in: Irina W. Hawkins (ed.), Promoting Biodiversity in Food Systems, Boca Raton (FL, USA): CRC Press, p. 179-187.

causes of elevated extinction rates around the world. This trend ultimately affects agricultural productivity since the decline of wild populations and species includes pollinators and natural enemies of pests. Thus, the imperative to promote and expand biodiverse farms and ranches is great. Planning the size and configuration of farms and natural habitats at the landscape scale is critical for maintaining species and ecosystem services over the long term.

Both traditional forms of peasant agriculture (such as shade coffee) and recent innovations (such as perennial-grain polycultures) feature species and habitat diversity and ecological processes as fundamental to the design and operation of farms. Transforming agriculture to become sustainable and regenerative must involve diversified farming systems and conservation of biodiversity as the norm. Scaling up the many successful examples of biodiverse farming is an urgent goal for both humanity and nature.

VIGNETTE 10.1 Understanding Veganic Agriculture

Mona Seymour

INTRODUCTION

Veganic agriculture refers to organic farming without inputs from farmed animals. In going "beyond organic," veganic growing not only avoids synthetic fertilizers, pesticides, fungicides, and GMOs, but also farmed animal wastes and remains such as manure, blood meal, feather meal, fish meal, and bone meal that are typically used to enhance soil fertility in organic agriculture (Veganic Agriculture Network 2014). A veganic system enhances soil fertility through the use of inputs including plant-based composts and mulches, green manures (plants that are grown and returned to the soil for fertility purposes), chipped branch wood, seaweed fertilizers, and mineral amendments. Veganic agriculture incorporates agroecological and regenerative techniques such as planting to attract beneficial insects and creating barriers to eliminate pests rather than using synthetic products (Hall and Tolhurst 2007, Veganic Agriculture Network 2012, 2014, 2016).

Historically, agriculture without synthetic and farmed animal inputs has been practiced around the world in societies without access to these resources. For instance, some horticultural societies did not keep domesticated animals and thus had no ready source of manure (Mt. Pleasant 2011, Richerson et al. 1996). The "three sisters" system of planting beans, corn, and squash together that was practiced by indigenous peoples of northeastern North America is an example of an indigenous cropping system free of chemical and farmed animal inputs. As mentioned previously, corn stalks provide support for climbing beans, which fix nitrogen in the soil to the benefit of the corn. Squash leaves suppress weeds and keep the ground cool and moist as decomposing plant residues provide nutrients essential to growth (Mt. Pleasant 2009). Interestingly, veganic growing encompasses many approaches and can be implemented at multiple scales.

As opposition rises both to conventional chemical-based agriculture and to intensive animal agriculture, veganic agriculture is garnering increased attention

around the world although it remains a fringe activity. There are thought to be fewer than 50 commercial veganic farms in the United States, about a quarter of which are certified organic, (Seymour 2017) in comparison to 12,818 certified organic farms (USDA National Agricultural Statistics Service 2016b). However, research trials point to the viability of veganic systems. For instance, U.S. trials have demonstrated veganic corn and soybean yields to be similar to those of comparator animal organic and conventional systems—and sometimes outperform one or both of those systems in drought years (Lotter et al. 2003, Pimentel et al. 2005). Trials in the United Kingdom (U.K.) have shown yields of a veganic system generally comparable to or exceeding average organic yields in the U.K. (Watson et al. 2000; Welsh et al. 2002).

ENVIRONMENTAL HEALTH BENEFITS

Veganic growing shares the environmental benefits conferred by organic agriculture. For instance, consistent with organic principles, veganic systems avoid synthetic pesticides. They use green manures and create habitat for wildlife. Crop rotation and low or zero tillage principles are employed. These practices support on-farm plant and wildlife biodiversity while conserving water and minimizing soil loss. Further, fossil fuel inputs are minimized while soil organic matter content is enriched—all while improving the soil's carbon dioxide sequestration potential (Bengtsson et al. 2005; Gomiero et al. 2011; Hole et al. 2005; Mondelaers et al. 2009).

Veganic farmers avoid animal waste and other by-products to avoid introducing likely contaminants into the environment. Manure obtained from conventional farms may contain veterinary pharmaceuticals (such as antibiotics and hormones that have been fed to the animals for reasons including infectious disease suppression and growth acceleration) as well as naturally occurring hormones. These compounds will enter soils and waterways and adversely impact terrestrial and aquatic ecosystems (Kemper 2008; Sarmah et al. 2006). For instance, estrogens from manure-treated soils can be transported into water bodies where they have the potential to negatively affect the reproductive biology of aquatic species (Kjær et al. 2007). Use of animal manures can also lead to soil salinization, soil phosphorous loading, and nitrate pollution of groundwater (Cherr et al. 2006; Dahan et al. 2014).

Veganic growing has the potential to diminish agriculture's contribution to global warming. Organic green manure-based systems may in some cases require less fossil energy inputs than organic systems that incorporate animal manure, reducing the amount of carbon dioxide released into the atmosphere (Pimentel et al. 2005; Clark and Tilman 2017). Animal agriculture is responsible for substantial greenhouse gas emissions and global warming, as well as air and water pollution and biodiversity loss (Food and Agriculture Organization of the United Nations 2006). Veganic agriculture avoids such environmentally damaging externalities through refraining from the purchase and use of farmed animal waste products.

The broad vision of some veganic farmers is a plant-based food system. Such a shift would constitute a less wasteful mode of food production, as it is more efficient for humans to consume the grain directly as indicated in

Chapter 3 (Cassidy et al. 2013, Goodland 1997, Pimentel 1984, West et al. 2014). Furthermore, the land used to raise livestock and the land used to grow feed for livestock could be redirected toward growing plant food for people. As an example, a rough calculation of the amount of land required to feed the population of Britain using vegan organic cultivation (one approach to veganics) and producing a vegan diet shows a reduction in agricultural land needs from 18.5 to 7.3 million hectares (Fairlie 2010). The millions of hectares of land removed from cultivation could be restored as native habitat, promoting biodiversity while mitigating climate change. These benefits would accrue at a smaller scale and magnitude if the shift to veganic cultivation and veganism were not universal.

BENEFITS TO HUMAN HEALTH

Like organic systems, veganic systems avoid the health risks to farm workers, agricultural community residents, and consumers who are exposed to chemical pesticides and pesticide residues associated with conventional agriculture. These include increased risks of certain cancers, neurological damage, reproductive effects, developmental disorders, immune system suppression, and acute poisoning (Alavanja et al. 2004, Lozowicka 2015, Lu et al. 2000, Muñoz-Quezada et al. 2016, Pimentel 2005).

Veganic growers avoid additional sources of contaminants in rejecting fertility inputs from farmed animals. Manure can harbor pathogens such as *Salmonella*, *Escherichia coli*, and *Campylobacter.* Application of contaminated manure to farm fields is one way contaminated crops may reach consumers (Heaton and Jones 2008, Mukherjee et al. 2004, Nicholson et al. 2005). The use of animal wastes and remains can also lead to soil and crop contamination by antibiotics and other drugs (Kumar et al. 2005). For instance, feather meal produced from broiler chickens, which are commonly fed arsenical drugs, has been shown to contain levels of inorganic arsenic. When used as organic fertilizer, this feather meal may contribute to arsenic exposure in farmers and gardeners through inhalation and dermal contact, and in consumers through the ingestion of crops that have accumulated arsenic from fertilized soil (Nachman et al. 2012).

OTHER VALUES OF VEGANIC GROWING

Farmers and gardeners may implement a veganic approach to realize additional values may include the following:

- Veganic methods eliminates concern for animal exploitation. This is a key value for many veganic growers.
- Veganic agriculture offers additional economic benefits. Animal-based fertility can be difficult to source in regions that are inhospitable to animal agriculture. Local sourcing or on-farm preparation of resources that are readily available such as green manures and composts eliminates the need for growers to purchase and import synthetic inputs and fertility from distant animal-based farms or slaughterhouses. Farmers without the capital to

invest in livestock for their holding can take a veganic approach to enhance soil fertility.

- Like organic agriculture, veganic growing has the potential to be practiced as a closed-loop system, with all inputs derived from the holding. This appeals to farmers and gardeners who value self-sufficiency, efficiency (for instance, the direct return of nutrients to the soil in the form of grass rather than manure), resource conservation, and low-impact lifestyles. However, factors including site, scale, growing method, and desired yield dictate whether some veganic fertility sources must be imported.

CONCLUSION

In summary, veganic agriculture is a promising approach to agriculture that is sustainable and regenerative (Hagemann and Potthast 2015, Taylor and Morone 2005). As the need for regenerative agriculture becomes increasingly urgent, expanded research will help to discern the potential of veganic methods to bolster our approach to organic and regenerative agriculture as well as biodiversity.

SELECTED VEGANIC AGRICULTURE RESOURCES

The following websites are recommended as resources for further information on veganic approaches, including instructional articles, key books, and videos:

Stockfree Organic Services http://stockfreeorganic.net/

Vegan Organic Network http://veganorganic.net/

Veganic Agriculture Network http://www.goveganic.net/

Vegan Permaculture www.veganicpermaculture.com

Veganic.World http://veganic.world/

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