that treats the agricultural wastes, producing biogas and bioslurry
- **69000 t/year of manure treated**
- 17475 MWh/year of primary energy generated
- Consumption of at least **77,000 LPG cylinders per year shifts to biogas**
- **Savings** of around **1.13 M USD per year** in LPG subsidy
- **Fertilizers are recycled** in amounts of approximately 434 t of Nitrogen (N), 194 t of Phosphorus (P) and 158 t of Potassium (K) per year.
- **Emissions to the atmosphere of 6500 t of CO2/year are avoided→ 73000 t CO2 for the whole lifespan**

Budget: 4.7 M USD
(1.2 MUSD for direct flat subsidy)

Lessons learned related to climate technology transfer:

- **The most efficient technology is not ever the most appropriate technology**. Social and economical aspects play an important role to select a proper technology.

Just right technology

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UN environment
UNIDO UNITED NATIONS INDUSTRIAL DEVELOPMENT ORGANIZATION
United Nations Framework Convention on Climate Change

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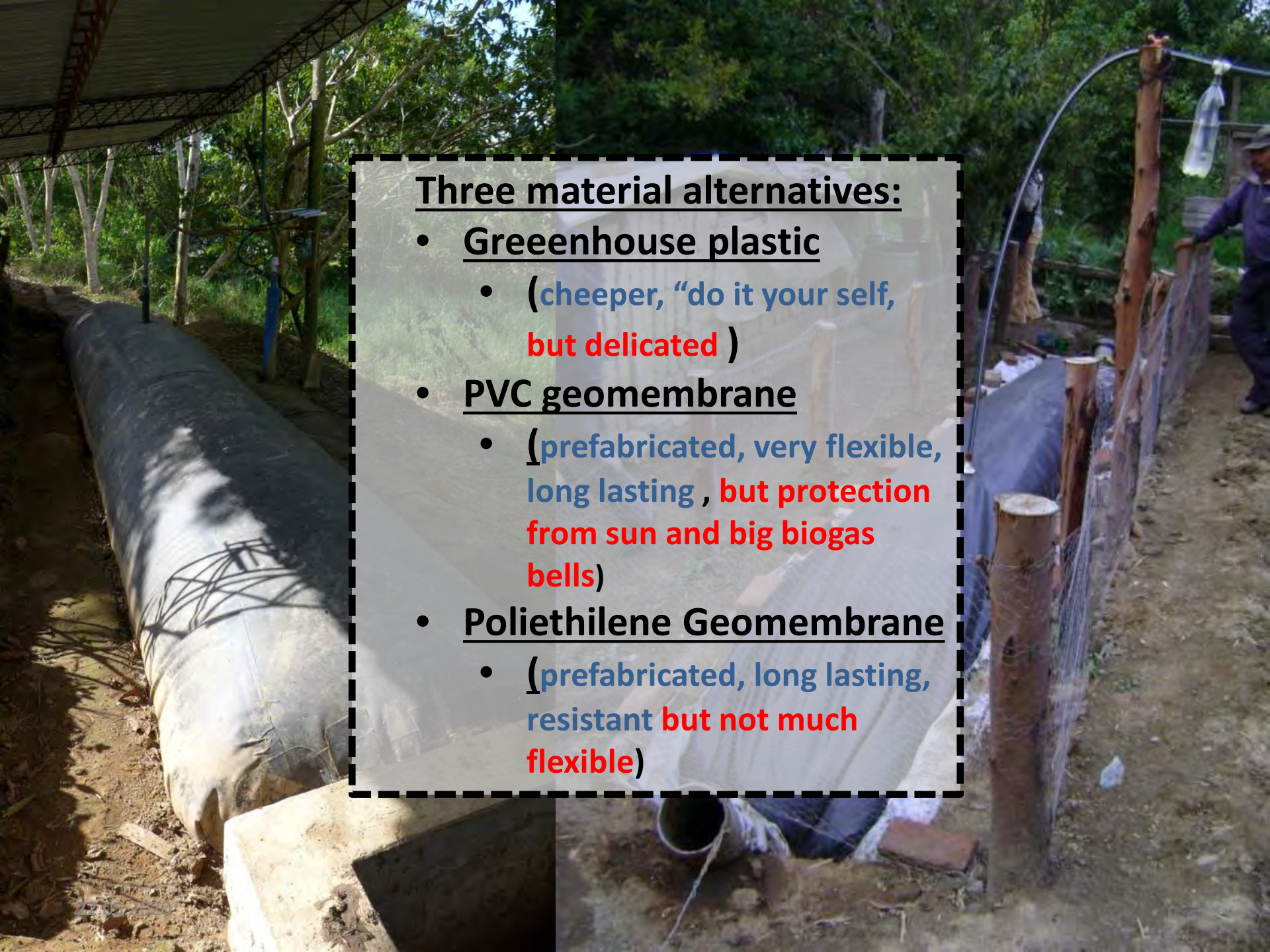
Varios bdgs en serie

Stoves can be adapted

Stoves can be adapted



Three material alternatives:

- **Greeenhouse plastic**
  - (cheeper, "do it your self, but delicated)
- **PVC geomembrane**
  - (prefabricated, very flexible, long lasting , but protection from sun and big biogas bells)
- **Poliethilene Geomembrane**
  - (prefabricated, long lasting, resistant but not much flexible)


Biogas reservoir