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Editorial

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# Making assisted reproductive techniques a disruptive innovation in production agriculture

## Editorial

From a business perspective, a disruptive innovation is one that changes working practices by replacing a nolder methodology. 1 At first the innovation might actually limit productivity, but as the industry accepts and adapts to the practice, productivity is increased. Therefore, for a technology to be truly disruptive, and change a practice within a field, it must be accepted industry wide.

Using this definition as a standard, it is difficult to assess the impact of Assisted Reproductive Technologies (ART) on the field of agriculture. While procedures such as artificial insemination (AI) and semen cryopreservation are common, 2 one can hardly call the practice universal across species or even within breeds. While AI has been widely accepted by the dairy industry, its use in beef cattle is much more limited. 3 Other forms of ART, such as embryo transfer, in vitro fertilization (IVF), semen sex selection and cloning have found niches, but are currently far from the industry standard.

So while it is generally agreed that AI is the most efficient means currently available for rapid and widespread dissemination of superior male genetics and embryo transfer represents the equivalent for the female of the species; why has their use not been more widely accepted across the entire field of agriculture? Quite simply it can be reduced to a few factors; some technical, some logistical and some based on upfront cost.

Even though the practice of most ARTs are now decades (or in the case of AI-centuries) old, the procedures remain far from standardized. The biology of each species represents its own unique challenges requiring its own unique modifications. For example the cryopreservation of semen from most cattle breeds has become rather routine and yields highly acceptable conception rates. However, some breeds, such as the Jersey, are more problematic. Further, the successes seen in cattle sperm cryopreservation have not translated into horse, sheep and pig; where conception rates following AI with frozen semen, fall far below what is seen with fresh-extended semen. Research must continue to discover better ways of performing these procedures which will allow them to work in a more universal fashion.

Logistics may be the biggest limiting factor in wider use of ART procedures. Procedures such as semen sorting and IVF require highly specialized equipment not routinely located close to production facilities. Further, the techniques require technical staff with highly specialized training. Even procedures such as AI, may be dependent on preparatory techniques (cryopreservation) beyond the abilities of most facilities. These limitations require animals to be shipped to centralized facilities, creating additional expense, risk of health of animals during the shipping process and dependence on other facilities for the final product.

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Samuel D Prien
Department of Animal and Food sciences, Texas Tech University, USA

**Correspondence:** Samuel D Prien, Department of Obstetrics and Gynecology, Texas Tech University Health Sciences Center, Lubbock, Texas, 79430, USA, Tel 806 743 2047, Email Samuel.Prien@ttuhsc.edu

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Finally there is the overall cost of taking on a new production venture. Assisted Reproductive Technologies are, by their very nature, technology dependent. The highly specialized nature of the procedures often requires equipment that was designed and built specifically for the application. This specialization of equipment, along with the specialization of the personnel who work with the equipment translates into increased expenses which make the procedures cost-prohibitive in all but the cases of the most genetically superior animals.

For technologies to be useful they must be accessible. With ARTs, accessibility is limited by all of the factors listed above. An obvious solution to these issues is to discover easier and simpler ways to accomplish the same task. This might start with AI, where obtaining frozen samples, routinely require animals to be shipped to a centralized facility. While processing the samples is not technically difficult, the expense of instrumentation makes on-facility freezing cost prohibitive. Further, thawing is generally best preformed in facilities with access to both clean water and electricity, limiting the application to set locations on facilities that may cover tens of thousands of acres. The development of cheaper more portable instrumentation, which would accomplish the same goals, would lead to expanded use by allowing producers of all sizes the ability to incorporate more of the procedures directly into their routine management practice, allowing the techniques to become that disruptive innovation in animal production.

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## Conflict of interest

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