# Cover Crop Seed Production Grown with Climate Smart Wheat

***Executive Summary of Pilot Project***

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**Compelling Need for the Project**

For row crop agriculture to sequester carbon in the soil, the number of days and areas where plants are actively sending atmospheric carbon into the soil through plant roots needs to substantially increase. In recognition of this, the Federal government has committed at least 5 billion dollars in support for adoption of cover crops. The corn, soy, and pork boards have also shown support, collectively setting a goal to increase the acres that are planted to cover crops from the current estimate of 20 million acres to 30 million acres by 2030. In addition to the advantages for the climate and environment, farmers now see market-based reasons to adopt cover crops. Corporations such as Walmart and Ralph Lauren are actively working to source products from farmers using cover crops but are facing supply chain shortages. And those farmers who want to adopt cover crops, are already reporting a shortage of the cover crop seed they want to plant.

To meet the growing demand for cover crops, the US needs to **invest in increasing the size of the cover crop seed industry now**. Increasing acres and demand necessitate developing new regions of seed production in order to increase supply and minimize risk of a large percentage of production being decimated due to bad weather in one area. This means increasing the number of acres planted to cover crop seed, diversifying production regions, and increasing the processing capacity. The **inland Pacific Northwest (iPNW**) is an optimal area to increase the production of cover crop seed because the Mediterranean climate provides cool, wet winters and an extended period of dry weather in the summer which is ideal for seed maturation and quality. This area has a long history of a wheat fallow system which often includes no rotational diversity, minimal cover, and repeated tillage. By implementing this pilot program in this region we can help meet the need for cover crop seed and transform their system to include more climate smart practices. Additionally, the proximity to many wholesale seed companies, located in the western half of Oregon, is optimal to maximize efficiency related to transport and processing.

Producers in the iPNW often use their land for wheat or cattle production. Rather than replacing the current wheat fallow system, this project aims to add cover crop seed production into the rotation in areas with sufficient precipitation or irrigation. This will increase the number of days with living roots in the ground and increase plant and market diversity. The increase in living roots, decreased disturbance, increased rotational diversity, and anticipated decrease in synthetic nitrogen (N) fertilizer due to the incorporation of leguminous cover crops will allow producers participating in this pilot program to market their wheat as "climate smart wheat." Research from Maaz et al. (2018) clearly showed that other similar regions have successfully integrated oilseed and pulse crops into dryland wheat systems through public policy, market incentives and aid in risk management strategies.

It is challenging to contract acres for cover crop seed production in new regions because new crops represent new risks, and require new equipment, new skills, and new logistics. In addition to the time it takes to learn how to produce a new crop, there is also a delay in getting paid for the crop itself due to processing and shipping constraints. Most of the species utilized for cover crops must be planted in the fall. These fields are then harvested the following June/July. Processing the seed is time consuming and most of the seed harvested will not be able to ship to the end user until the spring following the harvest year. Within the current system, it normally takes at least 20 months from planting to final shipment. This causes a delayed payment to the producer and makes cover crop seed production unattractive in comparison to wheat, which has a historically shorter processing time, always has a ready buyer, futures markets, and crop insurance options. Forecasting the demand for cover crop seed due to new government funded programs is also a high-risk venture for a seed company. There is no doubt, these programs are a vital step to incentivize producers to adopt practices that will simultaneously address climate change, soil loss and degradation, water quality, and the loss of biodiversity. However, for farmers to utilize this opportunity, these same programs need to include incentives and **support for the production** that will be needed to make these programs successful.

Grassland Oregon (doing business as GO Seed) has partnered with the **Confederated Tribes of Umatilla Indian Reservation (CTUIR),** who are ready to start producing cover crop seed. The team at GO Seed is working closely with the Farm Enterprise management at CTUIR to adopt a soil health, systems-based approach that integrates seed production into existing operations. A farmer-owned grain marketing cooperative, **Northwest Grain Growers (NWGG)**, has partnered with us to market identity preserved **climate smart wheat (CSW**). Agoro Carbon Alliance and Curtis Evanenko from Ace Connect LLC have also joined the partnership as subcontract awards to support carbon marketing opportunities and financial management, respectively. This project also has support from the Oregon Climate and Agriculture Network and the Oregon Wheat Grower's League who each play an active role in the development of local market-based solutions for Oregon producers and want to pursue climate smart strategies. In my role as a scientific advisor to the Soil Health Institute (SHI) I will continue to learn from their research and work with SHI in collaboration as decisions are made. The Shoshone-Bannock Tribes have also indicated that they are very interested in participation and we have planned to start placing some acres with their farm enterprise system in Idaho starting in year three of the project. Finally, as a cover crop seed company, we at GO Seed see great opportunity to satisfy an urgent need in the market and will help manage the agronomic, logistical, and organizational coordination for scaling up the production and processing of cover crop seed.

To increase cover crop adoption while government supports are in place, the industry needs to **ramp up seed production** immediately. The seed production in this project will be done using climate smart management practices including increasing the crop rotational diversity (328), adjusting to a no till program (329), and strategic nutrient management plans that incorporate biological activity and legume crops with the anticipation of lower N requirements (590). This proposal lays out the financial and agronomic support plan for producers, the capital needed to increase processing capacity, the financial support needed for seed companies to carry contracts, and direct payments to farmers willing to include climate smart practices in cover crop seed production. In developing this pilot, partnerships and support throughout the supply chain have been brought into the process to collaboratively build the industry that will increase farm resilience, expand market opportunities, and strengthen America's food security.

**Approach to Minimizing Transaction Costs Associated with Project Activities**

We approach this pilot program like an investment opportunity to jump-start an emerging market that will result in multiple self-sustaining business units. Multiple partners throughout the supply chain are engaged to ensure that the system is scalable in response to the market for both cover crop seed production and climate smart wheat.

In the first year, the project will target a limited roll-out of roughly 500 cover crop seed production acres. A central theme through this program will focus on communicating successes and challenges with participating producers and the Climate Smart Commodity Partner Network. The primary cost associated with the project is an incentive payment of $150 per acre for each year that acre is used for growing cover crop for seed production using climate smart practices. An iterative process and **fostered sense of partnership between the farmers and the GO Seed agronomy team** with experience growing cover crop seed will decrease the likelihood that farmers will have cropping failures allowing us to build confidence in the production system.

Water availability is the most influential factor on yield in dryland wheat production (Williams et al., 2020; Schillinger et al., 2006). Cover crop and alternate crop research done in this region for the last 30 years, indicates annual cropping systems can be successful in areas with more than 14 inches of mean annual precipitation (Maaz, et al., 2017; Pan et al., 2017; Connolly et al., 2016). Equipment designed to minimize disturbance and conserve water is cited as one of the most critical elements of success for annual cropping in this region. Even with this guidance, there may be early years where the soil's capacity to hold water has not increased yet or there is a below normal precipitation. Diversifying the cropping portfolio of the lands at CTUIR by growing several cover crop species will help to **minimize the potential losses**, allowing us to lean more heavily on lower water-use crops in dryland areas and plant crops that need more water in regions with irrigation or during springs with above-average precipitation. Production diversification will help to optimize profit in various precipitation zones.

The methods used for greenhouse gas (GHG) benefit verification will minimize transaction costs in several ways. GO Seed has specialized in producing cold-tolerant legumes that produce high biomass in many growing conditions. A primary benefit for producers who integrate legumes, is that nitrogen (N) is fixed through symbiotic relationships with rhizobia. The nitrogen produced and stored in the biomass of the cover crops allows for decreased N fertilizer usage in the subsequent years (UGA cover crop calculator https://aesl.ces.uga.edu/mineralization/ ). Our project agronomist and agronomic support team will work with the farmers in the program **to reduce synthetic-N fertilizer applications (NRCS standard 590)**. The manufacturing process of synthetic-N uses an estimated 1.2-2% of the

world's total energy each year and produces 420-500 million tons of $CO_2$ accounting for roughly 1% of total $CO_2$ emissions (Liu, et al., 2020; Hasler et al., 2015; US EPA, 2009). Reduction in usage results in a direct reduction in carbon dioxide equivalents ($CO_2e$) which does not require verification through soil sampling or laboratory analysis - a significant cost avoidance. Nitrogen use reduction and subsequent GHG benefit will be calculated from participating farms in the program and from the increased acres that can include legumes in their cover crop blend as a direct result of this project.

Most wheat farmers who are not growing cover crops but want to participate in the CSW marketing pilot through NWGG will need to demonstrate eligibility, which could include participation in a carbon market program. The carbon market programs available in this region provide **additional incentives for growers to incorporate cover crops in their rotation, reduce tillage, and reduce synthetic nitrogen fertilization**. If they are not currently enrolled in a carbon market program, our project partner, Agoro Carbon Alliance, is ready and willing to sign up wheat farmers in the iPNW. In this way, verification and monitoring will add minimal costs to this program.

**Reducing Barriers to Implementing CSC for Producers and Marketing**

GO Seed will purchase the cover crop seed from farmers participating in this pilot program and sell it to our distributors throughout the USA and others in the **Climate Smart Commodities (CSC)** partnership network. When GO Seed enters a production contract for cover crop seed, we sell the producers the right to use the seed. In this program, the cost of the seed used will be deducted from incentive payment, so that there is no out of pocket cost at planting. This is described in the production contract that will be signed for each field entering the program. The wheat that is grown in rotation with cover crop seed and wheat from cooperative member farmers who have joined a carbon market will be purchased and marketed by NWGG. This will maintain continuity with current marketing logistics for farmers. NWGG and GO Seed will work together to develop a **"CSW"** seal and educate customers about the concept. An infographic will be produced detailing the goals of the program, the benefits of purchasing climate smart wheat, and the requirements to achieve a CSW seal. We hope to work with other wheat focused projects to come to a consensus regarding a nationally coordinated climate smart wheat campaign. Our proposal is that in order for producers to qualify they will need to have implemented at least one NRCS conservation standard and have soil test results that are higher than the low-baseline carbon stock value for their soil type. This participation requirements will be described through marketing channels, on each of our respective websites, and will be attached to every CSW purchase order to allow the millers to use the information in their marketing.

**Geographic focus**

Our committed partners are in the iPNW in the Columbia River Basin of Oregon and Washington. There is interest from Tribes on reservations in Central Oregon and Idaho who may choose to participate as the program is further developed. Since learning of our tentative acceptance, we have heard that both the Shoshone-Bannock Tribes and Coeur d'Alene Tribe have expressed more interest in this program. After several conversations with CTUIR and Shoshone-Bannock farm managers, we have planned to start demonstration plots at Fort Hall Reservation in year two of the project and start some cover crop seed production there in year three. These regions also have an established seed production industry and a climate that lends itself to fall-planted seed production crops.

**Management Capacity of Partners**

GO Seed has been in the cover crop seed breeding, research, and production business for 22 years, contracting directly with producers and providing agronomic support for successful cover crop seed production. Specifically, Dr. Shannon Cappellazzi, the project principal investigator (PI) was an **agricultural commodities trader** in the northwest for three years prior to pursuing her PhD focused on soil health from Oregon State University where she managed a soil health **analytical laboratory**. After graduation she was the **lead project scientist** for the North American Project to Evaluate Soil Health Measurements, at the Soil Health Institute.

Northwest Grain Growers is a farmer-owned cooperative that markets grains and seeds, operating 31 elevators in the PNW with a total capacity of **40 million bushels** throughput and a track record of managing identity preserved products. One of these elevators has been rented from the Confederated Tribes of the Umatilla Indian Reservation and they have worked together to market the grain from CTUIR for many years. This cooperative also handles the marketing of wheat and the sale of wheat seed for the 2000 member farmers covering 200,000 acres of wheat production in Oregon and Washington.

The farm enterprise manager, Kevin Hudson, at CTUIR is directly responsible for agricultural management practices on land owned by CTUIR, and the land rented from the Bureau of Indian Affairs. The Tiicham soil water conservation district representative is Katherine Minthorn, a CTUIR tribal member and the technical assistance specialist of the Intertribal Agricultural Council in Oregon and Idaho. She will be providing support and coordination for this project.

John Pullis, M.S. and John Shanahan, Ph.D. are both agronomists on the Agoro Carbon Alliance scientific advisory team. John has worked in conservation and precision agriculture for 15 years, currently as Agoro Agronomist in Carbon Cropping and Sustainability. John has **40+ years of agronomic experience** including as a professor at Colorado State, research agronomist at the USDA-ARS, and most recently as a project manager for the Soil Health Institute, prior to joining Agoro Carbon. John is now the row-crop and scientific lead for Agoro Carbon.

***Plan to pilot climate-smart agriculture at large scale***

**Description of CSA Practices to be Deployed**

This project will be integrating cover crop seed production into wheat fallow systems where there is greater than 14 inches of precipitation. Each year land that typically would have been fallowed will be utilized to grow a variety of different cover crops for seed production. This is an immediate increase in the **crop rotational diversity** (NRCS practice standard 328). This will work with a fall planting and summer harvest schedule. This will roughly double the number of days when there are living-roots in the ground, **increase the amount of time with plant biomass covering the surface, decrease the nitrogen fertilizer requirement** of the subsequent crop (NRCS practice nutrient management 590), and enable them to **move to a true no till system** (NRCS practice standard 329). Research on the long-term experiment station at the Columbia Basin Agricultural Research Center at OSU has demonstrated that these practices will increase the soil carbon in this production zone (Ghimire and Machado, 2022). In addition, by increasing the amount of seed available, increased cover crop seed production will allow for greater cover crop adoption and increased soil carbon rates throughout the country (Martins et al., 2021). The management history forms will allow us to **ensure that the practices implemented meet the NRCS standards.** The history and records, which will be **required for**

**the incentive contract**, will include nutrient management, soil sample results, implements and number of passes used for seed bed preparation, and the crops planted and harvested.

For other wheat producers who want to market Climate Smart Wheat but have not signed onto the pilot program to grow cover crop seed, eligible practices will include those who are using cover crops, rotational diversity, no till production, and advanced nutrient management plans. The climate smart success of these practices will be monitored through soil test results.

**Plan to Recruit Producers Including Scale of Project**

This pilot is designed with full partnership cooperation from the Board of Trustees at the Confederated Tribes of the Umatilla Indian Reservation (CTUIR). Their farm enterprise committees, water commissions, and departments of economic and community development are fully committed to this project and see this as a means of regenerating the natural capacity of their land along with the opportunity to lead an emerging market. The acres that will be used for cover crop seed production, the primary pilot program which will qualify for the safety net, are on the CTUIR. The farm manager has had conversations with people who are currently leasing land from the reservation and private landowners on the reservation. Mark Wadsworth, on behalf of the Board of Trustees of the Shoshone-Bannock Tribes of the Fort Hall Reservation also has signed a letter of support stating that they are interested in the project and have reached out several times since learning of our success to discuss how they can participate.

The Northwest Grain Growers, a farmer-owned cooperative, has also agreed to partner with us, representing an additional 2000 wheat farmers in the Columbia basin. These member cooperators will be many of the producers marketing their wheat through the "Climate Smart Wheat" (CSW) seal. Together these partnerships represent roughly 250,000 total acres of potential land. Although not all the land is suitable for the proposed seed system, roughly half of these acres are already managed with some type of climate smart practice and will be assessed for eligibility for marketing CSW.

Another project partner, Agoro Carbon Alliance, will discuss carbon market options with producers in the area, providing a potential entry into a private carbon market. For the legacy soil health champions who may not qualify for additionality-focused carbon markets, our agronomy team will take a detailed management history and soil samples to compare their soils to regional baseline reference soils to demonstrate that their long-term management practices have in fact increased soil carbon, to determine if they can also be included in this marketing program.

In fall of 2023, we anticipate planting 500 acres of various cover crop species for seed production on top of what GO Seed would have normally contracted. These acres will produce approximately 500,000 lbs. of small-seeded cover crops. This seed production will allow for an additional 50,000 acres of row crop land to be covered after the first year of production or, if added to a cover crop blend, improve roughly 100,000 acres. We anticipate increasing these plantings by as much as 2,000 acres each year of the program, for an estimated total of 7,500 additional acres of cover crop seed crops planted in 2027 which could cover as much as 1,500,000 acres in the fall of 2028. This represents 15% of the major commodity boards' stated goal of increasing cover crop use by 10 million acres by 2030.

**Plan for Technical Assistance Outreach and Training Qualifications and Timeliness**

One of the central goals of this project is to train farmers how to grow cover crop seed. GO Seed has worked with producers and coached them through cover crop seed production for the last 15 years. Over the years we have developed techniques to deliver industry leading yield

for producers growing seed. We do this by maintaining a close working relationship with our producers, regular field monitoring, and a constant focus on research. For instance, one of our producers had a lower-than-average yield of our Frosty Berseem clover. We were able to identify that the problem was a species of phoma, a fungal pathogen. As a result, we were able to advise on the appropriate fungicide that alleviated the problem and increased yields by 30%. Our current staff has intimate knowledge of production techniques unique to cover crop seed production and recognize that to minimize the learning curve for pilot program participants we will need to hire an additional agronomic support. The lead agronomist will be the primary point person for all farmers working on this project. Priority responsibilities will include conducting educational outreach and providing decision support on how to successfully grow cover crop seed while using soil health principles to make management decisions. Additional technical assistance will be supplemented by the Agoro carbon agronomist, the owner of GO Seed who has 40 years of experience in seed production, and Shannon Cappellazzi who has 13 years of experience in soil health assessment and practice implementation.

Since we will need to start planting in the late summer of 2023, we will start with a cover crop seed production boot camp. This will be a three-day training session held at CTUIR. The training series will cover production techniques including weed management, operational timelines, dealing with residue, pests and disease monitoring and management, water use efficiency recommendations, and soil sampling protocols. While we are there in person, we will walk the fields and work with the partnering producers to make a field plan for the cover crop species to be planted in each field. Throughout the growing season, the agronomy team will be available to help make decisions, follow up on field scouting reports, and help with adjustments that might be required due to weather, equipment issues, or unforeseen circumstances.

The first year we will also establish two five-acre demonstration sites at CTUIR, one in a low rainfall area and the other in a >16 inch rainfall area. These plots will have water monitoring devices installed to address the concerns of producers related to cover crops stealing water from subsequent wheat crops. Plots will consist of 10-15 different species/varieties of cover crops that are expected to work in each respective area. The region has demonstrated success with canola (Schillinger and Paulitz, 2018) and peas (Singh et al., 2022) and so the demonstration site will highlight several varieties with similar growing systems as canola and peas. Higher valued clover varieties that GO Seed has bred that are less familiar to producers in the region will also be planted. The demonstration site will also have wheat grown in rotation with each cover crop. Both phases of the rotation will be demonstrated each year, to showcase the goals for climate smart wheat creating a total of 20-30 plots. This will serve as a means for recruiting additional growers, a potential space for assessing alternative strategies, and as a location for annual training field days. Starting in the spring of 2023 there will be an annual field day where any interested farmer, with an emphasis on those who are working land on the reservation, can visit the demonstration sites to learn more about and sign up for the pilot program. There will also be a post-harvest (~August) annual assessment in which all participating land managers will gather with the agronomists, soil scientists, and production teams to discuss crop yields, challenges from the last year, adjustments for the upcoming year, market outlooks, and additional concerns and questions.

**Plan to Provide Financial Assistance to Implement CSC**

The primary financial assistance requested is an incentive payment. The potential for low yields while learning the skills required for a new cash crop and the uncertainty about influence

on the primary cash crop are the primary reasons it has been a challenge to convince farmers to grow cover crop seed. In addition, **growing a cover crop without terminating before seed production makes farmers in this region ineligible for federally regulated summer fallow crop insurance on their primary cash crop which would further increase their risk and decrease interest.** This proposal would provide an incentive payment of $150/acre which is similar to a federal insurance payout for a failed wheat crop in a very bad year. This should provide the extra support needed to comfort the farmers that think cover crop seed production will steal water from their wheat and lead to poor yields. When signing up for the program they will sign their production contract that states their participation in this program will make them ineligible for crop insurance on the wheat crop following cover crop seed production.

There are several specialized implements needed to adopt climate smart practices for production of cover crop seed. The primary partner is currently using a paired, drill air seeder with a STIR value of 17 and a vertical tillage implement with a STIR value of 17 to manage residue. To plant the very small seed needed for cover crop seed production and to decrease the disturbance to a no till system, we propose adding a **Case IH 550 DS double shoot, a single disk drill seeder** with a STIR rating of 2.4 which will also decrease the number of passes on the field. This will enable good seed to soil contact for the brand new crop, eliminate the challenges with crop residue, and decrease the overall disturbance and fuel use.

The other equipment that is unique to the area and the newly proposed production system is a Macdon **Combine Pickup Header.** This is the preferred harvesting header for small seed crops that are prone to shatter such as the clover and brassicas. Having the proper equipment will allow for maximum yield and fuel efficiency. Producers have been able to demonstrate a considerable increase (2-5 bu/acre) in harvested yield when using specialized pick-up combine headers for clovers (Johnston, 2013).

These implements are vital to the success of the project because water is the primary limiting factor in this region which makes it vital that we minimize disturbance and maximize the ability to leave residue on the surface. There is no one in this region currently using this equipment and it has been noted by OSU researchers at the Pendleton research station that the lack of availability of moisture conserving equipment has led to failure of other annual cropping systems.

The other considerable challenge to increasing the size of the cover crop seed industry is that most producers are not able to get seed through a cleaner and have it processed in the same year that the seed is harvested. This creates a situation where someone must inventory the crop for nearly a year. To incentivize the producers, GO Seed may utilize an advance on grant funds to purchase some seed prior to our typical payment period. When we sell product that we bought using the advanced payment, the proceeds would go into our grant management account and be used to fulfil the rest of the grant obligations. Any profits made from the sale of seed that was purchased with these advanced funds would be released back to GO Seed at the end of the 5-year grant period.

The CTUIR has offered to build a permanent structure in their Industrial Park as part of their commitment to this project with no financial assistance or accounting in the grant. This would be used for temporary seed storage. The pilot program would **pay the storage fees accrued on the cover crop seed produced through this pilot** at $0.0015/lb, the current market rate, until the product is shipped to the end user that is planting the cover crop seed. The seed storage fees would be paid directly to CTUIR. As the industry and markets develop, it is

expected that CTUIR will add additional equipment to their Industrial Park that would allow for all the seed processing and cleaning to happen onsite, which would eliminate the short-term need for seed storage. Storage fees are necessary because there is a lag time between when seed is produced, cleaned, and when it can be shipped. The growers and GO Seed are taking a risk by producing and purchasing considerably more cover crop seed than is needed to meet the current market demand. It is expected that the projects funded by the Partnership for Climate Smart Commodities and other government incentives will fuel the cover crop demand, but the organizations working to get ahead of the market are not situated to take the financial cost of storage as the industry builds. Storage fees for the first few years are an essential element of building the supply chain needed to scale up cover crop usage throughout the US.

To minimize the need for this storage after the first two years, funding is needed for a small amount of specialized seed cleaning equipment for the existing NWGG seed cleaning facility. A nearby processing line will minimize transportation costs, fuel, and carryover associated with production in this region and will help to minimize the required storage. By increasing this seed cleaning capacity, storage fees are expected to decrease. This will help scale up the size of the industry immediately. It does not make financial sense to create and operate a new seed cleaning business and facility in the CTUIR Industrial Park until there is an estimated 1 million pounds of seed produced per year in this region. Our goal is that by the end of this pilot program, CTUIR will feel well enough established in the business to invest in the specialized equipment needed to process their own seeds.

**Plan to Enroll Underserved Producers**

Our project is a partnership with Tribal leaders from the Confederated Tribes of the Umatilla Indian Reservation. The Shoshone-Bannock Tribes have sent a letter of support and the Coeur d'Alene Tribe and farm manager from the Warm Springs Reservation have expressed interest in the project. Together this project will have the opportunity to work with many tribal farmers and have the potential to indirectly influence tribal members from multiple reservations by supporting the development of an emerging industry that works towards regenerating the land, recharging the waters, and decreasing the reliance on a single crop. Most of the individual landowners on reservation land manage a small number of acres and have modest income. Several of the people we have discussed contracts for agronomic support and farm management positions come from underrepresented communities including tribal members, women, and veterans.

***MMRV Measure Monitor Reporting Verification Plan***

**GHG Benefit Quantification – Methodological Approach**

There are three primary indicators that will be assessed to quantify the impact on GHG emission balance from our program; **the reduction from historical averages of N fertilizer use, soil carbon changes through time**, **and the number of acres that can add cover crops to their rotation because of the additional seed produced**. All ownership of benefits will remain with the farmers, unless they have entered a carbon market contract that states otherwise. Grain purchasers and millers can use participation in marketing but will not take ownership or credit for the work done on-farm to reduce GHG emissions.

All fields that are signed up for this seed production pilot program will be required to complete a thorough management history that includes estimated rates of N fertilizer used over the last 10 years. It has been demonstrated time and again that legume cover crops provide a

nitrogen credit for the following crop (Sullivan et al., 2020; N'Dayegamiye et al., 2015; Powers and Ruzek, 1922). This has also been the experience of the cover crop seed producers that GO Seed works with in the Willamette Valley of Oregon (personal communication with Mike Coon at Oak Park Farms). The project coordinator/agronomist will work with the producers to assess nitrogen availability and the rate of microbial activity (C-mineralization or respiration) to calculate the agronomically optimal N rate to use on the following wheat crops (Bean et al., 2020; Cappellazzi et al., 2020; Haney et al., 2015). We will utilize results of our ongoing N mineralization timing trials being conducted in Oregon using our own cover crop products. This work combined LiCor $CO_2$ measurements, laboratory incubations where we measured $CO_2$ and $NO_3$ through the duration of the growing season, actual plant N uptake, and the relationship between these outcomes and the measurements of total organic carbon, nitrogen and a 24 hr $CO_2$ burst test. Changes in synthetic N use will be tracked and calculate the direct reduction in emissions that are the result of decreased N application. The production of one ton of ammoniacal N emits 2.6 metric tons of $CO_2e$ (Liu et al, 2020; Hasler et a., 2015), the further processing of that same ton into typical N fertilizer produces additional $CO_2e$ equivalents. The N lost in the form of $N_2O$ from one ton of ammonium nitrate is estimated at 1% of the N applied (IPCC 2017) which has a $CO_2e$ of 310 $CO_2$. Each ton of N not applied due to legume integrated, will be calculated as $CO_2e$ avoided

The management history will include questions required to complete a COMET farm model. In this way the data gathered on initial soil samples can help inform the model regarding dryland wheat fallow systems. The model results of a simulated cover crop addition will be compared to the actual results of adding cover crop seed crop to the rotation. The COMET farm model is used by many carbon market companies to estimate future carbon additions resulting from an adoption of conservation practices. The carbon sequestration potential of dryland systems in the iPNW have not been thoroughly ground-truthed in COMET (Paustain et al., 2017) and the body of data from this project will be available to improve the accuracy of the model.

Increases in soil carbon stock (calculated using soil organic carbon concentration and bulk density), water infiltration, and water holding capacity will be assessed by measurements taken upon entry into the seed production program and at the end of the pilot project (Year 5). We will utilize a regional stratification soil sampling design using data layers that include soil texture, landscape features, and climate. In the iPNW, these characteristics are shown to influence the propensity for soil carbon to increase in the soil. The statistical approach is based on inherent variability to determine the optimal number of locations to sample within each stratified zone in each year. Preliminary analysis of the soil map data, and conversations with carbon market companies in the area indicate this will average roughly one composited sample for every 20 acres.

Once the optimal number of locations is determined, soil sampling points will be randomly placed within each stratum. For each sampling point two soil organic carbon (SOC) samples (0-15cm and 15-30cm depths) and two bulk density samples (0-15cm and 15-30cm depths) will be taken and then analyzed for SOC using the dry combustion method. As this region contains some calcareous soils, total inorganic carbon tests will be taken as needed based on an acid effervescence test. The same, intact cores used for bulk density sampling will also be used to assess available water holding capacity using a tension table to measure intact water holding at field capacity. The agronomy team will use a single ring infiltrometer with one inch of water to capture the initial infiltration dynamics and sorptive capacity of the soil. This aggregated sampling will be used to assess changes in soil carbon and water dynamics over the

project period through the transition from a wheat fallow system to a wheat-cover crop seed system. Capturing the changes in SOC will provide the data needed for a carbon or ecosystem service market programs as well as verification that practices employed in this program have had an impact.

The number of acres that can have cover crops incorporated because of our project will represent the potential of our project. Decreased GHG emissions because of reduced synthetic N rates and increased potential for soil carbon storage are expected, but we will not have the ability to directly measure changes for all those who purchase the seed that is produced from this pilot. We will report a calculated potential benefit estimate by using peer reviewed literature regarding the N credit and carbon storage over time from a theoretical cover crop blend that contains 30% legumes and 70% cereal which is representative of the cover crop species usages (Smith, 2020). We will share this information with the partnership network and hope to receive feedback regarding actual carbon storage and N reduction rates. Though we are providing a potential benefit calculation, any actual benefit will be carried and accounted for by the producers who utilize the seed.

**Approach to Monitoring Practice Implementation**

A farm that signs up for the cover crop seed pilot program will be working with us to source cover crop seedstock and as a result, GO Seed will have a direct record of the number of acres that are planted to cover crop seed each year. Our goal is to get 500 acres planted in the first year for harvest of 2024, 2000 acres for harvest 2025, 3200 acres for harvest 2026, 5200 acres for harvest 2027, and 7500 acres for harvest in 2028. The producers will work in consultation with the project agronomist to maintain a management history using our template that will be integrated into our database that will track changes in management practices. This template will include tillage intensity, rotation diversity, chemical use, nutrient management and cover cropping practices.

The wheat producers that are members of the NWGG and want the opportunity to market their wheat through the climate smart wheat brand will need to provide verification of production practices. All growers who have contracted with any of the carbon or ecosystem service market providers have provided management history and baseline soil sampling data. Therefore, those who have already entered a carbon market will be eligible to bring their wheat to the identity preserved CSW elevator managed by NWGG. If the farm has not contracted with a carbon market that is helping them to manage their own verification process, our supporting partner, Agoro Carbon Alliance, can work with them to educate them more about the opportunity.

We want to encourage participation in the CSW pilot among the progressive wheat farmers in the surrounding area. This program provides a unique opportunity for early adopters to realize a marketing benefit to their long-term, wise, land management, even if the carbon markets continue to require additionality for the sale of carbon credits. For producers who do not qualify for a current carbon market plan, we will take a detailed management history and soil samples to compare them to reference soils. While I was at the Soil Health Institute (SHI), I worked on the team that developed the idea and testing plan for using reference soils. The idea laid out below follows a similar method to what SHI has been using to determine a soil's inherent capacity to store carbon.

The reference soils will be stratified by texture and precipitation in each region and will provide references around the range of carbon concentrations that a soil in that strata could expect. The low-end reference will be taken by sampling fields with no conservation practices.

The upper-end or target reference will be taken from a minimally managed, perennial grass area which tends to demonstrate the soil's optimal capacity to function. Comparing a progressive farmer's soil to these two brackets will demonstrate the relative progress that a farmer has made toward regenerating soil carbon and soil health on their farm. Farms will be eligible for the Climate Smart Wheat program if they have already implemented an NRCS conservation practice standard and if their soil carbon stock is statistically greater than the low-end reference in their respective region and strata.

Among the 200,000 acres that are managed by farmers who are cooperative members at NWGG, it is estimated that roughly 50,000 acres would already be eligible based on tillage reduction to qualify for CSW marketing program with another 50,000 that are expected to join the program over the next five years. These estimates come from member meetings and production discussions between the grain purchasers and farmers.

**Approach to Reporting and Tracking GHG Benefits**

Each participating farm with their management data, soil test results, and funds allocated will be organized in a master spreadsheet (database) that will be used for economic analysis, agronomic calculations, COMET data entry, and GHG benefit tracking. Synthetic-N use reduction is a permanent subtraction of energy use and therefore $CO_2e$. Delivering a promise on the longevity of soil carbon storage is beyond the scope of this applied pilot project. There are numerous rigorous scientific investigations to understand the multiple interacting factors that influence the longevity of soil carbon (Lehmman and Kleber 2015). Current literature on sequestration and data entered into the COMET model will be used to make estimates for the reporting of longevity of carbon sequestration. We expect that the data generated from this pilot will help farmers, the research community, and carbon market forecasters to understand how to increase soil carbon in arid regions.

The most prescient impact of this project is the development of additional cover crop seed production capacity. We will make a direct impact on the availability of high-quality seed at affordable prices which will increase the profitability of using cover crops for producers. Once farmers figure out how to make cover crops work on their land, they often continue along the path of adding regenerative practices. Building the underlying capacity and infrastructure to increase the cover crop seed industry will have long-term impacts on how agriculture is conducted. We expect that further increases in the amount of cover crop seed that can be produced will be a self-supporting system. Further, it is expected that the demonstration of this system, and the changes in moisture dynamics over a long-term pilot program will give other producers in the region the data they need to incorporate cover crops.

At the end of each harvest year, we will calculate the change in $CO_2e$ from reduced N on an annual basis to report the benefit per acre per project dollar. At the end of the pilot, we will report the total costs, N reduction, and C storage that was accomplished to report the overall value of this investment that would allow for a future program to incentivize climate smart production.

**Approach to Verification of GHG Benefits and Ownership**

Greenhouse gas benefits from reduced N applications will require thorough completion of a management questionnaire each year. This will be a requirement of the program before farmers are eligible for payment or receive more seed for production. To verify the GHG benefit we will use the life cycle assessment results from Skowronska and Filipek (2014) and the

Technical Support Document for the Ammonia Production Sector from the Office of Air and Radiation of the US EPA (2009) to calculate the $CO_2e$ reduction from lower synthetic N application rates. The acres signed up who have already increased soil carbon will be reported quarterly and verification of increased soil carbon for new systems will be reported at the end of the five-year period. The stratified soil sampling plan will be used to compare the results of the carbon stock analysis taken in the first year of the program to the samples taken in the last year. The number of acres in the program multiplied by the increase in soil carbon in the top 30cm of soil of program participants will be the reported change in soil carbon storage.

Wheat farmers who are participating in a private carbon market and selling CSW will not be included in the calculation of our direct GHG impact of this project. Because our project is not financially supporting a transition in practices among these farmers, we do not credit this project with their carbon storage. Rather we are expanding the CSW market to include them so that the market is big enough for the NWGG to handle identity preserved wheat from those in our pilot program who have integrated cover crop seed production into their wheat operation. This marketing opportunity may entice more people to join carbon markets and adopt new practices, but they are not dictated nor managed through this program. The early adopters will be included in our calculations of impact since these producers would be left out of the market were it not for our reference-based sampling approach.

**Agreement to Participate in Partnership Network**

Shannon Cappellazzi is the team representative who will actively engage with the partnership network. This is a great opportunity for the partnership to help match the supply and demand side of the cover crop seed markets while creating a value-added category for climate smart wheat. The partnership network could be used as a forecasting tool for the total number of acres that are going to be covered and what kinds of seeds are needed. Balancing supply and demand can reduce the risk on the seed production side and ensure that more pilot programs will be able to get high quality seed, maximizing the likelihood of farmer's success with cover crops. Communicating with the other projects that aim to increase the number of acres that utilize cover crops would be helpful for our project, the seed industry in general, and the future of climate smart agriculture in the US.

***Plan to Develop and Expand Market for CSC Generated as a Result of Project Activities***

**Partnership Designed to Market Resulting CSC**

Cory Christiansen is the grain marketer at NWGG who has been assigned the task of developing the market and structures for purchasing, handling, and selling the CSW pilot. This market will be cultivated through existing relationships with millers and exporters. All wheat marketed through this program will have a "CSW" seal on the purchasing paperwork. NWGG will purchase Climate Smart Wheat and be responsible for storage, logistics, identity preservation, and selling it to the end users. During our planned marketing team meetings, we will create a document that details the requirements of participation in the pilot program and what CSW means. This will include details regarding the NRCS practice standards that can be implemented to qualify **and** the soil sampling reference-based system to quantify the carbon that has been stored through the program. Our team will work directly with millers to create a marketing platform that allows them to demonstrate value to the customers purchasing wheat grown with the climate consequences in mind.

The Oregon Wheat Grower's League, who has provided a letter of support, has a good working relationship with NWGG, and they have indicated interest in participation if there are opportunities to market more broadly. Cory has already been in contact with several export companies who are interested in purchasing high quality soft white winter wheat grown in the iPNW using climate smart practices. There are also several local milling companies who have expressed interest and will be offered the opportunity to purchase CSW as the program develops.

The funds from this project will be used to contract a marketing consultant to promote the concept of Climate Smart Wheat. They will build brand awareness around CSW among the public to increase the likelihood that purchasers will feel pressure from their consumers. Part of this messaging will be focused on the positive impact farmers have made by changing their practices for CSW production. The imagery will invoke a new image of farmers who help regenerate the land, work with nature, and help fight climate change. They will also work to emphasize the high quality soft white winter wheat grown in the Northwest and help purchasers connect with NWGG as their source for the best baking quality CSW.

While farmers working in this program will be implementing additional climate smart practices to grow the cover crop seed, there is not a plan to market cover crop seed coming from this program separately from the rest of the cover crop seed that is produced by other contracted growers. By expanding the cover crop seed production market this pilot will enable the expansion of climate smart agriculture in general.

**Plan to Track CSC Through Supply Chain**

This pilot program is based on partnerships with multiple components of the agricultural supply chain including the breeders, producers, processors, and marketers of cover crop seed. Because of this design, we will have records of all the cover crop varieties and quantities that are produced, the value to the farmer, the breeder, and the agricultural regions where the cover crop seed has been distributed. The CSW that is grown in conjunction with this project will be marketed by NWGG who have experience in identity preserved storage, processing, and clean out procedures. NWGG presently markets to millers who require meticulous tracking for quality assurance. Most farmers in the region do not manage their own storage, it is transported to NWGG immediately upon harvest. This makes tracking of CSW through NWGG more secure. Cooperative members of NWGG and CTUIR can work directly with Cory Christiansen at NWGG to discuss logistics related to the delivery of their wheat. He will track the quality and quantity of wheat coming from each member cooperator into the identity preserved CSW program.

**Estimated Economic Benefit for Participating Producers Including Market Returns**

We anticipate that growing cover crops for seed production will increase the net profits of the farms that have adequate water by an average of $200-400/acre/year. This is using conservative yield values for cover crop seed and an assumption that they will be able to reduce their fertilizer bill by 50% and their chemical bill by 30%.

The marketing plan does not make any promise to farmers that they will see an increase in the commodity price of the wheat that is marketed through CSW pilot program. However, the goal will be to sell this wheat to the millers at about a 4% above the standard commodity price for spot or future contracts. Anything over a 1% increase in market price will go directly to the

growers. For example, if a producer is growing 50 bu/acre at $10/bu standard market price, the value added at 4% increase would be $15/acre.

In addition to the potential access to increased wheat market prices, growers that participate in cover crop seed production may be eligible for payments in the voluntary carbon marketplace. The Agoro Carbon Alliance has the local expertise and agronomic and market capability to help growers navigate the process of signing up for a carbon market. The most common practice that growers in this region will qualify for is minimum tillage production. The current offers for carbon change due to this practice depend on the program they sign up for, but tends to be between $6-15/acre. There are additional markets available for reduced nitrogen application and cover cropping that can bring their total carbon options up to about $30/acre.

**Post Project Potential, Including Anticipated Viability to Scale Project Activities**

This project will provide an increased chance for success of the Partnership for Climate Smart Commodities. If the USA can achieve the goals of increasing the acres using cover crops **by at least 50% in the next eight years**, there will be increased and continued demand for cover crop seed. This pilot program is designed to build the pieces needed to grow the capacity of the industry without adversely affecting the production of current commodities as it would potentially replace a fallow year. By participating in the pilot project, the farms at CTUIR would be leading the way. Getting into this production system early will give them the advantage through time and allow them to continue to build the systems that will regenerate agricultural lands throughout the US. Because this is focused on overcoming barriers to market entry, we feel that there will be a great incentive to continue production once the initial hurdles have been overcome.

The up-front incentive payment could be a viable means of helping other farmers in other new production systems transition to climate smart practices. The goal is, this support is available during the time that it takes to work through the transition, while producers are learning and soil is healing. A central premise in soil health and regenerative ag is that the soil does the work rather than paying for all the inputs that farmers typically use to try to control each step in the production process. It takes time for the soil ecosystem to achieve optimal function, and there are often a couple of hard years of transition where water holding has not yet increased yet, or the microbial community is not yet cycling nutrients as quickly as would be needed for optimal yield. By setting up a temporary incentive, we can minimize the risk for producers who are ready and willing to change. This kind of system could be scaled to any practice or region that is targeted for improvement.

**Likelihood of Long-term Viability Beyond Project Period**

This project will build what is expected to be a profitable system for the farmers, processors, and marketers. The Partnership for Climate Smart Commodities will be an incentivizing investment that will cause a sudden increase in seed demand. Once we get past the initial influx of cover crop incentives, the industry will be able to move within natural market cycles. As the entire climate smart agricultural industry grows, seed producers will be better positioned to increase contracted acres and forecast the market demand. This will allow cover crop seed companies to stay ahead of demand and to keep cover crop seed prices low enough to be affordable for unsubsidized adoption. As this project moves forward, GO Seed will still be investing in research on varietal development to increase the suitability of cover crops for every kind of production system and challenge. The long-term viability of cover crops as a climate

smart practice depends on the availability of **high quality, reasonably priced seed so that producers will continue to have decreased input costs and increased net farm profits when they add cover crops.**

The project will encourage producers to participate in carbon markets, thereby helping establish the permanence of increased cover crop seed production and other regenerative practices. Growers who sign up for carbon markets will typically sign a five to ten-year contract with a potential for renewal. By the end of a contract period, it is likely that a grower will continue the improved land management practice or work with conservation agronomists to maintain and enhance regenerative practices.

**Ability to Inform Future USDA Actions to Encourage Climate Smart Ag**

There is no doubt that agriculture offers an exceptional win-win situation for climate mitigation. However, producers are already dealing with climate instability, and policy makers also must consider management practices that are aimed at adaptation to climate change. Working with our agronomic team, the data gathered will help assess changes in water infiltration and water holding capacity because of cover crop seed production integration. This is a major concern among people in the region and more farm scale data is needed to increase adoption. It also provides information on how a practice targeted for climate change mitigation can also help with climate change adaptation. Assessing practices that may minimize the impacts of severe weather will help to demonstrate a tangible benefit to farmers. This information will be coupled with soil carbon data to show that practices that increase soil carbon also increase the farm's resilience in the face of severe weather.

***Summary***

There is an urgent need to increase cover crop seed production. This pilot has gathered a team with various expertise to organize the components of the supply chain that will help build climate smart production of the cover crop seed industry and simultaneously create a new market category of climate smart wheat. The program will remove barriers to production for the farmers and businesses working to support the system. This funding structure will provide the assurances through the transition years while the farms move toward regenerative systems that have an increased ability to mitigate climate change, allow for greater infiltration and storage of water, cycle nutrients, and provide a vital living agro-ecosystem that supports life.

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