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Evaluating the Role of Agricultural Extension and Veterinary Services in Reducing the Spread of Foot-And-Mouth Disease (FMD) In Babylon Governorate, Republic of Iraq

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Abstract: The role of agricultural extension and veterinary services in limiting foot-and-mouth disease (FMD) in Babylon Governorate, Iraq, was evaluated in this study. The evaluation domains were ranked according to the ratings given by staff, and the main obstacles facing these services were identified. For this purpose, a 40-item scale based on the CIPP model was constructed and grouped into four domains (context, inputs, processes and outputs), and a list of 10 obstacles was added to it. The data were obtained from a simple random sample of 80 employees of the extension and veterinary departments in the governorate. The services were rated at a moderate level overall (mean = 157.25, SD = 21.03). The highest domain rating was given to context (weighted mean 4.11), whereas the lowest was given to inputs (3.69). At item level, the first rank was occupied by the preparation of an annual extension plan for FMD prevention (4.51), and the last rank by the availability of diagnostic equipment and supplies for early detection (3.51). Late delivery of vaccines (4.41), shortage of veterinary equipment and supplies (4.35) and limited funding (4.31) were regarded as the most serious obstacles. It is recommended that vaccines be supplied on time, that diagnostic capacity and budgets be strengthened, that coordination among the concerned agencies be improved, that awareness activities for livestock keepers be expanded, and that FMD control programs be monitored and evaluated on a regular basis.

Key words: Extension, veterinary, FMD, evaluation, obstacles.

1. Introduction

Livestock production is regarded as one of the main supports of food security, rural income and the agricultural economy as a whole. A large part of the animal protein in the diet is provided by livestock, and a considerable share of the cash income of rural households is derived from it. Greater importance has been given in recent years to animal health, productivity and the quality of services

offered to farmers, because of the pressures that are being placed on food and farming systems. In Iraq, the protection and development of the livestock sector are therefore considered a practical requirement for animal production and national food security **(Hemissi & Khanfar, 2023)**.

Foot-and-mouth disease (FMD) is considered one of the most serious health problems by which livestock are affected. The disease is caused by a virus that is spread very rapidly among cloven-hoofed animals such as cattle, buffalo, sheep and goats. Several serotypes of the virus are known, and little protection against the other serotypes is conferred by infection or vaccination with any one of them. For these reasons, the prevention of FMD and the control of its spread are still regarded as difficult tasks by animal health authorities **(Grubman & Baxt, 2004)**.

The losses caused by FMD are not restricted to the infected animal. Milk and meat output is reduced during outbreaks, the cost of vaccination and control is raised, and the income of farming families is lowered. The degree to which an outbreak is controlled is largely determined by the ability of the responsible authorities to detect and follow up cases, to apply preventive measures and to work jointly with livestock owners **(Barasa et al., 2008; Paton et al., 2018)**.

FMD was first recorded in Iraq in 1937. Since then, the epidemiology and history of the disease in the country have been described by Iraqi researchers, and virus isolates collected from different regions have been characterised at the molecular level by others **(Al-Salihi, 2019; Baba Sheikh et al., 2021)**. Through such work, the movement of the virus between areas and its possible change over time can be better understood, and this information is used when vaccination and prevention programs are planned. The disease has also been reported widely in other Asian countries, so the situation in Iraq should be viewed within the regional and international context **(Aslam & Alkheraije, 2023; Ahmed et al., 2026)**.

A large agricultural and livestock base is found in Babylon Governorate, and local animal production would be directly affected if an FMD outbreak occurred there. Before the disease can be dealt with effectively, a clear picture of the programs and services offered to livestock keepers must be obtained. It should be known whether these programs are matched to farmers' needs, whether sufficient resources are allocated to them, how well field activities are carried out and which obstacles are encountered. The answers to these questions are needed before priorities can be set and the response of local institutions can be improved.

Technical advice is delivered to livestock keepers mainly through agricultural extension. Farmers are informed by extension workers about the ways in which the disease can be prevented, good hygiene and management practices are encouraged at farm level, and farmers are urged to report suspected cases early, to follow preventive instructions and to cooperate with veterinary staff. It was shown by **Ritter et al. (2017)** that the adoption of disease-control practices by farmers is influenced by their prior knowledge, by the trust placed in the advice received, by the relevance of that advice to their own conditions and by the type of advisory service available to them. Behavioural and extension-related factors should therefore be taken into consideration when animal disease control is studied.

Animal health surveillance, laboratory diagnosis, the tracking of infectious diseases, vaccination campaigns and the provision of health advice to farmers are carried out by veterinary services. The performance of these services is affected by the availability of staff, equipment and funds and by the way in which they are organised. Close links with extension are also required so that biosecurity measures are understood and applied by farmers. When the weak points in the institutions and among livestock keepers are identified, improvement efforts can be directed to where they are most needed. For this reason, a systematic evaluation is required in which the setting of the programs, the methods used to assess needs and set priorities, the available human, material and organisational resources, the efficiency of activities, the results obtained and the obstacles encountered are all examined. The information needed by decision-makers for revising and improving programs is provided by such an evaluation **(OECD, 2002)**.

No systematic assessment of extension and veterinary work against FMD in Babylon Governorate has been carried out so far, and this gap is addressed in the present study. The four CIPP dimensions (context, inputs, processes and outputs) were used to examine the suitability of the working context, the sufficiency of human, material and organisational inputs, the efficiency with which activities are

performed and the outputs achieved; the latter were judged mainly by the compliance of livestock keepers with preventive and biosecurity measures. The obstacles by which the effectiveness of these services is reduced were also identified, so that areas for improvement could be indicated and practical recommendations could be made.

Research Objectives

1. To assess the overall contribution of agricultural extension and veterinary services to FMD control in Babylon Governorate.
2. To rank the four evaluation domains according to respondents' ratings.
3. To determine respondents' ratings of the individual items within the context, inputs, processes and outputs domains.
4. To identify the obstacles that limit the effectiveness of extension and veterinary services in FMD control.

Research Hypotheses

The mean of respondents' evaluation scores for the role of extension and veterinary services in FMD control in Babylon Governorate does not differ significantly from the hypothetical mean of the scale.

2. Materials and Methods

A descriptive evaluative design was used. The evaluation followed Stufflebeam's CIPP model, which examines a program from four angles: the context in which it operates, the inputs (resources and capacities) available to it, the processes and activities through which it is delivered, and its products or outcomes. In this study, outcomes were judged by the extent to which livestock keepers know about and follow preventive and biosecurity measures.

The questionnaire, the analysis of data and the interpretation of results were all organised according to this model, so that the strengths and weaknesses of the services could be determined and linked to specific recommendations.

Research Population and Sample

The study population was made up of all 320 employees of the bodies responsible for agricultural extension and veterinary services in Babylon Governorate. These employees were distributed among the Animal Services Department (96), the Agricultural Extension Department (86), the Veterinary Division (72) and the Agricultural Extension Center (66). A simple random sample of 25% of the population (80 employees) was selected.

Research Tools

The questionnaire was prepared after reviewing previous studies and interviewing specialists in agricultural extension, veterinary medicine and animal production. It had three parts. Part one covered the professional characteristics of respondents. Part two contained 40 CIPP-based statements divided equally among four domains (context, inputs, processes and products; 10 statements each), answered on a five-point Likert scale from strongly agree (5) to strongly disagree (1). Part three listed 10 obstacles to the effectiveness of extension and veterinary work against FMD, rated on a five-point scale from very high (5) to very low (1). Face validity was checked by a panel of experts in agricultural extension and veterinary medicine. Each statement was scored 2 (agree), 1 (agree with modification) or 0 (disagree), and a statement was retained only if it reached at least 75% agreement; actual agreement for domains and statements ranged from 89.285% to 100%. The questionnaire was then pre-tested on 20 extension agents and veterinarians, and some wording was adjusted. Reliability was high (Cronbach's alpha = 0.894). Data were collected from 1 July to 1 August 2026 and analysed in SPSS. The Shapiro–Wilk test ($W = 0.986$, $p = 0.510$), together with the skewness (0.101) and kurtosis (−0.401) values, showed that total scores were approximately normally distributed. Frequencies, percentages, weighted means and a one-sample t-test against the hypothetical mean were used in the analysis.

3. Results and discussion

First objective: Overall evaluation of the role of extension and veterinary services in FMD control in Babylon Governorate

Respondents gave an overall moderate rating to the role of extension and veterinary services in limiting FMD (mean = 157.25, SD = 21.03). Scores were divided into three levels (low, moderate and high), as presented in Table 1.

Table (1). Distribution of respondents by overall evaluation level of extension and veterinary services in FMD control

S.	Evaluation Level	Categories	Frequency	Percentage	Mean Evaluation per Category	Overall Arithmetic Mean	Overall Standard Deviation	t-test	Overall Evaluation
1	Low	142-114	22	27.5	131.86	157.25	21.03	15.84 **	medium
2	Medium	171-143	38	47.5	157.57				
3	High	200-172	20	25	184.55				
SUM			80	100					

Nearly half of the respondents (38; 47.5%) fell in the moderate category, with a mean of 157.57. The low category included 22 respondents (27.5%; mean 131.86) and the high category 20 respondents (25%; mean 184.55).

A one-sample t-test was used to compare the sample mean (157.25) with the hypothetical mean of the scale (120). The calculated t-value (15.84) exceeded the tabulated value (2.64) at the 0.01 level with 79 degrees of freedom. The null hypothesis was therefore rejected: the respondents' mean rating was significantly higher than the hypothetical mean.

Second objective: Ranking of the evaluation domains according to respondents' ratings

Weighted means of the four domains of the 40-item scale ranged from 3.69 to 4.11 (73.8%–82.2% of the maximum score). All four values lie above the hypothetical mean of 3.00 (Table 2).

Table (2). Evaluation domains of extension and veterinary services in FMD control ranked by respondents' ratings

Ranking by survey	Areas of Evaluation	Weighted Average of Items	Standard Deviation	Percentage Weight*	Ranking by Evaluation Score	t-test	Evaluation of the sample for the role
1	Context: suitability of the setting in which extension and veterinary programs for FMD control are implemented	4.11	0.59	82.2	1	**16.60	high
2	Inputs: adequacy of human, material and organisational resources for FMD control	3.69	0.76	73.8	4	**7.99	high
3	Processes: efficiency of extension and veterinary activities for FMD control	4.07	0.57	81.4	2	**16.60	high
4	Outputs: results achieved by extension and veterinary services in FMD control	3.86	0.62	77.2	3	**12.33	high

* Maximum score on the scale 5

The context domain came first (weighted mean 4.11; 82.2%). Respondents appear to regard the environmental, social and organisational setting of extension and veterinary work as broadly suitable, which in turn helps these services reach farmers with information on FMD and on ways to prevent and contain it.

The inputs domain came last (weighted mean 3.69; 73.8%). This points to shortages in human, material and organisational resources, such as the number of specialised staff, vehicles, equipment and operating funds, that may restrict both the quality and the reach of field services. One-sample t-tests comparing each domain mean with the scale midpoint (3) gave t-values of 16.60, 7.99, 16.60 and 12.33, all greater than the tabulated value of 2.64 ($p < 0.01$; $df = 79$). Every domain was thus rated significantly above the hypothetical mean.

Third objective: Respondents' ratings of individual items in the context, inputs, processes and outputs domains

Item means across the 40 statements ranged from 3.51 to 4.51 (70.2%–90.2%), so all items were rated above the hypothetical mean of 3.00 (Table 3). In general, respondents valued the work of extension and veterinary services in FMD control.

Table (3). Weighted means, percentage weights and ranks of the evaluation items by domain

S.	Domains	Weighted Average	Percentage * Weight	Rank
First	Assessment of Contextual Appropriateness			
.1	An annual extension plan for the prevention of Foot-and-Mouth Disease (FMD) is developed.	4.51	90.2	1
.2	Accurate and up-to-date information on the prevalence of FMD in the governorate is available.	4.11	82.2	9
.3	Areas most susceptible to infection are identified prior to the development of extension and veterinary plans.	4.19	83.8	2.5
.4	The extension needs of livestock farmers are assessed periodically.	4.13	82.6	7
.5	Extension and veterinary plans are based on current scientific data.	4.06	81.2	12.5
.6	A clear mechanism exists for reporting new cases of infection.	3.86	77.2	27
.7	Intervention priorities are determined based on the level of disease prevalence.	4.10	82	10
.8	The circumstances of farmers and local resources are considered when developing plans.	4.13	82.6	7
.9	Findings from the evaluation of previous programs are utilized when developing new plans.	3.96	79.2	20
.10	A joint plan exists among relevant stakeholders for the control of Foot-and-Mouth Disease.	4.06	81.2	12.5
second	Assessment of Input Adequacy			
.11	Enough extension and veterinary personnel are available for disease control programs.	3.91	78.2	24
.12	Foot-and-mouth disease (FMD) vaccines are available in sufficient quantities and in a timely manner.	3.64	72.8	36
.13	The available vaccines are of high quality and effective.	3.78	75.6	30.5
.14	Necessary equipment is available to maintain the vaccine cold chain.	3.70	74	33
.15	Spraying equipment and disinfectants are available for affected areas.	3.83	76.6	29
.16	Transportation and fuel are available to carry out field campaigns.	3.58	71.6	38
.17	Sufficient financial allocations are available to implement preventive programs.	3.53	70.6	39
.18	Training programs are available to develop the capabilities of extension and veterinary personnel.	3.74	74.8	32

S.	Domains	Weighted Average	Percentage * Weight	Rank
.19	Veterinary diagnostic equipment and supplies are available for early detection of the disease.	3.51	70.2	40
.20	Effective communication channels are available for the exchange of information among relevant stakeholders.	3.65	73	35
third	Evaluation of Operational Efficiency			
.21	Extension staff conduct regular field visits to livestock breeders.	4.05	81	14.5
.22	Seminars and training sessions are organized to raise awareness among breeders regarding disease symptoms and preventive measures.	4.19	83.8	2.5
.23	Informational materials about the disease are produced and distributed in sufficient quantities.	4.08	81.6	11
.24	Digital media and social media platforms are utilized to disseminate extension messages.	4.13	82.6	7
.25	Timely advisory consultations are provided to livestock breeders.	4.15	83	5
.26	Continuous coordination and cooperation are maintained between agricultural extension and veterinary services.	4.05	81	14.5
.27	Vaccination campaigns are implemented in accordance with the established plan.	3.91	78.2	24
.28	Veterinary teams respond promptly to reports of suspected cases.	4.16	83.2	4
.29	Breeders are monitored following vaccination campaigns to ensure adherence to preventive measures.	3.96	79.2	20
.30	Extension and veterinary campaigns are periodically evaluated to leverage their outcomes.	4.00	80	17
fourth	Output evaluation			
.31	Agricultural extension programs and veterinary services have contributed to raising the level of breeders' knowledge of foot-and-mouth disease.	4.04	80.8	16
.32	Breeders' commitment to periodic vaccination programs has increased.	3.93	78.6	22
.33	The breeders’ commitment to biosecurity procedures inside barns improved.	3.84	76.8	28
.34	Breeders are becoming better able to detect and report symptoms of disease early.	3.91	78.2	24
.35	Breeders must isolate infected or suspected animals.	3.78	75.6	30.5
.36	Breeders are required to quarantine imported or newly purchased animals.	3.66	73.2	34
.37	Breeders refrain from transporting or selling infected animals during an outbreak.	3.61	72.2	37
.38	Improved cooperation between breeders, extensions, and veterinary teams during campaigns.	3.96	79.2	20
.39	The implemented programs contributed to increasing the vaccination coverage rate.	3.90	78	26
.40	Agricultural extension efforts and veterinary services have contributed to reducing the spread of foot-and-mouth disease.	3.99	79.8	18

*Maximum score on the scale 5

The highest-rated item was the preparation of an annual extension plan for FMD prevention (weighted mean 4.51; 90.2%). Planning ahead allows awareness and prevention activities to be scheduled, farmers' most pressing information needs to be identified, and the work of different agencies to be coordinated. A plan on paper, however, is only useful when it is carried through into concrete preventive action in the field.

The lowest-rated item was the availability of diagnostic equipment and supplies for early detection (weighted mean 3.51; 70.2%). Possible reasons include procurement difficulties, poor maintenance, or limited access to such equipment by field staff. Without adequate diagnostic capacity, suspected cases cannot be confirmed quickly and the response to an outbreak is delayed, so strengthening this capacity should be a priority.

Fourth objective: Obstacles limiting the effectiveness of extension and veterinary services in FMD control

Late delivery of vaccines was the most serious obstacle (weighted mean 4.41; 88.2%), followed by the shortage of veterinary equipment and supplies (4.35; 87%) and insufficient funding for control programs (4.31; 86.2%) (Table 4). The three leading obstacles all concern resources, namely vaccines, equipment and money, rather than the knowledge or willingness of staff. Timely vaccine supply, provision of the necessary equipment and larger budgets for extension and veterinary work should therefore come first.

Table (4). Obstacles to the effectiveness of extension and veterinary services in FMD control in Babylon Governorate, ranked by weighted mean and percentage weight

S.	Obstacles	Weighted Average	Percentage * Weight	Rank
.1	A limited number of extension and veterinary personnel reduces the efficiency of program implementation.	4.00	80	10
.2	A shortage of transport and fuel hinders the execution of field visits.	4.28	85.6	5
.3	Insufficient financial allocations negatively impact the implementation of disease control programs.	4.31	86.2	3
.4	A lack of veterinary equipment and supplies diminishes the efficiency of disease control efforts.	4.35	87	2
.5	Delays in the provision of vaccines weaken the effectiveness of prevention programs.	4.41	88.2	1
.6	The failure of some livestock owners to adhere to preventive guidelines limits the success of control programs.	4.29	85.8	4
.7	A scarcity of training programs hinders the development of the professional competence of extension and veterinary staff.	4.26	85.2	6
.8	Poor coordination among relevant stakeholders undermines the effectiveness of disease control.	4.16	83.2	8
.9	Difficulties in accessing certain rural areas impede the implementation of field activities.	4.13	82.6	9
.10	The spread of inaccurate information regarding the disease affects the extent to which livestock owners comply with preventive measures.	4.20	84	7

4. Conclusions

1. The overall rating of extension and veterinary services was moderate. Having plans and activities in place is not enough; more attention is needed to how well they are implemented and what they achieve in the field.
2. The context domain received the highest rating and the inputs domain the lowest. A favourable working environment does not guarantee that the staff, equipment and funds needed to run programs efficiently are available.
3. Annual extension planning was the best-rated item and the availability of diagnostic equipment the worst. Planning of preventive activities should be linked to the provision of the technical means needed to carry them out and to respond to suspected cases.
4. Late vaccine delivery, lack of veterinary equipment and supplies, and insufficient funding are .the main constraints, and they weaken the impact of awareness and regulatory efforts
5. The roles of extension and veterinary services are complementary, since farmers' awareness is raised, preventive practice is encouraged and early reporting of suspected cases is promoted by both. However, a reduction in FMD incidence cannot be proven directly by the perceptions of staff about their own role; independent epidemiological data on case numbers and vaccination coverage would be required for such an effect to be confirmed.

5. Recommendations

1. A clear procedure should be established by which vaccine needs are estimated and vaccines are procured and distributed on time, and vaccination campaigns should be followed up against the approved schedule.
2. Priority should be given to the supply of diagnostic equipment and materials, cold-storage facilities for vaccines and other field requirements, in accordance with the actual needs of veterinary units and teams.
3. The budget allocated to FMD control programs should be revised so that vaccines, equipment, transport, fuel, field visits and awareness activities are covered.
4. A formal mechanism for coordination and information sharing should be agreed upon by extension, veterinary services and the other concerned bodies, in which responsibilities, .reporting routes and procedures for handling suspected cases are defined
5. Awareness work should be expanded through seminars, farm visits and traditional and digital media, and attention should be focused on vaccination, early reporting, isolation of suspected animals, quarantine and biosecurity.
6. Performance indicators should be developed for vaccine and equipment supply, the implementation of extension and veterinary activities, the speed of response and the compliance of farmers with preventive measures, and the results of monitoring should be used to adjust future plans.
7. Further studies should be conducted in which the level of program implementation is related to recorded epidemiological indicators (number of cases, vaccination coverage, speed of reporting and response), so that the extent to which disease spread is reduced by these programs can be measured objectively.

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