Four Fallacies in Agricultural Sustainability,

and Why They Matter:

Part 3- Farm Technologies Can Be Picked From a Menu

GEORGE MORRIS CENTRE

MAKE INFORMED DECISIONS

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Introduction

The view that additional steps should be taken to confirm that food is produced sustainably has become ubiquitous in Canada, as well as in other developed countries. Consistent with this, the downstream food industry has become much more interested in the upstream elements of its supply chain, especially the farm segments and the technologies/processes it employs, and has sought to derive metrics that measure and influence the sustainability of this food end product. This plays out across a range of parameters, including carbon footprint, water use, pesticides, fertilizers, antibiotics, hormones and growth promotants, animal welfare, labour standards, as well as others. In some cases, specific technologies or techniques related to the above have been targeted, such as genetically modified, specific pesticides, specific animal health products, certain livestock housing systems, etc.

This represents a plausible response to increased public awareness of natural resource scarcity and of food security. However, important aspects of this movement are simplistic, misguided, or simply wrongheaded, and following these through to their logical extent presents the prospect of pitfalls for the agri-food system. Perhaps more fundamentally, it begs the question as to how the agri-food system, and primary agriculture in particular, grew to become so unsustainable to begin with. In Canada many generations of farmers have seen themselves as stewards of the land, farm product production has greatly increased and intensified, and rather than starve or cause mass illness, we have produced significant surpluses for export at steady or improving quality standards.

Others, including some farmers, are deeply concerned about the future of the agri-food system, how natural resources, human resources, and technologies are used and what the potential consequences may be. There are examples that can be cited that lend support to these types of concerns.

This highlights a gap that has emerged in our understanding of how agri-food production systems develop and evolve, and how this relates to sustainability. The purpose of this paper is to help develop the case for a more holistic and coherent view of agri-food sustainability as a process. As a means of advancing, four fallacies related to agri-food sustainability are identified and discussed in the sections below. These are:

1. We should tread more lightly on the agricultural land base
2. Small farms are better
3. Farm technologies can be picked from a menu
4. New technology will solve all problems

This paper is the third in the series of four, which considers the third fallacy- that farm technologies can be picked or targeted independently from a menu.

Farm Technologies Can Be Selected From a Menu

An important and growing element of sustainability in the food system is the rejection of, or insistence upon, certain technologies used in agricultural production. Increasingly this occurs as an element of food marketing, as food marketers seek assurance that their products were or were not produced using specific technologies. More generally it is used to differentiate products based on perceived sustainability attributes.

In some ways, this is no different than other types of private standards used by product manufacturers of all sorts to position their products differently. Just as some retailers don't want to be seen as selling plastic baby bottles made using bisphenol-A, some food processors and retailers don't want to be seen marketing products using certain farm technologies, like genetically modified (GM) crops or pork from hog production systems using gestation crates.

However, the rejection of, or insistence upon, specific technologies in agriculture involves important nuances which appear not to be broadly appreciated. Agriculture exists in a dynamic environment in which the many elements of the production system have complex links; changes in technology at one facet are linked to sequential adjustments and realignment in others. It also operates in a context of inherent uncertainty, from known but unpredictable hazards like weather, and from adaptation in organisms and unknown thresholds in biological systems. In effect, when one technology is selected from the menu to be excluded or included, it alters the remaining items on the menu.

In particular, when specific technologies are targeted for inclusion or exclusion, the resulting realignment elsewhere can create unintended consequences. A colleague likened this to a domino effect, in which production system segments adjacent to the targeted technology "flip" in adjustment; however, this analogy suggests that the adjustment is linear. In reality, some adjacent production system segments may change dramatically, some very little, and some shift contingent on other external factors like weather or pests. Learning is required to understand how the production system responds in different situations and how it can be managed to maintain its stability and mitigate the unintended consequences. By the time the production system has fully adapted across all segments, it may not resemble its initial conditions at all in terms of structure and technologies employed adjacent to the targeted technology. It is not obvious that food marketers have grasped this given the development of private sustainability standards that zero-in on certain technologies.

Agricultural production systems are also highly decentralized, as the vast majority of farms are family businesses rather than corporate conglomerates, even if the processors supplied by farmers are large firms. This matters. To illustrate, in a particular category of household products, a major retailer might have a handful of suppliers with whom they work, which in turn have a handful of industrial suppliers. This provides a supply chain dynamic within which private standards easier are to implement. In contrast, a major retailer that takes on a private standard relating to a farm practice or technology, even if it is implemented through a large processor-supplier, ultimately ends up reaching back to literally hundreds or thousands of individual farms, each of which are connected to the downstream supply chain in a free enterprise/market context, and with aspects of agricultural policy that protect them from downstream customers. The two procurement situations facing the retailer are very different.

This makes it sound like tailoring agricultural production systems to exclude or include specific technologies is onerous or impossible. This is incorrect, and agricultural systems can evolve under restrictions on specific technologies. For example, European livestock industries have not collapsed in the face of restrictions on antibiotic use, and many countries in the world have significant crop industries without using GM technology. Rather, the difficulty in targeting specific technologies is that the complexity of production systems makes adjustment difficult to anticipate, takes time and learning, can be costly, and must be implemented in a market context rather than simply dictated. The adjustments made in other segments of the production system to accommodate the targeted technology can be counter to the sustainability intent in targeting the specific technology. The expectations of what will actually occur when a specific technology is targeted need to be in line with this.

For example, GM is among the farm technologies commonly targeted in private standards. One of the more ubiquitous GM crop traits is resistance to the herbicide glyphosate. Since the weeds don't go away just because a standard says that glyphosate-tolerant crop varieties cannot be used, some other means of weed control in the growing crop is necessary when GM is excluded in a private standard. Farmers must use some other herbicide for post-emergent weed control in place of glyphosate. These will generally have higher toxicity characteristics than glyphosate, as observed in the 2010 National Academies of Science study on the topic[1]. Thus, one unintended result can be an increase in the application of more toxic herbicide products in place of glyphosate.

Some farmers may be unwilling to switch away from GM or feel locked into GM technology due to their broader production system; others may attempt to misrepresent their product as non-GM when it actually is GM. The reduction in demand due to the private standard may reduce the price of GM crops, reducing the receipts of those continuing to use GM seed, while supporting the prices of non-GM crops. This creates income inequities among producers. Rules, tolerances, enforcement, penalties, and appeal procedures may be required to control fraud, and some farmers may end up being charged. Presumably, none of this was intended when a downstream purchaser introduced private standards on the use of GM crops.

[1]The committee observed that "the introduction of [GM] crops has reduced pesticide use or the toxicity of pesticides used on fields where soybean, corn, and cotton are grown".

Hypothetical Example

To further illustrate, consider a hypothetical example based on making hay. On the surface, what could be simpler- the hay is cut, it dries, is raked, and then baled. However, weather is a major influence, both in terms of the timing of cut (e.g. early vs. late) and the weather after the hay is cut. The individual forage species in the hay crop mix will also matter, as forage and legume species dry at different rates under a given set of conditions. The harvesting equipment used is also an important factor, especially in terms of how it crushes or fractures the stems of the hay as it is cut. Another influence is the use of bacterial inoculants or mild acid additives that help accelerate the hay drying/curing process.

Suppose that, for some reason, a downstream food marketer decided that forage inoculants and acid additives were not a desirable element of dairy or beef product marketing, and it requested its supply chain be free of these products. This presents the prospect that hay would not dry or cure as quickly, potentially reducing hay quality. What would be the effects?

For some farmers, there would be no immediate effect because they weren't using this technology to begin with. For others that currently use inoculants and additives, there would be impacts, and individuals would need to assess how best to adjust their production system- even as it is acknowledged that in some hay crops inoculants would not have been needed, simply due to favorable weather.

One approach to adjustment would be to focus on new investment in equipment that speeds the hay drying/curing process, such as new generation mowers that crimp and spread the hay out as it is cut. Alternatively, dryers can be installed in hay storage facilities that allow the hay to be harvested when it is higher in moisture. Another, more labour intensive approach, is committing to tetting and re-raking hay as intermediate steps prior to baling. Yet another approach would be to change nutritional practices and simply adjust to lower quality hay by replacing lost nutrients with grain feedstuffs in the diet. Others might choose to re-seed hay stands toward forage species that dry faster, and adjust feed rations with grain feedstuffs appropriately.

Each of these plausible adjustments to segments in the hay production system comes with secondary adjustments, predicated on factors such as the budget that a given farmer has to invest in new equipment, the labour supply available that can be augmented for hay harvest, and the land base available to substitute grain production for hay to replace lost nutrients in lower quality hay, and/or the budget to purchase grain feeds for this purpose. For some, the minor adjustment to the inoculant/additive issue would be just enough to justify or spur larger changes in farm structure; alternatively the adjustments could be trivial. Because farmers compete for assets, even the farmers that have not used inoculants or additives end up being impacted- as others are negatively impacted, they end up being relatively advantaged, so the resulting change is distortionary. Regions that typically have wider windows for a haying season benefit at the expense of regions with a narrower window, so it may also be regionally distortionary.

While this may seem to be a fringe issue and is an intentionally constructed example, this type of diversity of adjustments can and does occur, predicated on shifts in specific farm technologies. Rather than accurately reflect all of the permutations and combinations of adjustment in hay production, the more fundamental point here is that there could be multiple adjustments, and these adjustments are complex and diverse. Thus it is practically difficult to anticipate the nature of adjustments to an apparently straightforward targeting of a specific agricultural technology. It is similarly difficult to be unequivocal regarding the sustainability effects, when the resulting adjustments in other segments of the production system could have more negative effects than the targeted technology was perceived as having to begin with.

Cage-free Layers

The shift from egg production in battery cages to cage-free systems presents a real example of the adjustments in the adjacent segments of production to a targeted aspect of technology. Laying hens housed in battery cages can be restricted from exhibiting some of their natural behaviours. These natural behaviours include aggression, fighting and, in some cases, cannibalism. The design of cage-free housing systems, such as aviaries, must anticipate this and design space such that the more docile hens have access to refuge from more dominant or aggressive hens. In an aviary housing system, this is done by partitioning the length of the barn to limit bird group sizes. However, as noted in recommendations by Big Dutchman, a poultry equipment supplier[2], ventilation, building style, lighting and flock breed all play a crucially important part in influencing group size. Thus each of these factors are prospectively different in a cage-free layer barn compared with battery cages.

Lay *et al* (2011), in a review article, assessed studies of outcomes from a range of layer housing systems to observe sustainability characteristics of each. They found a broad range of differences related to housing systems. For example, they observed that hens exposed to litter, as in cage-free systems, generally had higher mortality rates compared with conventional caged systems. Many other differences were observed such as disease incidence, pest pressure, and nutritional requirements. Addressing these issues presents the prospect of different or increased use of animal health products and pesticide products. In particular, Lay *et al* observed the following:

> "Although environmental complexity increases behavioral opportunities, it also introduces difficulties in terms of disease and pest control. In addition, environmental complexity can create opportunities for the hens to express behaviors that may be detrimental to their welfare. Any attempt to evaluate the sustainability of a switch to an

[2] Snow, Bill *Managing Aviary Systems To Achieve Optimal Results* Technical information from Big Dutchman, Inc.

> alternative housing system requires careful consideration of the merits and shortcomings of each housing system".

Thus, while some view egg production from cage-free systems as being more humane, the environmental sustainability of these systems versus battery cages appears unclear, as the change in housing has a systemic effect almost all aspects of production, including energy consumption (through nutrition), the use of medications to treat different diseases, and the prospective need for pesticides to control pests. This doesn't make cage-free good or bad compared with battery cages, but it does make the difference multi-faceted and equivocal. As producers and the industry gain experience with cage-free production over time, many of its differences compared with existing production systems will likely become better understood and many of the challenges overcome. But this expectation and understanding should be factored in as downstream customers set standards in this area.

Conclusions

As food marketers have increasingly seized upon specific farm technologies or practices as singularly good or bad, private standards used by downstream food sellers have proliferated. These seem to have proceeded under the assumption that a commitment to openness in audit, verification, and "radical transparency" will be sufficient to convince consumers of the merits of these standards, and that these will provide a meaningful contribution to the sustainability food system.

This is a simplistic view. As discussed in the first paper in this series, many restrictions on technology logically lead to more extensive land and resource use, which is in contrast to environmental sustainability. As discussed here, restrictions on specific technologies set in motion adjustments in other aspects of the production system, the nature of which can be difficult to anticipate. Some adjustments may contradict or even offset the desired sustainability intent of the restriction on technology. Moreover, the biology of the system adapts as new technologies are restricted or mandated, and environmental conditions such as weather and pests influence the ultimate impact.

Thus, farm technologies cannot be simply picked and chosen by food marketers; the situation is more complex than this if the aspiration is to make real sustainability improvements. The implication for food marketers appears to be the following.

Effort is required to thoroughly understand the nature of farm production that you seek to regulate through standards you place on farm technologies. The technical expertise to understand this will go well beyond the standard procurement or sustainability manager skill set, and may require expertise not typically present in food companies. No army of auditors unleashed on the countryside to measure compliance with sustainability protocols will substitute for a thorough understanding of agricultural production systems and the nature of potential adaptation to restrictions on technology.

Working more closely with farmers and farm organizations on the *intent* of prospective technology restrictions/mandates, rather than on specific rules, has a better prospect of producing real sustainability gains. Sustainability standards should not be so prescriptive. Farmers are in the best position to experiment within their own production systems to achieve a desired sustainability outcome, which they may have never previously paused to think about. Farm organizations can help facilitate and coordinate these initiatives across the many farms that feed the supply chain.

Finally, having reasonable expectations as to what can really be achieved is important. Because of the complexities of production systems and biological adaptation it will take time to get effective sustainability measures implemented and see results. These measures must also move through a diffuse market system to induce compliance, rather than via a centralized command and control system. Patience will be required for voluntary adoption and learning before real sustainability results can be seen, from well researched sustainability initiatives that truly stand up to scrutiny.

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References

Committee on the Impact of Biotechnology on Farm-Level Economics and Sustainability; National Research Council. (2010) *Impact of Genetically Engineered Crops on Farm Sustainability in the United States*. National Academies Press.

Lay, D.C. Jr., R. M. Fulton, P. Y. Hester,D. M. Karcher, J. B. Kjaer, J. A. Mench, B. A. Mullens, R. C. Newberry,C. J. Nicol, N. P. O'Sullivan, and R. E. Porter. (2011) Emerging Issues: Social Sustainability of Egg Production Symposium Hen welfare in different housing systems", *Poultry Science* doi:10.3382/ps.2010-00962. 1-17.

Snow, Bill. *Managing Aviary Systems To Achieve Optimal Results*, Technical information obtained from Big Dutchmen. http://egg-cite.com/NewProducts/BigDutchmen/cagefree.pdf