Annex 3: Expert survey

The Action Alliance for Sustainable Bananas (ABNB) pledged to intensify its activities in the field of climate change adaptation and mitigation in the banana sector. Various measures to adapt to climate change effects are widely in place, some are already adopted by innovators and some are yet to be tested. ABNB wants to utilize the expertise and knowledge of experts in the field of climate change adaptation and mitigation in order to evaluate, which measures – that are currently available to most farmers – are most effective, cost-effective and pose the fewest risks.

Using Decision Analysis tools, the qualitative expertise and knowledge will be channeled and analyzed - quantifying individual knowledge and for making it measurable. The goal is to receive a prioritized list of measures, which should guide not only plantation owners and farmers but also certification schemes.

This questionnaire is to consult with banana and climate change experts to understand more about the banana production system as well as the potential of climate change adaptation and mitigation measures.

Please note that the questions refer to commercial banana production in humid regions. If you have any relevant resources or feedback, please kindly share in your answer or email cory.whitney@uni-bonn.de

1. My Name:……

2. I would like to answer questions about:

1. Buffer system, reforestation and system diversification	*Skip to question 3*
2. Irrigation and drainage	*Skip to question 11*
3. Pest management	*Skip to question 31*
4. Soil and plant nutrient	*Skip to question 39*
5. Waste management	*Skip to question 45*
6. Energy system	*Skip to question 54*
7. Extreme weather events and disasters	*Skip to question 61*
8. None of these	*Skip to section 11 (Thank you for taking the time to fill in our survey!)*

I. Buffer system, reforestation and system diversification

3. In banana plantations, are buffer areas compulsory parts of the system? *Mark only one.*

   1. Yes 2. No 3. Other (specify) _____

4. What do you think would be the best vegetation for buffer zones? *Choose all that apply.*

   1. Grasses 2. Shrubs 3. Timber trees

   4. Other (specify) _____

5. How wide do you think the buffer areas around forests and waterways should be to be effective? Which factors most determine the width standards for buffer zone?

   _____

6. How can wind breaks be designed for banana plantations? *Choose all that apply.*

   1. Grow trees in buffer zone 2. Alley cropping 3. Trees planted scattered over the farm

   4. Other (specify) _____

7. How do growers manage unproductive areas in their banana plantation? *Choose all that apply.*

   1. Leave it as natural habitat 2. Convert to other annual crops 3. Convert to agro-forestry

   4. Other (specify) _____

8. Is it feasible for commercial banana growers to integrate shading trees into their production systems? *Mark only one.*

   1. Yes 2. No 3. Other (specify) _____

9. Is crop diversification (e.g. intercropping or crop rotation) practical in large scale banana production? *Mark only one.*

   1. Yes 2. No 3. Other (specify) _____

10. Please tell us about any additional benefits and obstacles for banana intercropping system?

    _____

II. Irrigation and drainage

11. What are the main sources of water that banana production relies on? *Choose all that apply.*

1. Rainfall 2. Ground water 3. Waste water

4. Surface water (rivers, lakes, ponds, streams) 5. Other (specify) _____

12. To what extent is banana production reliant on rainfall? *Mark only one.*

	0	1	2	3	4	5	6	7	8	9	10	
Not at all	◯	◯	◯	◯	◯	◯	◯	◯	◯	◯	◯	Totally dependent

13. To what extent is banana production reliant on groundwater for irrigation? *Mark only one.*

	0	1	2	3	4	5	6	7	8	9	10	
Not at all	◯	◯	◯	◯	◯	◯	◯	◯	◯	◯	◯	Totally dependent

14. To what extent is banana production reliant on surface water (rivers, lakes, ponds, streams) for irrigation? *Mark only one.*

	0	1	2	3	4	5	6	7	8	9	10	
Not at all	◯	◯	◯	◯	◯	◯	◯	◯	◯	◯	◯	Totally dependent

15. Is waste water used for irrigation in banana production? *Mark only one.*

	0	1	2	3	4	5	6	7	8	9	10	
Not at all	◯	◯	◯	◯	◯	◯	◯	◯	◯	◯	◯	It is frequently used

16. Do banana production systems face water shortages? *Mark only one.*

1. Yes 2. No 3. Other (specify) _____

17. What are common irrigation techniques used in large scale banana plantation? *Choose all that apply.*

1. Furrow irrigation 2. Flood irrigation 3. Drip irrigation

4. Under canopy single and series sprinkler irrigation 5. Overhead irrigation

6. Other (specify) _____

18. Rank the importance of the following irrigation techniques for banana plantations: *Choose all that apply.*

Rank	Furrow irrigation	Flood irrigation	Drip irrigation	Under canopy single and series sprinkler irrigation	Overhead irrigation
1st					
2nd					
3rd					
4th					
5th					
6th					
Not important					

19. How efficient are furrow irrigation techniques? *Mark only one..*

	0	1	2	3	4	5	6	7	8	9	10	
Not efficient at all	◯	◯	◯	◯	◯	◯	◯	◯	◯	◯	◯	Highly efficient

20. How efficient are flood irrigation techniques? *Mark only one.*

	0	1	2	3	4	5	6	7	8	9	10	
Not efficient at all	◯	◯	◯	◯	◯	◯	◯	◯	◯	◯	◯	Highly efficient

21. How efficient are drip irrigation techniques? *Mark only one.*

	0	1	2	3	4	5	6	7	8	9	10	
Not efficient at all	◯	◯	◯	◯	◯	◯	◯	◯	◯	◯	◯	Highly efficient

22. How efficient are "under canopy single and series sprinkler irrigation" techniques? *Mark only one.*

	0	1	2	3	4	5	6	7	8	9	10	
Not efficient at all	◯	◯	◯	◯	◯	◯	◯	◯	◯	◯	◯	Highly efficient

23. How efficient are "overhead irrigation" techniques? *Mark only one.*

	0	1	2	3	4	5	6	7	8	9	10	
Not efficient at all	◯	◯	◯	◯	◯	◯	◯	◯	◯	◯	◯	Highly efficient

24. How efficient are "other irrigation" techniques? *Mark only one.*

	0	1	2	3	4	5	6	7	8	9	10	
Not efficient at all	◯	◯	◯	◯	◯	◯	◯	◯	◯	◯	◯	Highly efficient

25. Do you think drip irrigation is a feasible option for banana production system? *Mark only one.*

1. Yes 2. No 3. Other (specify) _____

26. Would antitranspirants effectively save water without compromising banana yield? *Mark only one.*

1. Yes 2. No 3. Other (specify) _____

27. What are the main risks of using wastewater from packing plant for irrigation? *Choose all that apply.*

1. Salinity 2. Toxicity 3. Other (specify) _____

28. What is a typical drainage system in banana plantation? *Mark only one*.

1. Open drainage 2. Under-ground drainage 3. Other (specify) _____

29. Are typical drainage system in banana plantation effective to avoid water- logging? *Mark only one.*

1. Yes 2. No 3. Other (specify) _____

30. How do you think drainage system should be designed to minimize possible risks (e.g. waterlog, flooding) for banana plantation? Please explain briefly

_____

III. Pest management

31. Are Integrated Pest Management practices commonly used in pest control in commercial banana production? *Mark only one.*

1. Yes 2. No 3. Other (specify) _____

32. How do farmers make spraying decision? *Choose all that apply.*

1. Based on regulations on spraying 2. Based on farm monitoring system

3. Mainly based on farmers' experiences 4. Other (specify) _____

33. What are common practices for weeding? *Choose all that apply.*

1. Using chemical herbicide 2. Using organic herbicide 3. Soil cover

4. Manually 5. Mechanical equipment's 6. Other (specify) _____

34. Which materials of ground cover do you think are practical and the most effective in the context of banana plantation? *Choose all that apply.*

1. Banana plant residues 2. Plastics or other synthesized materials

3. Cover crops 4. Other (specify) _____

35. Can ground cover reduce weeds and the necessity for herbicides? *Mark only one.*

1. Yes 2. No 3. Other (specify) _____

36. Do farmers remove suckers of banana plants? *Choose all that apply.*

1. Yes 2. No 3. Other (specify) _____

37. How effective are mechanical and biological controls such as using mechanical traps and natural enemies for pest control comparing to chemical measure? *Mark only one*

1. More effective and labor intensive 2. Same effects and labor intensive

3. Less effective and labor intensive 4. Other (specify) _____

38. Please list any important risks to using mechanical and biological methods.

_____

IV. Soil and plant nutrients

39. How common is compost use in banana plantations? *Mark only one.*

	0	1	2	3	4	5	6	7	8	9	10	
None	◯	◯	◯	◯	◯	◯	◯	◯	◯	◯	◯	Very commonly applied

40. What are the common sources for composting materials in banana plantations? *Choose all that apply.*

1. Internal plant biomass from banana farm
2. External plant biomass from outside
3. Animal manures
4. Other (specify) _____

41. What is a more effective use of farm organic waste? *Choose all that apply.*

1. Composting 2. Returning to the field for soil cover 3. Other (specify) _____

42. How often is the soil tilled in banana plantations? *Choose all that apply.*

1. More than once a year
2. Once a year
3. Every two years
4. Once every 3-5 years
5. Other (specify) _____

43. Is reduced tillage necessary in current banana cultivation? *Choose all that apply.*

1. Yes
2. No
3. Other (specify) _____

44. What are the common methods for fertilizer application in banana production? *Choose all that apply.*

1. Through irrigation
2. Side dressing
3. Foliar application
4. Other (specify) _____

V. Waste management

45. What is the proportion of commercial banana growers having waste management stations?

_____

46. At which production scale is a waste management station should be reasonable?

_____

47. What could be the options to manage the plastic waste from banana plantation? *Choose all that apply.*

1. Reduction 2. Reutilization 3. Recycling 4. Landfill

5. Other (specify) _____

VI. Energy system

48. Are there external renewable energy supply in the banana plantation area? *Mark only one.*

1. Yes 2. No 3. Other (specify) _____

49. Where there is no external renewable energy supply, is it feasible to set up renewable energy systems on banana plantations? *Mark only one.*

1. Yes 2. No 3. Other (specify) _____

50. Which types of renewable energy do you think feasible for a commercial banana farm? *Choose all that apply.*

1. Solar 2. Biomass 3. Wind 4. Hydropower 5. Geothermal

6. Other (specify) _____

51. What are the main drawbacks to using solar energy for a banana farms? *Choose all that apply.*

1. High installation cost 2. Risk of power supply shortage 3. Weather dependent

4. Associated pollution 5. Other (specify) _____

52. Is biomass energy a viable solution for banana plantations? *Mark only one.*

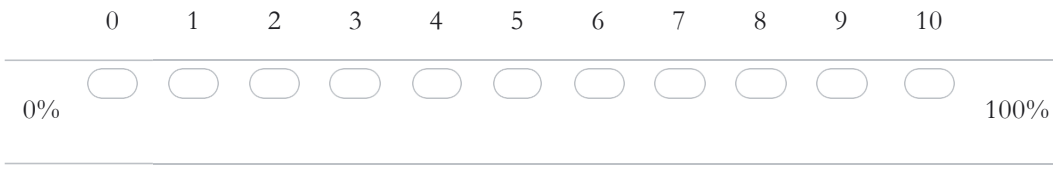
1. Yes 2. No 3. Other (specify) _____

53. What are the main drawbacks to using biomass energy? *Choose all that apply.*

1. Availability of inputs 2. High cost 3. Resource trade-offs

4. Environment effects 5. Other (specify) _____

54. What is the percentage of biomass energy, relative to total energy consumption, that would be reasonable to adopt? *Mark only one.*



II. Extreme weather events and disasters

55. Which weather events or disasters most likely to threaten banana production systems? *Choose all that apply.*

    1. Cyclone/hurricane 2. Flooding 3. Drought Pest outbreak

    4. Strong wind 5. Other (specify) _____

56. Which measures can mitigate the impacts of weather events and/or disasters that most likely to threaten banana production system?

    _____

57. Are there weather forecasting or early warning systems in place for banana production? *Mark only one.*

    1. Yes 2. No 3. Other (specify) _____

58. Is it feasible to provide banana farmers with weather forecasts with agricultural advisories? *Mark only one.*

    1. Yes 2. No 3. Other (specify) _____

59. Is weather indexed insurance applied by banana growers? If yes, is it a good option for reducing risks?

    _____

60. Are automated technical tools (e.g., GPS or remote sensing) used commonly in banana production? In which parts/activities these tools could be applicable?

    _____

Thank you for taking the time to fill in our survey!