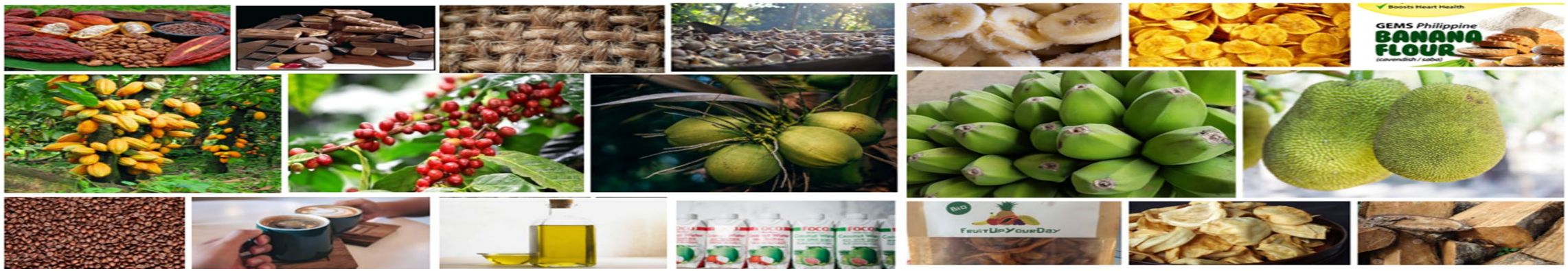


Where Are We in the Innovation Pathway towards Agri4.0?

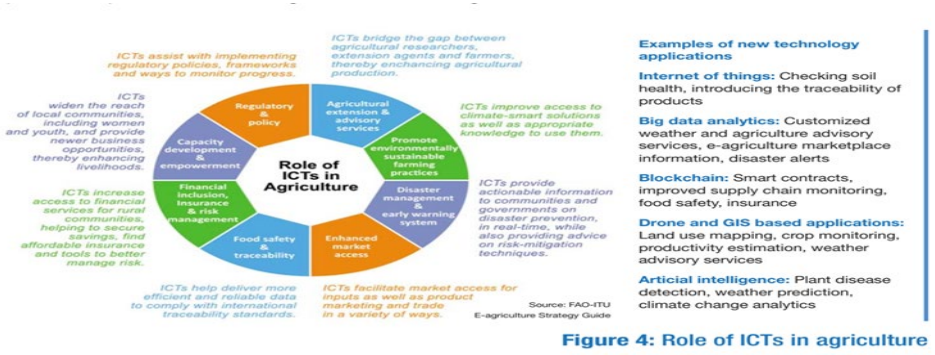
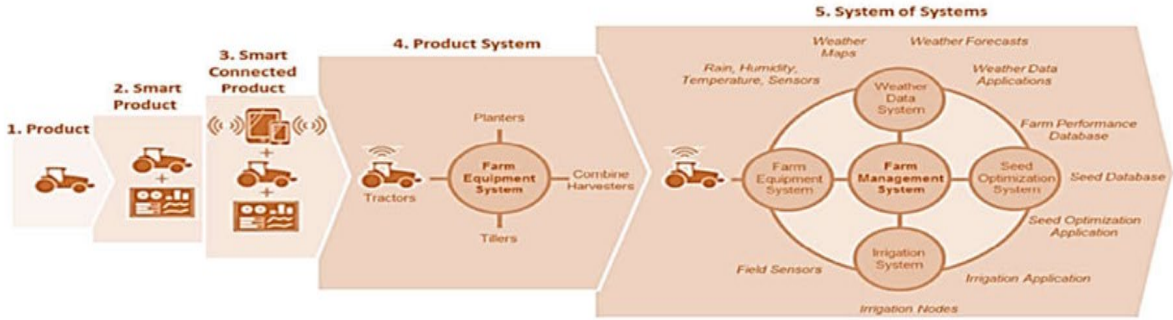


Figure 4: Role of ICTs in agriculture



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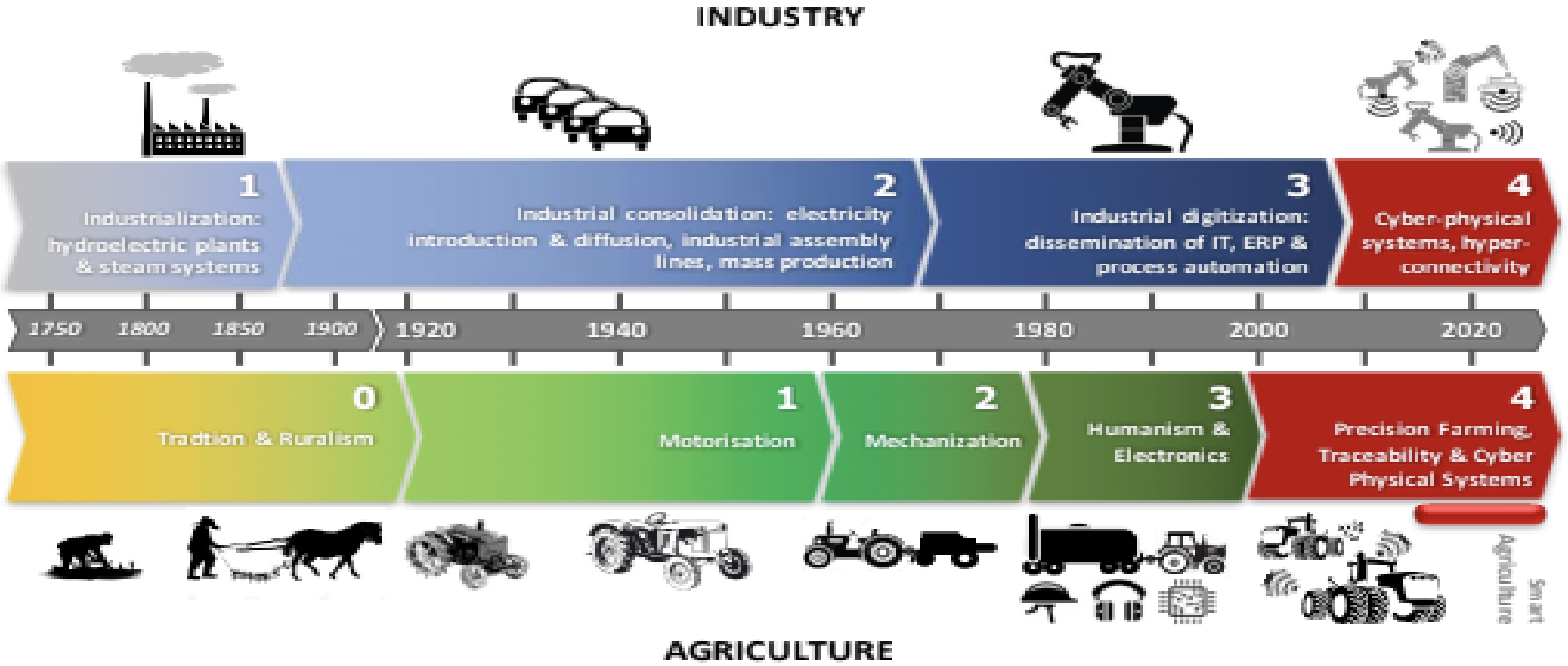
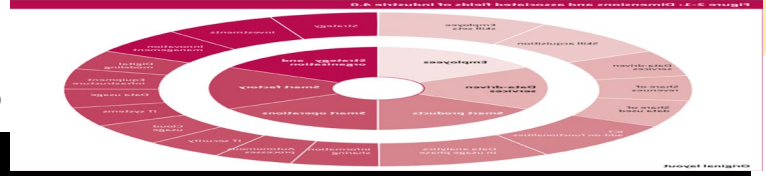


Agriculture 1.0: animal power → Agriculture 2.0: combustion engine → Agriculture 3.0: precision agriculture → Agriculture 4.0: cyber-physical

Source: Mazzetto (2020) “Reflections and methodological proposals to treat the concept of “information precision” in smart agriculture practices. Sensors: 20, 2847

Readiness levels: (0-1: newcomer; 2: learners; 3+: leaders



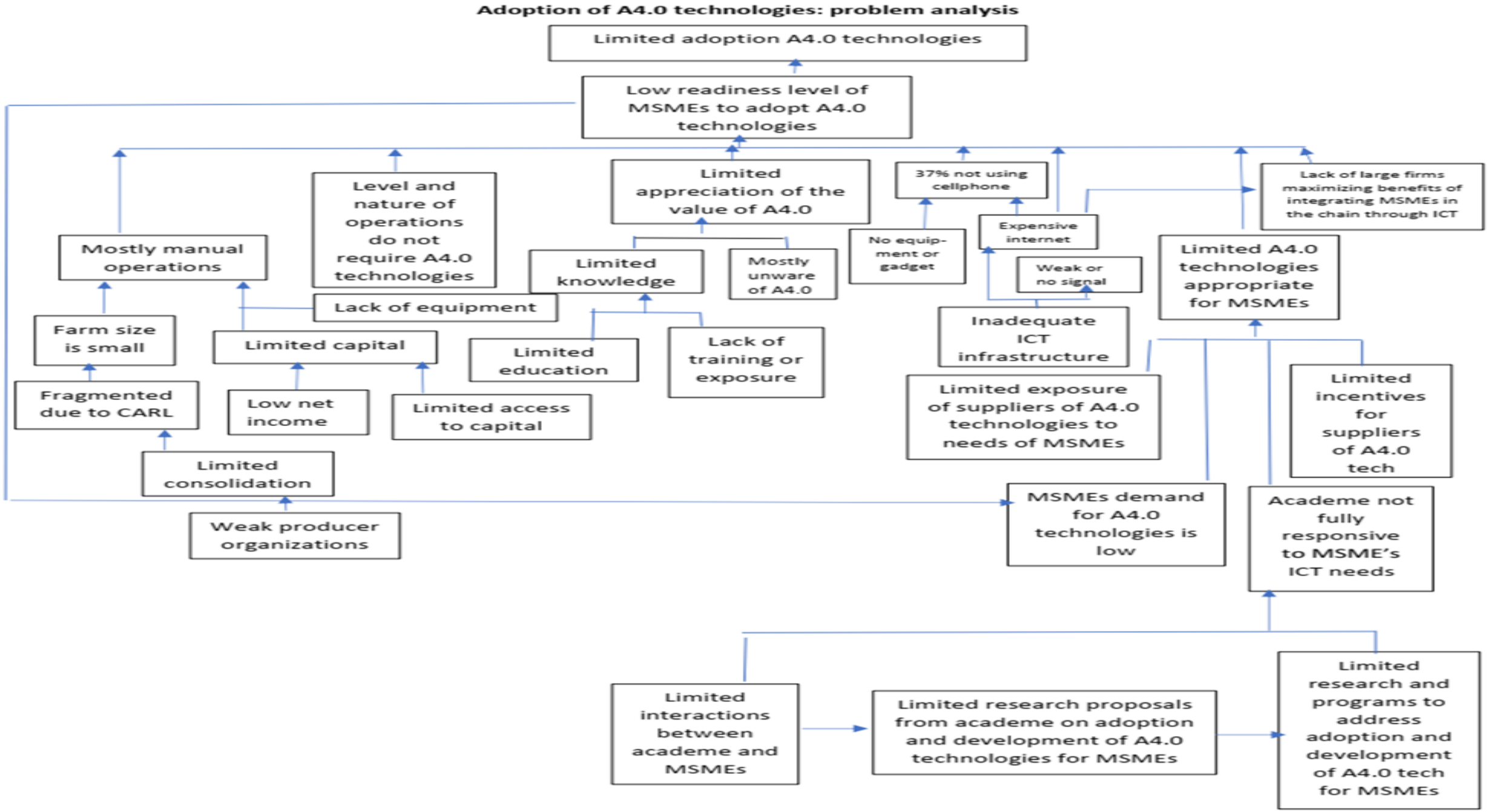
READINESS TO ADOPT I4.0 TECHNOLOGIES BY REGION BASED ON IMPULS	CHAINS					
	COFFEE	CACAO	COCONUT	CARDABA	JACKFRUIT	OVERALL
Farmers: 0	91	90	95	100	100	**95**
Farmers: 1	9	10	5	0	0	**5**
MSMES: 0	75	79	93	99	-	**85**
MSMES: 1	25	21	7	1	-	**15**
R8: 0	-	-	100	100	100	**100**
R8: 1	-	-	0	0	0	**0**
R9: 0	100	86	-	-	-	**88**
R9: 1	0	14	-	-	-	**12**
R10: 0	81	80	-	-	-	**80**
R10: 1	19	20	-	-	-	**20**
R11: 0	89	88	-	-	-	**88**
R11: 1	11	12	-	-	-	**12**
R12: 0	-	-	97	100	-	**98**
R12: 1	-	-	3	0	-	**2**
R13: 0	-	-	89	99	-	**94**
R13: 1	-	-	11	1	-	**6**
OVERALL: 0	**86**	**86**	**95**	**99**	**100**	93
OVERALL: 1	**14**	**14**	**5**	**1**	**0**	**7**

% LEVEL OF MECHANIZATION

CATEGORIES	R9		R10		R11		R12		R13		R8		OVERALL	
	MANUAL	SEMI-MECHANIZED	MANUAL	SEMI-MECHANIZED	MANUAL	SEMI-MECHANIZED	MANUAL	SEMI-MECHANIZED	MANUAL	SEMI-MECHANIZED	MANUAL	SEMI-MECHANIZED	MANUAL	SEMI-MECHANIZED
Production	86	14	97	3	99	1	100	0	90	10	97	3	94	6
Processing	79	21	94	6	98	2	100	0	99	1	100	0	98	2
Marketing	11	89	3	97	0	100	15	85	42	58	83	17	12	88
Farmers	81	19	97	3	98	2	100	0	69	31	100	0	94	6
MSMEs	50	50	12	88	68	32	96	4	37	63	71	29	57	43
Coconut	-	-	-	-	-	-	98	2	42	58	89	11	79	21
Cardaba	-	-	-	-	-	-	100	0	71	29	74	26	90	10
Jackfruit	-	-	-	-	-	-	-	-	-	-	100	0	100	0
Coffee	60	40	75	25	72	28	-	-	-	-	-	-	73	27
Cacao	76	24	75	25	81	19	-	-	-	-	-	-	78	22
OVERALL	**74**	**26**	**75**	**25**	**78**	**22**	**99**	**1**	**56**	**44**	**93**	**7**	**82**	**18**

CATEGORIES	% USE OF CELLPHONES													
	R9		R10		R11		R12		R13		R8		OVERALL	
	HAVE NOT USED	USED	HAVE NOT USED	USED	HAVE NOT USED	USED	HAVE NOT USED	USED	HAVE NOT USED	USED	HAVE NOT USED	USED	HAVE NOT USED	USED
Farmers	39	61	39	61	66	34	85	15	54	46	45	55	62	38
MSMEs	57	43	57	43	49	51	85	15	73	27	65	35	60	40
Coconut	-	-	-	-	-	-	81	19	58	42	55	45	66	34
Cardaba	-	-	-	-	-	-	90	10	54	46	68	32	72	28
Jackfruit	-	-	-	-	-	-	-	-	-	-	21	79	21	79
Coffee	42	58	47	53	50	50	-	-	-	-	-	-	48	52
Cacao	49	51	49	51	62	38	-	-	-	-	-	-	58	42
OVERALL	**47**	**53**	**48**	**52**	**58**	**42**	**85**	**15**	**56**	**44**	**47**	**53**	**62**	**38**


LOGIT MODELS
COCONUT
CARDABA BANANA
JACKFRUIT
CACAO
COFFEE
Farmer's model 1
Farmer's model 2
Farmer's model 3
MSMEs model 1
MSMEs model 2
Farmers
MSMEs
Farmers
Farmers
MSMEs
Farmers
MSMEs
Dependent variable
Plans to apply
Technology use
Current investment
Independent variable
Age
Gender
Household size
Education
Completed tertiary
Annual household income
Farm experience
Area
Land ownership
Location
Region
Share of machine cost
Share of labor cost
Net income
Training
Assistance
Readiness score
Main income
Type of organization
Years in operation
Asset size
No of employees
Annual revenue
Credit source
Heard 4.0
Invested in 4.0
Technology use
Membership
Type of product
Volume
Buyer
Variable was used in the model
Variable was used in the model with positive statistically significant effect
Variable was used in the model with negative statistically significant effect


Adoption of A4.0 technologies: problem analysis
Limited adoption A4.0 technologies
Low readiness level of MSMEs to adopt A4.0 technologies
Mostly manual operations
Level and nature of operations do not require A4.0 technologies
Limited appreciation of the value of A4.0
37% not using cellphone
Lack of large firms maximizing benefits of integrating MSMEs in the chain through ICT
Farm size is small
Lack of equipment
Limited knowledge
Mostly unware of A4.0
No equip-ment or gadget
Expensive internet
Limited A4.0 technologies appropriate for MSMEs
Fragmented due to CARL
Limited capital
Limited education
Lack of training or exposure
Weak or no signal
Inadequate ICT infrastructure
Limited exposure of suppliers of A4.0 technologies to needs of MSMEs
Limited incentives for suppliers of A4.0 tech
Low net income
Limited access to capital
Limited consolidation
Weak producer organizations
MSMEs demand for A4.0 technologies is low
Academe not fully responsive to MSME's ICT needs
Limited interactions between academe and MSMEs
Limited research proposals from academe on adoption and development of A4.0 technologies for MSMEs
Limited research and programs to address adoption and development of A4.0 tech for MSMEs

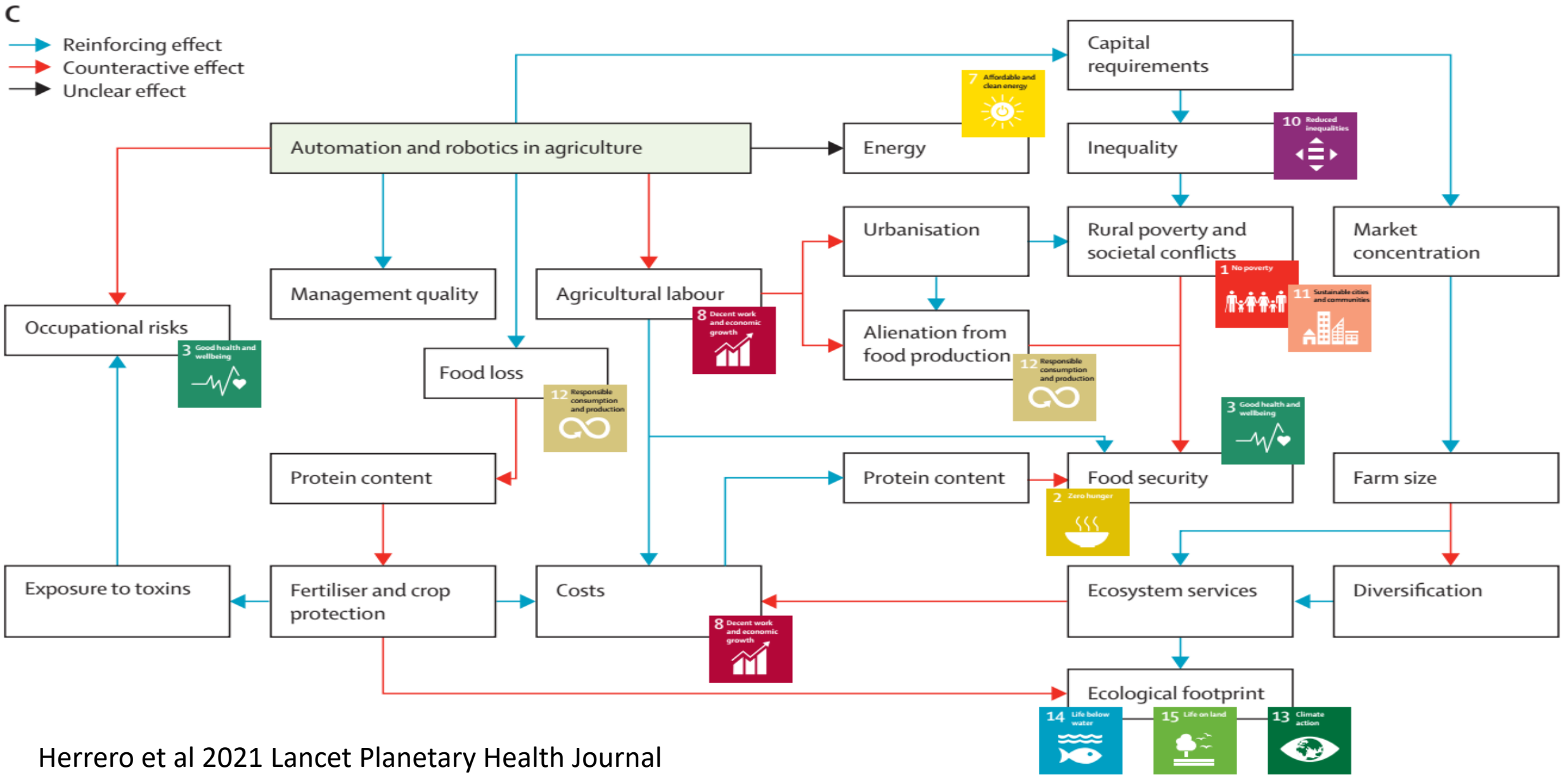
A note to consider in introducing agri4.0 technology: Bundle innovations to transform agri-food system (AFS)

(Barett et al 2020, expert panel)

- Cornell Atkinson Center for Sustainability and Sustainability Nature convened expert panel composed of 23 recognized world experts in various disciplines last Dec 2020
- Objective: healthy, equitable, resilient & sustainable (HERS) agri-food system
- Recommendation: Bundle innovations because

1. Innovations require broad AFS stakeholder participation which is essential to co-create the right bundle for a specific time and place.
2. single innovations typically yield incomplete gains.
3. single technologies inevitably involve trade-offs across multiple desirable objectives

Introducing innovation and trade-offs among SDGs



Herrero et al 2021 Lancet Planetary Health Journal

Suggestions to improve uptake of A4.0

1.0 Create pilot projects that showcase benefits of appropriate I4.0 technologies

- Link different modules to be interoperable in partnership with stakeholders (users, tech service providers, government)
- Facilitate dialogues among stakeholders
- Strengthen capacity building to improve uptake/adoption (eg module on innovation and I4.0 technologies on entrepreneurship training programs)

2.0 Reinforce institutional development to enhance adoption of I4.0 technologies

- Chain/ Triad approach – users (agri-industry, anchor firms, producer org), service providers, government or Pentahelix (to include media and civil society)

3. Address research gaps on

- Development, implementation and evaluation of appropriate/user-friendly I4.0 tech in value chains
- Trade-offs in introducing AI4.0 technology in the chains and among SDGs