Considerations for Implementing Artificial Insemination on Arizona Cow-Calf Operations

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Artificial Insemination (AI) is an advanced reproductive technology with several potential benefits to a cow-calf producer's profitability. Arizona producers who implement AI on their operation may increase calf crop value by creating more uniformity and introducing high-quality genetics into their herd. However, there are also factors and costs related to cattle management, facilities, labor, and marketing that producers should consider when deciding to implement AI.

Questions producers should ask before implementing artificial insemination into their herd:

Making the Decision:

1. What is my end goal with Artificial Insemination?
   - Why do I want to implement AI in my operation, and what are my objectives?
2. What costs are associated with starting AI?
   - Consider all potential costs, including equipment, labor, and veterinary services.
3. Can I capture added value on the calf to recoup the added cost per cow?
   - What's my marketing strategy to ensure AI adds value to my operation?
4. Do I have a specific number of cattle required to reach the "break-even" point?
   - Is AI economically feasible for a small herd, or do I need to scale up?
5. Do I need to learn AI techniques, or can I hire a professional?
   - What are the costs and benefits of each option, and which is more suitable for my operation?
6. How much time and effort will AI require?
   - Consider the time needed for heat detection, AI procedures, and overall cow management. Are my current practices compatible with these demands?
7. How fast and significantly can AI improve my herd's genetics?
   - What are my genetic goals, and how does AI fit into my breeding plan?

Making AI Work for You:

1. Maintain an optimal Body Condition Score (BCS) for breeding cows.
   - Ensure cows have a BCS of at least 5 out of 9 to maximize the chances of a viable pregnancy.
2. Provide adequate nutrition throughout pregnancy and lactation.
   - Secure enough feed resources to maintain cow health and support calf development, increasing the likelihood of successful rebreeding.

3. Develop and follow a comprehensive herd health, nutrition, and management plan.
   - Do I have appropriate vaccinations needed for pregnant animals to prevent abortive losses. Do I have good herd surveillance for infectious disease?
4. Ensure facilities are safe and stress-free for both cattle and handlers.
   - Set up your facilities to minimize stress during AI procedures, which can improve success rates.
5. Do I have animals that are able to be bred and if not have I had them checked to make sure they are able to conceive?
   - Are your heifers of breeding age? Do I have a veterinarian check for pregnancy, breeding soundness, and other reproductive issues?

There are two major benefits to AI: bringing in and capitalizing on genetics that might otherwise not be available to a producer and unifying a calf crop to increase value.

Improving Genetics

Purchasing Bulls.
Purchasing top-quality bulls can be a costly (and risky) endeavor. Good bulls with high-quality genetics routinely top sales and may be out of reach for some producers or impractical for Arizona's range conditions. With an average bull ratio of 15:1 (Teegerstrom & Tronstad, 2016), compared to the national average of 25-35:1 (APHIS, 2009), Arizona ranches face higher bull costs due to the expansive landscapes typical of the region. Each bull on an operation comes with additional costs beyond just his purchase price: proper bull management including yearly breeding soundness exams and trichomoniasis testing is crucial in any cattle operation to ensure bulls are sound and fertile. Bulls can be extra hard on fences and equipment, and they may wander on to neighboring ranches risking exposure to diseases like trichomoniasis, which can render them unsuitable for breeding. Purchasing quality bulls from out of state further exacerbates these challenges. Bulls that are accustomed to higher-quality grazing and more temperate climates often struggle to adapt to Arizona's harsher range conditions. The combination of lower quality forage, extreme heat, and the physical demands of covering vast terrain can lead to significant declines in their performance and overall health. As a result, these naïve bulls may rapidly deteriorate when expected to work under these challenging circumstances, making them less effective in breeding operations.

Purchasing Genetics.
While purchasing live bulls can be costly and competitive, especially when selecting from a limited pool of available animals, artificial insemination offers a more affordable and flexible alternative. With semen straws priced between $20-$60 on average, AI allows you to choose from thousands of bulls, selecting the genetics that best fit your operation without the limitations of local availability or the risk of a high-value bull deteriorating under Arizona's harsh rangeland conditions. Instead of investing in a few bulls at a higher purchase price ($3,000-$6,000), you can optimize your herd's genetic potential with AI, avoiding the challenges of acclimating a live bull to the local environment, reducing the biosecurity risk of introducing new animals, and reducing the overall cost per cow.

Expected Progeny Differences.
Another significant advantage of AI is the ability to select bulls based on Expected Progeny Differences (EPDs), a tool that estimates the future performance of a bull's offspring compared to the breed average. Purchased bulls seldom come with EPD data, whereas bulls marketed for AI require EPD data to be listed. Expected Progeny Differences are available for various traits, such as calving ease, birth weight, weaning weight, rib eye area, and marbling; this provides a lot more data and can help make better decisions about how his offspring will perform. Additionally, most breed organizations offer EPD indexes that combine multiple traits into a single score, helping producers identify bulls that excel in specific areas like carcass quality, growth, efficiency, or maternal traits. While EPDs have some limitations—such as lower accuracy in bulls with fewer offspring and limited application in crossbred cattle—recent advances in genomics are enhancing their utility, especially in crossbred operations. These advancements provide producers with even more precise information, allowing for well-informed decisions when selecting the best genetics for their herds. You can also purchase extra straws of a bull's semen and store them for later use, especially if you find certain characteristics in your herd that you'd like to preserve. Semen can be stored indefinitely, provided that the liquid nitrogen tank is properly maintained.

Increased Calf Crop Value

Uniform Calf Crop.
There are benefits to AI beyond just improving the genetics of your herd. A successful AI program will include estrus synchronization, where a specific sequence of hormones is administered to bring all the cattle into heat within a short, predictable time frame. In addition to allowing you to AI all the cows within a set time frame of your choosing, synchronization protocols offer two key advantages: a condensed calving season and a more uniform calf crop. A shorter calving season not only increases the value of your calves by producing a heavier, more uniform group but also enables you to better monitor calving for potential issues. With calves being born within a more concentrated time frame, you can position them closer to the ranch for

easier observation and management, reducing the time and resources needed to ensure a successful calving season. Research from the University of Tennessee demonstrated an additional 20% of calves could be born in the first 30 days of the breeding season utilizing AI (Griffith et al., 2020). This could translate to an additional 20-44 lbs. of weaned calf just from using an estrus synchronization protocol ("Costs of Siring Calves: Artificial Insemination Compared to Natural Service," 2018). Cows that are inseminated on the same day will calve within 2-3 weeks, with the majority born within a 10-day period. Calves will also be more uniform in color and growth, as you can achieve consistent genetics across your herd by using semen from a select few AI bulls, rather than relying on multiple live bulls for natural breeding.

Genetic Improvement.
The use of AI also allows the mating of specific cows or groups of cows to specific bulls. The entire herd doesn't have to be artificially inseminated. Some examples of choosing AI for specific subsets of the herd include breeding first calf heifers to a bull proven to have low birth weights, producing future replacement heifers with specific genetics, or increasing carcass characteristics in the calf crop. You could even choose to use AI on your entire herd and then use cleanup bulls for those that are open. For registered herds, AI is often heavily utilized to obtain the desired genetics. Some producers may choose AI one year and then opt for a bull the following year. There are numerous management strategies available that can be tailored to meet the objectives of your operation.

Marketing.
Marketing should be a consideration in the decision to implement AI into your operation. Artificial Insemination should be viewed as an investment in your operation. The producers who are operating successful beef businesses recognize the importance of capturing a premium when investing in the operation. Because you have an increased investment of time and money into each cow you AI, you need to consider how to capture that cost within your operation. It may be as discussed, in the form of quality replacement heifers or a more uniform calf crop, which will hopefully translate into more calves on the ground and more pounds on the hoof. While utilizing some form of advanced marketing (i.e. selling on the grid, direct marketing) makes it easier to capitalize on the benefits of AI, it is still possible to see improved profitability on the value of your calves no matter how you choose to market.

Cost of AI

Expenses.
Utilizing AI on an operation does come with a cost. The numbers provided here are estimates meant to give you an idea of the initial investment and possible cost per calf of AI vs natural service. Individual operations vary significantly in cost to keep bulls, labor, and potential facilities adjustments needed, so these numbers are intended as a starting guideline only. There are several resources available at the end of this publication to help your operation better identify the potential costs and benefits of AI specific to your situation.

Time.
The time required for AI varies depending on the chosen synchronization protocol. Estrus synchronization protocols range from 5 days to 10-14 days, with cattle needing to be worked from 1-4 times during that period (not including the insemination process itself). Some protocols are timed AI,

Item	Cost	Details
Initial Supplies	~$400	Includes semen thawer, AI gun, basic disposables (sheaths, lube, etc.). Pre-assembled kits are available.
Semen Storage Tank	$800-$2000	Cost varies with size.
Semen Tank Maintenance (approx. yearly)	$100-$200	Tanks require re-filling with liquid nitrogen and should be checked monthly to ensure they do not run dry
Synchronization Hormones	~$25-$35 per cow	Cost depends on the chosen protocol.
Semen	$20-$60 per straw	Specialty genetics may cost more.
Facility Alterations and Labor	Variable	Costs depend on specific operation and need for additional labor or hiring an AI technician.

where all animals are insemination on a fixed time schedule regardless of whether they are showing signs of heat. Heat detection protocols require frequent checking of animals over a 1-2 day period to identify those showing signs of estrus and inseminating them approximately 12 hours after signs of heat are observed. Additionally, successful AI should be followed by pregnancy checking, ideally 32-40 days after breeding. This step is crucial as it allows producers to identify open animals promptly and rebreed them to avoid any loss of time. Knowing exactly when the animal was bred and when to check for pregnancy not only helps in managing the breeding schedule but also provides valuable feedback on the effectiveness of the AI techniques used.

Return on Investment.

Using the Bull vs AI Breeding Cost Excel Spreadsheet from Kansas State University (Pendell & Johnson, 2015) and Arizona specific cost estimates (Teegerstrom & Tronstad, 2016), the estimated cost per head for AI is approximately $61/cow. Together, with the cost for the clean-up bulls (approximately $46/cow) this equals $107 total cost per cow exposed, or $126/calf, assuming an 85% pregnancy rate. In contrast, the average cost per cow of all-natural service is approximately $110, with the same assumptions about pregnancy rate and a 20:1 cow-to-bull ratio. In this scenario, an additional $16 in value is needed per calf to break even on the cost of implementing AI. A study conducted by the University of Tennessee comparing the cost of timed AI vs natural service estimated a similar amount: from approximately $10-$26 additional cost for an AI pregnancy, depending on bull purchase price and herd size (Griffith et al., 2020). This value could be capitalized on by weaning heavier calves and marketing calves with superior genetics for carcass characteristics. Of course, every operation has different costs for bull maintenance, labor, and may choose semen at a higher or lower price point.

   To make the best decision if AI is right for your ranch, it's essential to compare these costs against those of natural service. For a detailed and personalized cost comparison, check out the **Bull vs AI Breeding Cost** Excel Spreadsheet from Kansas State University. This tool allows you to input your own operational estimates and assess the cost of AI versus natural service on a per-pregnancy basis, helping you determine the most cost-effective breeding strategy for your operation.

Challenges to implementing AI

Artificial insemination is not ideal for a year-round breeding operation or one that doesn't check cows for pregnancy every year to ensure they are open before the estrus synchronization process is started. A year-round breeding schedule unnecessarily complicates the AI process, as not all the cows you want to breed will be predictably open at the same time. Administering hormones to a bred cow may result in the loss of the fetus she is carrying. If you do leave your bulls out year-round, you will want to transition to a defined breeding season before attempting to implement AI.

Veterinary Involvement.

A relationship with a veterinarian is also crucial, as the hormones used in estrus synchronization are available by prescription only (though they can be administered by the producer). These synthetic hormone products must be handled with care and adequate personal protective equipment, as they can be absorbed through the skin and interact with the human endocrine system (Wright, 2023). The importance of establishing a veterinary client-patient relationship (VCPR) cannot be overstated. Your veterinarian is an important resource for pregnancy detection and breeding soundness exams, and can advise you on a vaccination protocol, nutrition, and recommend the best estrus synchronization protocol for your herd.

Technician.

A trained AI technician is crucial because the AI process must be executed correctly at every step. The success rate for well-trained AI technicians in cattle can vary, but research indicates a success rate of around 60-70% (Perry et al., 2011). To ensure that cows not successfully bred via AI still produce a calf, you will need to use clean-up bulls. While AI won't eliminate the need for bulls in your operation, it can reduce the number you need, allowing you to maintain a smaller bull battery. Although the average producer can learn to AI their own cows, attention to detail is essential. The AI process involves many potential pitfalls, including mishandling of semen, deviations from estrus synchronization protocols, improper straw thawing or preparation, and incorrect deposition of semen. All of these factors can lead to a lower success rate. For those interested in learning AI, attending an AI clinic or school is highly recommended. A good understanding of anatomy and palpation experience is crucial. Not knowing how to safely perform AI can lead to perforations in the reproductive tract, resulting in peritonitis and the animal's inability to be bred. Causing trauma to the reproductive tract can induce bleeding, and since blood is toxic to sperm, this may result in reduced conception rates, permanently infertile animals, or animal death. Begin with a small group of cows and refine your technique until you achieve a satisfactory success rate before expanding your AI program to a larger portion of your herd.

Facilities.

Access to facilities poses a significant challenge for many producers in Arizona. During a one-week to ten-day period, cows must go through a chute 2-4 times for synchronization protocols and the AI process itself, depending on the chosen estrus synchronization protocol. Well-designed facilities and

calm, easy-to-handle cattle make the AI process smoother and increase the likelihood of successful pregnancies compared to handling stressed cattle.

Health and Nutrition.

Finally, AI cannot overcome significant management issues including inadequate vaccination protocols, Bovine Viral Diarrhea Virus (BVDV) or Trichomoniasis in the herd, or a poor nutrition plan as body condition score is highly correlated with pregnancy rate (Carvalho et al., 2022). If, however, your ranch has a good handle on herd health, a sound nutrition and mineral program, and is looking for a way to invest in genetics and improve the value of the calf crop, AI might be a consideration.

Helpful Resources

https://beefrepro.org/

https://www.agmanager.info/ksu-bull-vs-AI-breeding-costs

References

Services: Centers for Epidemiology and Animal Health Retrieved from https://www.aphis.usda.gov/animal_health/nahms/beefcowcalf/downloads/beef0708/Beef0708_is_BullMgmt_1.pdf

Carvalho, R. S., Cooke, R. F., Cappellozza, B. I., Peres, R. F. G., Pohler, K. G., & Vasconcelos, J. L. M. (2022). Influence of body condition score and it schange after parturition on pregnancy rates to fixed-timed artificial insemination in Bos indicus beef cows. Animal Reproduction Science, 243.

Costs of Siring Calves: Artificial Insemination Compared to Natural Service. (2018). https://www.beefresearch.ca/blog/costs-of-siring-calves-artificial-insemination-compared-to-natural-service

Griffith, A. P., Boyer, C. N., Rhinehart, J. D., & Carter, C. (2020). Cost-Benefit Analysis of Timed A.I. and Natural Service in Beef Cattle (University of Tennessee Department of Agriculture and Resource Economics Extension Reports, Issue W 899).

Pendell, D., & Johnson, S. (2015). KSU-Bull vs AI Breeding Costs. Retrieved 12/15/2023, from https://www.agmanager.info/ksu-bull-vs-ai-breeding-costs

Perry, G. A., Dalton, J. C., & Geary, T. W. (2011). Management Factors Influencing Fertility in Beef Cattle Breeding Programs. Applied Reproductive Strategies in Beef Cattle, Joplin, MO.

Teegerstrom, T., & Tronstad, R. (2016). Arizona Ranching Budgets: 2016. (az1734). https://extension.arizona.edu/sites/extension.arizona.edu/files/pubs/az1734-2017.pdf

Wright, A. D. (2023). A Guide to the Hormones Used in Cattle Ustrus Synchronization for Artificial Insemination. https://extension.arizona.edu/pubs/guide-hormones-used-cattle-estrus-synchronization-artificial-insemination

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