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New Zealand, Sustainable Farming

New Zealand: A Possible Solution for Better Farming Techniques and Fewer Methane Contributions.

Despite increasing efforts and awareness to promote sustainable farming, researchers are still on the lookout for better farming techniques that can sustain the global food supply, reduce methane contributions from livestock, and inform farmers about such techniques. This is the challenge of New Zealand, a country that relies on agriculture for a living.

New Zealand is a resource-abundant island filled with natural wonders. Famous for the majestic snowy mountains, its soft green hills featured in the movies “The Lord of The Rings” and “The Hobbit”, and Zespri kiwi fruits, New Zealand is a temperate climate, oceanic island country with large coastal plains, located in the South Pacific Ocean, southeast of Australia (CIA). In addition to its natural beauty, New Zealand is known for its agriculture and exported farmed goods, with farming making up “more than half” of New Zealand’s annual income (Bruce).

Kiwis have access to all they need: housing, utilities, food, and natural resources. Of the country’s 4,991,442 inhabitants, 86.8% live in cities while 13.3% live in rural areas (CIA). Because the country is linked under the Commonwealth realm of the United Kingdom, a prime minister takes charge of the country (CIA). The average family size in New Zealand is about 2.7 persons (Robertson); families and individuals live in suburban-style homes like townhouses and apartments (New Zealand Now). A typical family meal consists of one plate of meat and three vegetables (Manch et al) that may include peas, potatoes, and carrots, to name a few (New Zealand All Over). The Māori meat diet consists of fish (New Zealand Global) while the New Zealander meat diet consists of lamb or pork (New Zealand All Over). Families get their foods in supermarkets, convenience stores, farmers' markets, coffee shops (for breakfast), and/or takeout restaurants when wanting to take a break from cooking (C.). A typical breakfast consists of scrambled eggs, bacon, cooked tomatoes, mushrooms, hash browns, and baked beans. A simpler breakfast consists of cereal and toast with a cup of coffee, tea, juice, or milk (New Zealand Global). Going to lunch, salads, pies, or fruits are the typical options. For dinner, cooked meat and vegetables, especially potatoes, are served on the plate (New Zealand Global). Fish and chips are an alternative to a simpler, convenient lunch or dinner. Butter, cheese, and milk are heavily used by Kiwis to cook their food, with “the cheese most often applied on potatoes and baked in the oven” (New Zealand Global). Kiwis are selective in terms of picking out the food they eat: they want fresh legumes, which the country sufficiently provides (Manch and Clayton). A traditional Māori meal (Māori Hagi) has meat and legumes placed on red hot stones, covered with vegetation, placed in a dug hole on the surface of the land. More vegetation was placed on top of the meat and legumes (New Zealand Tourism Guide), and the pit was buried to steam the meat and vegetables for six hours (New Zealand Global).

New Zealand’s job options range from construction to agriculture. To be specific, construction work, bartending, fruit picking/packing, farming, and WWOOfing (C.), or Worldwide Opportunities on Organic Farms, in short, a program that allows volunteers and travelers to work with organic farmers in encouraging sustainable farming practices (Gureckas), are popular jobs offered in the country. The

average salary per year is "$56,160 New Zealand Dollars per year based on a forty-hour week" (New Zealand Shores). The average farmland has 252 hectares of land (Environment Foundation), which is about the size of a 622.7-acre field. In terms of accessibility to health care and education, families are given free health care (Gauld) and education from New Zealand, primary and secondary (New Zealand Now), as long as they are of New Zealand citizenship or obtain a legal residency from the country (Taylor). Even if health care and education require monetary costs, both are overall affordable to families. A typical family has access to clean water, toilets, electricity, telephones, roads, and local markets in the country.

Currently, sustainable agriculture is a weak and limited topic in New Zealand because the country's current farming practices have not been overall sustainable, indicating that many farms do not know about sustainable farming or have yet to take action to improve their farming practices in producing goods without hurting the health of the soil, the quality of water, and biodiversity of the land and water (Our Land and Water): there was a continuous increase in soil erosion, loss of land biodiversity (Bruce), and increasing nitrogen and nitrous oxide concentrations in natural water sources from cow manure in dairy farms and frequent application of nitrogen-based fertilizers on crop soils (Haggerty and Campbell). Large amounts of water were used for irrigation for planting crops for feeding livestock, as seventy percent of New Zealand's water was used for pastoral agriculture (Baskaran et al.) and processing milk products (Hutching). In addition to methane emissions from combustion or transporting of fossil fuels, breaking down of organic waste in landfills, or growing rice, cow manure contributed to methane emissions when left unmanaged or when stored in storage ponds, where breakdown took place by anaerobic bacteria, releasing methane as a by-product into the atmosphere, increasing the concentration of greenhouse gasses in the country (Clark et al).

Consequently, the contaminated ground and surface waters from nitrogen fertilizers and livestock manure decrease the amount of clean water that could be consumed or used by the expanding population and agricultural industries. Moreover, fertilizers and untreated livestock manure contribute to the increase in dead zones surrounding the country (nutrient runoff; cultural eutrophication), destroying coastal ecosystems or estuaries and their biodiversity (Morton) as "three-quarters of New Zealand's fish species are at risk of extinction…" (Hancock). For humans, adults and young children alike, consuming nitrate-contaminated water could result in infant methemoglobinemia (blue baby's syndrome), a rare condition that makes the skin turn blue around the mouth, hands, and feet, displaying symptoms including loss of consciousness, seizures, diarrhea, and in severe cases, death (Galan). When the body is exposed to nitrogen through consumption, the body converts nitrate to nitrite, which binds to hemoglobin to form methemoglobin, which cannot carry oxygen throughout the bloodstream (Galan).

The increased soil erosion in the country came from increased soil compaction by the numerous cows grazing on grassland beside heavy farm machinery working on the farmlands, with forty-four percent of the soil falling below the range of soil microporosity (Morton), despite recent efforts of incorporating no-till farming into farming practices. With an average cow weighing "more than half a tonne" (Hutching), their numerous numbers and pressure on the soil, especially during wet weathers, led to lower soil porosity, resulting in an unproductive soil that allowed phosphorus, nitrogen, and eroded topsoil to flow into water sources nearby, contaminating the waters (Morton). Farmers that could not keep their soils productive or had to expand pastoral lands had to find other areas with more productive soils or

clear more trees, making some natural native ecosystems potential targets for agricultural lands, leading to the shrinking and destruction of native terrestrial habitats for farm development (Baskaran et al), thus decreasing terrestrial biodiversity of the country. Each year, nearly "two hundred million tonnes of soil were lost, with more than half of the soil loss contribution coming from pastures" (Morton). With so much soil lost, New Zealand may someday run out of productive soil for farmers to grow sufficient food to export overseas, earn money, and feed everyone in the country, including themselves.

Fortunately, trends are improving as farmers begin developing farming practices less harmful to soil and the environment, like reducing fertilizer and pesticide application to increase crop and pasture diversity (Siegfried). Both rural and urban populations are aware that sustainable farming is essential: for urban populations, this is an opportunity for affording more food by "buying directly from farmers" (Our Land and Water). For the farmers, they see sustainable farming as a chance to change their farming practices to grow healthy produce and earn profit without harming the environment via reducing chemical contamination of soil and emitting less carbon by clearing fewer trees for arable land. Because New Zealand recently increased efforts to provide "gender equality in education, working opportunities, and training for women" (UN Women), sustainable farming can open doors for women to share their ideas, grow the New Zealand economy, and contribute to making sustainable farming come true. The elderly and children, through sustainable farming, can eat fresh, trustworthy, and healthy produce. Sustainable farming can also open doors for the indigenous population by giving them job opportunities in the agriculture sector and research that allows them to work with farmers to keep the environment and land as clean and natural as possible. Agricultural industries now have collaborated with indigenous tribes to help them run their farms sustainably (Siegfried). By developing better and sustainable methods to farm for the general public, soil health restores, land biodiversity increases, job opportunities, education, and research opens up to more people, and cleaner water results from less nitrogen, synthetic chemicals, and phosphorus contributions by agriculture.

To encourage the advancement of sustainable farming, the Government of New Zealand enforced a Sustainable Farming Fund (SFF) that funded "research and projects led by farmers, growers, and foresters" (MPI government) to make farming practices more eco-friendly in any agriculture, dairy or crop (Now the Sustainable Farming Fund was renamed Sustainable Food & Fiber Futures). For the past 14 years, the government spent "122.8 million New Zealand dollars on 906 SFF projects" (Oakden et al), investigating data, conducting research, diving into case studies, using and practicing with innovative technology, educating farmers about efficient ways to farm, restoring environments, and finding effective farming practices (Taunton) while seeing if the fund created a difference in the way New Zealanders farm. The evaluations showed that the funded projects went successfully into action with "lower nutrient runoffs on lowland farms" (Guy) and obvious improvement in the social, economic, and environmental health of the country. The only backfire was government budgeting: with so much money funded into other aspects such as education, health, and social security through high income taxes, company taxes, goods and services tax, and other taxes (Goldsmith), the government may run out of money to continue the SFF fund in the future.

In attempts to reduce methane contributions to greenhouse gasses, the New Zealand government created and enforced regulations/legislations to promote fewer methane emissions in the country. The Emission Trading Scheme in 2008 to "control methane emissions by putting a price on New Zealand

products" and the Fart Tax of 2003 that "allowed the government to collect taxes from farmers on cow methane emissions" were both examples of the government being involved in protecting the environment (MacDonald). The only backfire to government-imposed legislation was the opposition from farmers: many farmers were infuriated by the government taxing and protested against the legislation. As a result, many of the environmental laws were overturned by farmer protests and government lobbying (MacDonald).

Overseas, in the United States, methane became usable with methane digesters by converting methane into usable electricity. The manure got placed in the digester, which captured the methane released from the decomposing manure. The digestor converted the captured gas into renewable energy in an electric server "through an electrochemical process" (Fifield). The electricity that was generated from the methane digesters was used to power up the farm or sold to utilities to power up houses, other farms, and/or industries. The digester-processed manure was applied on fields as organic fertilizer or soil bedding for crops (Fifield); alternatively, the fertilizer could be sold to other farms if there was a surplus in fertilizer supply. The water used to process the manure was used to water the crops. One example of successful digester use was Reinfords Farms in Juniata County, Pennsylvania, which installed a 1,000-cow methane digester that took care of 12,000 gallons of manure each day and trapped 60% methane that yielded about 1.2 million kWh per year, saving $5,000 per year of electricity cost and earning $20,000 each year from selling extra electricity to utilities (Huso). Moreover, this farm took food waste from supermarkets and stores and processed the food waste with manure to create more usable electricity. The cost for the farm's methane digester was about $1 million, but the USDA gave the farm two grants that covered 60% of the digester cost and the maintenance costs were 70% covered by the state's department of natural resources, making the digester more affordable and the farm more sustainable in recycling farm waste (Huso). This technology could be implemented into New Zealand's sustainable farming because any manure, from cow to sheep manure to manure from other livestock, as well as unwanted/expired foods, could be digested in the machine. Moreover, New Zealand is the "eighth largest milk producer in the world and sheep farming has been New Zealand's most important agriculture industry" (GreatSights), displaying that the country also relied on dairy to make money. With New Zealand having "6.7 million cows producing 66 million tons of manure per year" (Forgie), those manures ended up running off and contaminating rivers and streams with nitrogen, "encouraging the festering of parasites and flies" (Forgie). With methane digesters installed, cow and livestock manure, as well as unwanted food, could be processed and used as organic fertilizer and bedding while allowing dairy farmers to earn extra profit through selling surplus electricity to utilities and extra fertilizers for farms that need fertilizers to grow crops, thus reducing the use of synthetic nitrogen fertilizers. The only downside to methane digesters was efficiency: Methane digester is a new technology and though the machine is affordable with combined government grants and earnings, the digestion process wasn't very efficient. For now, there isn't any new technology that could simplify the converting process. Moreover, some governments weren't willing to invest in the digesters because doing so may be costly, thus many governments invested in wind and solar alternatives to spend within the federal budget (Evans).

The SFF and the methane digesters above would meet the needs of the population in New Zealand because extensive research and incorporating eco-friendly techniques are essential to improve and encourage sustainable farming in New Zealand. Since research projects through the SFF have been successful in improving farming techniques to suit the environment, the SFF should be continued. The

government of New Zealand should reallocate at most 2% of overall revenue from taxes to agricultural research to keep the SFF projects running long term. Introducing methane digester to farms can contribute to reducing overall methane emissions in New Zealand (New Zealand has considered implementing methane digesters into agriculture but have yet to make the consideration come true). With the usable energy produced, farms can sell surplus electricity to utilities, which then gives citizens ample electricity to power up their homes. More farms could use the organic fertilizers processed from the methane digesters as an alternative to nitrogen-based synthetic fertilizers created from the use of fossil fuels. The production of organic fertilizer from livestock farms with methane digesters could reduce the price of organic fertilizers, allowing crop farms to purchase organic fertilizer from livestock farms at a cheaper cost.

The New Zealand government should reallocate at most 1 to 2% of the tax money that goes to healthcare to purchase at least 20 digesters from the United States or Europe at a negotiated price (New Zealand invests the majority of the money collected from income tax and other taxes, around 12.6 billion New Zealand Dollars, to healthcare, according to Goldsmith), install the digesters at area 40-50 miles within concentrated farm areas, and encourage farms to try the digester by delivering manures to the digesters. The government could then use 75% of the electricity generated by the digesters to sell to utilities, earning back the investment for methane digesters over time while the remaining 25% could be used or sold by the contributing dairy farms after the 25% electricity was distributed evenly among the farms. The amount of money left over after earning back invested costs could allow the government to hire workers to maintain and operate the methane digesters. The remaining money after subtracting digester and employee costs could be then distributed to contributing farms according to how much manure the farms delivered to the digesters (farmers should weigh their manures ahead of time to receive their money accordingly). When the manure processing in the digester is complete each time, farmers get to take home the manure, distributed according to how much they delivered to the digester, and either uses the manure as bedding for livestock or sell as fertilizer, bedding, or potting mixes for crop farms and earn more profit. Data collected about profit from selling electricity and organic fertilizer as well as methane emission turnouts from tested methane digesters could then be shared with other farmers interested in participating, ensuring that the digesters are worth installing for better profit and sustainability. According to Evans, a staff news writer for PowerTechnology, the converted biogas is not recommended to be applied to cars because the biogas may include impurities that can corrode metals of engines, which may increase the need for the cost of car maintenance. Agribusiness, non-profit and civic organizations, and the New Zealand government should contribute to running the project. Non-profit research organizations and agribusiness should co-manage/oversee the project.

To fund the project, fundraisers should be encouraged by non-profit organizations and agribusiness to inform the citizens about sustainable farming and the project so that government expenses for purchasing the technology could be greatly reduced to balance out the federal budget. Community members can contribute to sustainable farming by being informed and educated on the environment and what they could do to reduce their mass consumption so that collaborating with working farmers, the soil and water quality, as well as the overall environment of New Zealand, could be restored. Through participating in volunteering activities, like planting trees, WWOOFing, gathering samples for research, and getting hands-on experience in agriculture, community members could better understand the role that farmers and researchers play in protecting the environment while feeding the population and earning

money for a living, thus can give farmers, researchers, and foresters suggestions to better improve the environment and restore damaged ecosystems. Donations are encouraged in the community to help fund government research projects and the affordability of methane-digester technology.

To make the project successful, the government should emphasize maximum standards to the water and soil quality of the country in terms of nitrogen and phosphorus concentrations because the standards can drive less informed farmers to be more aware of their farming practices, encouraging the farmers to connect with informed farmers and researchers to change how they plant their crops or care for their livestock. Through the emphasized standards, soil and water quality can greatly improve with less soil erosion, less culture eutrophication, and cleaner water to consume. When developing the plan, affordability of methane digesters, how typical, less informed farms conducted agriculture, and traditional farming practices as well as its effects on soil and water quality of the country were considered.

Through continuing SFF projects, active engagement of the entire community, and incorporating methane digesters into sustainable agriculture, the soil, air, and water quality of New Zealand can be improved, which increases both land and water diversity of the country, contributing less to greenhouse gasses from methane emissions. Moreover, any unwanted food can be taken care of by being processed in the digester instead of being wasted away, which becomes compost incorporated in the manure fertilizer or bedding. With farmers gaining more profit from the selling of surplus electricity and fertilizer to utilities and other crop farms (respectively), electricity could become a sufficient source for the entire country, new job opportunities could open up from operating and maintaining the methane digesters, and the need to purchase synthetic fertilizers and the prices of grown goods could reduce, providing other farms sufficient organic fertilizer to farm goods and giving more families access to food and nutrients they needed to survive. Word count: 3299

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