MS in Climate Smart Agriculture
Institute of Climate Smart Agriculture
Patuakhali Science and Technology University, Dumki, Patuakhali

Course Profile

Course Code: CSA 5113
Course Title: Mitigation of emissions from agriculture
Credit Hour: 2
Student Level: Level- 4, Semester –2

Rationale: Students of this course are expected to understand and enrich knowledge about climate smart agriculture (CSA) concepts, pillars and portfolios for CSA interventions. They will learn concepts related to mitigation of greenhouse gas (GHG) emission in agriculturetheir importance, impacts,and potential mitigation strategieswith a focus on Bangladesh and South Asia.

Objectives: At the end of this course, the students will able to:

- Articulate basic concepts of CSA and its pillars.
- Show competence in how CSA can be applied to mitigation mitigate emissions in agricultural productions systems.
- Describe CSA portfolio interventions and their relevance.
- Formulate the potential GHGmitigation strategies for local adaptation.
- Describe tools and methods for measuring mitigation.
- Demonstrate knowledge of IPCC and UNFCCC commitments and in country policy implications.

Learning Outcomes	**Course Content**	**Teaching-Learning Strategy**	**Assessment Strategy**
Introduction to the problem of GHG emissions Understand the basic concepts of CSA and pillars of CSA. Understand CSA based mitigation concepts and principles.	**Introduction**: Introduction to climate and agriculture, climate change, role of GHG emissions. Carbon cycles and relevance of nitrogen and methane. Definition, background and history, and concepts; The three pillars of CSA Clarification of GHG emissions, background; importance of mitigation in climate change; Sources of agricultural emissions, with emphasis on livestock and agriculture; Relationship between climate change	Lecture Reading assignment Presentation QA	-Short Answer -Essay -Checklist

	and agricultural productions systems; Impacts of business-as-usual (current) agricultural practices on agricultural productions systems and climate change.		
Enrich basic knowledge of CSA portfolios interventions for sustainably agricultural production systems	CSA portfolios; Define the six "S" agricultural GHG mitigation concepts (water smart, nutrient smart, carbon smart, energy smart, weather smart and knowledge smart).	Lecture Reading assignment Presentation Discussion QA	-Short Answer -Essay -Completion
Formulate and develop potential technological solutions and Agro-emissions mitigation strategies for local adaptation	Understand local challenges and limitations in agricultural production systems; Assessment the reasons of for high in business-as-usual (current) agricultural practices. Identify the key options to mitigate GHG emissions for crops and agriculture. **Efficient water management options:** Precise laser land leveling, alternate wetting and drying irrigation, improved nutrient use efficiency, tensiometer based irrigation, crop demand-based irrigation, micro-irrigation systems, fuel efficiency in production and post-harvest operations, etc. **Nutrient management:** soil test based nutrient recommendation, decision supported guided tool based nutrient management (LCC, NDVI), crop response based nutrient management, adjusting nutrient rates with yield targets, etc. **Carbon sequestration:** conservation agriculturally based practices, crop residue and organic farm waste management, sustainable crop diversification and intensification,	Lecture Reading assignment Discussion QA	-Short Answer -True-False -Matching term

	integration with livestock and farming systems etc. **Energy efficient:** Minimum tillage based practices, optimize cropping and farming systems; appropriate mechanization. **Weather forecast:** Weather forecast information for short- and medium-term decisions, Long-term climate based soil and crop simulations information for guiding the decision process. **Knowledge awareness and skill development:** Agro-advisory services based on weather and market, high yield varieties and suitable crops, inclusive decision process of women and youth, business models for agricultural services **Salinity and acidity management:** understand the problems; salt movement and mechanism, technological solutions for salt and pH management **Livestock:** livestock feeding strategies, substitution of high-methane producing animals with low GHG emission sources, discussion on dietary considerations and meat preferences		
Increase knowledge on decision and measuring tools of Agro-emissions mitigation.	**Methods of emissions measurements** Laboratory analysis: Equipment's for laboratory analysis, sample collection process and requirements; setup of sample collection chambers; process	Lecture Group assignment Demonstration Practical	-Short Answer -Completion -Practical exam

	samples and analysis of samples; calculation and interpretations. Input based measurements and quantification: Describe models and tools for emissions quantification, data requirements, data collections, inputting and process the data, interpretation of data outcomes. Explore the science based evidence for emissions alternatives and reduction	QA	-Peer rating
Enrich knowledge on IPCC and UNFCCC commitments and mitigation country goal and country policy for mitigation of Agro-emissions	Understand the importance of IPCC and UNFCCC commitments to climate change and emissions mitigations; Scenario and status of agricultural-based emissions globally and countrywide and contribution to total emission, Bangladesh goal to reduce the emissions, Current polies to mitigate agricultural GHG emissions, Institutional changes needed toachieve mitigation.	Lecture Reading assignment Presentation QA	-Short Answer -Essay -Matching term

Recommended Books and Periodicals

Smil, V. 2000 : *Cycles of Life: Civilization and the Biosphere*, *Scientific American Library*, New York, x + 221 p.

Smil, V. 2013 : *Should We Eat Meat? Evolution and Consequences of Modern Carnivory* Wiley ISBN 978-1118278727

Jat, ML; Jat, HS; Agarwal, T; Bijarniya, D; Kakraliya, SK; Choudhary, KM; Kalvaniya, KC; Gupta, N; Kumar, M; Singh, LK; Kumar, Y; Jat, RK; Sharma, PC; Sidhu, HS; Choudhary, M; Datta A; Shirsath, PB and Ridaura, SL. 2020. A Compendium of Key Climate Smart Agriculture Practices in Intensive Cereal Based Systems of South Asia. P.42. International Maize and Wheat Improvement Center (CIMMYT), New Delhi, India.

Dickie, A., Streck, C., Roe, S., Zurek, M., Haupt, F., Dolginow, A. 2014. "Strategies for Mitigating Climate Change in Agriculture: Abridged Report." Climate Focus and California Environmental Associates, prepared with the support of the Climate and Land Use Alliance. Report and supplementary materials available at: www.agriculturalmitigation.org

Sanz-Cobena, L. Lassaletta, E. Aguilera, A. del Prado, J. Garnier, G. Billen, A. Iglesias, B. Sánchez, G. Guardia, D. Abalos, D. Plaza-Bonilla, I. Puigdueta-Bartolomé, R. Moral, E. Galán, H. Arriaga, P. Merino, J. Infante-Amate, A. Meijide, G. Pardo, J. Álvaro-Fuentes,

C. Gilsanz, D. Báez, J. Doltra, S. González-Ubierna, M.L. Cayuela, S. Menéndez, E. Díaz-Pinés, J. Le-Noë, M. Quemada, F. Estellés, S. Calvet, H.J.M. van Grinsven, H. Westhoek, M.J. Sanz, B.S. Gimeno, A. Vallejo, P. Smith,. 2017. Strategies for greenhouse gas emissions mitigation in Mediterranean agriculture: A review, Agriculture, Ecosystems & Environment. 238: 5-24, https://doi.org/10.1016/j.agee.2016.09.038.

Gonsalves J, Baguilat I, Bantayan R, Bernardo EB, Sebastian L. 2020. Eight guide steps for setting up a Climate-Smart Village: A trainer's guide. Cavite, Philipppines: International Institute of Rural Reconstruction.

FAO, 2013. Climate-Smart Agriculture Sourcebook. http://www.fao.org/climate-smart-agriculture-sourcebook/en/

Climate-Smart Agriculture Manual for Zimbabwe, Climate Technology Centre and Network, Denmark, 2017.https://www.ctc-n.org/system/files/dossier/3b/climate-smart_agriculture_manual_final.pdf

Gathala, M.K., Laing, A.M., Tiwari, T.P., Timsina, J., Rola-Ruzben, F., Islam, S., Maharjan, S., Browm, P.R., Das, K.K., Pradhan, K., Chowdhury, A.K., Kumar, R., Datt, R., Anwar, M., Hossain, S., Kumar, U., Adhikari, S., Magar, D.B.T., Sapkota, B.K., Shrestha, H.K., Islam, R., Rashid, M., Hossain, I., Hossain, A., Brown, B., Gerard, B., 2020. Improving smallholder farmers' gross margins and labor-use efficiency across a range of cropping systems in the Eastern Gangetic Plains. *World Development*. 138: 105266. https://doi.org/10.1016/j.worlddev.2020.105266

Gathala, M.K., Laing, A.M., Tiwari, T.P., Timsina, J., Islam, S., Bhattacharya, P.M., Dhar, T., Ghosh, A., Sinha, A.K., Chowdhury, A.K., Hossain, S., Hossain, I., Molla, S., Rashid, M., Kumar, S., Kumar, R., Dutta, S.K., Srivastwa, P.K., Chaudhary, B., Jha, S.K., Ghimire, P., Bastola, B., Chaubey, R.K., Kumar, U., Gerard, B., 2020. Energy-efficient, sustainable crop production practices benefit smallholder farmers and the environment of the Eastern Gangetic Plains, South Asia. *Journal Cleaner Production*. 246:118982. https://doi.org/10.1016/j.jclepro.2019.118982.

Gathala, M.K., Laing, A.M., Tiwari, T.P., Timsina, J., Islam, S., Chowdhury, A.K., Chattopadhyay, C., Singh, A.K., Bhatt, B.P., Shrestha, R., Barma, N.C.D., Rana, D.S., Jackson, T.M., Gerard, B., 2020. Enabling smallholder farmers to sustainably improve their food, energy and water nexus while achieving environmental and economic benefits. *Renewable & Sustainable Energy Reviews*. 120: 109645. https://doi.org/10.1016/j.rser.2019.109645.

Jat, H.S., Choudhary, M., Datta, A., Yadav, A.K., Meena. M.D., Devi, Ritu., Gathala, M.K.,Jat, M.L., McDonald, A., Sharma, P.C., 2020. Temporal changes in soil microbial properties and nutrient dynamics under climate smart agriculture practices. *Soil & Tillage Research*. 199:104595. https://doi.org/10.1016/j.still.2020.104595

Sapkota TB, Rai M, Singh LK, Gathala MK, Jat ML, Sutaliya JM, Bijarniya D, Jat MK, Jat RK, Parihar CM, Kapoor P, Jat HS, Dadarwal RS, Sharma PC, and Sharma DK. **2014**. *Greenhouse Gas Measurement from Smallholder Production Systems: Guidelines for Static Chamber Method*. International Maize and Wheat Improvement Center (CIMMYT) and Indian Council of Agricultural Research (ICAR), New Delhi, India. CIMMYT/CCAFS Manual 2014/1: p. 18.