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# The Agroecological Farmer's Pathways from Agriculture to Nutrition: A Practice-Based Case from Ecuador's Highlands

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#### ABSTRACT

Agroecology is increasingly recognized as a sustainable production strategy that is appropriate for the rural poor. Meanwhile, agricultural initiatives have received much attention for their role in improving farmer nutrition, and three key pathways between agriculture and nutrition include consumption of own production, income and women's empowerment. In this study based in Ecuador's Imbabura province, we used qualitative methods to explore the practices of agroecological farmers with respect to these three key pathways. Results demonstrate the heterogeneity of lived experiences through which agroecology increases agricultural diversity and builds social and human capital to improve nutrition. We further identify barter as an under-explored means to nutrition outcomes, and we discuss the role of the complex rationales that mediate farmers' performance on agriculture-for-nutrition pathways. Finally, our results illustrate agroecology's potential to spread nutrition-promoting practices through endogenous farmers' networks.

#### **KEYWORDS**

Agriculture; diversity; nutrition; sustainable; agroecology

#### Introduction

Effectively addressing malnutrition in the rural sector remains a critical international priority, especially as increasing evidence shows that people who are malnourished as children not only experience the developmental consequences of chronic nutrient deficiencies, but are also more likely to be overweight or obese as adults (Black et al. 2013; Godfrey, Gluckman, and Hanson 2010). Further, they are more likely to experience the comorbidities of obesity, such as diabetes, heart disease, and metabolic syndrome (Godfrey, Gluckman, and Hanson 2010). In Ecuador, rural populations are the most affected by this double burden of malnutrition, and particularly indigenous rural populations (Freire et al. 2014). Indeed, stunting caused by nutrient inadequacies affects 42% of Ecuador's Indigenous children, whereas the national prevalence is 25%.

**CONTACT** Ana Deaconu ana.deaconu@umontreal.ca Research Group on Nutrition Transition and Development (TRANSNUT), Nutrition Department, Faculty of Medicine, Université de Montréal, Montreal, Canada This article has been republished with minor changes. These changes do not impact the academic content of the article. 2019 Taylor & Francis Group, LLC Meanwhile, Ecuador's rural children are more likely to be overweight or obese than their urban counterparts (Freire, Ramírez, and Belmont 2015). The nutrition transition toward high-calorie, low-nutrient foods exposes populations in rural sectors to simultaneous nutrient deficiencies and excesses even in remote and resource-poor areas of the world (Popkin, Adair, and Ng 2012).

Responding to the persistent problem of rural nutrient inadequacies, "nutrition-sensitive agriculture" and "agriculture-for-nutrition" (used here interchangeably), have become common practice in international development (Balz, Heil, and Jordan 2015; Danton and Titus 2018; Pinstrup-Andersen 2013). The associated literature highlights three demonstrated pathways connecting agriculture and nutrition: consumption of own production, increased income, and women's empowerment (Arimond et al. 2011; Danton and Titus 2018; Herforth and Harris 2014). Importantly, the effectiveness of each pathway is mediated both by local contextual factors as well as by specific intervention investments in different types of capital (Berti, Krasevec, and FitzGerald 2004; Danton and Titus 2018). For example, interventions that diversify agricultural production can make important contributions to dietary diversity, which is in turn associated with micronutrient sufficiency (Arimond and Ruel 2004), but only if farmers actually know how to and want to consume the new additions to their production (Cook 2018). Similarly, increased agricultural income can provide better economic access to nutritious foods, but only if the income is in fact used for this purpose, or if nutritious food is available for purchase (Cook 2018). Because of such contingencies, agricultural interventions are more likely to have positive effects on nutrition if they simultaneously invest in multiple forms of capital (physical, natural, financial, social, and human), and especially in human capital, with particular emphasis on the importance of nutrition education and gender considerations (Berti, Krasevec, and Sian 2004).

While some scholars have recently made nods to the need for nutritionsensitive agriculture to avoid harm with respect to overweight and obesity (Herforth, Lidder, and Gill 2015), its role is unclear for addressing this side of the double burden of malnutrition. Given correlations between nutrient inadequacies in early life and overweight in later life (Godfrey, Gluckman, and Hanson 2010), investing in maternal and child nutrient adequacy may inherently contribute to long-term prevention of overweight. Nevertheless, rising prevalence of the double burden of malnutrition among the rural poor (Black et al. 2013; Fernald and Neufeld 2007; Kimani-Murage 2013; Shafique et al. 2007) warrants more explicit exploration to understand how agriculture-for-nutrition pathways may affect overweight and obesity.

Beyond these remaining knowledge gaps, agriculture-for-nutrition pathways have demonstrated strong potential to align with a broader global agenda toward sustainable development, which promotes ideals including economic resilience, climate change adaptation, ecological stewardship, gender equality,

and empowerment of Indigenous peoples (United Nations, UN General 2015). Many of these objectives have been captured in recent institutional pushes to move away from the "specialization" zeitgeist that dominated for generations toward one of diversity (Frison 2016). Agricultural diversity, in particular, has received attention for its role in promoting economic resilience in the face of market disruptions or natural shocks, regenerating ecosystems, hedging against the risks of climate change, mobilizing traditional Indigenous knowledge and empowering women. These not only contribute to the Sustainable Development Goals, but can have positive indirect effects on nutrition (Cook 2018; Frison 2016; Frison, Cherfas, and Hodgkin 2011). Furthermore, empirical evidence from many countries demonstrates a positive correlation between agricultural diversity and dietary diversity, leading to direct effects on nutrient adequacy. According to context, this correlation is most often attributed to the consumption of own production, to increased income, or to a combination of the two (Frison 2016; Frison, Cherfas, and Hodgkin 2011; Herforth and Harris 2014; Pellegrini and Tasciotti 2014; Powell et al. 2015). Recently, women's empowerment has also received increased attention as an important mediator of this relationship, given women's roles as stewards of agricultural diversity and primary decision-makers around food (Cook 2018).

One of the most promising means for increasing agricultural diversity appears to be agroecology, which has risen on the global governance agenda in recent years as an accessible and appropriate strategy for resource-poor farmers (Altieri and Nicholls 2012; Frison 2016), and may also be compatible with agriculture-for-nutrition pathways. Agroecology applies ecological principles to the design and management of food and agricultural systems to create a self-sustaining and environmentally regenerative agro-ecosystem; this process involves eliminating synthetic agrochemicals and instead cultivating high levels of plant and animal biodiversity in order to promote beneficial interactions, protect against pests, and increase productivity (Altieri and Toledo 2011; Tittonell 2014). In some spaces, agroecology functions as an institutionally backed intervention strategy; in others, it functions as a social movement spread by farmers' networks (Wezel et al. 2009). In Ecuador, agroecology appears to be simultaneously an intervention and a social movement, as it is spread through both institutional programs as well as through self-organized networks such as Indigenous and peasant federations, and is often a collaboration between the two (Intriago et al. 2017). The multimodality of agroecology's dissemination makes it a strategic focus of research, especially because promising practices may be scaled up among future farmers by today's early adopters (Frison 2016).

Agroecology initiatives may be informed by the agriculture-for-nutrition literature, which provides important lessons for intervention and policy planning. However, the outcomes of such programs, such as dietary change, occur at the level of individual practice. Behavioral science research repeatedly points out that individual practice is not usually the result of evidence-based, rational decision-making, but rather the product of social and cultural contexts, emotion and meaningful experiences (Kahneman 2003), and the same holds true for both production decisions (Herforth and Harris 2014) and dietary decisions (Chadwick, Crawford, and Ly 2013). Responding to the complexity of the physical and interpersonal influences that affect people's interactions with their food environments, and ultimately their dietary practices, food studies have gradually narrowed their focus from attempts to characterize a broader "context" to a more individual scale that can better capture these complexities (Chen and Kwan 2015). Similarly, the "practice" approach develops profound, qualitative accounts of practices to give attention to the heterogeneous array of human activities (Schatzki 2001).

In this study, we thus focus on individual practice and recount farmers' empirical lived realities such that their experiences may enter into conversation with the quantitatively established patterns and pathways for nutrition-sensitive agriculture. Whereas previous research has reviewed what agriculture interventions have done right or wrong for improving nutrition (Arimond et al. 2011; Berti, Krasevec, and Sian 2004), our attention to individual farmers' practice allows us to also recognize the agency of farmers (rather than intervention planners) in generating production and dietary changes. This article thus has the dual objective of empirically describing food and agriculture practices among agroecological farmers in our study site, as well as drawing lessons from their experiences that are relevant to the evolving body of knowledge related to agriculture-for-nutrition. Specifically, we frame qualitative inquiry on the hypothesis that agroecology in our study site would affect nutrition through some or all of the same pathways established in the agriculture-for-nutrition literature, namely consumption of own production, increased income, and women's empowerment, and that these pathways are mediated by different forms of capital. We defer to the farmers' lived experiences to understand how they do, or do not, follow these pathways.

#### Methodology and methods

#### Study site

This study is situated in the rural communities of Ecuador's northern-highland province of Imbabura, where agroecology has made strong inroads. A recent survey identified and interviewed the heads of 676 agroecological farms in Imbabura, suggesting that at least 2% of the province's total farms are agroecological; nevertheless, the authors note that this is likely an underestimate (Heifer 2014; INEC 2000). Conventional farming in the province is dominated by small-holder family farming, with many farmers practicing traditional,

subsistence-oriented production practices that hold much in common with agroecology (Heifer 2014). The boundaries of the study site are defined by the locations of farmers participating in agroecology initiatives. While its extremities are no more than 60 km apart, people within the study site live and grow crops at altitudes varying between 1500 and 3500 m above sea level. They thus experience a range of ecosystems, soil types, rainfall patterns, and temperatures, resulting in diverse agricultural strategies. Communities within the study site experience high poverty rates, reaching up to 84% in some villages (INEC 2016). Such inequities are reflected in nutritional status, and Imbabura's childhood stunting prevalence of 35% surpasses the national average of 25%. This is likely related to the region's high levels of inadequate dietary intakes of protein and fat as well as deficiencies in iron, zinc, and vitamin A (Freire, Ramírez, and Belmont 2015). Meanwhile, Imbabura's adult overweight and obesity prevalence of 62% is similar to the national level (Freire, Ramírez, and Belmont 2015). Of Imbabura's total population, 25.8% self-identify as Indigenous (INEC 2010), and 86.6% of Imbabura's Indigenous population is rural (INEC 2006). In this region, today's rural Indigenous people have inherited the circumstances of a history of marginalization that relegated them to distant and unfavorable agricultural lands with challenging growing conditions and reduced market access (Waters 2007; Zamosc 1994).

## **Research** approach

This research is part of the Farm to Plate study, which uses mixed methods to understand the dietary, agricultural, and social practices of farmers in Imbabura province to examine the potential nutrition outcomes of agroecology. Prior to deploying Farm to Plate's cross-sectional comparative survey of agroecological and conventional farmers, we recognized the need to conduct qualitative research to deepen our understanding of local practice, flag predominant mediators of the relationship between agriculture and nutrition, and identify emergent themes for inclusion in the survey. We therefore applied Long's Actor-Oriented Approach (Long 2003) to develop the field and analytical methods for such inquiry. Namely, we used qualitative instruments to: identify relevant actors and actor-defined issues; document social heterogeneity; and, explore how knowledge and power are constructed and reconfigured (Long 2003). Through this approach, we pay special attention to "practice" in order to highlight, rather than dilute, deviations from preconceived expectations (Schatzki 2001).

# Instruments

Qualitative instruments included ethnography, key informant interviews, and participant observation in relevant spaces. In May and June 2017, we

conducted semi-structured key informant interviews with nine individuals, five of whom were agroecological farmers' association leaders, two of whom directed NGO programs promoting agroecology, and another two that were municipal employees in charge of coordinating relationships with agroecological associations. All farmers' association leaders and one NGO representative are also members of the Imbabura Indigenous Peasant Federation. Interviews focused on the history of agroecology in the region, current organizational structure and inter-organization relationships, and activities and events surrounding agroecology.

We conducted ethnography during July 2017 and January 2018 to include both the winter and summer seasons. This involved immersive homestays of approximately one week each with five agroecological families, in which the ethnographer (the first author) utilized participant observation and semistructured interviews to collect data around food, agriculture, gender dynamics, and food-related social practice in the family's homes and in their communities. We selected participating families following discussion in key informant interviews, aiming to cover a variety of eco-zones and durations of participation in agroecology. We identified key themes for inquiry and observation according to our hypotheses, focusing specifically on gender dynamics, dietary content, food origin, agricultural practices, and perceptions of health with respect to diet. We used a critical ethnography approach, which recognizes that the ethnographer is not an unobtrusive "fly on the wall" and instead incorporates reflexive inquiry as to the ethnographer's influence on daily practice (Madison 2005). Data collection instruments included: handwritten field notes; a food journal kept by the ethnographer; lists of agricultural products in the field and stored food items; and, photography of meals, food storage, and farms.

We conducted participant observation in relevant events and spaces from May to August 2017, December 2017 and January 2018. These included farmers' association meetings, agroecological markets, and agroecology-related workshops. Further, we integrate participant observation as documented in field notes from visits to agroecological and conventional farmers' homes (n = 61 and n = 30, respectively) during implementation of the cross-sectional survey from July 2017 to October 2017 (in this article, we do not discuss results of the survey itself).

# Qualitative content analysis and presentation

To analyze content, we combine a directed procedure in which we organize qualitative data according to the three pathways proposed by our hypothesis, with an inductive procedure in which we also identify emergent themes (Hsieh and Shannon 2005). We return to the Actor-Oriented Approach to categorize and thematically explore the experiences and actions of farmers in their daily

interactions with food and agriculture, giving attention to contextual underpinnings, social relationships, material and resource interactions, and power dynamics (Long 2003). To present our analysis results, we apply a "critical approach to food studies," that uses narrative accounts in academic research to demystify food by exploring the significance of "people, ideas, and things in the reality of their food actualities," and that also recognizes the researchers' role as a non-invisible actor within the study (Arce, Sherwood, and Paredes 2017). We occasionally use names for clarity and to unite data points from the same farmer, but all names are fictitious to protect identity.

# **Ethical approval**

All participants gave informed consent according to the study protocol that was approved by the Health Research Ethical Committee of the University of Montreal, certificate number 17-053-CERES-P, and by the Institutional Review Board of the *Universidad San Francisco de Quito* in Ecuador, certificate number 2016-118E.

# Results

## Agroecology in Imbabura

#### The local emergence of a new practice

Key informant interviews with local leaders of agroecological associations situate the roots of agroecology in Ecuador's northern highland provinces within the region's Indigenous movement and its discourse on food sovereignty, traditional identity, and solidarity-based local economy. They explain that the production aspects of agroecology emerged as a pathway to achieve food sovereignty and restore Andean traditions. Meanwhile, local NGOs were working in parallel to the Indigenous movement to promote environmentally sustainable rural development through pesticide reduction and strategies for ecosystem regeneration. Acknowledging their similar means to compatible ends, local NGOs and farmer's associations tied to the Indigenous movement began to collaborate, giving rise to new forms of joint civil society organization. Together, they promoted agroecological production practices and created specialized farmers' markets for direct sale of agroecological products, with agroecological farmer's markets emerging in 2009. As farmers and institutions expanded their interests, agroecological associations began inviting local experts, including farmers themselves, to give workshops on nutrition, food preparation, and medicinal plants, among other subjects.

NGO directors explain that, because their organizations targeted marginalized communities, many of Imbabura's agroecological farmers are from remote Indigenous communities that experience complex environmental conditions and have high poverty levels. In adaptation to their conditions, these farmers tend to maintain agricultural diversity for subsistence and utilize organic fertilization and pest control methods. Rather than a matter of conviction, they often use such practices out of lack of economic access to "modern" alternatives. NGO representatives explain that such practices are already largely agroecological, and their role as NGOs is to strengthen these practices as well as to integrate farmers into specialized markets that recognize the higher quality of their organic products. Due to prevailing gender roles in livelihood strategies, agricultural management, and food preparation, agroecological associations are predominantly comprised of women.

While many farmers trace their routes to agroecology through the joint interventions of local Indigenous federations and NGOs, others do so via social relationships to other agroecological farmers, and still others arrive entirely by their own agency. One young farmer began growing more diversity and eliminated pesticides when her son was born with multiple allergies and she believed her own nutritional status during pregnancy and her use of pesticides were to blame. When she later happened on an agroecological market, she not only found it to be an appropriate place to commercialize her products, but also to connect with other farmers with shared interests.

# Identity of the agroecological farm and farmer

Our farm observations suggest that, for most Imbabura farmers, adopting agroecology means implementing several production changes: (1) increasing diversity of products, especially of vegetables; (2) increasing inter-cropping; (3) producing and applying organic compost, green manure, and organic pesticides; (4) and, eliminating or greatly reducing application of synthetic pesticides and fertilizers. The extent and means by which these strategies are implemented varies greatly by farm. For example, some farmers also base their cropping strategy on specific beneficial relationships between plants, leave areas unmanaged to create habitat for birds and pollinators, apply green barriers, and/or agroforestry, collect rainwater, or restore endangered traditional crop varieties. Some agroecological farmers also integrate aspects of traditional Andean farming, such as using the moon phase to guide production activities. Farmers also explain that they maintain or recover Indigenous identity by planting traditional crops and their cultivars that have lost cultural favor, for example melloco, mashua, oka, jicama, and amaranth, as well as by re-valorizing the role of certain endemic plants that traditionally had utility in food, medicine, or the agro-ecosystem, but are now conventionally considered to be "weeds."

Beyond production strategy, we observed how identity as "agroecological" is most strongly determined by participation in the specialized markets created by and for agroecological production. We attended a regional meeting that brought together farmers from several agroecological markets to exchange seeds, perform educational field visits, and discuss relevant political matters. To close the meeting, farmers created a ceremonial mandala comprised of traditional grains, tubers, and fruits. One association leader gave a speech to motivate continuation on the agroecological path and ended by leading the group of over 100 farmers in a chant of "Que viva la agroecología!" meaning "long live agroecology!" For many, affiliation with agroecology transcends participation in the market. As one farmer explains, "agroecology is not just producing in a certain way. I made my house out of natural adobe because that is also part of it. It is everything we do, the way we eat."

# Hypothesized pathways between agroecology and nutrition

# Pathway 1: consumption of own production

In one ethnographic visit, we stayed with María Dolores, an agroecological farmer on the outskirts of a growing urban center. She told us "my land is my refrigerator," and we observed that the daily cooking process began with sending her son or daughter to harvest the fresh ingredients, even though her husband's municipal job and the family's proximity to the city would have made market purchase an easy option. Many agroecological and conventional farmers echoed this rhetoric upholding the connection between the products on the farm and the ingredients on the plate, and observations in their homes concur that both groups of farmers consistently integrate their production items into their diets. When products are no longer or not yet available from the farm, they obtain them elsewhere, and when they have a surplus, they either sell it, barter it or gift it. We observed how both agroecological and conventional farmers maintained relatively diverse production, but this diversity was visibly greater on agroecological farms. For example, while we observed widespread production of onion, carrots, cabbage, and chard, which have established roles in Ecuadorian cuisine, it was mostly on agroecological farms that we saw newer products, such as broccoli, spinach, several types of lettuce, cauliflower, zucchini, and now even kale. Further, agroecological farmers appear to maintain more diversity within species, such as multiple types of potatoes, maize, onions, and lettuces. Such differences follow agroecological farmers into the kitchen, where we observed kale integrated into a meal that would traditionally only feature chard, broccoli sautéed to accompany potatoes, and salads featuring three lettuce varieties. To season their foods, they diverge from the ubiquitous cilantro and also use celery, parsley, fresh oregano, and lovage from their production.

We observed how multiple motivations contribute to agricultural diversity decisions. For example, farmers report that they grow some varieties for their unique taste, even if they are not considered commercially viable because they take longer to grow, are more difficult to prepare, or are esthetically less pleasing. They integrate other products or cultivars out of a sense of curiosity and experimentation, for example to see if a low-land cultivar will eventually adapt to a high-altitude region. Many farmers express pride in having unique products, or pleasure in the esthetics of diversity. One agroecological farmer competes each year in a contest for the highest number of maize varieties, and another farmer, who grows a papaya plant in a region for which it is not suited, states "I know it will not give fruit, but it looks nice and the birds seem to like it." Further, farmers explain that diversifying varieties increases availability throughout different moments of the growing season. Presenting her five potato varieties, one agroecological farmer explained the order in which each would be ready for harvest.

#### Pathway 2: Income

Farmers identify agroecological spaces as a unique opportunity to simultaneously integrate into markets and maintain diversified production for the family's diet, rather than becoming cash croppers. They explain that they cannot participate in conventional markets unless they have a wholesale quantity, which would mean that they would have to specialize in fewer products. Zoila explains,

I can't sell my babaco [*Carica pentagona*, relative of the papaya] to the [conventional] markets. I would need to take an entire crate for them to buy it. And the intermediaries, they're abusive. They always want a lower price, and they won't take the product if it isn't perfect. What would I do with my ten babacos? In the agroecological market, I can sell my few babacos, and the consumers know that if it isn't perfect, it's because I don't use poison. That's their quality guarantee.

By selling to informed consumers, farmers are thus also able to sell products that would otherwise be rejected due to esthetic blemishes. Through direct sale, farmers are also able to capture a better price on their products, such as Esperanza, who is able to sell her milk at a higher price than she would receive from the milk collection truck. Yet not all farmers that participate in agroecological markets turn a profit, and some commented that everything they earn at the market is consumed by transport costs, or else they spend it on lunch. Nevertheless, they continue to participate for social reasons and to barter, as described in further sections.

Another economic motivator for increasing agricultural productivity and diversity is the desire to reduce expenditures on food and liberate income for other purposes. One agroecological association leader explains that the women selling at her market are able to save on the staples and vegetables that they grow, and instead spend on goods that were previously out of their budget, such as eggs, meat, or dairy. Carlos, who used to specialize in tomatoes but has greatly increased the diversity on his farm in his transition

to agroecology, explains: "before, sure, I could eat food from the farm, if all I wanted was tomatoes. Everything else, I had to buy. But now, I only buy the basics: rice, sugar, oil, salt... everything else is from the farm!" Because Carlos spends less on food than in the past, he uses the liberated income for other productive investments.

# Pathway 3: Women's empowerment

Women's narratives describe how adopting a new production strategy, participating in markets and gaining social status can disrupt household gender dynamics. For Lourdes, agroecological production has been a slow process of gaining figurative and literal ground from her husband, a peach cashcropper. Several years ago, he reluctantly ceded a small plot of land to Lourdes for her vegetable garden, but as she demonstrated her garden's utility, she gradually gained access to more land. For María Dolores, her husband reacted to her transition to agroecology with aggression. He was suspicious of her when she attended agroecological association meetings and he believed that her agricultural "experiments" were a waste of time. María Dolores states:

Before agroecology, I was very quiet. We Indigenous women, that's what is expected of us. I kept my mouth shut. I never confronted my husband. But then I learned to speak, and when I began to say what I wanted to say, my husband did not like it.

María Dolores comments that her experience is not unique, and names other women whose husbands reacted violently to their involvement in agroecology, including one who had to withdraw due to escalating domestic abuse. Yet María Dolores adopted the position that "if he doesn't beat me for this, he will beat me for something else," and defiantly pursued agroecology.

Eventually, both Lourdes and María Dolores's husbands became more accepting after personally experiencing the sensory benefits of agroecological production (e.g. better taste, esthetically pleasing landscape), the convenient access to fresh products, and the reduction of household food expenditures. In fact, María Dolores's husband now not only acknowledges his previous misconduct, but has also begun helping in agroecological production activities. For farmers like Elvía and Zoila, the transition into agroecology was received more smoothly by their husbands, who joined forces with them to support this new lifestyle. Multiple women, including Lourdes and María Dolores, note that the agroecological market is a way to have money in their own pockets, even if the amount is usually not large.

The home is not the only space where agroecology stirs up women's social relationships. Some women, such as Lourdes, report receiving positive feedback from their villages and rising in status, as their neighbors appreciate

both the esthetic beauty of their farms and the diversity that it allows them to share. On the other hand, others like María Dolores and Esperanza report that neighbors believe their production strategy to be ignorant and whimsical, or even dangerous. María Dolores recounts: "My neighbors say I am a witch. They think I am using dark energies to grow such a nice garden. Recently, a neighbor swallowed poison [pesticide] and the village said I was responsible for her killing herself. They are envious." In contrast, within the agroecological sub-culture, María Dolores is well-respected and has been invited to give cooking and production workshops. For two years, she cohosted a weekly local radio program on food sovereignty, and has been a guest on the national public radio channel. "With agroecology, I am always going from one event to another, making friends, meeting foreigners, sharing experiences," says María Dolores. Esperanza, who is also a leader in her agroecological association states, "people here in the village, they do not like to see anything different. In the market, I am at home. I am respected." In fact, her leadership role has prompted her to enroll in secondary school for adults on weekends, such that she may develop the capacities to better serve her association. Digna, who is 73 years old, makes the long and tiring journey to the agroecological market despite the fact that she perceives the profit as nearly negligible. Instead, she says, "I go to the market for the people, for the friendships. There, we see each other, we talk, we laugh." She contrasts this with the people in her village, who she finds to be "closed off" and judgmental. Her participation in the market also introduced her to travel for the first time, taking her to Colombia as well as to different regions of Ecuador for agroecology conferences and events.

## **Emergent themes**

#### Food and seed exchange in agroecological markets

In agroecological markets, transactions are not limited to those between farmers and their clients; rather, farmers commonly engage in barter and sale with each other, exchanging products, varieties, and seeds from distinct ecological zones. Carola, an agroecological farmer whose remote location gives her privileged access to wild edibles but limited access to purchased goods, states that "the reason I go to the market is to barter and eat the foods that my colleagues bring." Farmers exchange seeds for products or varieties that they do not already have. When exchanging harvested products, they explain that they mostly seek those that would not be able to grow in their region, for example exchanging high-altitude tubers (oka, melloco) for lowaltitude fruit (papayas). Miguel, who lives in a region where cold, wind, and high altitude greatly limit production to starchy staples, states:

We eat more variety than others in our village, than those who are not in the agroecological market, because we barter in the market. The others only eat what they grow, but we also eat fruit, we eat products from warmer regions.

They also exchange for products that are not yet ready for harvest on their own farm, or that they have in smaller quantities. One farmer states that at times, they also "exchange just to exchange," out of a sense of diplomacy and community-building.

# Dissemination of dietary, agricultural, and health knowledge

We followed the flow of dietary, agricultural, and health knowledge in agricultural spaces to find that, in some cases, NGOs or food activist groups impart information in organized workshops, and in others, knowledge spreads informally from farmer to farmer, or between farmers and market clients. Esperanza, who comes from a region where high altitude and extreme diurnal temperature variation limit growth, attributes the increased diversity on her farm and in her diet to the agroecological market:

Before the market, I did not even know that there are different types of onion. I did not know about chives or leeks. I also did not know about jackfruit or chayote. I thought red lettuce only grew in greenhouses. I never thought I could grow red lettuce or zucchini on my own land.

Upon learning how to grow these products in workshops and how to prepare them from her colleagues, these new fruits and vegetables are now present in her meals, entering her kitchen either from her own production or from barter at the agroecological market.

We also observed informal conversation with clients whose interest in food and health appear to be what first attracted them to agroecological markets, where they seek pesticide-free foods and unique products or varieties that they cannot find elsewhere. Farmers are aware of this, and they seek to bring unique products to leverage an economic advantage. In one instance, Esperanza accidentally bought seed for spring onions instead of chives. In her market, chives were a popular product, but spring onions were largely unknown. She reluctantly brought her "failed chives" to the market, assuming they would not sell. A client came over elated to find spring onions, bought up several bunches, and explained the culinary uses to other clients as well as other farmers. Within minutes, all of Esperanza's spring onions sold, and other farmers were asking where to get the seed. That evening, Esperanza invited her neighbors to share a meal of sautéed spring onions with potatoes. Notably, the information channels between farmers and clients are two-way. As one farmer notes, "In the market, we farmers become doctors. [The clients] tell us what problem they have, and we recommend the plant or food that will help them."

Indeed, farmers in agroecological spaces frequently reiterate the notion of food as medicine, and they speak to the importance of eating more fruits, vegetables, leafy greens, whole grains and traditional products, as well as general dietary diversification. María Dolores, states, "Health is diversity in the field and in the food." These beliefs follow the farmers through the kitchen door, and one elderly woman states: "I've been trying to add chard into my potato soup. I didn't used to, or I did very little, but in the [agroecological] market they say that it's good to add." Discourse also addresses foods to avoid, such as pasta and rice, which are unanimously considered inferior due to their association with modernity and urbanization. One man attributes the longevity of his centenarian uncle to his diet: "If he eats meat, it's only from the pig that he himself raised. He only eats the ancestral grains - barley, quinoa, wheat - no rice." Similarly, seasoning cubes are denounced as "chemical," and are considered incompatible with agroecological diets. Industrial processed foods are denounced so heavily in agroecological spaces that, when María Dolores consumes a school-issued, nutrient-fortified granola bar gifted to her by a teacher, she does so hidden behind her market table and asks the researcher not to tell on her for eating "junk" food. One farmer illustrates how the translation of knowledge into practice is also contingent on sensorial attributes, stating that, "they say it's better to eat potatoes with their skins. Sometimes I do that, but not so much. I don't really like it that way." Another farmer instead explains that whether or not she eats the potatoes with their skin depends on the type of potato, as some have more palatable skin than others, and whether or not it comes from her own production: she consciously weighs the nutritional benefits of potato skins against the health risk of the pesticides they may contain.

# Scaling agroecology into the community

Agroecological farmers' practices appear to trickle down in their villages and social networks. Esperanza states, "whenever I have a new product, I share it with my entire family," referring to her conventional-farming relatives that live nearby. Barter and gifting is not unique to the spaces of agroecological markets; rather, in Imbabura province, it is a common practice associated with Indigenous identity. Similarly, it is common to directly purchase from or sell to others in the village, rather than going to urban markets. Further, we observed farmers gifting products to elderly, ill or otherwise vulnerable relatives or neighbors. Through the dynamics of community-level trade, foods from own production change hands to meet needs. For example, María Dolores gifted celery and parsley on one day and exchanged a sack of fava beans for barley seed on another, and Carmen sold avocados, oranges, guavas, and medicinal plants. Carmen informs us that such trade practices are ubiquitous in her community, but that people seek her out because her agroecological production strategy allows her to offer a greater diversity of products.

Similarly, seeds and production strategies flow through communities. For one conventional farmer, Rubi, a confluence of factors has pushed her into extreme poverty and food insecurity. However, she credits her agroecological neighbor not only for sharing her products with her, but for having given her the seed and the knowledge to grow her own iron-rich broccoli, chard, and *paico* (Dysphania ambrosioides), as well as other vegetables including cauliflower, cabbage, and zucchini to accompany her production of potatoes and beans. Upon her neighbor's encouragement, she has now participated in two agroecology workshops, and hopes to eventually integrate into the agroecological market.

#### Discussion: from agroecology to nutrition

The practices of agroecological farmers in Imbabura province show the diverse and complex ways that they utilize agroecology to transform their production and dietary practices as well as their social environments. Ultimately, many of these transformations converge with the three major pathways identified for leveraging agricultural interventions for nutrition, namely (1) consumption of own production, (2) increased income, and (3) women's empowerment (Arimond et al. 2011; Herforth and Harris 2014). Our observations suggest that agroecology may act on these pathways not only by increasing agricultural diversity, which is a direct outcome of the production strategies espoused by agroecology, but also by constructing social capital (e.g. relationships) and human capital (e.g. knowledge). In Imbabura, agroecological markets, workshops, and events appear to create a social space for the exchange of foods, seeds, production knowledge, and food use knowledge, as well as creating opportunities for women to earn income, make new acquaintances, travel, and take on leadership responsibilities. These attributes of agroecology position it as an interesting integrated strategy for promoting nutrition objectives alongside environmentally regenerative agricultural practices. Yet zooming in at an individual level, our observations illustrate how farmers take multiple trails and sometimes detours as they journey on these pathways between agroecology and nutrition.

Our finding that both agroecological and conventional farmers obtain substantial parts of their diet from their own production is consistent with previous research in the region (Orozco et al. 2007), and agroecological farmers explicitly describe how their adherence to this production strategy has positively impacted their consumption of their own production. In some cases, we heard farmers quaintly mirror the framework that ties agriculture to nutrition: when María Dolores states that "Health is diversity in the field and in the food," this resonates with the positive relationship between agricultural diversity and dietary diversity as described in multiple reviews (Pellegrini and Tasciotti 2014; Powell et al. 2015). Yet noise is created in this correlation when esthetics motivate a highland farmer to devote space and resources to low-land papaya (thus increasing agricultural diversity), fully knowing it will never bloom (thus having no impact on dietary diversity). These behavioral complexities may partly explain why correlations between agricultural diversity and dietary diversity are frequently statistically minor, as found in a recent meta-analysis of 45 studies (Sibhatu and Qaim 2018). Likewise, when a farmer maximizes the number of corn varieties she grows out of a sense of pride, she is likely sacrificing potential yield and nutritional intake, especially because certain rare corn varieties may be unpopular precisely due to low yields or limited culinary utility. The role of affect (feelings and emotions) in determining food practice was also observed by Sherwood and colleagues, who find that food practices in a neighborhood of rural-to-urban migrants in Ecuador's capital are at times motivated by a nostalgic cultural tie to rurality (Sherwood, Arce, and Paredes 2018). Our findings resonate with the results of behavioral studies (Kahneman 2003) in that decisions are not limited to the cause-and-effect rationality of growing more food to eat more food. As such, the way farmers experience the relationship between their own production and their diet at times diverges from the logical frameworks established by agriculture-for-nutrition literature.

Agroecology's interaction with the income pathway to better nutrition is less clear from our observations and by no means uniform. Imbabura farmers' experiences point to a trade-off between agricultural diversification and income generation in the region's conventional markets, as most markets require products that can be delivered in bulk quantities, and this is difficult for farmers with limited land access. This runs contrary to numerous other contexts where increased agricultural diversity has been associated with increased income (Pellegrini and Tasciotti 2014). Agroecological markets allow farmers to bypass this situation and earn income on smaller quantities of diversified products. However, the markets do not generate a profit for all participants, and for those that do earn a profit, our methods did not explore whether that income would lead to nutrition outcomes. Instead, our observations indicate that increasing agricultural diversity and partaking in barter reduce certain food expenditures, liberating income for other uses. Farmers expressed that they use liberated income for purchasing higher value food products or investing further in production. As discussed by others, the relationship between income and nutrition outcomes is complex and uncertain (Cook 2018; Herforth and Harris 2014). However, the experience of Imbabura's agroecological farmers suggests that besides generating new income, agricultural interventions may have a role to play in liberating existing income for new uses.

Women's positive and negative social experiences within their homes, communities, and agroecological associations show the complicated but nevertheless existent path to women's empowerment. For many women, the influence of agroecology in their lives put money in their pockets, gave them autonomy to participate in events and travel, placed them in leadership positions, gave them control over farming decisions, and increased their status within the household. While some faced strong resistance from their husbands or communities, many

overcame this resistance to develop a stronger sense of agency and self-efficacy. These experiences are largely consistent with the conceptualization of women's empowerment as assessed by the Women's Empowerment in Agriculture Index, which assesses women's role in production decisions, access to and decision-making power about productive resources, income control, leadership, and time allocation (Alkire et al. 2013). In multiple contexts, performance on this index has been positively associated with nutrition indicators, including dietary diversity among women, children, and households (Malapit, Jean, and Quisumbing 2015; Malapit et al. 2013; Sraboni et al. 2014). Within this framework, the gender implications of agroecology may have similar positive outcomes for nutrition.

Besides the own production, income and women's empowerment pathways, barter emerged in our results as an unanticipated additional pathway with potential to impact nutrition in this context. Previous work describes the persisting cultural importance of barter in Imbabura province and other regions of Ecuador (Ferraro 2011; Korovkin 1998). Our results suggest that farmers with more diversity in their own production might have stronger bartering power. Further, agroecological markets give farmers an opportunity to obtain goods that are not available in their own communities, such as products from different eco-zones. Farmers also report bartering for seeds in agroecological spaces, which may further improve their agricultural diversity and thus dietary diversity down the line. In Peru, barter is similarly discussed as an important means to exchange products across eco-zones, such as by providing access to low-land vitamin C-rich fruits in high-altitude regions (Argumedo and Pimbert 2010). In Nepal, barter has been described as a strategy for filling food deficits (Bohle and Adhikari 1998). Yet despite the continued importance of barter across agricultural communities in multiple cultures, it does not yet appear to be systematically integrated into agriculture-for-nutrition thinking, and may merit further attention.

Further, our results shed light on how agroecology interacts with different forms of capital that may play a role in nutrition outcomes. In a review on types of capital that mediate the effectiveness of agriculture interventions for nutrition outcomes, the authors did not find investment in social capital to stand out as a strong determinant of success (Berti, Krasevec, and Sian 2004). Yet in our research context, farmers manifest how the social capital created by agroecology affects their food and agricultural practice. In some cases, social capital is an important mediating factor for the decision to practice agroecology and thus access any of its potential nutritional benefits. For farmers who find the social environments in their home communities to be stifling or even oppressive, agroecology becomes a space where they find social inclusion and a supportive network. The ability of agricultural initiatives to create community may have downstream health impacts, as studies demonstrate the importance of supportive social networks for healthy lifestyles, effective learning of health behaviors, and cardiovascular health (Berkman and Glass 2000; Heaney and Israel 2008; Uchino 2006).

Social capital in agroecological spaces may also be a channel for physical and human capital, the latter of which has been identified as critical for promoting nutrition outcomes (Berti, Krasevec, and Sian 2004). While we already make the case that the social spaces of agroecology, such as markets and events, are important for exchanging products and seeds, we also find that these spaces house social transactions that inform participating farmers' production and food practices. By exchanging dietary recommendations and recipes, agroecological farmers are essentially building food literacy, which is a concept that integrates nutrition knowledge, preparation skills, self-efficacy and confidence, and decision-making ability around food. Improving food literacy is increasingly considered fundamental for effecting long-term dietary change (Perry et al. 2017). By accompanying increases in agricultural diversity with food literacy development, agroecological farmers are able to effectively integrate new products from their farms into their meals, and this may translate into nutritionally relevant increases in dietary diversity. Further, the dietary information disseminated in agroecology's social spaces, such as the promotion of fruits, vegetables, and whole grains and the avoidance of processed foods or high-sodium seasoning cubes, are consistent with recommendations to meet micronutrient requirements and to prevent diet-related chronic disease (Monteiro et al. 2018; WHO and FAO 2003), thus attending to both sides of the double burden of malnutrition.

Agroecology may be a pathway to effectively scale up food literacy without heavy resource investments, given that much of this knowledge is spread informally via farmers' own agency in their social interactions. Promoting nutrition and culinary knowledge has been integrated into many agriculture-for-nutrition programs (Arimond et al. 2011), but such interventions may come at a high cost, given that food literacy interventions must generally be continuous and long-term in order to have lasting and profound impacts (Murimi et al. 2017). Our observations suggest that agroecology in Imbabura has not only contributed to the construction of food literacy, but that the endogenous transmission of knowledge that transpires within agroecological networks may also be particularly effective because it occurs through peer learning. In turn, peer learning has been shown to be more effective than conventional hierarchical approaches in solidifying knowledge for both the person "learning" and the person "teaching" (Topping 2005). This peer-based pedagogic approach functions through farmers' own agency, and could be pertinent for other agriculture-for-nutrition initiatives seeking to build human capital without exorbitant costs.

Our results also identify how agroecology may have downstream nutritional impacts on non-agroecological neighbors. Given community-level trade habits, high agricultural diversity may not only increase availability on agroecological farmers' own farms, but also increase availability of diversity within the community through the pathways of sale, barter and gifting. Further, relationships within communities demonstrate how other productive resources, such as seeds and knowledge, spread in the community, potentially expanding positive outcomes on production and eventually nutrition. In this sense, agroecological farmers may act as model farmers, who effectively spread knowledge, materials, and legitimacy of promising agricultural practices within their communities (Taylor and Bhasme 2018). Nevertheless, each agroecological farmers' potential success as a model farmer is contingent on complex factors, such as their social standing within their communities. Farmers' allegiance to agroecology, as expressed in their ceremonial chants and in their construction of a shared identity, shows how agroecology in Imbabura takes on the form of a lifestyle that is organized and spread as a social movement, similar to what has been described in other contexts (Wezel et al. 2009). By acting as a social movement rather than simply a shared intervention strategy, agroecology may be particularly effective in the self-organized spread of ideas and practices. Sherwood, Van Bommel and Paredes propose that self-organization in agriculture and food is an effective but neglected resource for spreading sustainable practice. Farmers who feel tied to a broader movement may be more likely to want to share their knowledge and essentially recruit others into the movement (Sherwood, Van Bommel, and Paredes 2016). Such dynamics may most immediately promote the spread of agricultural diversity and other agroecological production strategies, but in the longer term, they may also spread the social transformations and dietary outcomes that follow.

# Conclusions

While our observations are based on a single region in a single country, we aspire that this qualitative research has illustrated the role that agroecology may play in promoting nutrition outcomes, and that we have added some color to illustrate the pathways between agriculture and nutrition. Doing so, we hope we have also colored just enough outside the lines to expose several subjects that merit continued attention, namely:

- (1) The importance of understanding farmers' complex rationales (e.g. curiosity, pride, esthetics, social factors, health incentives) in adopting specific practices in order to better align intervention strategies with farmers' motivations.
- (2) The role of less conventional, context-specific pathways for farmers to access dietary diversity, such as barter.
- (3) The relevance of creating spaces for social interaction to strengthen peer bonds and create shared meaningful experiences that can build food literacy and solidify positive food practices.

- (4) The downstream potential for positive impacts of agroecology (or similar initiatives) to affect the production and dietary practices of others in their communities via knowledge exchange and trade of products and seeds.
- (5) The potential of social movements to scale up positive health practices, and the role of agricultural interventions as a part of them.

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