thermotolerance to potato crop. Therefore, cultivars Kufri megha and Rangpuria can be considered to have better tolerance to high temperature. Thus, morphophysiological characteristics can be efficiently used to screen potato cultivars for heat tolerance.

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ACKNOWLEDGEMENT. This work was supported by Jawaharlal Nehru Memorial Fund, New Delhi (Grant No. SU-I/050 2015/123).

Received 11 December 2015; revised accepted 12 May 2016

doi: 10.18520/cs/v111/i7/1226-1231

Lab to land – factors driving adoption of dairy farming innovations among Indian farmers

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In India sustaining dairy farming as a rural livelihood and to meet the growing demand of milk, necessitates development and dissemination of technology for improving the farm's output. There is also a need to understand how far existing innovations are adopted by farmers and factors influencing adoption and/or rejection. Hence, the factors that influence adoption and the extent of adoption were consolidated from past research using meta analysis and other techniques. It was found that at large-level farmer's knowledge (true effect size *r* value +0.64) and at medium-level (true effect size *r* value ranging from +0.32 to +0.47) attitude, risk-taking behaviour and economic motivation, milk production and sales, education, extension agency contacts and mass media exposure influenced adoption of dairy innovation. Further, along with the above factors poor innovation attributes were limiting adoption to 55%.

Keywords: Dairying, diffusion and adoption, innovation, meta analysis, rural livelihood.

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DAIRYING is an important occupation of the rural population in India. It has been in the forefront in generating additional employment and income, empowerment of rural women and as a cope-up mechanism during family emergencies. More than 70 million families are engaged in dairying. They produce 132.4 million tonnes of milk per annum and are contributing INR 2075 billion (at 2004–05 prices) per annum. At the same time, increasing urbanization, population growth and changing consumer preferences have been pushing the demand for milk. By 2020, the demand for milk is estimated to be 160 million tonnes[1,2]. This increasing demand generates pressure on upstream activities of the milk value chain to increase production and productivity. Thus, for sustaining dairy farming as a livelihood of the rural population and for meeting the increasing demand, it is required to develop appropriate technologies, design 'technology know-how' dissemination programmes and evolve better interface between technocrats and clients (farmers). In this direction, the present study is an attempt to understand the factors promoting uptake of innovation among clients. For this purpose, 84 published research articles on 'adoption of dairy innovation', published during 1990–2014, were collected for consolidation of research findings.

Collected research articles reported a wide range of results, sometimes with conflicting views, which complicated the drawing of inferences from them. However, understanding the literature is essential to draw any conclusion. In order to sum up the literature findings, 'narrative literature review' method can be used. However, it is more subjective in nature, lacks systematic rules to generalize, and depends upon sample size and significance of the results. To overcome the above issues, an alternative method, i.e. 'meta analysis' was used to establish the presence of an effect, magnitude of an effect and resolve differences in the literature[3]. Prerequisite to accomplish the meta analysis is the availability of sufficient literature with necessary statistical information. In the present study, statistical interpretations (Student's *t* test, linear regression, Mann–Whitney U test, ANOVA and chi square values) of the collected research articles (which had the necessary statistics) were converted to correlation 'effect size' based on established procedures[3,4]. From this, homogeneity of effect size (correlation *r*) was estimated. Subsequently, 'between study variance' was calculated. Based on the above, average *Z*-transformed effect size was calculated. From this 'true effect size', which is the summated estimate of relationships was calculated. The above calculations were made based on the prescribed procedures of random method of meta analysis[5].

Out of 84 research articles, 53 studied relationships between adoption of dairy innovations with farmers socio-psychological variables. To draw a conclusion on the factors influencing adoption, 39 out of the 53 research articles were selected which had necessary statistical information for meta analysis. The adoption behaviour (dependent variable) was related with 48 independent variables. For analysis, variables which had a minimum of 10 studies were taken. Thus, 18 variables became part of the analysis. Similar approach was adopted by other researchers as well[6]. Table 1 provides details on the number of studies, total sample size of studies and range of correlation.

As discussed earlier, the analysis was carried out using random method (Table 2). Variables like knowledge, attitude and economic motivation had the highest relationship on dairy innovation adoption. Based on the Cohen[7] classification (using true effect size) of variables, in this study 'knowledge' fell under the larger effect category of influence on adoption of innovation. Further, variables like farmer's attitude, economic motivation, risk-taking behaviour, milk production and sales, education, extension agency contact (refers to farmers' contact with technology promotional/dissemination agencies/individuals) and mass media exposure has a medium level of influence on adoption. The socio-economic variables, specifically land, occupation, caste, social participation, herd size and agriculture income had smaller effect. However, the variables age and family size had the least influence on innovation adoption. The findings of present study were compared with the results of a narrative literature by Rao *et al.*[8] carried out in 1992. In the present study, variables like land, herd size and social participation had smaller effect on adoption. While Rao *et al.*[8] reported that the farmers with a high level of the above attributes were better at adopting to innovations. Similarly attitude, economic motivation, risk-taking behaviour and milk production which were reported to have less influence on adoption in the previous studies, were now found to have medium level of influence on adoption. This may be attributed to the methodological differences, and changing social and cultural factors in the market-driven economy.

Out of 84 articles, only ten articles documented the factors (constraints) related to innovations that restrain diffusion of dairy innovations. These articles analysed constraints in two patterns, namely as a 'set of innovations' and 'total dairy innovations'. The top-rated constraints were collated and categorized based on Roger's[9] innovation attributes (relative advantage, compatibility, complexity, trialability and observability). None of the studies reported constraints related to observability of results of innovation. Table 3 presents these results. It can be inferred that low relative advantage of dairy innovations, high complexity and poor compatibility limit the diffusion of such innovations. Further, among the collected literature, 16 articles only analysed and reported the extent of adoption. The extent of adoption ranged from 20% (ref. 10) to 71% (refs 11, 12). Additionally, from the research articles published during 2011–2014, it was found that weighed mean for 'extent of adoption' was 55% for dairy innovations (Table 4). This necessitates

Table 1. Details on studies and relationship between independent variables and adoption of dairy innovations

Independent variables (socio-psychological)	No. of studies	Total samples	Range of correlation
Age	28	4372	–0.64 to +0.29
Education	32	4883	–0.09 to +0.86
Family size	15	2201	–0.22 to +0.26
Land	29	4399	–0.24 to +0.62
Occupation	12	1730	–0.37 to +0.43
Caste	11	1920	–0.20 to +0.53
Family education status	12	1900	–0.20 to +0.64
Knowledge	17	3750	+0.16 to +0.90
Attitude	16	2986	+0.11 to +0.70
Economic motivation	14	2821	–0.88 to +0.76
Risk	16	2986	+0.11 to +0.70
Extension agency contact*	20	3360	–0.08 to +0.89
Mass media exposure	20	3151	+0.02 to +0.68
Social participation	20	3199	–0.26 to +0.72
Herd size	22	3387	–0.21 to +0.79
Milk production	11	1829	+0.15 to +0.57
Milk sales	10	1389	+0.10 to +0.53
Agricultural income	11	1499	–0.65 to +0.50

*Contact of farmers with technologies disseminating agencies.

Table 2. Estimation of homogenicity, variance, *Z*-transformed and true effect size

Independent variables (socio-psychological)	*Q* value	Between studies variance	Average *Z*-transformed effect size	True effect size (*r* value)
Age	1067.54	0.25	–0.08	–0.09
Education	241.04	0.05	0.37	+0.34
Family size	52.38	0.02	0.07	+0.03
Land	303.42	0.07	0.26	+0.24
Occupation	16.69	0.00	0.15	+0.15
Caste	34.91	0.02	0.19	+0.18
Family education status	58.73	0.04	0.33	+0.34
Knowledge	541.99	0.15	0.71	+0.64
Attitude	147.78	0.05	0.52	+0.47
Economic motivation	153.71	0.05	0.49	+0.46
Risk-taking behaviour	62.22	0.04	0.36	+0.39
Extension agency contact	413.64	0.12	0.46	+0.43
Mass media	174.91	0.05	0.35	+0.32
Social participation	212.38	0.06	0.22	+0.23
Herd size	239.34	0.07	0.28	+0.28
Milk production	43.91	0.02	0.47	+0.43
Milk sales	38.08	0.02	0.36	+0.35
Agricultural income	204.53	0.18	0.21	+0.20

Table 3. Number of research publications reporting constraints

Attributes of innovation	Relative advantage	Compatibility	Complexity
Set of innovations			
Feeding innovations	4	1	–
Breeding innovations	2	–	3
Heath care innovations	1	–	1
Total dairy innovations	2	–	2

Table 4. Extent of adoption recommended technologies/techniques (innovations)

Period	No. of studies	Sample size	Weighed mean – extent of adoption (%)
1990–2000	5	810	49.56
2001–2010	5	1128	55.87
2011–2014	5	449	55.18

immediate attention of the scientific community to evaluate individual technologies in terms of its attributes.

From above it can be concluded that research on adoption of dairy innovation has attempted to understand the attributes of innovation in a limited manner only. It missed out to probe the relationship between adoption and attributes of dairy innovation, which explains 49–87% of the innovation adoption[9]. Understanding the role of 'attributes' is well documented in consumer innovation adoption[6]. The research gap in understanding the role of innovation attributes and limited validation in farmer's field may be another reason for the poor uptake of dairy

innovations. Researchers[13,14] also mentioned that there is 'lack of fit' to farming situation and 'functional gaps' in technologies spawned in the laboratories.

It can be summed up that literature on adoption has been focusing mostly on the socio-psychological characters and their influence on adoption. The socio-psychological characters, such as knowledge, economic motivation, attitude, extension agency contact, mass media exposure, milk production and sales are dynamic and subject to change. Thus, increasing the exposure to technologies through extension agencies and mass media may have an impact on knowledge and increase the adoption. Further, technology generators need to focus on improving technology in terms of performance, ease of use and fit for farming situations. Also, there is research gap in understanding the relationship between dairy innovation attributes and adoption, which needs to be addressed.

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ACKNOWLEDGEMENT. We thank the Tamil Nadu Veterinary and Animal Sciences University, Chennai for supporting the study.

Received 16 November 2015; revised accepted 12 May 2016

doi: 10.18520/cs/v111/i7/1231-1234

Surface treatment of the Secretariat Building, Chandigarh, India using selected concrete sealers for protection from environmental deterioration

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The Secretariat Building is located inside the Chandigarh, Capitol Complex, India. The exterior surface of the building has deteriorated due to weathering effects. The aim of the present study was to assess efficacy of selected protective materials on exposed heritage reinforced concrete surface of the Secretariat Building for restoration. Selected concrete sealers and Evercrete DPS with essential oil of peppermint and eucalyptus were evaluated for UV degradation yellowing test on white cement panels, accelerated ageing test on concrete beams up to 5 years, field trial on the exterior surface of the Secretariat Building up to 38 weeks and test for determining the water absorption on concrete cores (ASTM D 6489-99) up to 4 years. The result reveals that Konex WRA-2318 and La Shield WR Xtra are effective for surface treatment of the Secretariat Building without changing the colour of the surface up to 4 and 2 years respectively.

Keywords: Accelerated ageing, concrete sealer, environmental deterioration, heritage buildings, water absorption.

THE Secretariat Building, Chandigarh, India, built in 1953, was designed by noted architect Le Corbusier. It is part of the heritage Chandigarh Capitol Complex comprising three buildings – Legislative Assembly, Secretariat and High Court. The heritage building monuments in any country are mute testaments of its glorious past. However, they require regular repair and maintenance[1]. Restoration of heritage buildings involves preserving the existing appearance of a place and prevent deterioration[2]. Moisture plays an important role in most damage processes in concrete structures, such as frost damage and reinforcement corrosion. Many water-repellent agents such as silane and siloxane have shown to give a good protection against moisture and chloride ingress, thereby prolonging the service life of the concrete structure[3]. Natural factors like air, water, climate, wind, humidity and rain are the prime sources for degradation of the heritage structures. Water through capillary action enters and reduces the strength of concrete, thereby making it susceptible to corrosion[4]. The exterior surface of the Secretariat Building, was found to bio-deteriorated due to environmental conditions. Application of water-repellent agents

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