

Modeling Diffusion of Eco-friendly Innovations

- Innovation :
 - New product – Xerox machine, solar cooker
 - New process – power co-generation, wind mill
 - New idea – franchising IT education, e- tutoring
- Diffusion
 - By law – cost accounting
 - By advertising – investment in plantation
 - By word of mouth - Gutkha
- Some important innovations
 - Hybrid varieties
 - Small pox Vaccination

Solar cooker

- Universe - all users in Pune
- Frame – list of customers
- Stratification – different parts of the city
Kothrud, old Pune, PCMC

- Questions ?
 - Use – for what?
Is it good?
 - Process of adoption
 - Who told you?
 - Why adopt?

- Draw backs - weight, paint, wheels
- No users from low income group. Why?
 - Lack of access to sun
- Only high income group users
 - No subsidy needed
- Which attribute to advertise?
 - Preserves nutritional value
 - Convenient, saves LPG
 - Ecologically good
 - Right gift for newly weds
- Other similar innovations –Solar heaters, lamps
 - Are they becoming popular?
 - Any bottle necks?
 - Deserves study

DOMESTIC BIOGAS PLANT

- Clean fuel – convenience of housewife
- Effluent as fertilizer
- Kitchen waste disposal – efficient, safe
- Mail questionnaire survey of users
 - mainly farmers near Pune
- Objectives : estimate saving in traditional fuels
 - Identify problems in diffusion

Survey

- 600 biogas plants constructed during 1975-1985
By RAIN
- Questionnaire filled twice
 - Before and after erecting plant
- Respondents:
 - 200 before, 230 after, 91 common

Energy saved per family per year by adoption of biogas

Source (1)	# families (2)	Reduction in use (3)	Calculation (energy saving) (4)=(3) X 12 X CF	Energy saved (kcal) / family/ year (1000Kcal) (5)	Total energy saved / year (1000Kcal) (6)
Dung cakes(kg)	34	219	$219 \times 12 \times 230$	604.44	20,551
Firewood (collected) (kg)	83	138	$138 \times 12 \times 814$	1347.98	1,11,883
Kerosene (lt) (cooking)	83	3.1	$3.1 \times 12 \times 4561$	169.67	14,083
Kerosene (lt) Illumination	77	3.3	$3.3 \times 12 \times 4561$	180.62	13,907
Total					1,60,424

- energy saving \equiv 2166 kg firewood or 387 lt kerosene /year
- With this order of saving idea did not spread enough. Why?

Problems in diffusion

- Average size of plant :
 - 4 cubic meter
 - Raw material needed in large amounts
 - Can work with full efficiency if family size is 25
- With family size 25
plant can produce about 2071 cubic meter of biogas
Energy produced- 5.86×10^6 kcal /family/year
Current saving $160424000/91 = 17,62,901$ kcal/family /year
Just 30% of the capacity!

Cross bred goat adoption

- Cows – Manibhai Desai BAIF
- Goats – Srikant Sabnis RAIN, Narayangaon
- Goats – next only to dogs (in being close to humans)
 - Main source of milk in Spain, Greece
 - Saanen males – from Israel (1973)
 - Cross with local females
 - Guaranteed fertilization

Mail questionnaire survey

- Who adopts
 - poor farmers, destitute women, rarely ‘big farmers’
- Why adopt?
 - higher milk yield
 - Longer lactation period
 - Fetches higher price for baby goats
- How did you know?
 - neighbors, relatives
 - word of mouth

Why adopt?

Milk yield & Period of Lactation in Indigenous and Cross bred goats

Lactation Period (months)	Yield per day (litres) /goat						
	Indigenous				Cross – bred		
	< 0.25	0.25-0.5	0.5-0.75	Up to 1	0-1	1-2	>2
1-3	7	11	3	6	1	0	2
4-6	10	64	12	38	9	11	3
>6	1	4	0	12	11	32	15

Selling price of goats(mid eighties)

Price (Rs.)	Age(months)			Age(years)		
	Males			Females		
	1-3	4-6	>7	1	2	>3
≤ 300	25	21	2	7	1	1
300-600	1	3	8	7	2	2
> 600	2	2	6	2	14	13

Model for adoption

$$dN_t / dt = b N_t (K - N_t)$$

N_t : cumulative # adopters, K : Saturation level

$$N_t = K / (1 + \exp(- (a + rt))) \quad r : \text{growth rate, } a \text{ constant}$$

Other models :

external influence

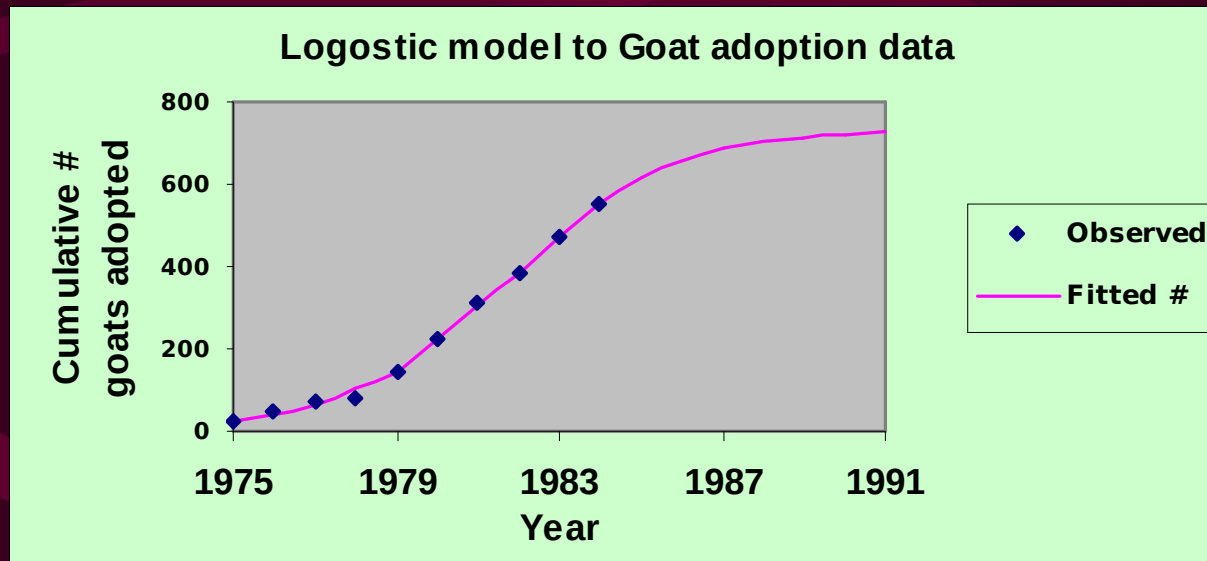
$$dN_t / dt = b_t (K - N_t)$$

mixed influence

$$dN_t / dt = (a + b N_t) (K - N_t)$$

frequently used in marketing research

- Vijay Mahajan & R.A. Patterson (1985- Sage)
- Models for Innovation Diffusion
- Use any ‘distribution function’- $P(X < a)$
e.g. normal, Weibull etc.
- In the present case
 - Logistic model gave good fit



Surrounding villages

$$dN_{2t} / dt = (b_1 N_{1t} + b_2 N_{2t}) (K_2 - N_{2t})$$

K_2 : Saturation level for surrounding villages

Est(K_2) = 6%, why so low?

Distance to service center- too much
make service available locally
males can be bought , raised and used
Done by groups all over the country