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STATUS OF PUBLIC AGRICULTURAL RESEARCH AND EXTENSION IN ASIA: A CASE OF MISSING LINKS IN INDIAN LIVESTOCK SECTOR

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ABSTRACT

Agricultural researchers and farmers require stronger linkages for improvement of research and extension scenario. In this context, an effort was made to highlight the status of agricultural research and extension system in Asia in general, and Indian livestock sector in particular using primary and secondary data. The study involving livestock farmers, extension workers and university scientists from four states of North India showed that about 21 per cent of livestock farmers contacted extension officers of state department while only 3 percent respondents contacted university sources for information.Further, review of literature (82.5 %) and personal field experience (65%) were the basic source of idea for research to the scientists and extensionists, respectively to generate and disseminate livestock technologies. The attitude of scientists and extensionists were more favourable than the attitude of farmers towards the livestock technologies developed. The wider gap between farmers-scientists and farmers-extensionists indicated a missing link among the stakeholders. It clearly showed that there is a need to gear-up the linkages among multi-stakeholders for generation and effective transfer of technologies. The study suggested that research & development institutions must generate and transfer need based, field relevant and appropriate livestock technologies to the farming community.

key words: Innovations, Livestock extension, Linkages, Multi-stakeholder, Percent gap

JEL Classification: Q16; Q18; Q38; Q55.

INTRODUCTION

The substantial and potentially profound changes in agricultural R&D and extension in general, and Asia in particular is observed. The studies (Thirtle *et al.*, 2003; Alston *et al.*,2010; Alston *et al.*, 2011) depicted a higher benefit-cost ratio in public agricultural research and extension investments which must be emphasised in developing countries for profitable returns and effective innovation systems. Hence, to improve the research and extension scenario, stronger linkages are needed between agricultural researchers and its end users (Flaherty *et al*., 2013). In this context, an effort was made to highlight the status of agricultural R and D in Asia in general and the status of research and extension in Indian livestock sector.

Poor productivity and quality of products remain a cause of concern in Indian livestock sector (Chander *et al.*, 2010). In an attempt to increase livestock productivity and improve food security at both national and household level, efforts are underway to generate and disseminate improved livestock technologies among smallholding farmers. Although various innovations and technologies are generated with heavy investments from public and private sources (Beintema and Stads, 2008; Dev,2012; Moreddu, 2013), most of the research results and recommended technologies related to livestock sector failed to find way to farmers field. This is also well proven by the fact that farmers continue to remain away from new technologies and guidance from state run research institutes (Livemint, 2014). The same study pointed out that over 59 per cent of the farm households received no assistance from either government or private extension services, while more farmers depended on other progressive farmers, media viz., radio, TV, newspaper and private commercial agents. Further, it was realized that there is a lack of awareness among researchers and extension agencies regarding the farmers' priorities and the suitability or relevance of the technologies (Rao *et al.,*1995, Chambers and Ghildyal, 1985).The existing situation in many developing countries calls for effective linkages between technology generation (research), technology dissemination (extension), technology users (farmers) and support mechanisms (inputs supply, market credit etc) (Chander *et al*., 2010).

The metaphor that farmers are mere recipients of technology which does not long last and also indicated that farmers are not passive consumers but active problem solvers who infact, develop technologies for themselves (Oladele and Fawole, 2007). Hence, there is a growing concern among the researchers, extension functionaries and policy makers to understand the farmers' perceptions with reference to technology generation and adoption. Since very negligible studies

were conducted in livestock sector to understand generation and transfer of livestock technologies, this paper has briefed the status of research and extension system, weak linkages, basis for research or generation of technologies and the percent gap among the multi-stakeholders with regards to livestock technologies. The policy implications for Indian livestock sector to improve the generation and transfer of livestock technologies has also been proposed.

MATERIALS AND METHODS

A judicial mix of both primary and secondary data was used in the study. Keeping in view the objectives of the study, the districts where the Veterinary Universities are situated were purposively selected for data collection. The existence of the veterinary universities and the concerned districts selected for study are presented in Table 1.The data from the dairy farmers were collected either at their farm or home using pretested interview schedule, while that of the scientists and extensionists was collected personally at their offices using questionnaire. Information through observation during interview, group discussion and secondary sources like departmental documents, records, reports and other sources also were collected.

Table 1. Sampling Frame

Universities under study (20 scientists and 10 extensionists in each university)	Study districts (90 dairy farmers each)	States	Geographical location
Indian Veterinary Research Institute (IVRI), Izatnagar (http://ivri.nic.in/)	Bareilly	Uttar Pradesh	28.36^0 N 79.41^0 E
G.B. Pant University of Agriculture & Technology (GBPUA&T), Pantnagar (http://www.gbpuat.ac.in/)	Udham Singh Nagar	Uttarakhand	28.98^0 N 79.40^0 E
National Dairy Research Institute (NDRI), Karnal(http://www.ndri.res.in/ndri/Design/Index.html)	Karnal	Haryana	29.69^0 N 76.98^0 E
Guru Angad Dev Veterinary and Animal Sciences University (GADVASU), Ludhiana(http://www.gadvasu.in/)	Ludhiana	Punjab	30.91^0 N 75.85^0 E

Attitude of the three stakeholders towards livestock technologies developed was studied using an attitude scale (Ogunsumi and Omobolanle, 2011) with suitable modifications on three point continuum as Agree, Undecided and Disagree with the scores of '3', 2 and 1, respectively. Attitude categories were classified based on the total attitude scores using equal interval method. The data collected from sample respondents were coded, tabulated, analyzed and presented in the form of tables. The per cent gap among the stakeholders towards the attitude was also calculated. The inferences were drawn in light of the results obtained, keeping in view the objectives laid in the study.

RESULTS AND DISCUSSION

Existing public agricultural research system in Asia and India: The public agricultural research and development scenario in few Asian countries has been discussed in brief with regards to their organization, strengths and weaknesses. The main agricultural R&D agency in Pakistanis the Pakistan Agricultural Research Council (PARC), whose broad mandate is the coordination of federal, provincial, and higher education and research agencies. It has a decentralized agricultural R&D system with comparatively strong farmer linkages and PARC has further restructured to strengthen its relevance and effectiveness. However, Pakistan faces the major challenges of low shares of Ph. D qualified scientists, poor participation of female scientists, low funding and high dependence on donor contributions to fund operations(Flaherty *et al*., 2012).The Agricultural Linkages Program (ALP) and its funding mechanism, the Agricultural Research Endowment Fund (AREF), have been operating in Pakistan since the year 2000 (PARC, 2012). In addition, Beintema *et al.*(2007) also reported that researchers at the government agencies face limited promotion opportunities, low salary levels, and few other incentives. This has led to a brain drain of researchers from the government sector to universities, non-research agencies, or to opportunities outside Pakistan.In Bangladesh, the activities of different crop, livestock, forestry, and fisheries research institutes are coordinated by the Bangladesh Agricultural Research Council (BARC). The country has historic dependence on World Bank fund for agricultural R&D which is spent erratically. The system faces the problem of poor participation of female scientists, numerous unfilled research positions and complex institutional structure that hinders effective coordination by BARC (Stads and Rahija, 2012).

The Sri Lanka Council for Agricultural Research Policy (SLCARP) exercises a high degree of central

authority over agricultural research by overseeing and coordinating the activities of all government and higher education agencies in Sri Lanka. The country has relatively good science infrastructure and has higher participation of female scientists in the system. There is decreased national government funding for agricultural R and D which calls for an urgent increase in its investment(Stads and Rahija, 2012).The vast majority of agricultural R&D in Nepal is carried out by the Nepal Agricultural Research Council (NARC), which assists the national government in formulating agricultural policies and conducts research related to agriculture and allied sectors. NARC faces the problem of poor participation of female scientists, numerous vacant research positions, lack of effective and efficient policy implementing bodies. It is very interesting that NARC has the strong participation of non-profit sector in conduct of agricultural R&D(Stads and Rahija, 2012).

The agricultural research expenditures to the size of a country's agricultural economy reveals that research intensities is higher in high-income countries and has increased from $0.56 of agricultural R&D for every $100 of agricultural output in 1960 to $3.59 in 2009 (Pardey and Beddow, 2013) while India has a very poor spending for agricultural R&D (Fig 1). Further, public researchers to million farmers' ratio in few Asia Pacific counties revealed that Malaysia (922) and Sri Lanka (164) had very good status while India has the poorest rate of 43 researchers to million farmers (Fig 2). Among the South Asian and Asia Pacific countries, the major focus of commodity research was crop science followed by livestock, natural resources, fishery-related issues, and forestry related issues (Stads and Rahija, 2012; Flaherty *et al*., 2013).

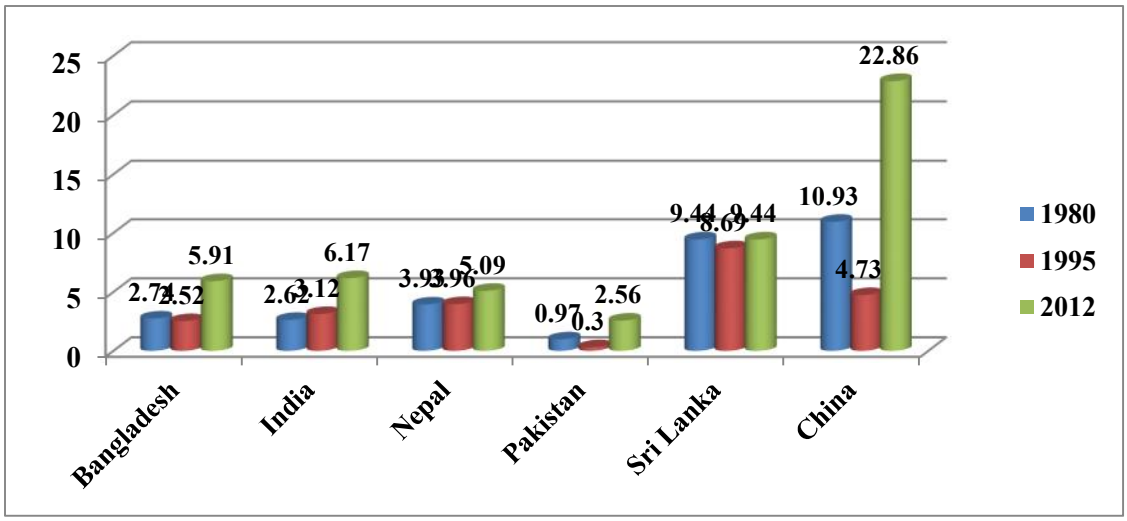

Fig 1. Public agricultural R and D Spending as a percentage of AgGDP(IFPRI, 2015)

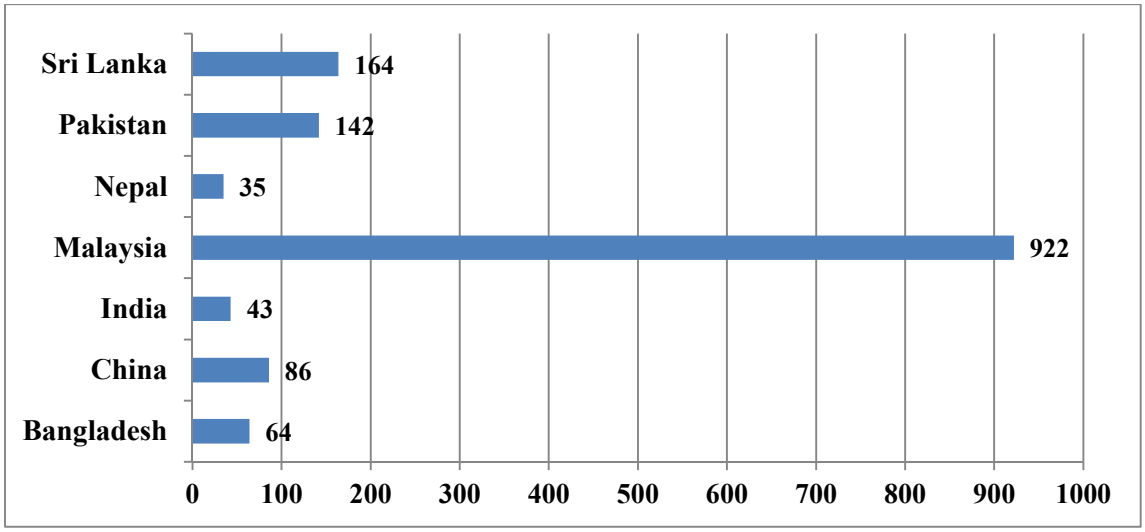

Fig 2. Public researchers to million farmers' ratio in Asian counties (Flaherty *et al*. 2013)

The public research and extension system referred as National Agricultural Research System (NARS) is one of the major policy instruments for promoting technological innovations and human resource development in India (Pal *et al*., 2008; Dev, 2012; Pal *et al*., 2012; Moreddu, 2013). India has the largest agricultural research and development (R&D) system with Indian Council of Agricultural Research (ICAR) which directly oversees 100 agencies, including 4 Deemed universities, 54 research institutes, 14 national research centers, 6 national bureaus, and 22 project directorates. India has more university-based researchers with Ph. D qualification (Stads and Rahija, 2012) engaged in research and education relating to agriculture and allied areas but compares less favourably with many developed nations in the world (Balaguru, 2013). Although NARS has been responding to the challenges faced by Indian agriculture, it is often criticized for not attending to the demands for improved technologies and also for the poor linkages between research and extension systems (Desai *et al*., 2011).

State Agricultural and Veterinary/Animal Science universities have greatly expanded in number with funding support from state governments but their research capacity has weakened (Pal *et al*., 2012) leading to poor interface of research, extension and education. There has been no parallel increase in the number of scientists implying lower research staff at the universities and increased overhead costs due to the proportionally larger administrative burden of more institutes. However, the agricultural R& D financial spending by ICAR institutes have major share (53.7 %) followed by state universities (34.2 %).About 34.0 per cent of staff is attached to ICAR institutes while state universities have 54.9 per cent of staffing level (Pal *et al*., 2012). Further, the investments for commodity-wise public R&D indicates that crop science got highest focus followed by animal science and fisheries in India. The 12th five-year planning commission has approved to set an agricultural R&D intensity target of 2 percent of AgGDP (Stads and Rahija, 2012).

Status of farmer-research- extension linkages in Asia and India: Even though majority of the extension organizations in the developing countries were established long back, the profession of extension has not received the proper status it deserves, compared to other agricultural professions. Baig and Aldosari (2013) have pointed out that extension services in many Asian countries has not been able to make due impact, assist farmers in addressing their issues and provide them with better and improvement strategies.In several developing countries, e.g. India, extension mainly places attention on the adoption of innovations, while in many former communist countries most attention is on investment and marketing decisions. Depending on the country, linkage activities are usually managed at varying administrative levels –national, regional, state and local levels. The constraints which hinder research–extension linkage potentially affect the agricultural output of farmers through the availability of farming innovations. Extension service must be supported and backed by the credible and strong agricultural research support system so that its activities are reliable, relevant and responsive to the needs of Asian farmers - and accountable to the overall mission of the Extension (Baig and Aldosari, 2013). Fig 3 depicts the average annual growth of agricultural output and total factor productivity (TFP growth) in few Asian countries. Since developing country extension models are not formally associated with universities (Boone, 1989) and therefore have poor linkages with research.

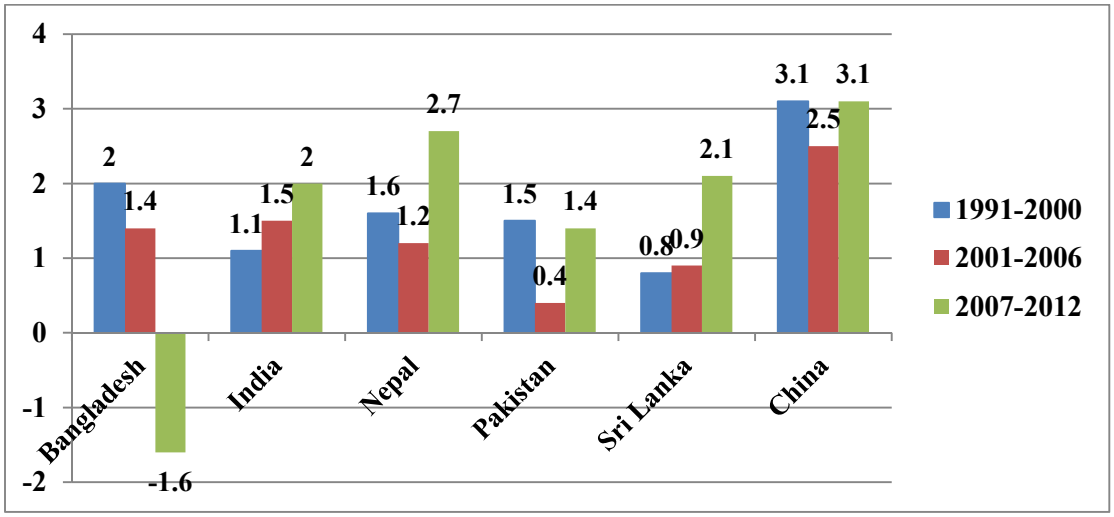

Fig 3. Average Annual growth of agricultural output and total factor productivity (TFP growth) (IFPRI, 2015)

Japan has the bottom-up management system in which decisions on linkage activities are taken at prefecture (state) level without the direct involvement of national officers. The use of subject-matter specialists, technical committees, and staff exchanges between prefectural research and extension organizations is very commonly observed. The strong research–extension linkage in Japan can partly be attributed to the exchange of staff between agricultural research and extension organizations, enabling personnel to work for a specified time in each other's establishment (Agbamu,2000). In South Korea, linkages between research and extension are made easier by virtue of the fact that both are administered by the same institution called the Rural Development Administration (RDA). Farmers' problems are identified through data collection and are jointly solved by researchers, subject-matter experts and other officials (Agbamu, 2000). Both the research management bureau and the extension management bureau have equal status inside the RDA. The scenario in Thailand depicts that only researchers identify farmers' needs and take decisions on research themes. Apart from meetings between researchers and subject-matter specialists, there is poor evidence of routine linkage mechanisms between research and extension. In Indonesia, extension services have been marginalized since most district governments have certain priorities, irrespective of national policy, which could generate revenues for a long term. It has successfully established new institutions called Agricultural Technology Assessment Institutes at provincial level, to bring farmers, researchers and extension specialists on a common platform. The countries like Nepal and Pakistan have recently embarked upon decentralization/devolution, to simplify the capacity-building measures for decentralized units, and can also draw lessons from the experiences of other countries (Qamar, 2005). Extension in Pakistan is formally the responsibility of the provincial governments, but linkages with PARC are not strong. Therefore, PARC has established technology transfer institutes (TTI) to conduct different activities including socio-economic research (Beintema *et al.,* 2007).

Very often, the livestock related technologies developed or modified in the research institutes do not reach the end-users for want of efficient and effective extension mechanisms and procedures (GOI, 2013) since public research and extension system is plagued by various challenges and constraints which is being discussed in this section. This research–extension link has been criticized for not absorbing or using feedback from farmers and extension staff due to passive nature and limited exposure of scientists to field realities (Reddy and Swanson, 2006). Further, Sulaiman and Holt (2002) have reported that feedback from extension to research is limited due to which research agendas are not influenced by extension experience.The public system also heavily suffers from failures of various issues like infrastructure, weak linkages and market structure failures (APO, 2006; Klerkx and Leeuwis, 2009; Shalaby *et al*., 2011).Further, lack of involvement of all relevant stakeholders in research, technology generation and learning frameworks and actions (GCARD, 2010) is also a major challenge for India.

Due to static and inflexible nature of the organizations, where a top-down hierarchical approach continues (Raabe, 2008), farmers see the quality of the information provided by the public extension staff as a major shortcoming (GOI, 2005) and information flow is considered to be supply-driven and not need-based or area-specific (Raabe, 2008). In this context, Babu *et al*. (2012) has indicated that quality and reliability of public extension system is still a constraint. Further, Swanson and Mathur (2003) have also depicted narrow focus of extension, lack of farmers involvement in extension programme planning, supply rather than market driven extension, lack of transparency and accountability, inadequate technical capacity, lack of local capacity to validate and refine technologies, inadequate communication capacity and inadequate operating resources and financial sustainability as other major challenges for Indian Extension system.

At the state level, various line departments have been criticized for working in isolation, with weak linkages and rare partnerships (Sulaiman *et al*.,2005; Meena *et al.,* 2013), which limits information flow. Further, state failures in agricultural and allied extension occur because of problems related to information, incentives, capacity, political interests, and bureaucratic procedures and attitudes (Birner and Anderson, 2007). Moreover, public services that are both transaction intensive and discretionary are particularly difficult to provide (Pritchett and Woolcock, 2004). In the absence of a market mechanism, public system has trouble in determining the types of knowledge and advice farmers actually need, determining of which is at the heart of making public sector extension demand-driven (Birner and Anderson, 2007).

Agricultural Technology Management Agencies (ATMA) were considered very effective instruments for promoting participatory planning and implementation. Although ATMAs improved farm income by strengthening the linkages between research, extension, farming, and markets (Raabe, 2008), still tighter linkage can be framed by overcoming shortcomings like limited staff, rigid organization, poor capacity, a top-down linear culture, weak links to the research system and limited reach to farmers. Another initiative, Krishi Vigyan Kendra **(**KVK) also known as "Farm Science Centre" clearly reveals a crop bias, with very little contribution towards livestock extension (Chander *et al*., 2010). These institutes also face challenges in terms of staff, partnership etc. which would facilitate the joint offering

of demonstrations of recent technologies (Glendenning *et al*., 2010). India has a pluralistic extension system(Glendenning *et al*., 2010), which suffer from duplication of programmes. Interestingly, after the completion of projects or programmes, extension and research agencies are often left with an increased number of staff members which is difficult to reduce in public sector agencies (Birner and Anderson, 2007).

Rathore *et al.,*(2008) has indicated that, very often specialists working in research institutions are considered to have higher status than that of the extension scientist in spite of the same level of educational qualifications. Further, professional competency of an agricultural or allied subject scientist is governed by the number of research publications produced than the technologies he has transferred effectively (Rathore *et al*., 2008; Mengistu, 2010). Another failure inherent in public sector extension is political interest capture which may be due to large scale farmers who often have more political influence than smallholders and weak political commitments of the leaders (Ravikumar and Chander, 2006; Feder *et al*., 2010). Further, bureaucratic culture and procedures is a typical obstacle to the reform of public sector agencies often discouraging the coordination of extension with other departments and also weakening the links to agricultural research system in spite of their obvious importance (Birner and Anderson, 2007).

Information sources of livestock farmers and frequency of use in India: The different source of information for the respondents is presented in Table 2. The primary data revealed that among the localite sources, friends and relatives were the most commonly used information sources. Among the cosmopolite sources, the livestock farmers used village level workers and veterinary officers as the most frequently used information sources. With regards to mass media sources, the Table 2 indicates that television and newspaper were the most commonly used information sources for the farmers. The study also revealed that 78.34 per cent of the farmers never contacted extension officers of state department, while 96.95 per cent of the farmers never followed university dairies or university magazines as information sources. This indicates the fact that universities were not considered as the important sources of information for livestock farmers. This reiterates the fact that only 5 percent of the households were able to access any information on animal husbandry against 40 percent of households accessing information on modern technology for crop farming (GOI, 2005). Moreover, livestock farmers sought information largely from private rather than public sources for information relating to livestock production. The same study also revealed that public sector extension services were not the preferred option for accessing information on modern technologies in livestock production. As per the latest reports (Livemint, 2014), over 59 per cent of the farm households received no assistance from either government or private extension services. More farmers depend on other progressive farmers, media including radio, TV, newspaper and private commercial agents.

Basis for developing/ planning an innovation/ technology as perceived by scientists: The study aimed to know the basis for developing/planning an innovation/technology as perceived by scientists using the primary data. Table 3 indicates that, review of literature, initial trials already conducted and organizational mandates or objectives were the major sources of research idea for scientists. Contact with farmers was frequently and less frequently used source of research idea by 42.5 per cent each of the scientists, respectively.It was observed in the study that, sometimes the scientists were forced to be a part of certain research projects despite their non-interest and poor contribution to the research or subject. Few of the scientists also complained that their idea was never considered by their senior professionals and were hence suppressed in many occasions. In the recent years, it was perceived by the scientists that they had to face complex procedures to obtain a quality project and hence, many of the scientists were not interested to take-up any quality projects. Further, it was also observed that due to constraints like human resource, time, funds etc., scientists were unable to interact with the farmers and hence could manage the research based on review of literature and organizational mandates or objectives. A study conducted by Ramasamy (2013) revealed that scientific temper and culture of creativity was much less in Indian agricultural research system compared to the developed countries. Most of the agricultural scientists of NARS in general considered research as a 'business as usual' activity without having a quest for acquiring knowledge, securing creativity and pursuing problem-solving. Further, Smith *et al.*(2004) also pointed out that there is a growing mountain of shelved, perfected yet unutilized research outputs, and there are large amounts of information getting tied up in journal publications targeted to peer groups rather than intended beneficiaries who rarely have access nor understand such publications.

Basis for developing/ planning an innovation/ technology as perceived by extensionists: The primary data involving extensionists revealed that personal field experience or observation, contact with farmers and personal research experience were the frequent sources of research idea (Table 4).Further, it was very interesting to note that, contact with farmers was considered as frequent source of research idea in the universities. It was observed in the study that, extensionists had realized the importance of need based research but could not however materialize due to various constraints like human

resource, time, funds, logistics etc.A study conducted by Sharma *et al.* (2013) in Rajasthan and Manjunath *et al.* (2008) in Karnataka revealed that lack of need based appropriate researches were the major problems confronted by the extension personnel. This highlights the fact there is a need for demand driven research and extension activities in the universities.

Attitude of multi-stakeholders towards livestock technologies developed by scientists: Majority of the livestock technologies developed by scientists are considered to be irrelevant and inappropriate for field conditions (Chambers and Ghildyal, 1985), leading to poor diffusion and adoption of livestock technologies (Melesse *et al.*, 2013; Rathod *et al.*, 2014).This also depicts that most of the research results and recommended technologies concerning livestock sector have remained confined to the four walls of laboratories and libraries. In this context, a comparison among multi-stakeholders towards livestock technologies developed by the scientists was also analyzed. It was noted that majority of the scientists and extensionists were in high score categories to the extent of 68.75 per cent and 80.0 per cent, respectively followed by high score categories to the extent of 21.25 per cent and 17.5 per cent, respectively. This status indicated that, scientists and extensionists had higher favourability towards the technologies as compared to farmers. Fig 4 depicts that attitude of scientists and extensionists were highly favourable, while the attitude of farmers was less favourable towards the livestock technologies developed by the scientists.

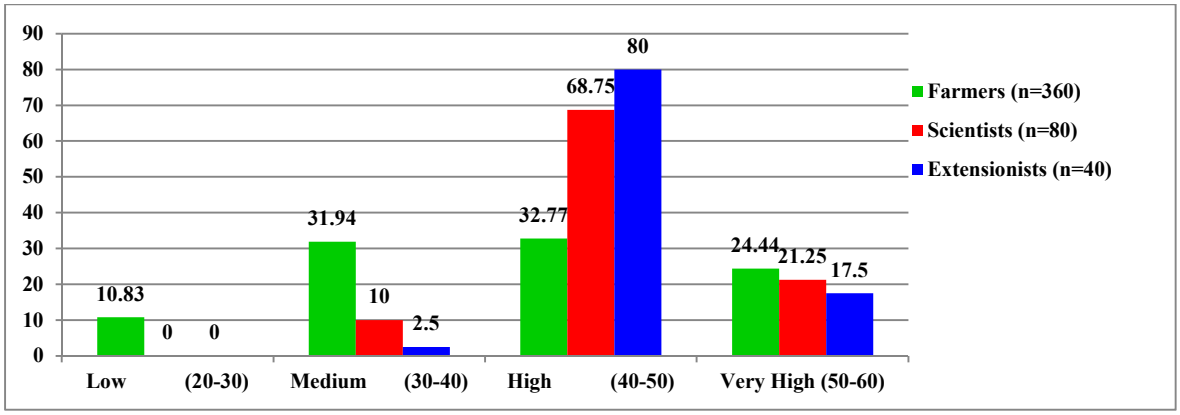

Fig 4. Attitude of multi-stakeholders towards the livestock technologies (favourability)

Percent gap for attitude among multi-stakeholders towards livestock technologies: Table 5 depicts the per cent gap that existed among the three stakeholders viz. farmers, scientists and extensionists. The study indicated that there was wider percent gap between farmers-scientists and farmers-extensionists, while the percent gap between scientist-extensionists was very low for attitude towards livestock technologies.

Table 5. Percent gap for attitude of multi-stakeholders towards livestock technologies.

Score Categories	Percent Gap among the Stakeholders		
	Farmers –Scientists	Scientists -Extensionists	Farmers -Extensionists
Low (20-30)	10.83	0	10.83
Medium (30-40)	21.94	7.5	29.44
High (40-50)	35.98	11.25	47.23
Very High (50-60)	3.19	3.75	6.94

The ineffective links between research and extension has impeded the development and transfer of technology appropriate for small-scale and resource poor farmers. The Asian Development Bank (ADB, 1993) study on policies and strategies for livestock improvement in developing countries concluded that the primary reason for policy failure was promotion of inappropriate technology. Karbasioun and Mulder (2004) also reported that shortcomings in extension systems originated from the lack of effective and constructive linkages between extension organizations and other institutions, e.g. universities and research centers. Further, Kaur and Kaur (2013) also reported that researchers and extensionists perceived low to medium linkages amongst each other. The same study also revealed that researchers and extensionists generally linked up with farmers only for their capacity building and consultation programmes.

Table 2. Information sources of livestock farmers and frequency of use.

Information sources	States												Pooled (N=360)		
	UP (90)			UK(90)			Haryana(90)			Punjab(90)					
	F	LF	N	F	LF	N	F	LF	N	F	LF	N	F	LF	N
Localite	00	25	65	02	13	75	01	20	69	00	19	71	03	77	280
Friends & relatives	(0)	(27.77)	(72.23)	(02.22)	(14.44)	(83.34)	(01.11)	(22.22)	(76.67)	(00.00)	(21.11)	(78.89)	(0.83)	(21.39)	(77.78)
Progressive farmers	00 (0)	17 (18.88)	73 (81.12)	00 (0)	12 (13.33)	78 (86.67)	00 (0)	14 (15.55)	76 (84.45)	00 (0)	24 (26.66)	66 (73.34)	00 (0)	67 (18.61)	293 (81.39)
Local Organizations	00 (0)	01 (01.11)	89 (98.89)	00 (0)	08 (8.89)	82 (91.11)	00 (0)	15 (16.66)	75 (83.34)	02 (2.22)	34 (37.78)	54 (60.0)	02 (0.55)	58 (16.11)	300 (83.34)
Village Leaders	00 (0)	16 (17.77)	74 (82.23)	00 (0)	14 (15.55)	76 (84.45)	00 (0)	08 (8.88)	82 (91.12)	00 (0)	15 (16.66)	75 (83.34)	00 (0)	53 (14.72)	307 (85.28)
Cosmopolite VLW's	24 (26.67)	58 (64.45)	08 (0.88)	36 (40.0)	44 (48.89)	10 (11.11)	34 (37.77)	55 (61.12)	01 (1.11)	04 (4.44)	43 (47.78)	43 (47.78)	98 (27.22)	200 (55.56)	62 (17.22)
LSS/Para-vet	03 (3.33)	62 (68.89)	25 (27.78)	02 (2.22)	20 (22.22)	68 (75.56)	00 (0)	20 (22.22)	70 (77.78)	00 (0)	10 (11.11)	80 (88.89)	05 (1.38)	112 (31.12)	243 (67.5)
LDO's/VAS/VO	02 (2.22)	23 (25.55)	65 (72.23)	15 (16.66)	34 (37.78)	41 (45.56)	24 (26.67)	37 (41.11)	29 (32.22)	49 (54.45)	36 (40.0)	05 (5.55)	90 (25.0)	130 (36.11)	140 (38.89)
Extension Officer	00 (0)	14 (15.55)	76 (84.45)	00 (0)	15 (16.66)	75 (83.34)	00 (0)	10 (11.11)	80 (88.89)	05 (5.55)	34 (37.78)	51 (56.67)	05 (1.38)	73 (20.08)	282 (78.34)
Scientific farmer clubs	00 (0)	00 (0)	90 (100.0)	00 (0)	08 (8.88)	82 (91.12)	00 (0)	15 (16.66)	75 (83.34)	05 (5.55)	14 (15.56)	71 (78.89)	05 (1.38)	37 (10.28)	318 (88.34)
Mass Media Radio	00 (0)	09 (10.0)	81 (90.0)	00 (0)	08 (8.88)	82 (91.12)	00 (0)	11 (12.22)	79 (87.78)	00 (0)	09 (10.0)	81 (90.0)	00 (0)	37 (10.27)	323 (89.73)
Television	00 (0)	27 (30.0)	63 (70.0)	00 (0)	24 (26.66)	66 (73.34)	00 (0)	39 (43.33)	51 (56.67)	00 (0)	56 (62.23)	34 (37.77)	00 (0)	146 (40.55)	214 (59.45)
Newspaper	00 (0)	05 (5.55)	85 (94.45)	00 (0)	15 (16.66)	75 (83.34)	00 (0)	26 (28.88)	64 (71.12)	04 (04.44)	28 (31.11)	58 (64.45)	04 (01.11)	74 (20.55)	282 (78.34)
Internet	00 (0)	00 (0)	90 (100.0)	00 (0)	01 (1.11)	89 (98.89)	00 (0)	07 (7.77)	83 (92.23)	00 (0)	09 (10.0)	81 (90.0)	00 (0)	17 (4.72)	343 (95.28)
Magazines	00 (0)	02 (2.22)	88 (97.78)	00 (0)	11 (12.22)	79 (87.78)	00 (0)	12 (13.33)	78 (86.67)	02 (2.22)	33 (36.66)	55 (61.12)	02 (0.55)	58 (16.11)	300 (83.34)
University dairies	00 (0)	00 (0)	90 (100.0)	00 (0)	00 (0)	90 (100.0)	00 (0)	04 (4.44)	86 (95.56)	00 (0)	07 (7.77)	83 (92.23)	00 (0)	11 (3.05)	349 (96.95)

F-Frequent; LF-Less frequent; N-Never (Figures in the parenthesis indicate percentage)

Table 3.Basis for developing/planning an innovation/technology as perceived by scientists

Source of idea	Universities												Pooled (N=80)		
	IVRI (20)			NDRI (20)			GBPUA&T (20)			GADVASU (20)					
	F	LF	N	F	LF	N	F	LF	N	F	LF	N	F	LF	N
Review of literatures	17 (85.0)	02 (10.0)	01 (5.0)	17 (85.0)	02 (10.0)	01 (5.0)	15 (75.0)	04 (20.0)	01 (5.0)	17 (85.0)	03 (15.0)	0 (0)	66 (82.5)	11 (13.75)	03 (3.75)
Personal research experience	12 (60.0)	08 (40.0)	0 (0)	12 (60.0)	07 (35.0)	01 (5.0)	14 (70.0)	05 (25.0)	01 (5.0)	14 (70.0)	05 (25.0)	01 (5.0)	52 (65.0)	25 (31.25)	03 (3.75)
Field experience/ observations	13 (65.0)	05 (25.0)	02 (10.0)	11 (55.0)	08 (40.0)	01 (5.0)	16 (80.0)	03 (15.0)	01 (5.0)	15 (75.0)	05 (25.0)	0(0)	55 (68.75)	21 (26.25)	04 (5.0)
Based on initial trials already conducted	14 (70.0)	04 (20.0)	02 (10.0)	13 (65.0)	06 (30.0)	01 (5.0)	17 (85.0)	03 (15.0)	0(0)	16 (80.0)	03 (15.0)	01 (5.0)	60 (75.0)	16 (20.0)	04 (5.0)
Organizational mandates/objectives	14 (70.0)	05 (25.0)	01 (5.0)	16 (80.0)	03 (15.0)	01 (5.0)	13 (65.0)	06 (30.0)	01 (5.0)	13 (65.0)	05 (25.0)	02 (10.0)	56 (70.0)	19 (23.75)	05 (6.25)
On trial and error basis	06 (30.0)	10 (50.0)	04 (20.0)	03 (15.0)	14 (70.0)	03 (15.0)	03 (15.0)	12 (60.0)	05 (25.0)	05 (25.0)	10 (50.0)	05 (25.0)	17 (21.25)	46 (57.5)	17 (21.25)
Scientific area which is not explored	08 (40.0)	10 (50.0)	02 (10.0	09 (45.0)	09 (45.0)	02 (10.0	07 (35.0)	10 (50.0)	03 (15.0)	10 (50.0)	08 (40.0)	02 (10.0	34 (42.5)	37 (46.25)	09 (11.25)
Projects notification from funding agencies like ICAR, ICMR etc	12 (60.0)	07 (35.0)	01 (5.0)	15 (75.0)	04 (20.0)	01 (5.0)	15 (75.0)	03 (15.0)	02 (10.0)	10 (50.0)	07 (35.0)	03 (15.0)	52 (65.0)	21 (26.25)	07 (8.75)
Contact with farmers	04 (20.0)	10 (50.0)	06 (30.0)	08 (40.0)	10 (50.0)	02 (10.0	10 (50.0)	08 (40.0)	02 (10.0	12 (60.0)	06 (30.0)	02 (10.0	34 (42.5)	34 (42.5)	12 (15.0)
Contact with field vets/personnel	05 (25.0)	10 (50.0)	05 (25.0)	08 (40.0)	11 (55.0)	01 (5.0)	10 (50.0)	09 (45.0)	01 (5.0)	07 (35.0)	11 (55.0)	02 (10.0	30 (37.5)	41 (51.25)	09 (11.25)
Discussion with experts/staff	14 (70.0)	05 (25.0)	01 (5.0)	15 (75.0)	04 (20.0)	01 (5.0)	13 (65.0)	06 (30.0)	01 (5.0)	13 (65.0)	05 (25.0)	02 (10.0	55 (68.75)	20 (25.0)	05 (6.25)
Through seminar, conference etc..	10 (50.0)	09 (45.0)	01 (5.0)	11 (55.0)	07 (35.0)	02 (10.0	09 (45.0)	10 (50.0)	01 (5.0)	14 (70.0)	05 (25.0)	01 (5.0)	44 (55.0)	31 (38.75)	05 (6.25)

F-Frequent; LS-Less frequent; N-Never ***(Figures in the parenthesis indicate percentage)***

Table 4. Basis for developing/planning an innovation/technology as perceived by extensionists

Source of idea	Universities												Pooled (N=40)		
	IVRI (10)			GBPUAT (10)			NDRI (10)			GADVASU (10)					
	F	LF	N	F	LF	N	F	LF	N	F	LF	N	F	LF	N
Review of literatures	08 (80.0)	01 (10.0)	01 (10.0)	02 (20.0)	05 (50.0)	03 (30.0)	07 (70.0)	03 (30.0)	0 (0)	05 (50.0)	04 (40.0)	01 (10.0)	22 (55.0)	13 (32.5)	05 (12.5)
Personal research	08	02	0	05	03	02	07	02	01	04	05	01	24	12	04

experience	(80.0)	(20.0)	(0)	(50.0)	(30.0)	(20.0)	(70.0)	(20.0)	(10.0)	(40.0)	(50.0)	(10.0)	(60.0)	(30.0)	(10.0)
Field experience/ observations	09 (90.0)	01 (10.0)	0 (0)	06 (60.0)	03 (30.0)	01 (10.0)	06 (60.0)	02 (20.0)	02 (20.0)	05 (50.0)	04 (40.0)	01 (10.0)	26 (65.0)	10 (25.0)	04 (10.0)
Based on initial trials already conducted	03 (30.0)	05 (50.0)	02 (20.0)	06 (60.0)	02 (20.0)	02 (20.0)	04 (40.0)	04 (40.0)	02 (20.0)	04 (40.0)	04 (40.0)	02 (20.0)	17 (42.5)	15 (37.5)	08 (20.0)
Organizational mandates/objectives	06 (60.0)	04 (40.0)	0 (0)	06 (60.0)	02 (20.0)	02 (20.0)	07 (70.0)	02 (20.0)	01 (10.0)	03 (30.0)	05 (50.0)	02 (20.0)	22 (55.0)	13 (32.5)	05 (12.5)
On trial and error basis	02 (20.0)	04 (40.0)	04 (40.0)	06 (60.0)	03 (30.0)	01 (10.0)	03 (30.0)	05 (50.0)	02 (20.0)	04 (40.0)	05 (50.0)	01 (10.0)	15 (37.5)	17 (42.5)	08 (20.0)
Scientific area which is not explored	04 (40.0)	05 (50.0)	01 (10.0)	02 (20.0)	06 (60.0)	02 (20.0)	06 (60.0)	03 (30.0)	01 (10.0)	04 (40.0)	05 (50.0)	01 (10.0)	16 (40)	19 (47.5)	05 (12.5)
Projects notification from funding agencies like ICAR, ICMR etc	06 (60.0)	04 (40.0)	0 (0)	04 (40.0)	04 (40.0)	02 (20.0)	07 (70.0)	02 (20.0)	01 (10.0)	04 (40.0)	04 (40.0)	02 (20.0)	21 (52.5)	14 (35.0)	05 (12.5)
Contact with farmers	06 (60.0)	03 (30.0)	01 (10.0)	06 (60.0)	04 (40.0)	0 (0)	07 (70.0)	03 (30.0)	0 (0)	05 (50.0)	05 (50.0)	0 (0)	24 (60.0)	15 (37.5)	01 (2.5)
Contact with field vets/personnel	05 (50.0)	03 (30.0)	02 (20.0)	06 (60.0)	03 (30.0)	01 (10.0)	6 (60.0)	02 (20.0)	02 (20.0)	06 (60.0)	04 (40.0)	0 (0)	23 (57.5)	12 (30.0)	05 (12.5)
Discussion with experts/staff	07 (70.0)	03 (30.0)	0 (0)	05 (50.0)	04 (40.0)	01 (10.0)	6 (60.0)	02 (20.0)	02 (20.0)	04 (40.0)	04 (40.0)	02 (20.0)	22 (55.0)	13 (32.5)	05 (12.5)
Through seminar, conference etc..	06 (60.0)	04 (40.0)	0 (0)	05 (50.0)	03 (30.0)	02 (20.0)	4 (40.0)	05 (50.0)	01 (10.0)	03 (30.0)	05 (50.0)	02 (20.0)	18 (45.0)	17 (42.5)	05 (12.5)

F-Frequent; LS-Less frequent; N-Never(Figures in the parenthesis indicate percentage)

Conclusion and policy implications: The public research and extension scenario in Asian countries varied with regards to their funding, human resource, Total Factor Productivity (TFP) etc. which also indicated that there was a weak linkage among research-extension and farmers. Further, Indian livestock sector depicted that university staff and extension officers of State Department were considered to be poor sources of information for livestock farmers. The study also revealed that review of literature and personal field experience were the basic source of research idea for scientists and extensionists, respectively to generate livestock technologies. The attitude of scientists and extensionists were more favourable while the attitude of farmers was less favourable towards the livestock technologies developed by the scientists. There was a wider percent gap between farmers-scientists and farmers-extensionists, while the percent gap between scientist-extensionists was very low for attitude towards livestock technologies.

The technologies can more swiftly disseminate to farmers by emergence of stronger research–extension–farmer linkages. This is possible by the process of participatory planning and review that involves farmers, subject matter specialists, and other interdisciplinary experts. The study suggests that research & development institutions must strive for development of need based field relevant and appropriate livestock technologies for higher diffusion and adoption at field conditions. Further, empirical efforts are needed to invest in terms of various resources like financial, human resource etc. to reach all categories of farmers (small, marginal etc.) with different content, approach and delivery mechanisms.

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