Understanding Indonesian Smallholder Dairy Farmers' Decision to Adopt Multiple Farm-Level Innovations

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Background

- Adoption of innovations is a complex process (Pannell et al. 2006; Shahin 2004)
- Most adoption studies only focus on a specific type of innovation, while farmers may consider multiple innovations.
- Few studies derive a single measurable index to measure adoption of multiple innovations:
    1. Sum of dummies (Boz et al. 2011; Singh et al. 2014; Rahelizatovo and Gillespie 2004; Karafillis and Papanagiotou 2011)
    2. Adoption index (Fita et al. 2012)
    3. Expert-weighted Index (Läpple et al. 2015)
- Research Gap
    - Considering multiple dairy farm innovations
    - Little has been done to compare the above methods
    - Consider more attributes of innovations

Objectives

1. To compare methods that derive an innovation index of dairy farms in Indonesia;

2. To examine the different level of innovativeness of the farmers taking into account their socio-economic characteristics.

Methodologies

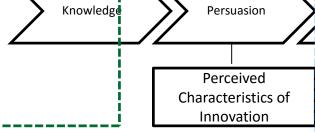| **First Round**	Cross-section datasets, conducted by Global Food Studies and MB-IPB
	Information on dairy farms and farmers characteristics and adoption of 20 dairy farms innovations
	242 dairy farm households
	Sukabumi and Bogor, West Java Indonesia
	December 2014 – January 2015
Second Round	Online Survey
	Expert assessment on characteristics of the dairy farm innovations
	25 experts: government, researchers, extension services, dairy cooperatives, dairy companies
	7 provinces
	Started on Dec 23rd 2015 (on going)

20 Dairy Farm Innovations

No	Innovations	Adopted in 2014
1	Artificial Insemination	96%
2	Using detergents for milking equipment	80%
3	Use of any fertilisers	62%
4	Rubber/plastic floor for the barn/cage	60%
5	Stainless steel milking equipment	58%
6	Water availability 24/7	46%
7	Mastitis Test	33%
8	Improved milking hygiene to reduce TPC	30%
9	Grow new improved grasses (high yield)	29%
10	Record keeping	26%
11	Feed legumes forages	22%
12	Teat dipping after milking	10%
13	Biogas units	9%
14	Cooling milk in water tanks	6%
15	Milk pasteurisation	5%
16	Conserving forages	4%
17	High protein concentrate	3%
18	Automatic milking machines	2%
19	Nutrient feed blocks	2%
20	Milk processing	2%

Conceptual Framework (Rogers 2003)

Knowledge → Persuasion → Decision → Implementation → Confirmation

Perceived Characteristics of Innovation

Yes= Adoption
No= Rejection

Yes= Continued
Yes= New Adopter
No= Discontinued
No= Cont Rejection

2010   **2014**

1. (Scaled) Sum of Dummies
(Boz et al. 2011; Singh et al. 2014; Rahelizatovo and Gillespie 2004; Karafillis and Papanagiotou 2011)

Yes= 1 Adopted in 2014;
0=otherwise

$$Sum\ of\ Dummies = \sum_{n=1}^{20} Innovation_n$$

$$Scaled\ Index = \frac{Sum\ of\ Dummies}{20}$$
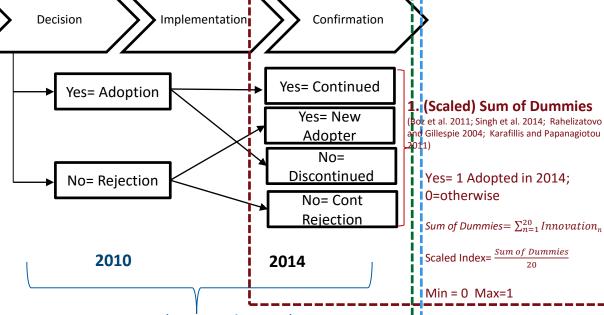
Min = 0 Max=1

3. Expert Weighted Index (Läpple et al. 2015)
Assessed-attributes: profitability, quality, access to information, level of innovativeness, complexity and cost

$$Score\ Innov\ (SI)_{1,\dots,20} = \frac{Means\ of\ charactertistic\ Score}{6}1,\dots,20$$

$$Farmer_i = \sum_{n=1}^{20} Adoption\ Behaviors\ x\ SI_n$$

$$Index = \frac{Total\ obtained\ score}{Expected\ Total\ Score}$$

Min=0 Max=1

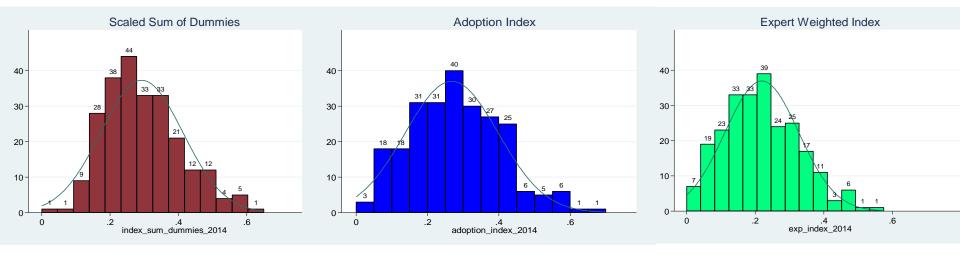2. **Adoption Index** (Fita et al. 2012)
Base year= 2010
3= continue, 2=discontinue, 1=new adopter, 0= not adopt

$$Farmer_i = \sum_{n=1}^{20} Adoption\ Behaviors n$$

$$Index = \frac{Total\ obtained\ score}{Expected\ Total\ Score}$$

Min = 0 Max=1

Result: Comparison of the Indices

Methods	Means (SD)	Time	Innovation Characteristics
Scaled-Sum of Dummies	0.293(0.120)	X	X
Adoption Index	0.268(0.130)	√	X
Expert-weighted Index	0.219(0.107)	√	√

Result: Descriptive Statistics

Variables	Sum of Dummies				Adoption Index				Expert Weighted Index			
	Low	Med	High	ANV	Low	Med	High	ANV	Low	Med	High	ANV
Farmers Characteristics												
HH Age (Years)	46.51(11.79)	45.80(11.42)	45.45(10.09)	ns	42.87(9.67)	46.30(11.89)	47.02(9.88)	ns	42.89(9.79)	46.28(11.86)	47.02(9.88)	ns
HH Edu (Years)	6.23(2.40)	6.97(3.40)	7.93(3.99)	ns	5.85(2.66)a	7.04(3.33)	7.8(3.83)a	*	5.97(2.57)a	7(3.35)	7.8(3.83)a	*
Family Size	4.54(1.80)	4.74(1.65)	4.12(1.51)	ns	4.62(1.63)	4.73(1.72)	4.23(1.49)	ns	4.65(1.63)	4.72(1.72)	4.28(1.49)	ns
HH Main Dairy (1=Yes)	0.87(0.34)	0.90(0.29)	0.94(0.24)	ns	0.87(0.34)	0.90(0.30)	0.95(0.21)	ns	0.87(0.34)	0.9(0.30)	0.95(0.21)	ns
HH Experience (Years)	**12.08(6.82)a**	**14.60(8.55)**	**18.30(9.13)a**	*****	**8.45(7.79)a,b**	**15.25(7.94)a**	**18.19(8.61),b**	******	**8.41(7.90)a,b**	**15.22(7.92)a**	**18.19(8.61)b**	******
Credit (1=Yes)	0.33(0.48)	0.51(0.50)	0.44(0.50)	ns	0.49(0.51)	0.47(0.50)	0.5(0.51)	ns	0.5(0.51)	0.46(0.50)	0.5(0.50)	ns
Farm Characteristics												
Owned farm size (ha)	0.10(0.13)	0.28(0.33)	0.26(0.27)	ns	0.014(0.18)	0.28(0.34)	0.21(0.18)	ns	0.14(0.18)	0.28(0.34)	0.21(0.18)	ns
Herd size (cows)	**5.41(6.51)a**	**7.11(7.27)b**	**13.62(20.31)a,b**	******	**4.51(6.09)a**	**7.81(9.28)**	**10.38(15.10)a**	*****	**4.53(6.17)a**	**7.79(9.26)**	**10.389(15.10)a**	*****
Milk Yield (L/cow/day)	11.79(4.16)	12.59(4.38)	13.34(5.59)	ns	12.55(4.56)	12.49(4.54)	12.83(4.51)	ns	12.55(4.56)	12.49(4.54)	12.83(4.51)	ns
Group Membership												
HH KUD (1=Yes)	0.85(0.37)	0.82(0.38)	0.82(0.39)	ns	0.77(0.43)	0.84(0.37)	0.84(0.37)	ns	0.76(0.43)	0.84(0.37)	0.84(0.37)	ns
HH Farmers group (1=Yes)	0.59(0.50)	0.76(0.43)	0.76(0.43)	ns	0.56(0.50)a	0.75(0.44)	0.82(0.39)a	*	0.55(0.50)a,b	0.75(0.43)b	0.82(0.39)a	*

- HH = Household Head
- SD in the parentheses
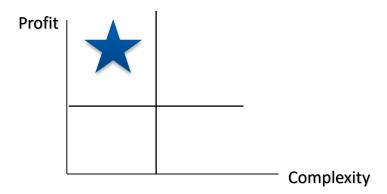- Means with the same alphabet are significantly different

*significantly different at p<0.05, post hoc Tukey HSD test
**significantly different at p<0.01, post hoc Tukey HSD test

Conclusions

- Each method captures different dimensions of innovation adoption.
  - Expert-weighted index captures more comprehensive assessment of innovation adoption as conceptualized by Rogers (2003).
- This study develops a new index to capture **the dynamics** and **characteristics** of adoption of **multiple** innovations.
  - Higher level of adopters significantly have more experience and herd size
- Further analysis
  - To assess the determinants of innovation adoption
  - To investigate the effects of adoption of multiple innovations on farm performance
  - To identify innovations based on farmers' preferences and assessment by experts for future policy and programs

Profit

★

Complexity

Thank you!

http://www.adelaide.edu.au/global-food
http://www.adelaide.edu.au/global-food/blog/

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