Annex 1

Guidelines on Application for Key Special Project (Agricultural and Rural Pollution Prevention and Control) under the 2022 Guangdong Key Field R&D Program "Precision Agriculture and Ecological Green Technology"

The Key Special Project (Agricultural and Rural Pollution Prevention and Control) under the 2022 Guangdong Key Field R&D Program "Precision Agriculture and Ecological Green Technology" (hereinafter referred to as the "Project") is launched as part of the national and provincial strategies for rural revitalization and plans for agricultural and rural pollution control. The Project aims to strengthen farmland conservation, ensure food safety, promote the green development of agriculture, and protect the rural ecological environment. It focuses on the improvement of farmland quality, monitoring and evaluation of agricultural non-point source pollution, prevention and control of aquaculture water pollution, prevention and control of typical agricultural waste gas pollution, utilization of agricultural and rural waste, research and demonstration of key technology for the development of new agricultural materials, so as to provide scientific and technological support for the sustainable development of Guangdong's agriculture, and help build beautiful and habitable villages.

The Project consists of 8 sub-projects. Applicants will be enrolled on merit. An application must cover all the research

content and assessment indicators of the target sub-projects listed below. The technology application and demonstration of the sub-projects will be carried out in Guangdong. In principle, each sub-project will be assigned to only 1 applicant, except under a circumstance where multiple applicants for the same sub-project have outstanding review results and different technical routes. For each sub-project, the implementation period is 3-5 years, the number of application organizations should be no more than 6 and the number of individual participants should be no more than 15.

Sub-project 1: Prevention and control of soil acidification and green farmland development (No. 20220201)

1. Research content

To address the problem of farmland acidification in Guangdong, this sub-project focuses on the following research targets: Study the acidification inhibitory effect of the interaction between soil minerals and microorganisms. Develop functional materials and microbial agents as new technologies for biochemical acidification treatment. Develop alkaline mineral and biomass improvers as new molecular sieve technologies for acidification barrier reduction. Develop acid-controlling liquid organic fertilizers as new technologies integrating water and fertilizer to tackle seasonal drought. Integrate technologies of farmland conservation and distinct plant cultivation to form a green agricultural development model featuring low carbon and less emissions, and centered on input reduction, organic fertilizer replacement, soil carbon sequestration, and agricultural waste recycling. Establish ecological farms for demonstration of acidification prevention and control and green

development technologies, and promote the achievement application.

2. Assessment indicators

(1) Centered on "reduction, prevention, and control", develop 3-5 kinds of products and materials for the biochemical treatment of acidified degraded farmland, obstacle elimination, soil fertility cultivation, and acid-controlling liquid organic fertilizers.

(2) Establish 2-3 technical models for acidification improvement and green development in typical acidified agricultural areas such as the mountainous areas in northern, western, and eastern Guangdong.

(3) Establish 2-3 ecological demonstration farms for improvement of acidified and poor-quality soil, and green farmland development. Promote new technologies in over 10,000 mu of farmlands and influence 1 million mu of farmlands. Increase the average yield by 10%-18%, fertilizer saving by 20%-30%, soil pH value by 0.2-0.5, organic matter by 0.5 percentage points, and crop yield by 10%.

3. Selection method, funding amount, and requirements

(1) Selection method: on merit

(2) Funding amount: no more than RMB 5 million

(3) Requirements: The applicant must be an industry-university-research consortium led by an enterprise.

Sub-project 2: Synergistic reduction of organic pollutants in farmlands through chemical-biological approaches (No. 20220202)

1. Research content

To address the high risk of organic pollutants in organically fertilized farmlands in Guangdong, this sub-project focuses on the following research targets: Study the micro-interface migration and degradation reaction mechanisms of rhizosphere soil pollutants based on the research on typical pollutants such as persistently halogenated organic pollutants, herbicides, and antibiotics. Develop low-cost, green, carbon-based, and iron-based chemical remediation materials for refractory organic pollutants using agricultural waste. Develop and achieve large-scale production of chemical-microbial-based remediation products for various organic pollutants, by combining the new remediation materials with high-efficiency pollutant-degrading bacteria or flora. Develop in-situ synergistic reduction technologies that integrate organic pollutant chemical remediation materials, functional microorganisms, and crops. Develop an in-situ integrated reduction and regulation system, and select demonstration bases for achievement application.

2. Assessment indicators

(1) Select 4-8 strains of highly active functional microorganisms, and at least 3 types of low-cost, green chemical remediation materials made from industrial and agricultural waste.

(2) Develop at least 2 in-situ integrated reduction technologies for organic pollutants.

(3) Develop at least 2 kinds of chemical-microbial-based remediation products. Build 1 production line with an annual output of no less than 300 tons.

(4) Establish at least 2 demonstration bases for chemical-biological synergistic remediation of organically polluted farmlands, with a total demonstration area of more than 1,000

mu. Increase the degradation rate of organic pollutants in farmlands by more than 30%.

3. Selection method, funding amount, and requirements

(1) Selection method: on merit

(2) Funding amount: no more than RMB 5 million

(3) Requirements: The applicant must be an industry-university-research consortium.

Sub-project 3: Intelligent monitoring and evaluation technologies and equipment for non-point source loss of nitrogen and phosphorus in agricultural areas (No. 20220203)

1. Research content

Given that the non-point source pollution in agricultural areas is hard to be accurately evaluated under the high temporal and spatial variability, and there is no real-time monitoring systems, this sub-project focuses on the following research targets: Develop the remote online accurate monitoring technology of nitrogen and phosphorus runoff and leaching in farmlands based on typical crops, planting patterns, and climate and terrain. Develop intelligent equipment and systems for rapid monitoring, perception and real-time data transmission based on farmland environment big data and IoT. Integrate the mechanism models for nitrogen and phosphorus loss measurement, crop growth forecast, and microclimate forecast at the field, basin, and regional scales. Build a big data-based risk evaluation system for non-point source monitoring based on cloud remodeling, virtual simulation, digital twinning, and machine learning intelligent algorithms. Establish a cloud

evaluation, decision-making and management platform that visualizes multi-source and multi-dimensional monitoring information. Realize all-round, multi-dimensional, and high-granularity intelligent, accurate monitoring and early warning evaluation of non-point source pollution.

2. Assessment indicators

(1) Build 1 IoT system for online monitoring of nitrogen and phosphorus loss at the basin scale and 1 set of automatic field monitoring equipment.

(2) Ensure that the access-layer server cluster of cloud devices can support more than 10,000 data collection points, and can dynamically expand to more than 1 million data collection points.

(3) Develop 2-3 digital models for the forecast and analysis of nitrogen and phosphorus loss, crop growth, and microclimate at the field, basin, and regional scales. Increase the forecast accuracy by more than 50%.

(4) Build 1 integrated, visualized platform and 1 mobile app for online monitoring and evaluation of farmland non-point source pollution at the basin scale in Guangdong to realize 1:1 modeling and digital simulation.

(5) Establish 1-2 demonstration bases with a total area of more than 3,000 mu for intelligent monitoring and evaluation of farmland non-point source pollution in typical agricultural areas with high non-point source nitrogen and phosphorus loss load.

3. Selection method, funding amount, and requirements

(1) Selection method: on merit

(2) Funding amount: no more than RMB 5 million

(3) Requirements: The applicant must be an industry-university-research consortium led by an enterprise.

Sub-project 4: Intelligent monitoring, early warning, and prevention and control of aquacultural water pollution (No. 20220204)

1. Research content

Given the complex pollution types in freshwater and marine aquaculture and the lack of monitoring, early warning, and control technologies, this subproject focuses on the following research targets: Carry out the source tracing and load accounting of aquaculture pollution to form methods of evaluating the impact of aquaculture on the water environment and identifying key source areas. Build libraries of indicator microorganisms and genetic components, develop a microbial sensing platform for intelligent identification of heavy metals in aquacultural water, and form an intelligent system for heavy metal identification and early warning. Study the law of heavy metal accumulation in organisms, build an integrated microbial-material system, and form a collaborative system for heavy metal monitoring and bio-enhanced treatment. Develop equipment for water quality control and tailwater circulation, as well as intelligent aquaculture systems, and build a green ecological aquaculture model. Develop high-efficiency modular facilities for filtration, purification, and other water treatment purposes, integrate aquacultural pollution prevention and control systems, and select demonstration bases for achievement application.

2. Assessment indicators

(1) Develop at least 1 technology for aquaculture pollution source tracing, load accounting, and source area identification.

(2) Find 9-10 microorganism species as indicators of heavy metal pollution and another 9-10 microorganism species that can remediate heavy metal pollution. Establish 1 library of microorganism species as indicators of heavy metal pollution, 1 genetic component library, and 1 library of microorganism species that can remediate heavy metal pollution. Select more than 5 types of new materials.

(3) Develop 1-2 microbial sensors. Form 1 intelligent system for heavy metal identification and early warning, and 1 set of collaborative monitoring and treatment system.

(4) Develop 1 set of equipment for green ecological aquaculture or tail water treatment, with the cost per ton no more than RMB 2. Develop 1 green ecological aquaculture model and 1 tail water treatment technology applicable for Guangdong.

(5) Build 2 technical systems for green ecological aquaculture and tailwater treatment. Reduce nitrogen and phosphorus emissions by 50%. Increase comprehensive benefits by 30%. Ensure that the tailwater COD is less than 5 mg/L, suspended solids content less than 20 mg/L, total phosphorus volume less than 0.5 mg/L, and chloramphenicol, malachite green, furazolidone metabolites, and sulfonamides are not detected.

(6) Establish at least 1 demonstration base in Guangdong, with an area of no less than 600 mu.

3. Selection method, funding amount, and requirements

(1) Selection method: on merit

(2) Funding amount: no more than RMB 5 million

(3) Requirements: The applicant must be an industry-university-research consortium led by an enterprise.

Sub-project 5: Prevention and control of malodorous waste gas pollution from aquatic feed (No. 20220205)

1. Research content

To address the complex malodorous waste gas pollution caused during aquatic feed production, this sub-project focuses on the following research targets: Study the characteristics of the odor emitted during aquatic feed production, develop high-efficiency waste gas collection systems for fugitive emissions based on the characteristics of aquatic feed production, and develop technologies for the prevention and control of fugitive emissions. Centered on end treatment of odorous waste gas, develop absorbents for complex malodorous waste gas, and develop key technologies for absorption enhancement and combined process of pretreatment plus in-depth treatment. Develop core equipment and intelligent management and control systems, and form a complete set of pollution prevention and control technologies for the entire production process. Build a pollution control system for malodorous waste gas generated throughout aquatic feed production. Select aquatic feed producers as demonstration bases for achievement application.

2. Assessment indicators

(1) Develop 2 types of high-efficiency absorbents, 1 set of new equipment, and 2 or more processes that combine absorption enhancement and in-depth treatment.

(2) Form 1 technical solution for the control of odorous waste gas emitted during aquatic feed production, and 2 or more complete sets of pollution prevention and control technologies

for malodorous waste gas generated throughout aquatic feed production.

(3) Establish a comprehensive demonstration project for the prevention and control of malodorous waste gas generated during aquatic feed production. Ensure that the capacity of a single end treatment project is ≥ 50,000 m^3/h, with the odor concentration down by more than 90% and ≤ 1,000 (dimensionless quantity), the concentration of major pollutants higher than the emission limit value, and the factory-wide odor concentration of fugitive emissions ≤ 20 (dimensionless quantity).

3. Selection method, funding amount, and requirements

(1) Selection method: on merit

(2) Funding amount: no more than RMB 5 million

(3) Requirements: The applicant must be an industry-university-research consortium.

Sub-project 6: Development of functional products for livestock and poultry waste treatment and recycling of planting and breeding (No. 20220206)

1. Research content

In view of the technical bottlenecks in the treatment of livestock and poultry waste, such as low pyrolysis efficiency and low-value resource utilization, this sub-project focuses on the following research targets: Optimize the process of continuous self-heating carbonization and modification, and develop biochar-based functional materials. Explore the compensation effect of the efficient hydrolysis of livestock and poultry manure combined with other waste such as bare/haired eggs, and the

non-destructive hydrolysis process, and develop multi-functional, water-soluble amino acid fertilizers and slow-release fertilizers, so as to solve the problems of large volume and high concentration of aquacultural wastewater and difficulties in complete separation of solid and liquid. Develop harmless treatment technologies for salinity, pollutants and pathogenic bacteria to solve the problem of excessive toxic and harmful substances in manure. Develop farmland in-situ biological synergistic technologies for manure reduction, select salt-tolerant, pollution-resistant, and stress-resistant forage of high economic value, and special oils and energy plants, and integrate safe and efficient technologies for manure recycling, so as to solve problems such as low planting-breeding recycling efficiency. Select large-scale breeding enterprises as demonstration bases for the application of planting-breeding recycling.

2. Assessment indicators

(1) Develop 2-3 biochar-based functional materials for aquaculture waste. Build/renovate 1 demonstration production line.

(2) Establish 2-3 carbon-based fertilizer application technologies applicable for the distinct crops and forage plants in Guangdong.

(3) Develop 1-2 harmless manure treatment units, with an annual capacity of more than 20,000 tons each.

(4) Using high-concentration organic aquacultural wastewater as the main raw material, form 1 efficient and non-destructive hydrolysis process for manure combined with other waste such as bare/haired eggs. Develop 1-2 technologies for the

preparation of water-soluble amino acid fertilizers and slow-release fertilizers, and efficient transformation and stabilization of key nutrients in water-soluble fertilizers.

(5) Develop 1-2 key technologies for in-situ farmland manure disposal. Establish more than 3 demonstration bases for safe disposal of livestock and poultry waste and green planting-breeding recycling around large-scale farms, with a total area for achievement application no less than 5,000 mu.

3. Selection method, funding amount, and requirements

(1) Selection method: on merit

(2) Funding amount: no more than RMB 5 million

(3) Requirements: The applicant must be an industry-university-research consortium led by an enterprise.

Sub-project 7: Development and high-value remanufacturing of environmentally-friendly mulch films (No. 20220207)

1. Research content

Given that the traditional mulching technology cannot meet the emerging needs brought by precision agriculture, this sub-project focuses on the following research targets: Develop technologies for efficient plasticization and transportation of the basic resin used for mulch film manufacturing, and improve the service performance and one-time mechanical recovery rate of mulch films. Develop the technology for microstructure control of mulch films based on the manufacturing process to realize the synergistic self-enhancement of the longitudinal/transverse performance of mulch films. Develop a mechanism to adapt the service performance of environment-friendly mulch films to the

crop planting cycle. Develop the short-process regeneration and granulation of recycled mulch films to achieve high-value remanufacturing of recycled mulch films.

2. Assessment indicators

(1) Develop 3 or more types of high-strength mulch films that match the climatic conditions of Lingnan and the crop growth cycle, and can be fully recycled after service. Ensure the films can mulch 3 or more types of crops, such as pineapple (thickness: 20 μm; service life: 18 months), sugarcane (thickness: 15 μm; service life: 12 months) and tobacco leaves (thickness: 10 μm; service life: 3 months). Increase the yield of mulched crops by more than 5%.

(2) Ensure that the longitudinal tensile strength > 60 MPa, transverse tensile strength > 50 MPa, tear strength > 130 kN/m, and retention rate of longitudinal elongation at break after laboratory aging > 90%.

(3) Develop 1 demonstration line for blow molding of high-strength multi-layer composite mulch film, with an annual production capacity of more than 2,000 tons.

(4) Ensure that the recycling rate of mulch films exceeds 85% (thickness: 10 μm; service time: 6 months or above).

(5) Develop a multi-layer composite packaging film containing no less than 40% recycled mulch film materials (packaging weight > 15 kg; thickness: 50 μm).

3. Selection method, funding amount, and requirements

(1) Selection method: on merit

(2) Funding amount: no more than RMB 6 million

(3) Requirements: The applicant must be an industry-university-research consortium.

Sub-project 8: Development of slow- and controlled-release materials for green and efficient agriculture (No. 20220208)

1. Research content

In view of the fact that pesticides and chemical fertilizers have a low utilization rate, and can pollute the environment and pose a threat to food safety, this sub-project focuses on the following research targets: Develop new slow- and controlled-release agricultural materials based on the agricultural waste and degradation products of functional waste, as well as slow- and controlled-release pesticides, synergistic stable urea, and high-efficiency seed coating products and related technologies. Study the impact of green agricultural inputs on crop quality and develop a mechanism for quality and efficiency improvement. Build systems for production, performance analysis, and application effect evaluation of green and efficient agricultural inputs. Establish demonstration bases for achievement application and promotion.

2. Assessment indicators

(1) Develop 2-3 kinds of slow- and controlled-release materials based on agricultural by-products of pesticides. Develop 1-2 kinds of slow- and controlled-release, water-based pesticide formulations. Ensure the utilization rate of green and high-efficiency water-based pesticide formulations is 30% higher than traditional equivalents. Develop 1-2 kinds of seed coating agents, and reduce the dosage of pesticides by more than 10% during the whole growth period of crops.

(2) Develop 1-2 key technologies or processes for the preparation of high-efficiency and stable urea based on functional waste degradation products. Develop 2-3 types of high-efficiency and stable urea that meet national and industry standards. Complete trials on the performance, application effect, and environmental impact of 2-3 products. Increase the nitrogen fertilizer utilization rate of rice, corn, and vegetables by more than 10% under the same nitrogen nutrient conditions.

(3) Establish 1 standard for evaluation of the quality and application effect of green and high-efficiency water-based pesticide formulations and stable urea products. Build 1 production line for green and high-efficiency water-based pesticide formulations and 1 production line for seed coating agents.

(4) Establish 3-4 demonstration bases for the application of green and efficient agricultural chemicals. Develop 3 technologies for the application of green and efficient water-based pesticide formulations, stable urea, and seed coating agents. Promote the achievement application in a total area of no less than 5,000 mu.

3. Selection method, funding amount, and requirements

(1) Selection method: on merit

(2) Funding amount: no more than RMB 5 million

(3) Requirements: The applicant must be an industry-university-research consortium.