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Farmers Decision Making Pattern on Agricultural Innovations: A Process Analysis

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ABSTRACT

Decision making on new practices in crop production and marketing among farmers was studied in different agro-climatic situations of Gujarat and Karnataka. The process was analyzed using the initiation pattern, activities engaged in and sources consulted before decision-making based on primary data collected from 787 farmers cultivating paddy, cotton, groundnut, maize and potato. Five patterns of initiation to decision making were identified, which varied for different functional areas and crops. Activities that followed indicated that majority of farmers resorted to quick decision making, mostly based on a single source of information. Based on the pattern of initiation, sources of information and activities, decision making was broadly categorized as imitation, induced and informed. Informed decision-making was more prevalent in the case of groundnut and maize crops, which were less problematic crops. On the contrary, cotton and potato farmers resorted to induced decision-making, probably due to complexity of problems in pests, micronutrient and marketing. In paddy, a traditional food crop cultivated in a more homogenous environment, farmers resorted to imitative decision making. Maximizing informed decisions while facilitating purposeful imitation could be a desirable strategy, although the specific strategies could be location and context-specific.

INTRODUCTION

Right farming decisions can improve farmers' livelihoods and support national goals. Farmers need to make decisions often in an environment of uncertainty. Improving the quality of farmers' decisions is therefore one of the primary concerns of the extension education across the globe and extension systems must understand farmers' decision-making process clearly. Decision-making is one of the basic cognitive processes of human behaviors. Classical economic theory argues for rational behavior in which decisions are made based on all available information. It may not be possible to obtain all the needed information and might make decisions that are good enough for reasonably acceptable outcomes. Farmers' decisions are influenced by several situational factors including access to technological information, extension agency's efforts, input availability etc. The five-stage adoption process "awareness-interest-evaluation-trial-adoption" (Ray, 1991), the innovation decision process "knowledge-persuasion-decision-implementation-confirmation" (Rogers, 1983) and "ignorance- aware-interest-compare-test –adopt/reject" suggested by Botha and Atkins (2005) were linear in nature. Bo Ohlmer et al., (1998) suggested four phases and four sub-processes in the decision-making process using case analysis approach. Problem detection, problem definition, analysis and choice were the phases. Searching and paying attention, planning, evaluating and choosing, and checking the choice were the sub processes. Most studies of innovation-decision making have

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analyzed the pattern of diffusion of one specific technology, whereas it is a common phenomenon that farmers do not adopt innovations as they appear on the market (Paul et al., 2003). Zachary et al., (1982) identified the constituents in decision making as the decision situation, the decision maker, and the decision process. The normative approach suggested eight-stage process of "aware – goal setting - diagnose problem - review alternatives – evaluate - choose the best option - implement and evaluate". Bos model of group opinion formation includes "Knowledge – Facts/ Interpretation of facts – Goals and Means – Choices (Van den Ban & Hawkins, 1998).

It is of paramount importance to educate and empower farmers to make informed decisions to sustain crop production with good agricultural practices. Pluralistic extension system of India has multiple service providers, each having its own network of establishment and activities to reach farmers, mainly to promote their products and services. Farmers are often faced with the challenge of making choices from these parallelly operating input and information providers. Ground realities indicate that farmers often lack adequate investment capacities in buying required seeds, fertilizers, micronutrients and pesticides, thus making them dependent on someone who provides these on credit basis. In such cases, farmers may not have complete control over the choices and decisions they make. Therefore, it is hypothesized that farmers' innovation-decision pattern is not the same for all innovations and situations. It is a dynamic process depending on the situation; hence the investigation was planned to understand the decision-making pattern of farmers for different crops and innovations and analyze the decision making process.

METHODOLOGY

The study was conducted in Karnataka and Gujarat states of India, with funding support from National Agriculture Science Fund (NASF) of the Indian Council of Agricultural Research (ICAR). Agro-climatically, Karnataka and Gujarat states have many similarities, having both irrigated and rainfed situations, and cultivating common crops under cereals, oilseeds, vegetables and commercial crops. Based on the secondary data on major crops, cotton (commercial crop), paddy and maize (cereal crops), groundnut (oilseed crop), and potato (vegetable crop) were selected as crops for studying farmers' decision-making process.

In each state, district with largest area under the selected crop was identified based on secondary data. The districts identified in Karnataka were Raichur (cotton), Dharwad (groundnut), Haveri (maize), Koppal (paddy) and Kolar/Chikkaballapur (potato). In Gujarat, Botad, Junagad, Panchmahal, Khed and Banaskantha districts were selected for the study. Further, clusters of villages were identified in consultation with the officials of the development departments for each crop. Informal discussions with the village leaders/ key informants were held to confirm the cultivation of the crop by majority of farmers. Finally, two villages for each of the five crops per state, 20 villages in total, constituted the study area. Households were arranged based on landholding and then 50 households were randomly selected as the initial sample. Households that consented to serve as respondents for the study were retained and others were dropped. The final sample size was 425 in Karnataka, which included 73 cotton, 90 groundnut, 89 maize, 73 paddy and 100 potato farmers. The sample size in Gujarat was 362, which included 85 cotton, 62 groundnut, 78 maize, 70 paddy and 67 potato growers. The total sample was 787 farmers from both the states.

Farmers' decision-making process was studied by using survey research method with ex-post research design. Five areas of crop production (i) varieties/hybrids, (ii) micro/secondary nutrients, (iii) pest management (iv) irrigation method and (v) marketing were considered for studying the farmers' decision-making. During the project period 2014-2016, each farmer was visited multiple times by the field invigilators to document the new practices adopted and the decision making process. Farmers' decision-making was ascertained keeping the "Context-Source-Goal" as the basis. Farmers were asked (i) what was the context / situation that demanded a change /continuation of a practice? (ii) what were the sources of information and the activities carried out? and (iii) what was/were the expected output/outcome? The results are presented using the descriptive statistics frequency and percentage.

RESULTS AND DISCUSSION

Context analysis

Five distinct contexts could be observed from the situations that triggered farmers' decision on innovations while cultivating crops and marketing their produce. These contexts were (i) within the village, purposeful and informal interactions; (ii) extension (public/private) functionaries visit to villages or farmers' participation in formal extension activities organized elsewhere; (iii) individuals facing problems in the farm / crop that required immediate solutions; (iv) individuals coming across new information accidentally, within and outside the village; and (v) individuals in search of new information, within and outside the village.

Source analysis

Sources varied widely from context to context and the number of sources differed substantially. Informal but known sources included family members, peer-groups, friends, and neighbors. Unknown sources from the outside the system included the agricultural/general exhibitions, fairs and road shows. Formal sources, both known and unknown included all types of media including television, radio, print and mobile/telephone. Officials representing both public and private extension systems, scientists and technical personnel from the research system, traders, intermediaries and agents were the sources of information at different stages.

Goal analysis

The main goal of farmers was to maximize yield from the crop/ farm and earn higher income. Except the marketing activity where higher price and maximization of income were the prime goals, the remaining four functional areas were related to enhancing yield and production. When faced with problems such as pest attack, moisture stress, or plant nutritional deficiency, farmers had a short-term goal to find immediate solutions. Trying a new idea and doing something new was the goal of some farmers who were "in pursuit

Table 1. Context-Source-Goal based identification of Initiation to Decision-Making Process

Context / Situation	Source of innovations	Goals of the decision maker (farmer)	Initiation pattern
Within the village, purposeful and informal interactions	Informal sources mostly family members, peer-groups, friends, neighbors	Produce a good crop by replicating successful practices observed in the neighborhood. Be part of the peer group / social clique by adopting the practices	Community sharing
Extension (public/private) functionaries visit to villages or farmers' participation in formal extension activities organized elsewhere	Formal sources from public / private extension functionaries, mostly known	Receive the material benefits offered by extension system. Establish and maintain relation with extension agency/personnel for continued support.	Extension agency-initiated
Individuals facing problems in the farm / crop that required immediate solutions	Input agencies, known sources	Get solutions to a suddenly noticed problem, along with necessary input	Problem-driven
Individuals coming across new information accidentally, within and outside the village	Formal / informal unknown sources	Not sure, but try the new information in the farm with the hope for better results	Incidental
Individual in search of new information, within and outside the village	Multiple sources - mostly institutional, media and officials	Look for new product/practice, satisfy the urge to try/test and introduce something new in the farm. Earn/maintain the innovator tag by trying new seed / practices that lead to higher yield or explore new markets that fetch higher price.	Self – driven

of something new". Broadly, five types of initiation were identified and the "Context-Source-Goal" paradigm that resulted in the five "Decision Initiation Patterns" is presented in Table 1.

The initiation pattern to the decision making differed within the five functional areas of crop management, among the five crops and between the states, although there were some commonalities (Table 2). Community-initiated decision-making was more in Gujarat (54.05%) compared to Karnataka (46.4%) and so was the case with extension-initiated decision making, 19.37 per cent and 8.18 per cent respectively. Problem-driven decision initiation was more in Karnataka (19.53%) than in Gujarat (11.80%). Incidental initiation was least in Gujarat (5.63%) whereas self-initiated decision-making was similar in both the states.

Within a state, the initiation process differed from crop to crop. Community sharing varied from 41.63 per cent among potato farmers to 74.19 per cent among rice farmers in Gujarat, whereas in Karnataka, it ranged from 31.55 per cent (potato) to 62.57 per cent (maize). Community sharing varied across the regions. For example, in Gujarat, brothers though lived separately, shared the experiences and resources with other members of the family. In Karnataka, peer group and friends' cliques played a similar role. This may be due to the difference in socio cultural constitution of the family structure, the social structure and also due to the nature of innovations predominant in each crop. The way they interact socially can affect diffusion of technologies and agricultural productivity. Greater the interaction between community leaders and other individuals, better the knowledge diffusion (Jennifer, 2008). Social learning of information reduces the uncertainty about a technology's performance in the community (Uaiene et al., 2009). Social networks and learning are the important factors in adoption of technology (Mamudu et al., 2012).

Incidental initiation of decision-making was more evident among maize farmers in Gujarat and cotton farmers in Karnataka (about 34%), although the ground situations that were responsible for this kind of behavior differed in the two states. In Karnataka, cotton is being promoted intensively by multiple agencies and farmers had plenty of opportunities to see many developmental activities in and around their villages, in a planned way for some and incidentally for many. Maize cultivation in Gujarat village was practically done without major support from outside agencies and

Table 2. Decision-initiation in different crops in the two states

Decision Initiation	Cotton	Groundnut	Maize	Rice	Potato	Overall
Gujarat						
Self-Initiation	9.79	15.63	0.00	0.00	6.53	9.15
Problem-driven	14.35	15.28	0.00	7.74	6.12	11.80
Incidental	5.01	1.39	33.33	1.29	13.47	5.63
Community-sharing	61.50	42.36	55.56	74.19	41.63	54.05
Extension-initiation	9.34	25.35	11.11	16.77	32.24	19.37
Karnataka						
Self-Initiation	4.59	24.12	7.02	12.46	2.52	9.31
Problem-driven	10.16	21.11	10.53	20.06	31.86	19.53
Incidental	33.77	5.53	13.45	7.60	17.98	16.58
Community-sharing	46.23	34.67	62.57	59.57	31.55	46.40
Extension-initiation	5.25	14.57	6.43	0.30	16.09	8.18

hence farmers' only way of getting to learn new things was incidental during their visits outside their system. Incidental initiation was also noticed among potato farmers in both the states, more in Karnataka (17.98%). The situation was characterized by limited time and opportunity to enquire / analyze the information as in the case of pesticides for potato crop in Karnataka. It occurred with no intention from either the learner or the source, happened without specific motive or formal instruction. Incidental initiation could be unintentional, unplanned (Baskett, 1993), and spontaneous. The network of private companies and input dealers are known to influence farmers' decision on use of chemical pesticides (Singh et al., 2022).

Extension system-initiated decision making varied widely among the crops and between the states. In Gujarat, extension-initiation was very much evident in potato (32.24%) and groundnut (25.35%). It was probably due to the presence of agricultural university and research institute / research station of the Indian Council of Agricultural Research on groundnut and potato in the district. Public extension system organized *krishi mela*, exhibitions, and used mass media like radio and print to inform farmers about latest technologies. Mass media reach of information to a large heterogeneous population of farmers (Margarita et al., 2014) is very well documented. In the case of Karnataka, the level of influence of extension system was less and it ranged from 0.3 per cent in rice to 16.09 per cent in potato. This could be due to limited time available with public extension system for educational activities as the personnel gave more emphasis on subsidy distribution. Private companies and input dealers served as sources of information to farmers through individual, group and mass contact methods. Private companies conducted pre-season campaigns, displayed posters and distributed leaflets about their new technologies.

Problem-driven initiation to decision-making was ranging from zero in the case of maize cultivated by Gujarat farmers and 31.86 per cent among potato cultivators in Karnataka. Potato farming was done in an environment full of risks involving pests and extreme weather events in Karnataka**.** When faced with emergency, farmers mostly consulted input dealers who dealt with several products from different companies. Private company extension agents visiting problematic fields used the opportunities to push their products. Equipped with limited alternatives, farmers accepted the information received from these sources as the basis for decision-making, fearing that delay or not taking any action would cause crop loss.

Self-initiated approach to decision making was not observed for food crops like rice and maize in Gujarat for different reasons. Rice farmers in the study villages of Gujarat intentionally did not use external inputs, cultivated the crop without using pesticides and by using limited quantities of chemical fertilizers as part of a community decision. Maize farmers, located in the interior area, had neither enough resources nor extension contact to get support for trying new ideas. Groundnut farmers in both the states, 24.12 per cent in Karnataka and 15.63 per cent in Gujarat exhibited higher levels of self-initiated decision-making. Self-initiated decision initiation was particularly observed among farmers who had genuine concern to improve farming as seen with one groundnut farmer in Gujarat village, who went to Maharashtra and Tamil Nadu to fetch the seeds of new varieties. Such farmers also tried to acquire and assimilate information through searching media, participating in formal discourses like crop seminars and farmer-to-farmer experience sharing sessions. Some of the self-initiated farmers searched for new management practices in order to improve their farming, by consulting multiple sources. It included sources from public/private extension agency, agricultural universities, input dealers and even other successful farmers. Farmers by nature experiment as they had to live by the results (Roling, 2009), and were willing to experience failures (Schlag, 2011).

Stages in decision-making

Based on the nature of source, the number of sources contacted and the activities carried out, the decision-making process was categorized as "two-step", "three-step with and without active engagement" and "four-step" process. Higher proportion of farmers (43%) followed the two-step decision-making pattern, which varied from 26.9 per cent in the case of irrigation practices to as high as 69.7 per cent in marketing decisions (Table 3). Marketing related decisions mostly followed the quick two-step pattern, as farmers tried to dispose-off the produce as early as possible after harvest. Prior commitments with lenders was the primary reason followed by the need to meet out the contingencies in the family. Rational decision making in marketing of agricultural produce by choosing the right market/channel and selling at the right time was a dream for many farmers. Education and empowerment on marketing (Ghosh, 2013) was found as important as the education on production technologies. Capacity building on value chain aspects (Emmanuelle et al., 2011) that specifically build farmers' confidence levels in marketing sector are needed. Marketing management is essential to be an entrepreneur (Kahan, 2013), but farmers need to be equipped to do it with right information (Pierre and Julie, 2013 & Mawazo et al., 2014). Emerging e-marketing platforms with transparent dealings (Vivek et al., 2021) could boost farmers' confidence for participating in marketing activities. The decision-making process on choice of micronutrients for majority of farmers (59.6%) was also a two-step process. Micronutrient was an unknown domain and most farmers were ignorant of the extent of the problem and the remedial measures. This helplessness is often exploited by the input dealers forcing farmers to make on-the-spot decisions. Potato and cotton farmers were seen spraying more than two chemicals at a time, some sold as tonic by the input dealers. For about 42.5 per cent farmers, decision making on plant protection chemicals was also a two-step process. This was more out of anxiety about the possible crop loss due to pests and diseases. The choice of micronutrient and chemicals was made mostly in the case of incidentally initiated and problem-driven decision-initiation. It mostly occurred in situations that forced farmers to take very little time (Bo Ohlmer et al., 1998) between initiation and action.

The three-step process involved both active engagement (discussions and consultations to understand) as well as passive engagement (observations and internal thinking). Active engagement (overall 26.9%) involved understanding through discussion but without actually seeing the innovation or its results. These were different from the two-step model as it took time for them to gather

Table 3. Activity stages of the decision-making process on five functional areas of crop production

Activity Stages	Variety	Irrigation	Micronutrient	Chemical	Market	Overall
Initiation – Action	32.3	26.9	59.6	42.5	69.7	43.0
Initiation – Understand - Action	29.5	38.9	19.7	25.2	24.6	26.9
Initiation – Observe - Action	22.6	15.4	9.8	28.1	4.3	21.5
Initiation – Understand / Observe - Try/ Verify - Action	15.6	18.8	10.9	4.2	1.4	8.6
Total	100.0	100.0	100.0	100.0	100.0	

additional information before getting convinced. Understanding the new methods/practices by listening to friends, relatives and input dealers was mostly evident for irrigation practices (38.9%) and while deciding on choice of varieties (29.5%). The informal discussion among the peer group (Sharma et al., 2020) affirming the performance of a particular product /innovation was a proof enough to believe the information and to make a decision. This was also noticed among a majority of farmers who were initiated from extension professionals (mostly public extension) through government's promotional activities. The passive three-step process was mostly based on observation and internal consultation, which happened with 26.9 per cent farmers, most probably among those who were initiated from the community sharing. Observation was an important aspect of assessing the performance of chemicals (28.1%) and varieties (22.6%), as these have higher observability attribute than that of markets (4.3%) and micronutrients (9.8%). Visibility of successful technologies (Mendola, 2007) influence decisions of neighborhood farmers.

There were also farmers who did not just believe in seeing or hearing, but wanted to try out for themselves before deciding to act. Trying innovative ideas before others was their professional goal. The multi-step process (overall 8.6%), ranged from 1.4 per cent in marketing related decisions to 18.8 per cent in irrigation methods. Self-initiated individuals, who are normally regarded as innovators and venturesome, mostly followed this process. Farmers had access to sources of innovation, opportunity to understand, and to try on a small scale. Studies indicated that most consulted sources of information by farmers were friends and relatives, their personal experience, extension agency, (public and private), input dealers, extension professionals, and mass media like radio.

Decision making patterns

Three broad decision patterns were identified based on the combination of initiation process and activity stages (Figure 1). Community-initiated decision-making was most prevalent, leading to all four types of activities and all three patterns of decision-making. Both passive and active three-step engagement were the majority leading to mostly imitation decisions. Community-initiated decisions that followed two-step and multi-step activity stages were few (connected by dotted lines). Extension-initiated decisions strongly resulted in three-step (both active and passive) as well as multi-step decision-making, and ended up mostly as informed or imitation decisions. Incidental and problem-initiated decisions followed a quick on the spot decisions or at the most passive three-step process leading to imitation decisions. Self-initiated decision-making followed multi-step process and ended up as informed decisions.

Crop-wise data (Figure 2) revealed that informed decision-making behavior was predominant in the case of groundnut (57.2%) and maize (56.5%). These crops have less infestation of pests and diseases compared to cotton (both the states) and potato (Karnataka). Induced decision-making behavior was frequently observed in commercial crops like potato (39.2%) and cotton (30.8%). The decision-making pattern largely depended upon cost and risk involved

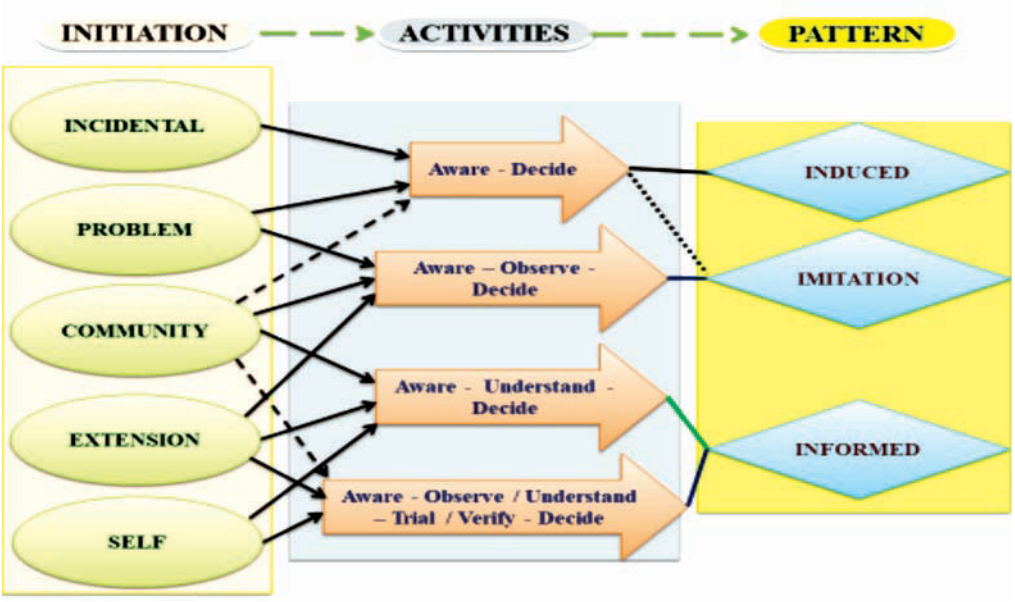

Figure 1. Decision Patterns based on Initiation - Activity Interrelationship

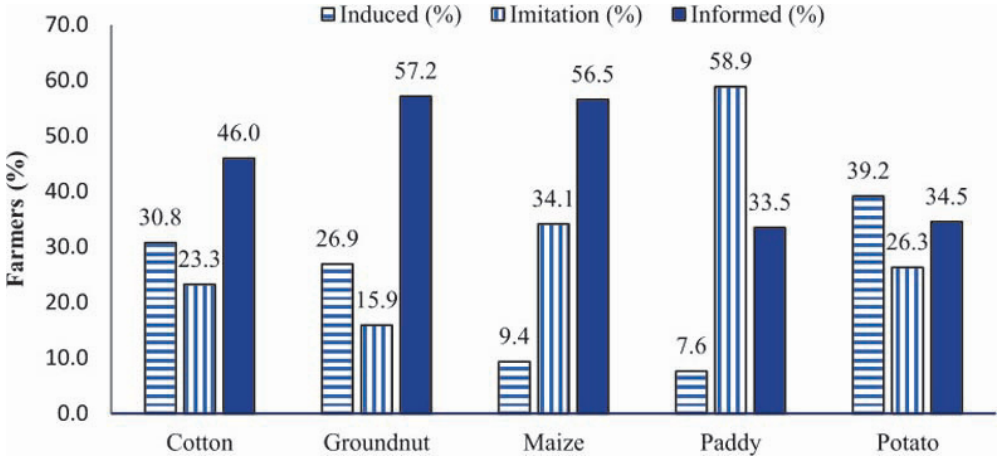

Figure 2. Farmers' decision making pattern in different crops

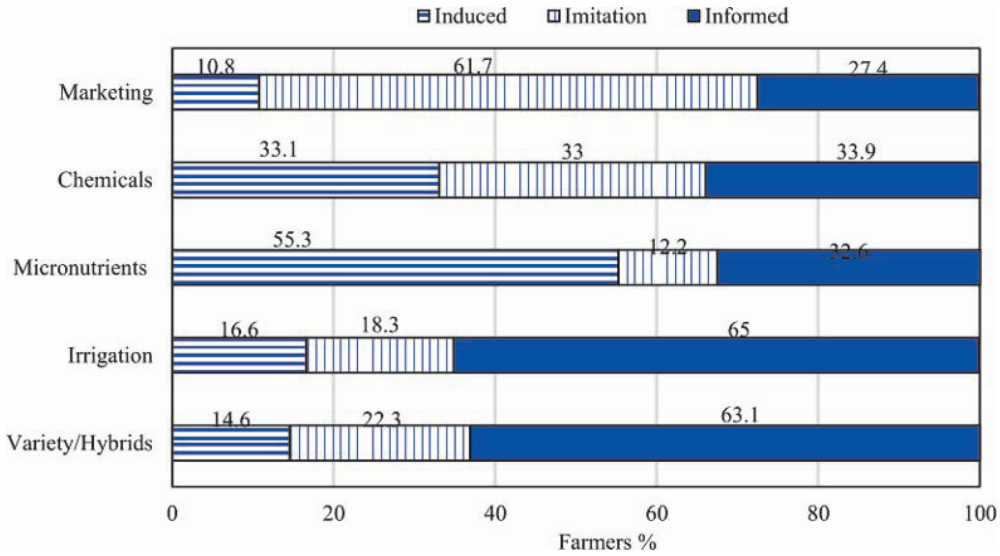

Figure 3. Patterns of decision making in different functional areas in crop production and marketing

in production of crops. In paddy, induced decision-making was least as there were more imitative decisions (58.9%) due to community sharing and peer-group learning. The imitation-decision behavior in paddy might be due to similar ecosystem in the command area of cultivation and similar management practices adopted by most farmers. Farmers cultivating two other food crops viz., groundnut and maize practiced informed decision-making. Imitation, a form of social learning, was an easy act for many farmers to avoid failures when taken together (Schlag, 2011).

In terms of different components within a crop (Figure 3), decision-making on irrigation (65.0%) and varieties (63.1%) were mostly informed. Farmers' decisions on choice of variety was mostly informed as they had more time to decide. An 'informed' decision was based upon a clear appreciation and understanding of the facts, and consequences of the action. Informed decisions were determined by the availability and accessibility of information (Ballantyne, 2009). Applicable and relevant knowledge must be made available to such farmers by the extension system. Micronutrients related decisions (55.3%) and decisions on use of plant protection chemicals (33%) were mostly induced in nature. Many induced decision making farmers were not even sure about their problems. For some even when the problem was known, the required information to overcome the problem was hard to find and thus they had to take induced decisions. 'Induced' decisions had both positive and negative contexts. It could be, positive when induced by the promotional activities of public extension system and negative when it was forced upon hapless farmers by the private extension system.

Educating the input dealers and continuously updating them with latest technological advances on managing emerging field problems will help minimizing induced decisions. The ongoing programme of Diploma in Agricultural Extension Services for Input Dealers (DAESI) offered by the Ministry of Agriculture and Farmers Welfare, Government of India must cover every input dealer in the country within a stipulated time frame. In the short-run, it is also possible to minimize the induced decision by facilitating the farmers to imitate the informed farmers, which is easier to achieve through well-planned extension activities. On a continuous basis, extension education must support, groom and encourage informed decision makers to access new information, adopt and share the successful aspects with others for imitation and replication. By enabling and supporting such farmers to search, access and use new information, the dependency on private input dealers could be reduced. Establishing model demonstrations can influence other farmers to facilitate cross-learning and farmer-to-farmer extension.

CONCLUSION

Dynamic nature of decision-making was evident where the same farmer followed divergent processes for different situations. The process of decision-making was analysed using context-source-goal approach. Initiation pattern and activities carried out before making decisions were different for different practices for different crops. Community-initiated and single-source based quick decision-making was a dominant process. All three patterns of decision making imitation, induced and informed decision-making were evident for different crops for different purposes. The study suggests "Max-Min-Facilitate" approach which implies maximized informed decisions, minimize induced decisions and facilitate imitation decisions. Priority is to minimize induced decisions, which mostly happened in problem-driven situation where private extension system played a critical role. Informed decisions by majority cultivators must be the long-term goal of the extension system. Availability of location-specific technical information drawn from reliable sources and ensuring its sharing at local level is the key to accelerating the process of informed decision-making.

REFERENCES

Ballantyne, P. (2009). Accessing, sharing and communicating agricultural information for development: Emerging trends and issues. *Information Development, 25*, 260, DOI: 10.1177/0266666909351634, http://idv.sagepub.com/content/25/4/260

Baskett, H. K. M. (1993). *Workplace factors which enhance self directed learning*, Report of a project on self directed learning in the workplace. International symposium on self directed learning, west palm beach, FL, USA, January 21-23, 1993. https://files.eric.ed.gov/fulltext/ED359354.pdf

Bo Ohlmer, Olsonb, K., & Brehmerc, B. (1998). Understanding farmers' decision making processes and improving managerial assistance. *Agricultural Economics*, *18*, 273-290.

Botha, N., & Atkins, K. (2005). *An assessment of different technical theoretical frameworks to study the uptake of innovations*, NZARES conference 2005, Nelson, New Zealand.

Emmanuelle Le, C., Eva, G. N., Pilar, S., & Florence, T. (2011). Enhancing farmers' access to markets for certified products: A comparative analysis using a business model approach, Food and Agriculture Organization of the United Nations, Rome. http://www.fao.org/3/k9849e/k9849e.pdf

Ghosh, N. (2013). Evolution and reconstitution of markets. In: *India's agricultural marketing. India studies in business and economics:* Springer, New Delhi. https://doi.org/10.1007/978-81-322-1572-1_2

Jennifer, W. S. (2008). The impact of multinational enterprise strategy on indigenous enterprises: Horizontal spillovers and crowding out in developing countries. *Academy of Management Review, 33*(2), 341-361. https://doi.org/10.5465/amr.2008.31193230 [Links]

Kahan, D. (2013). Market-oriented farming: An overview. Food and Agriculture Organization of the United Nations, Rome. http://www.fao.org/3/a-i3227e.pdf

Mamudu, A. A., Emelia, G., & Samuel, K. D. (2012). Adoption of modern agricultural production technologies by farm households in Ghana: What factors influence their decisions? *Journal of Biology, Agriculture and Healthcare, 2*(3), 1-13.

Margarita, G., Phoebe, K., Celine, N., & Vangelis, T. (2014). Information transmission in irrigation technology adoption and diffusion: social learning, extension services, and spatial effects. *American Journal of Agricultural Economics, 96*(1), 328-344.

Mawazo, M. M., Kisangiri, M., & Jesuk, K. (2014). Access to agricultural market information by rural farmers in Tanzania. *International Journal of Information and Communication Technology Research, 4*(7), 264-273.

Mendola, M. (2007). Agricultural technology adoption and poverty reduction: A propensity-score matching analysis for rural Bangladesh. *Food Policy, 32*, 372–393.

Paul, D., Meijl, H. V., Wuolters, A., & Bijak, K. (2003). Innovation adoption in agriculture: Innovators, early adopters and laggards, Wageningen University and Research Centre, Agricultural economics research institute, The Netherlands. http://ageconsearch.umn.edu/bitstream/205937/2/67-29-50.pdf

Pierre, C., & Julie, S. (2013). Farmer bargaining power and market information services. CSAE Conference 2013: Economic Development in Africa 17th - 19th March 2013, St Catherine's College, Oxford. https://www.tse-fr.eu/sites/default/files/medias/stories/sem_12_13/afio/subervie.pdf

Ray, G. L. (1991). *Extension communication and management*: Naya Prakash, 206, Bidhan Sarani, Calcutta.

Rogers, M. E. (1983). *Diffusion of innovations*: The Free Press, New York.

Roling, N. (2009). Pathways for impact: Scientists different perspectives on agricultural innovation. *International Journal of Sustainable Agriculture, 7*(2), 83-94.

Schlag, H. K. (2011). Imitation and social learning, Encyclopedia of the science of learning. Springer, Verlag.

Sharma, P., Riar, T. S., & Garg, L. (2020). Buying behaviour and farmers' practices regarding agrochemicals use on rice crop in Punjab. *Indian Journal of Extension Education, 56*(4), 87-91. http://epubs.icar.org.in/ejournal/index.php/ijee/article/view/108315

Singh, A., Jheeba, S. S., Pramendra, Manjunatha, B. L., & Dipika, H. (2022). Adoption of chemical pesticides under commercial vegetable cultivation in Sri Ganganagar district of Rajasthan. *Indian Journal of Extension Education, 58*(1), 1-6. http://doi.org/10.48165/IJEE.2022.58101

Uaiene, R., Arndt, C., & Masters, W. (2009). Determinants of agricultural technology adoption in Mozambique. Discussion Paper, 67.

Van den, B., & Hawkins, H. S. (1998). *Agricultural Extension* (second edition). CBS publishers and distributors, Daryaganj, New Delhi.

Vivek, M. C., Sahana, S., & Patil, K. K. R. (2021). Price behaviour of arecanut in the state of Karnataka (India) under e-tendering regime. *Indian Journal of Extension Education, 57*(2), 93-98. http://epubs.icar.org.in/ejournal/index.php/ijee/article/view/111683

Zachary, W., Wherry, R., Glenn, F., & Hopson, J. (1982). Decision situations, decision processes, and decision functions: Towards a theory-based framework for decision-aid design. In Proceedings of the 1982 Conference on Human Factors in Computing Systems.