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# Learning Agroecology Online During COVID-19

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Since March 2020, the COVID-19 pandemic propelled the “stay-at-home” policy worldwide under public health uncertainty, resulting in increased individualization, as well as an increased reliance or dependency on digital communication technology. Based on a review of existing literature alongside a reflection on personal fieldwork experiences, we aim to: (1) describe major elements of agroecological pedagogy, (2) explore adaptation pathways to combine digitalization and participatory action-learning, and (3) briefly discuss opportunities and challenges for agroecologists beyond COVID-19. Agroecological pedagogy is deeply embedded in the *praxis*, the *scientific* knowledge and ways of knowing (academic or not), and in the politics and agency of food *movements*. In line with Freire’s liberation pedagogy, *seeing* what already exists (e.g., in: ecosystems, home-gardens, fields, farms, and watersheds) through participation and volunteering. Alongside a critical *analysis* to explain and explore certain phenomena, causes and consequences will likely result in the *act* leading to the implementation of transformative practices and novel designs that improve the state of any situation being addressed. Participatory action research/learning methods are strategic in agroecological pedagogy. Overall, the lockdown period led to increased societal digitalization of human interactions. During lockdown, however, the implementation of strategies for remote agroecology participatory action-learning were hampered, but not vanquished. Key changes to agroecology education projects “before” and “during” lockdown include an increased reliance on digital and remote strategies. Creative adaptations in the virtual classrooms were designed to nurture, deepen, and foster alternatives in favor of diverse knowledges and ways of knowing for food system transformations.

**Keywords:** agroecological pedagogy, digitalization, remote education, distance learning, self-isolation, actionable knowledge, decolonial agronomy

## INTRODUCTION

Since March 2020, the COVID-19 pandemic propelled the “stay-at-home” policy worldwide. Consequently, most shops, restaurants, schools, and universities closed to reduce the spread of the virus. Online work meetings became the norm, and remote study and teaching methods were inevitably adopted. However, online learning/teaching is not the same as in person. The delivery of usually in-person practice-based trainings such as those related to agriculture, agronomy, animal sciences, soil ecology, and agroecology were hampered due to the physical distancing restrictions. Although many of the theoretical elements and foundational readings can be transferred digitally, the sudden shift from practice-based to online training caused a disruption in the research

and education systems worldwide. Moreover, implementation of remote education strategies was challenging since faculty, administrative personnel, and students often lacked training on how to properly conduct and respond to online teaching. Lockdown conditions and public health uncertainty at the beginning of the declared emergency due to the COVID-19 pandemic increased already-existing social inequalities (Timmermann, 2020). This translated into increased individualization, as well as an increased reliance or dependency on digital communication technology over the lockdown period. Traditional knowledge sharing and the diversity of ways of knowledge co-creation were certainly disrupted.

While everybody was “at home”, the lockdown conditions were not the same for all (Altieri and Nicholls, 2020; Gordon, 2020; Ramos-Gerena et al., 2020). On social media (i.e., Facebook, Twitter) it was indeed common to encounter phrases such as “*We’re all in this together*” while others stated, “*We’re all on the same sea but not on the same boats*”, illustrating the complexity and the disparity between personal situations. Access to stable internet connections or to calm study-areas was nearly impossible for a group of university students, most of them in the early 20’s and interested in the ways of agroecological food production. Inequalities were indeed exacerbated, although some creative opportunities emerged from this global public health crisis and the abrupt shift to a different mode of knowledge-sharing. The challenge for agroecology educators was particularly important since learning agroecology is rooted in theory, fieldwork, peer-to-peer exchanges, and *in situ* implementation. Based on a review of existing literature alongside personal reflections while conducting fieldwork and/or facilitating learning processes<sup>1</sup>, we aim to:

- (1) describe major elements of agroecological pedagogy,
- (2) explore adaptation pathways to combine digitalization and participatory action-learning, and
- (3) discuss opportunities and challenges for agroecologists beyond COVID-19.

We expect that our analysis will catalyze further discussions and innovations on how to effectively support and implement experiential and reflective participatory online action-learning strategies that can positively stimulate and transform higher education through modules that would “normally” require on-site field visits and outings.

<sup>1</sup>Based on four online facilitation processes: (1) an undergraduate-level training in Agroecology (TPAG 3019, 2020) and Agroforestry (TPAG 3017, 2018) within the Sustainable Agriculture BA program at the University of Puerto Rico at Utuado (UPRU), Utuado, Puerto Rico [GF in 2019-2020; AS in 2020-2021]; (2) an adult certification within the El Josco Bravo Agroecology School at Utuado, Puerto Rico (GF in 2020); (3) a youth summer training in Plant Sciences, offered by the Nature Team at Scout Camp Guajataka, Quebradillas, Puerto Rico (GF in 2020); and (4) a graduate-level module in Stabilisation Agriculture (7058 EXQ) within the Agroecology, Water and Food Sovereignty MSc at Coventry University, Coventry, England, UK (GF in 2020).

## AGROECOLOGICAL PEDAGOGY

### Becoming an “Agroecologist” at the University

Amid concomitant environmental and social crises, food production is increasingly globalized and industrialized, and, since the Green Revolution (late 1950s through early 1970s), numerous are the examples of failed technological packages for cultivation which relied on external inputs, an over-simplification of farming systems, and a concentration of food chains in the hands of few commercial intermediaries (Holt-Giménez, 2009). In this context, the agroecological approach to food and farming has gained worldwide recognition as an important vehicle to counter climate variability, to by-pass external market dependencies, and to transform social injustices into a situation of social equity, particularly in times of COVID-19 and other pandemics (Altieri and Nicholls, 2020).

Agroecology is a key building block for food sovereignty (Nyéléni, 2007). The core design principles of agroecology include diversity, recycling, synergy, interactions, and efficiency (Nicholls et al., 2017). These synthesized principles are based on farmer practices, also known as farmer innovations, and are useful to characterize and re-design sustainable and resilient food and farming systems as whole, dynamic, and complex systems. Learning the skills to become an agroecologist requires both theory and hands-on experience. As a transdisciplinary scientific field, agroecologists have a wide variety of backgrounds, from agronomical sciences to social and political approaches, to soils, biodiversity, food and farming systems. The goal of any agricultural producer is certainly to produce plant and animal products of economic and nutritional value. The goal of an agroecologist is to support transformation of food and farming systems, so that these can simultaneously benefit and nurture people, communities, and nature. Agroecology, as a systemic approach to food and farming systems, supports farmers, technicians, and researchers to take advantage of the complexities of food and farming systems and optimize them with ecological principles (Méndez et al., 2013). As “agents of change”, agroecologists often mobilize participatory action-research and action-learning tools that can support the transformation of food and farming systems. High self-reliance and low external-input dependency, at the various scales of the food systems (i.e., plot, farm, landscape, and territory), often characterize desired outcomes from agroecological training activities and implementation initiatives.

Based on insights from students having completed the Agroecology MSc program at the Norwegian University of Life Sciences (NMBU), the process of training as an agroecologist seems strongly rooted in experiential and reflective learning (Francis et al., 2016), through the stimulation to acquire key agroecological competencies and skills such as:

- a. observation,
- b. reflection,
- c. participation/immersion,
- d. dialoguing, and
- e. visioning.

*Observation* is central to understand the world as it is, reinforcing objectivity and attention to detail. *Reflection* allows to critically analyze, assess, and evaluate the outcomes of given processes, across local and international scales. *Participation/immersion* is key to stimulate cooperative group dynamics that are horizontal (non-hierarchical) and that foster conviviality and community-building, through volunteer action, full immersion in farm activities, and participant observation. *Dialoguing* is a skill that will be beneficial to share ideas, knowledge and wisdoms through effective communication that encourages receptivity, sensitivity, and empathy. *Visioning* refers to the capacity of dreaming, whether individually or collectively, of planning, of deciding and of implementing it after having assessed potentials, limitations, and risks. “*Learning by doing!*”, as the old saying goes, is a good way to start developing key agroecological competencies and skills.

## Facilitating Diverse Ways of Knowing in Agroecology

Agroecology as a more holistic perspective than Agronomy inherits from both the natural and the social sciences, with the concept of “systems thinking” as a base (Tittonell, 2013). In the past 30 years, the term has evolved from the mere observation of agricultural systems at the plot level with an ecological standpoint toward participatory action-oriented research, and an explicit acknowledgment of the diversity of knowledges, perspectives, and landscapes throughout food and agricultural systems (science, practice, and social movements). Thus, facilitating ways to learn the practices, principles, scales, methods, and acquiring the skills and competencies required to accompany and transform the ways of producing and consuming food globally, requires local territorial anchorage (Dogliotti et al., 2014).

In the Americas, farmer-to-farmer, or peasant-to-peasant, as a knowledge-sharing methodology, was effective to expand agroecological *praxis* and *ethos* across farmer groups, often in collaboration with local technicians and researchers (Altieri and Toledo, 2011). For example, the impact of participatory farmer-to-farmer methods on the expansion and intensification of agroecology knowledge has been well documented across Cuba (Rosset et al., 2011), Mexico (Toledo and Barrera-Bassols, 2017), Uruguay (Dogliotti et al., 2014), and other regions (McCune and Sánchez, 2019). The IALAs (*Institutos de Agroecología Latinoamericanos*) and the *Escola Campoense* of MST across several countries of the Caribbean, Central and Southern America, have been propelled by the popular education pedagogy of Paulo Freire and the need for political organization in rural and marginal areas (Rosset et al., 2020).

Agroecological pedagogy is indeed, deeply embedded in the *praxis*, the *scientific* knowledge and ways of knowing, academic or not, and in the politics and agency of food *movements* (Wezel et al., 2009). It is transdisciplinary in nature and requires strong bases in a variety of fields, both in the natural sciences (agronomy, landscape ecology, entomology, biology, and chemistry), and in the social sciences (economics, anthropology, political sciences, and philosophy). Strategically,

the movement, science and practice components of agroecology become actionable through (1) volunteering, (2) theory, and (3) implementation. These components also loosely resemble Paulo Freire’s experiential and reflective learning processes: See-Analyze-Act (Freire, 1968). First, *seeing* what already exists (e.g., in ecosystems, home-gardens, fields, farms, and watersheds) can be achieved through participation, volunteering, and knowledge sharing. Alongside a critical *analysis* to explain and explore phenomena, causes and consequences will likely enable the *act* leading to the implementation of transformative practices and novel designs that improve the state of any situation being addressed. Thus, participatory action research/learning methods are strategic in agroecological pedagogy. In this sense, transformative agroecology education can be reinforced through critical toolkits of participatory action-research and action-learning methodologies, as used by social movements to advance food sovereignty, based on four key characteristics or qualities (Anderson et al., 2019):

- horizontalism,
- *diálogo de saberes* (wisdom dialogues, peer-to-peer),
- combining practical and political knowledge, and
- building social movement networks.

According to Pimbert (2006), knowledge transformation could/should lead to: (1) Democratization of science and technology research, (2) De-institutionalization of research for autonomous learning and action, and (3) Enabling contexts for social learning and action. In **Table 1**, we propose an introductory agroecology curriculum that showcases key topics for agroecological training and integrates Freire’s pedagogy (see, analyze, and act) with the main dimensions of agroecology (movement, science, and practice). Key topics can be facilitated in any order provided that the training stimulates experiential and reflective learning outcomes. While the implementation of such a program is relatively straight-forward when in-person, the sudden shift from practice-based to digital ways of learning and communication represented a major challenge. In this case, creative adaptations of PAR methods to remote learning were indeed invaluable to both the learning process and the co-creation of module content for territorial anchorage, especially remotely. In the next sections, we explore adaptation pathways to digitalization and online learning of agroecology during COVID-19 lockdown, based on the authors’ facilitation experience between March 2020 and January 2022.

## LEARNING AGROECOLOGY IN TIMES OF COVID-19

### Digitalization and Remote Ways of Knowing in Agroecology

Due to the COVID-19 lockdown restrictions to self-isolate, the agroecology participatory action-learning projects that were active before March 2020 needed to suddenly shift from practice-based to online training methods and/or hybrid modes (combining face-to-face and remote teaching). For example, assessing soil quality requires touching the soil, identifying

**TABLE 1** | A proposal of methodologies and course contents for an online (or hybrid) introductory agroecology curriculum that integrates Liberation Pedagogy by Paolo Freire and the dimensions of agroecology: movement, science, and practice.

Dimension	Movement	Science	Practice
Seeing	Food sovereignty movements Local ecological knowledge	Healthy diets Global family farms Food sovereignty Ancestral practices	Cooking your harvest Co-Innovation/PAR Having your garden
Analyzing	Farm labor Collective action Policies and institutions	Agroecology principles Soil quality Plant/animal health Food sovereignty values	Composting Plant biology/physiology Intercropping Crop production Seed conservation Animal husbandry
Acting	Culture and traditions Farmer aspirations Co-Innovation	Indicator-based agroecological performance assessments Farm planning tools Computer and participatory modeling	Systems Design Participatory-Action Research (PAR) and learning Extension services Communication Experimentation

the flowers and observing the biophysical landscape features. Assessing plant health entails evaluating the crop condition and dialoguing with farmers. However, in-person dynamics are not equivalent to remote strategies. The challenge in times of COVID-19 to fostering acts of cognition, otherwise said, of generating actionable knowledge in the field of agroecology, whether synchronic or asynchronous, was indeed significant.

Fortunately, several pathways to obtain information that improve the quality of knowledge dialogues remotely are available. For example, video conferences and online presentations were held in a variety of platforms including Zoom, Skype, Microsoft Teams, Google Meet, YouTube, amongst others. In the case of specific online learning and folder sharing platforms for schools and universities, Blackboard, Moodle, Canvas, and Google Classroom excelled. In the case of group discussions, the chats available through mobile platforms such as e-mails, WhatsApp, Signal and Messenger were also employed as tools to increase information availability and communication throughout higher education, school curricula, and community-led workshops.

During lockdown, the implementation of strategies for remote agroecology participatory action-learning were hampered, but not vanquished. Stable internet access or availability of adequate communication hardware was challenging for some, but strategies to overcome were creatively found, especially with the extent of possibilities that smartphone mobiles provide. This said, frustration and un-easiness with remote communication technologies for agroecology education were not uncommon amongst trainers and trainees. One of the PAR methods that was very successful for students to simultaneously learn the process and the content was the semi-structured dialogue with local farmers and animal breeders. The students were able to call over the phone (or any other digital communication platform) to have an open dialogue about their farm activity and other related subjects. Reporting back to the classroom with a few images or a quote often provoked lively and timely conversations

about the study-cases amongst the students. Other PAR methods such as landscape and farm management characterizations, social network analyses and SWOTs could all feature in the process of participatory action-learning. More importantly, each student was prompted to develop a simple food production project at home. This catalyzed a myriad of innovations that, from a research perspective, build up databases, and from a learning experience, knowledge is co-produced and shared amongst peers (see **Figure 1**).

The face-to-face *theory* study sessions were converted into either live streaming or recorded presentations made accessible through various online platforms, to facilitate asynchronous facilitation. To stimulate group discussion, a selection of essential readings and key recorded presentations, provided the members of the learning circle time to do their “home-work”, in groups or individually. The lockdown period also fostered opportunities to share dialogue spaces directly with regional and international actors, through remote video conferencing tools. The possibility of inviting speakers to the virtual classroom was important to map-out local and over-seas experiences. In short, the lockdown period came with an opportunity to explore cases across a variety of latitudes without necessarily moving from home.

The pandemic created space for developing virtual farm visits, as well. For example, novel tools such as virtual reality (VR) have made accessible “digital transportation” for self-isolated persons to, not only explore world-famous museums,<sup>2,3</sup> but also to “visit” farms worldwide<sup>4</sup> as well as locally. The historical moment fostered unprecedented availability and accessibility to

<sup>2</sup>Facing Challenge with Resilience: How Museums are Responding During COVID-19 (2020): <https://www.imls.gov/blog/2020/04/facing-challenge-resilience-how-museums-are-responding-during-covid-19>.

<sup>3</sup>Museums worldwide react to COVID lockdown by offering virtual tours (by Riccardo Bianchini, 2021): <https://www.inexhibit.com/marker/museums-worldwide-react-to-covid-lockdown-by-offering-virtual-visits/>.

<sup>4</sup>*Farm Lighthouse Project*, led by Dr. Rogier Schulte and Dr. Vivian Valencia at the Farming Systems Ecology Group, Wageningen University, The Netherlands:



**TABLE 2 |** Changes and opportunities to participatory action-learning strategies before and during lockdown and self-isolation due to COVID-19, based on authors' fieldwork and facilitation experience.

Action-learning	Before lockdown	During lockdown
<b>Seeing</b> <ul style="list-style-type: none"> <li>• Volunteer</li> <li>• Describe</li> <li>• Diagnose</li> <li>• Participation</li> <li>• Observation</li> <li>• Immersion</li> </ul>	Field visits to neighboring farms, alongside trainers. Support to local farming projects by periodical visits undertaking farm and labor activities as needed.	Not possible, physically. Opportunity for video call and remote interviews with local and international farmers/projects, including "virtual farm tours", QandAs, and group discussion.
<b>Analyze</b> <ul style="list-style-type: none"> <li>• Theorize</li> <li>• Explain</li> <li>• Explore</li> <li>• Reflection</li> </ul>	Presentations, Key readings, Invited speakers and classroom discussion	Remote presentations, videos, readings. Possibility to include local and international speakers, with Q and As and groups discussion
<b>Act</b> <ul style="list-style-type: none"> <li>• Implement</li> <li>• Plan</li> <li>• Design</li> <li>• Visioning</li> <li>• Dialoguing</li> </ul>	On-site management of low-external input cropping system. Collective work, in collaboration with trainers.	At-home implementation of theoretical skills, including maintenance and/or creation of home-gardens and food recipes with local products, by taking into account design principles and individual resources, opportunities, and limitations (i.e., urban, rural, and coastal).

international webinars alongside a wider understanding of locally anchored food producers. Other than a considerable risk of screen over-saturation and reduced physical mobility, the added value of remote platforms lies in its capacity to share considerable volumes of information "just a click away".

## Innovations on Remote Volunteering and Implementation

Overall, the lockdown period led to an increased dependence on digital tools for human interactions that can lead to over-reliance on communication technology when people work at home, using videos, online resources, social media, for remote learning, networking, and working (Timmermann, 2020). The need to minimize physical contact in times of COVID-19 opened space to increase at-home food production, particularly in the case of agroecology learning modules that discussed and implemented the processes for low external input food production. Key changes to agroecology education projects "before" and "during" lockdown include an increased reliance on digital and remote strategies (Table 2). Creative adaptations of participatory action in the virtual classrooms were designed to nurture, deepen, and foster alternatives in favor of diverse knowledges and ways of knowing for food system transformations (see Figure 1).

Field visits and on-farm immersion experiences were restricted yet opportunities to interact with farmers or food movements was possible through video calling apps. For example, having a "virtual farm tour" with questions and answers, as well as collective group discussions were relatively successful, and this, despite long-distance frontiers and time-zone differences. Participating in farm activities as volunteers

was, however, limited to individuals visiting farms and following all COVID prevention recommendations. The need to observe sanitary measures at all times (in the case of COVID-19: to sanitize hands frequently, to wear face covering in closed spaces, and to maintain physical distancing), allowed individuals to eventually co-create hybrid learning strategies (i.e., combination of remote and in-person learning strategies).

The *volunteering* component was the most challenging for facilitators to propose remote experiential learning on-farm. In the case of face-to-face practical agroecology design modules, the training would be accompanied by mentorship from a more experienced trainer in elements such as soil quality, plant health, plant reproduction, and crop harvesting on-site. Because COVID-19 restrictions did not allow collective gatherings, the students were encouraged to assess the opportunities and limitations of their surroundings, as well as their existing resources for food production.

Maintaining a home-garden, a family farm and/or creating a new space to increase at-home food production was a central commitment to achieve learning goals throughout the modules. This presented itself as an opportunity to, despite lockdown, multiply an array of well-informed actors in home and community gardens amongst the different learning spaces. Once again, not everybody had "all" adequate resources at their disposal, which is indicative of underlying social differences (e.g., capital, space, time, and labor), yet key competencies of empathy and risk mitigation were fostered during self-isolation across the globe. Student immersion in the food production processes through individual implementation of agroecology and agroforestry farm design frameworks at-home were important outcomes of remote action-learning at each of the students' households, especially when sharing their experience with the rest of the group. The great variety of scenarios fostered by students working from home presented a suite of different agroecological

<https://www.wur.nl/en/Research-Results/Chair-groups/Plant-Sciences/Farming-Systems-Ecology-Group/Lighthouse-project.ht>



**FIGURE 1** | Creation of new food production areas at home during COVID-19: photo examples from student assignments in the “agroecology in practice” module at the University of Puerto Rico at Utuado, May 2020. **(A)** Rural planting beds in terraces (Corozal, Puerto Rico). **(B)** Urban home-garden in planting pots (Toa Baja, Puerto Rico). **(C)** Implementation of soil erosion-mitigation practices on steep terrain (Utuado, Puerto Rico). **(D)** Re-designing urban areas and implementing agroecological urbanism (Caguas, Puerto Rico). **(E)** Recycling egg boxes as germination plates (Cidra, Puerto Rico). **(F)** Exploring the ethnobotany of native agricultural diversity (San Juan, Puerto Rico). [Reproduced with authors’ permissions].

systems to all class participants by the presentations from peer students.

## Remaining an “Agroecologist” Beyond COVID-19

In the context where trainers and trainees missed out on the opportunity for collective in-person activities, the implementation of remote learning modules and independent application of agroecological principles fostered a unique learning situation that supported training activities to become an agroecologist. By observing, reflecting, and sharing different dimensions of knowledge, agroecologists develop capacities in empathy and dialogue that are essential to contribute as “agents of change” (Reynolds et al., 2014; Francis et al., 2016). Horizontal (non-hierarchical) and participatory methodologies with students, farmers, farm workers, and field technicians often get inspiration in participatory action-research and action-learning toolkits. An outcome to consider from agroecological training, is the change of attitude in the trainee that embraces

diversity and inclusion rather than homogeneity and exclusion (Geilfus, 2009). Additionally, much can be learned through dialogue with and by becoming practitioners and informed consumers. Indeed, many of the participatory action-research methodologies that are implemented by agroecologists in the field are adaptations of the “farmer-to-farmer” strategies (Rosset et al., 2011). For example, on-farm experimentation was applied by students by considering one change at a time in their home-garden or farm, and at small scales before extending to larger areas. Creative adaptations of the participatory “farmer-to-farmer” tools were great additions to university modules through combinations of synchronous and asynchronous activities.

There are numerous experiences in agroecological higher education across the globe, ranging from formal university degrees to top-down workshops and bottom-up community-driven strategies. MSc programs and other learning processes in agroecology and food sovereignty are well-documented for Europe (Francis et al., 2016; Wezel et al., 2018), the

**BOX 1 | Non-exhaustive list of higher education agroecology programs in Europe, Latin America, and North America.****Europe**

- Aarhus University (Denmark): Agroecology Bachelor, Master, and PhD programs, <https://agro.au.dk/en/education/bachelor-and-master-degree-programmes/>
- Coventry University (England, UK): Agroecology, Water and Food Sovereignty MSc and PhD programs, <https://www.coventry.ac.uk/course-structure/pg/2021-22/eec/agroecology-water-and-food-sovereignty-msc/>
- ISARA-Lyon: MSc in Agroecology, <https://isara.fr/en/how-to-apply/international-msc/msc-in-agroecology/>
- Norwegian University of Life Sciences (NMBU, Norway): Master of Agroecology, [https://www.nmbu.no/en/studies/study-options/master/master\\_of\\_science\\_in\\_agroecology/programme-structure](https://www.nmbu.no/en/studies/study-options/master/master_of_science_in_agroecology/programme-structure)
- Swedish University of Agricultural Sciences (SLU, Sweden): Agroecology Master's program, <https://www.slu.se/en/education/programmes-courses/masters-programmes/agroecology/>
- Universidad de Internacional de Andalucía (UNIA, Spain): Inter-University Master in Agroecology focused on Rural Sustainability, <https://www.unia.es/estudiantes/actividades-academicas/todos-los-cursos/item/master-oficial-en-agroecologia-un-enfoque-para-la-sustentabilidad-rural-2>
- Università di Scienze Gastronomiche di Pollenzo (UNISG, Italy): Master in Agroecology and Food Sovereignty, <https://www.unisg.it/en/programs-admissions/master-agroecology-food-sovereignty/>
- University of Natural Resources and Life Sciences, Vienna (BOKU, Austria): Master Organic Agricultural Systems and Agroecology, <https://boku.ac.at/en/studienservices/studien/master-en/uh066500?selectedTypes=group>
- Wageningen University (WUR, The Netherlands): Organic Agriculture MSc with focus on Agroecology or Sustainable Food Systems and PhD programs in Farming Systems Ecology, <https://www.wur.nl/en/Education-Programmes/master/MSc-programmes/MSc-Organic-Agriculture/Specialisations-of-Organic-Agriculture.htm>
- WUR-NMBU-UNISG-ISARA (European Master): Agroecology double degrees, <https://www.wur.nl/en/Education-Programmes/master/MSc-programmes/Msc-Agroecology-Europe-Master.htm>

**Latin America**

- ECOSUR – Unidad San Cristóbal de las Casas (Mexico): Máster en Agroecología, <https://posgrado.ecosur.mx/posgrado/maestrias/maestria-en-agroecologia/>
- Tropical Agricultural Research and Higher Education Centre (CATIE, Costa Rica): International Master's and Phd programmes in Agroforestry and Sustainable Agriculture, <https://www.catie.ac.cr/en/education-programs/posgrado/masters/academic-masters>
- Universidad Nacional de Colombia – Palmira (UNAL, Colombia): Agroecology PhD programme, <https://www.palmira.unal.edu.co/DoctAgroecologia/>

**North America**

- University of California – Santa Cruz (UC Santa Cruz, USA): Undergraduate Agroecology major and Environmental Studies PhD programs, <https://casfs.ucsc.edu/education/undergraduate.html>
- University of Nebraska – Lincoln (USA): Agronomy/Horticulture MS and PhD programs with Agroecology minor, [https://www.unl.edu/gradstudies/academics/programs?interest\\_area=Allandfield\\_location\\_tid=Allandfield\\_department\\_tid=61andterm\\_node\\_tid\\_depth=Allandcombine=andsearch=Search](https://www.unl.edu/gradstudies/academics/programs?interest_area=Allandfield_location_tid=Allandfield_department_tid=61andterm_node_tid_depth=Allandcombine=andsearch=Search)
- University of Vermont (UVM): BS Agroecology, <https://www.uvm.edu/agroecology/learning/uvm-courses/>
- University of Wisconsin – Madison (UW Madison, USA): Agroecology M.S., <https://agroecology.wisc.edu/>

United States (Gliessman et al., 2017), and Latin America (Rosset et al., 2020). These include university-level degrees (undergraduate, graduate, and post-graduate), capacity-building curricula (schools, international and local NGOs, and governments), and community-driven workshops (often informal knowledge exchanges). In these spaces, participants can develop a variety of skills and key capacities that are useful to become an agroecologist, which usually include environmental, economic, and socio-political factors in their curricula.

To go beyond, there are a variety of options for students that want to pursue higher education degrees, thereby expanding networks and multiplying job opportunities for the future (see **Box 1**). Many study programs have evolved to either fully online or hybrid formats, which facilitates university-level training in agroecology while studying remotely. Remote and participatory action-learning of agroecology can be a good place to start for many who cannot travel but want to become knowledgeable in the analysis and design of low external-input sustainable farming systems.

## CONCLUDING REMARKS

Today we see a mixture of agroecology scholars and students that are inclined to either the social or the natural sciences, but for the most part these scientists are situated in a “gray” area where research and education processes take biophysical and social-political issues into account. Simultaneously, others may have extensive knowledge of many farming contexts across regions and even across latitudes. Hence, becoming an agroecologist *per se* needs to be grounded on extensive practice, whether by gardening at home, or by frequently visiting farmers across territories to engage in transformative dialogues and actions (McCune and Sánchez, 2019; Rosset et al., 2020). Otherwise said, in Paulo Freire's words, “*liberating education consists in acts of cognition, not transferal of information*”. As a consequence, agroecological pedagogy triggers actionable knowledge through participatory action-research (Geertsema et al., 2016) and transformative education (Anderson et al., 2019). During lockdown periods, it was challenging for all persons involved in the learning process to have access to necessary resources in order to undertake remote education. However, instances



for participatory action-learning can be created to motivate students to engage with learning material by observing, analyzing and applying knowledge. This was accomplished by organizing modules where elements of volunteering, theory and practice are systematically implemented. As discussed here, agroecology curricula integrated the theoretical and the practical components of the module through digital communication, online media, and remote self-study. While far from perfect, during the lockdown period it was still possible to facilitate agroecology trainings through the adaptation of remote participatory action-research and action-learning activities in the virtual classroom. The learning outcomes are implicit in the process: “See, Analyze, Act”.

## DATA AVAILABILITY STATEMENT

The original contributions presented in the study are included in the article/supplementary material, further inquiries can be directed to the corresponding author.

## AUTHOR CONTRIBUTIONS

GF and AS contributed to conception and design of the manuscript. GF organized the database and study-cases and wrote the first draft of the

manuscript. AS contributed with analytical and conceptual frameworks. Both authors contributed to manuscript revision and have read and approved the submitted version.

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