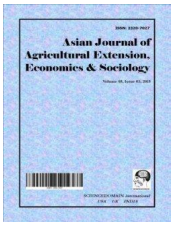

Asian Journal of Agricultural Extension, Economics & Sociology

24(1): 1-8, 2018; Article no.AJAEES.37793
ISSN: 2320-7027

Farmers' Social Network Ascribed to Mobile Phone Agro-Advisory Services of m4agriNEI in Meghalaya, India

R. J. Singh[1*], T. S. Anurag[2], Ram Singh[3], L. Hemochandra[4] and Alethea Dympep[5]

[1]Department of Agricultural Extension Education, School of Social Sciences, College of PG Studies, Central Agricultural University (Imphal), Umiam-793103, Meghalaya, India.
[2]Digital India Corporation, Section 8 Company Under, Ministry of Electronics & IT, Government of India, New Delhi, India.
[3]Department of Agricultural Economics, School of Social Sciences, College of PG Studies, Central Agricultural University (Imphal), Umiam-793103, Meghalaya, India.
[4]Department of Agricultural Statistics, School of Social Sciences, College of PG Studies, Central Agricultural University (Imphal), Umiam-793103, Meghalaya, India.
[5]Department of Agricultural Extension, m4agriNEI, College of PG Studies, Central Agricultural University (Imphal), Umiam-793103, Meghalaya, India.

Authors' contributions

This work was carried out in collaboration between all authors. Authors RJS and TSA designed the study, performed the statistical analysis, wrote the protocol, and wrote the first draft of the manuscript. Authors RS and LH managed the analyses of the study. Author AD managed the literature searches. All authors read and approved the final manuscript.

Article Information

DOI: 10.9734/AJAEES/2018/37793
Editor(s):
(1) Philippos I. Karipidis, Department of Agricultural Technology, Agricultural Economics of Alexander Technological Education Institute of Thessaloniki, Greece.
Reviewers:
(1) U. Barman, College of Agriculture, Assam Agricultural University, India.
(2) Leela Dhar Mangi, Sher-e-Kashmir University of Agricultural Sciences & Technology, India.
Complete Peer review History: http://www.sciencedomain.org/review-history/24052

Original Research Article

Received 10th September 2017
Accepted 29th November 2017
Published 9th April 2018

ABSTRACT

Information related to farm practices is a crucial input for critical decision making by farmers. Social Network Analysis, an innovative analytical tool which provides excellent scope to analyse complex networking system has been applied in the study to explore the invisible nature of communication

**Corresponding author: E-mail: josndri@gmail.com;*

networks between mobile based Agro-Advisory Services (AAS) & farmers and to study the flow of information from farmers to farmers of Umsning block, Ri-Bhoi district of Meghalaya. The social networks of farmers were based on three domains - Crop Production, Crop Protection and Animal Husbandry. Findings reveal that the social network of Crop Production domain and Crop Protection domain is clearly sparse in nature with fragmented components of about 8 and 11 while the social network of Animal Husbandry domain was tightly knit with only two components. The Network Centralization Index values of the three domains were prominently high, implying that the farmers relied on AAS of m4agriNEI.

Keywords: Agro-advisory services; centrality measures; cohesiveness measures; social network analysis.

1. INTRODUCTION

Agriculture continues to be regarded as the backbone of the Indian economy as it shares GVA of 17.3 per cent during 2016-17. Agricultural growth is essential for fostering economic development and feeding the growing population. One component which can boost agricultural production is the contribution of information and knowledge. A majority of farmers in rural areas do not have access to any source of information for advanced agricultural technologies resulting in huge adoption gap. This is owing to inaccessibility of information to the farmers; Information and Communication Technologies (ICTs) therefore can be used as a medium in bridging the information gap. Among the ICTs, mobile communication in agriculture is an emerging field focusing on the empowerment of farming communities in India. It involves application of innovative ways to use Information & Communication Technologies in the rural domain [1] & mobile telephony has emerged as the technology of choice for majority of the urban and even the rural masses [2]. The possession of mobile phones particularly has become a necessity in the contemporary society irrespective of age, status, profession, income groups or place of residence. In this context, mobile phone based Agro-Advisory Services (AAS) can offer the means for development in developing countries [3] by reaching more farmers through easy and timely access to local or global information and knowledge. A mobile phone based AAS functioning vibrantly in hill state of Meghalaya is m4agriNEI.

1.1 Mobile Phone Based Agro-Advisory System in North-East India (m4agriNEI)

The m4agriNEI is an innovative mix of mobile and web applications along with Toll Free IVRS based farmer specific advisory system. There is a mobile interface at the front end for the farmers and web interface at the back end for the agricultural experts. The system allows transmitting the data through voice, text and images from both end (farmer to expert and back). Also, the farmer can call the system to get any information as well as to get the AAS. This system provides the options to the farmer to subscribe for the various information services. Farmer will receive information (SMS/Voice Call/Picture/Video clippings) for only those services for which farmer has subscribed and has an option at a later date to either select some more services or unsubscribe to some of the existing services. The experts at back end (m4agriNEI laboratory with domain expert and virtual experts) can access to the database of the farmers while responding the farmer's queries. Further, designated farmer coordinators and rural youth facilitate the registered farmers in getting farm information and knowledge and also, they provide feedback to the m4agriNEI system. The system is connected to a centralized database, which have information on farmer, farm history and previous interactions. The project – m4agriNEI has been taken up by the Media Lab Asia a section 25 company setup by the Department of Electronics & Information Technology, MeitY, GoI along with the Central Agricultural University, Imphal (CAU, I). The College of Post-Graduate Studies, Umiam, Meghalaya of CAU, I is the prime agency for the implementation of the pilot project in Meghalaya. The project was launched in June, 2012 and is still being successfully implemented till date.

1.2 Problem Statement

In order to ascertain the complex interrelated pattern of the communication network of m4agriNEI, a strong innovative analytical tool is needed which can empower the farmers and agricultural scientist of organizations to reveal the invisible networking patterns feeding an

agricultural development system. Social Network Analysis (SNA) is such an innovative approach, which focuses on the inquiry of a set of actors and a set of relations between them, the ways in which people are connected through various social familiarities ranging from casual acquaintance to close familiar bonds [4,5]. Strong social networks have been shown to improve collaborative governance processes by facilitating the generation, acquisition and diffusion of different types of knowledge and information by overcoming many of the traditional barriers associated with knowledge sharing [6].

There is a need to understand the functioning of communication from m4agriNEI to registered farmers and the communication network from farmer to farmer in order to successfully empower the farmers by providing right information at right time through a mobile phone based AAS. Therefore, the study determines to ascertain the objective: - Ascertaining the centrality and cohesiveness of social.

2. MATERIALS AND METHODS

The present study underscores the social network data on three important domains of AAS under m4agriNEI *viz.,* Crop Production, Crop Protection and Animal Husbandry, as it is supported by Table (1). The SNA generates the sociogram on how the AAS of m4agriNEI are being disseminated and shared within the community in all the three identified domains and subsequently, the identified social networks have been described in terms of network properties. The properties of the three different networks were compared to point out their Communalities and Differences.

2.1 Study Area and Sampling Method

Out of the four project districts *viz.,* Ri-Bhoi, East Khasi Hills, West Khasi Hills and West Jaintia Hills of the state Meghalaya, the Ri-Bhoi district has been purposively selected for the study due to its agricultural importance in the state. Considering the maximum registered farmers under m4agriNEI, the Umsning Community and Rural Development Block (CRDB) of Ri-Bhoi was chosen. Through cluster sampling, three contiguous clusters of villages from Umsning CRDB was finalized and by observing 1:10 ratio estimation. Each 40 registered farmers under domains of Crop Production, Crop Protection and Animal Husbandry respectively, were selected by following snowball sampling in order to constitute 120 respondents for the study.

2.2 Data Analysis

In order to study the characteristics on pattern of distribution of relationship among respondents for sharing of AAS from m4agriNEI, the SNA has been performed using the software UCINET 6.0. The SNA of farmers in the study incorporated the following two measures *viz.,* (1) The 'Centrality Measures' and (2) The 'Cohesiveness Measure'.

The 'Centrality Measures' is studied by examining 'Degree Centrality' and 'Betweenness Centrality'. The 'Degree Centrality' is the row (or column) sums of the adjacency matrix. If d_i is the degree centrality of actor *i* and is the *(i, j)* entry of the adjacency matrix, then $d_i = \sum_j xij$. The 'Betweenness Centrality' of node *j* is given by $b_j = \sum_{i<k} \frac{g_{ijk}}{g_{ik}}$ where g_{ijk} is the number of geodesic paths connecting *i* and *k* through *j,* and g_{ik} is the total number of geodesic paths connecting *i* and *k* [7].

The 'Cohesiveness Measure' is examined by analysing 'Network Density', 'Average Distance', 'Components' and 'Fragmentation'. The 'Network Density' represented by *D* is expressed as $D = \frac{\lambda}{N(N-\lambda)/2}$ where *λ* denotes the total number of lines (ties) present and N is the number of nodes in the network. The 'Average Distance' is the average geodesic distance between two

Table 1. Three identified information domains of AAS under m4agriNEI

Information domain of AAS	Nature of information
Crop production	Scientific Package of Practices of Agricultural & Horticultural Crops, Quality Seed Production, Post-Harvest Management,
Crop protection	Source of Inputs and Finance, Marketing of Produce etc. IPM of crops, vegetables & flowers, Judicious use of agricultural
Animal husbandry	chemicals/pesticides, Rodent control etc. Treatment of zoonotic diseases of animals and poultry birds, Scientific Feeding, Breeding and Health Care Management, Artificial Insemination, Clean Milk Production, Hygienic Meat Production etc.

adjacent actors. A 'Component' is defined as a maximal set of nodes in which every node can reach every other by some path. The 'Fragmentation' denoted by F is explained as, F =1- $\frac{\sum_{i \neq j} r_{ij}}{n(n-1)}$ where is 1 if nodes I and j are in the same component and 0 otherwise [8].

3. RESULTS AND DISCUSSION

The social network data from the respondents in the study was collected by using the pretested semi-structured interview schedule during the month of April 2017 through focus group interview in the selected sites.

3.1 Centrality Measures on Social Network of Registered Farmers of m4agriNEI

Analyzing the 'Centrality Measures' of the social network of respondents, the study has considered the following measures *viz.,* Average In-Degree, Maximum In-Degree, Average Out-Degree, Maximum Out-Degree, Network Centralization Index and Network Betweenness Centrality.

On assaying the data in Table (2) and Fig. (1) and Fig. (3), it could be unveiled that with respect to informative AAS network of farmers on Crop Production domain and Animal Husbandry domain, the respective Average In-Degree and Average Out-Degree were exactly same with values of 2.82 and 2.93 respectively, with Maximum In-Degree values of 7.00 in both domains and Maximum Out-degree values of 4.00 and 32.00 respectively. The findings connoted that on an average each farmer in the identified social network disseminated the information related to both Crop Production and Animal Husbandry domains to around two other farmers and received such information from about two farmers. It could be further, noted that when maximum efforts have been persuaded, a respondent/registered farmer in the social network with respect to Animal Husbandry, could receive informative AAS from seven actors and disseminate to thirty-two actors, while in case of Crop Production domain, they could receive informative AAS from a maximum of seven actors and disseminate to four actors. This implies that farmers were keener to learn or know about information related to livestock or animal husbandry. However, inspecting the Crop Protection domain by referring Table (2) and Fig. (2), the Average In-Degree and Average Out-Degree was 3.11, with Maximum In-degree and Maximum Out-degree values of 10.00 and 5.00 respectively. Hence, in the identified social network of Crop Protection, it could be concluded that informative plant protection AAS are disseminated to around three farmers and received such information from about three farmers. With utmost effort of the respondents, an actor in the social network could receive the informative plant protection AAS from ten actors and disseminate the same to five actors. As the centrality measures are regularly associated with power [9] and innovations in the farming community [10] indicating that those with higher scores on centrality measures tend to be distinctively capable in dissemination of AAS to the actors in the identified social network.

The Network Centralization Index of the three domains *viz.,* Crop Production, Crop Protection and Animal Husbandry with respective values of 10.68 per cent, 18.18 per cent and 13.53 per cent had prominently reflected the limited number of maximum connections in the network. It could be narrated that the farmers in this category relied on a central actor for AAS while performing their agricultural and animal husbandry practices for their livelihood. The sociogram proved the central actor to be m4agriNEI.This, hence paused a risk in the social network of the farmer as when these central actors are removed or disconnected from the network [11] many farmers will be left isolated from the network of agriculture development.

On subsequent examination of the data in Table (2), it could be unveiled that the Network Betweenness Centralization Index value of Crop Production domain was 26.31 per cent which was significantly high. This indicated that there were many information brokers within this social network, thereby many nodes/farmers in the network were connected but as and when these diverse actors are removed or disconnected from the network, many farmers will be substituted. A very low Network Betweenness Centralization Index value of 5.38 per cent and 5.88 per cent was obtained for the social network of Crop Protection domain and Animal Husbandry domain. This indicated that there were few information brokers within the social networks, many nodes in the network were isolated or it might also imply that the network was significantly strong as the nodes had the shortest distance to their information source without any need of an intermediate actor. The resulting

dense networks formed by farmers generate shared understandings that reduce cognitive distance and so enhance the sharing of knowledge [12].

Table 2. Centrality values of the social network of registered farmers of m4agriNEI

Particulars	Measures	Crop production	Crop protection	Animal husbandry
Centralization	Average in-degree	2.82	3.11	2.93
	Maximum in-degree	7.00	10.00	7.00
	Average out-degree	2.82	3.11	2.93
	Maximum out-degree	4.00	5.00	32.00
	Network centralization index	10.68%	18.18%	13.53%
	Network betweenness centralization	26.31%	5.38%	5.88%

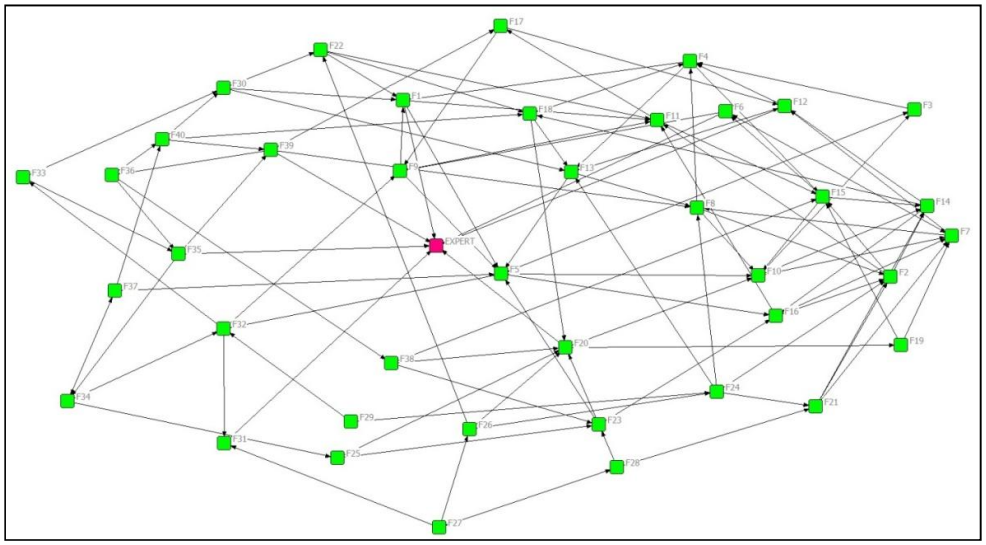

Fig. 1. Social network of farmers in crop production domain

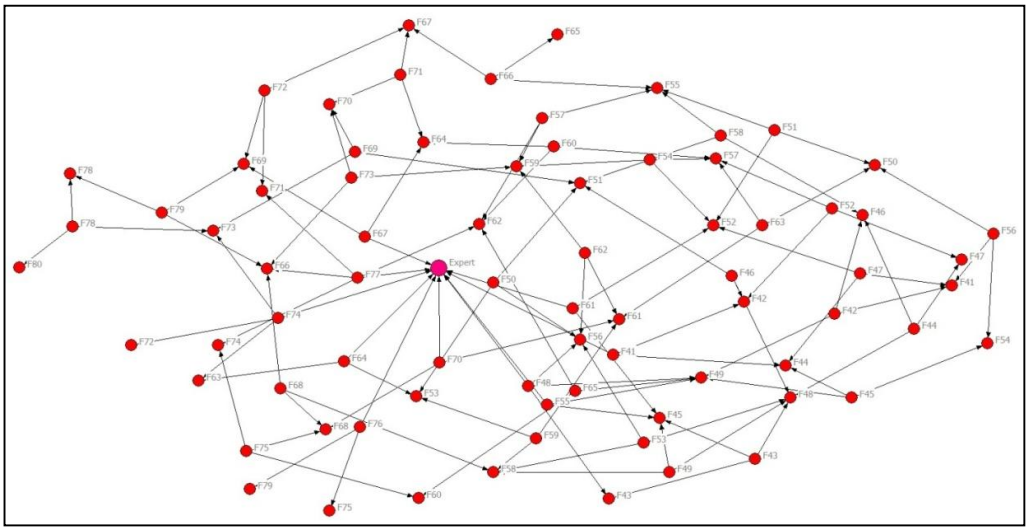

Fig. 2. Social network of farmers in crop protection domain

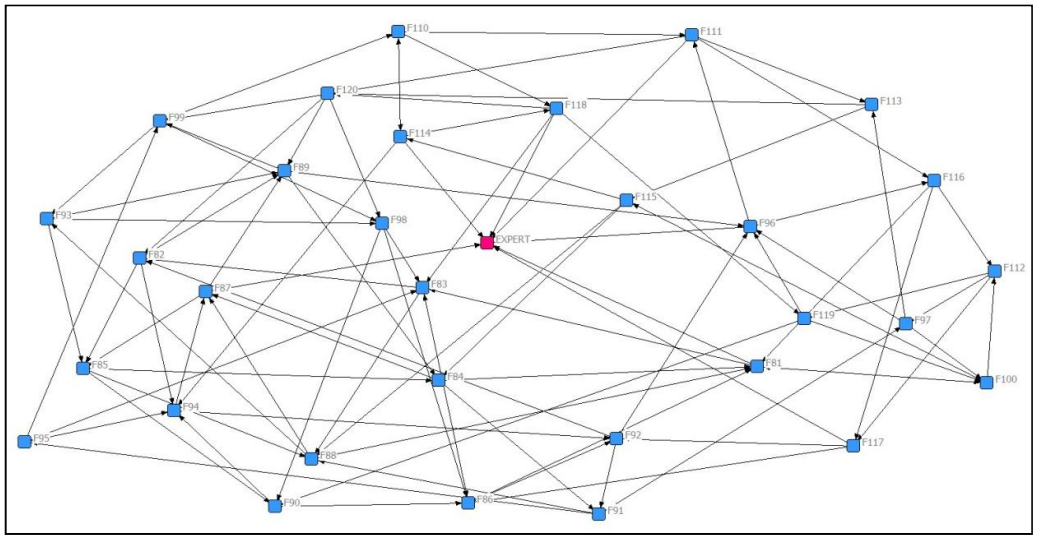

Fig. 3. Social network of farmers in animal husbandry domain

3.2 Cohesion of the Social Network of Farmers of Registered Farmers of m4agriNEI

A keen perusal of Table (3) could reveal that the average geodesic distance in Crop Production was 3.81, which indicated that a farmer, on an average in his/her village had to go though three node or instances in order to gain access to informative AAS on crop production. However, in domains of Crop Protection and Animal Husbandry, the average geodesic distances were 2.87 and 2.99, which revealed that a farmer/an actor on an average in his/her village had to at least parleyed two nodes in order to gain accessed on information to enhance their integrated pests & diseases and livestock management.

Further**,** referring to the same Table (3) could unveil that the identified social networks of farmers in Crop Production, Crop Protection and Animal Husbandry domains showed very low Cohesiveness Density of 0.051, 0.073 and 0.065, respectively. The presence of low Cohesiveness Density implied that there existed slow rate of diffusion of information on securing and enabling environment for development and mainstreaming of sustainable agriculture in overarching agricultural plans at village and farming community levels [13]. This was due to existence of very level of introvertive characters of farmers and low level of cosmopoliteness among the farmers [14].

The identified social networks in Crop Production domain and Crop Protection domain had 8 and 11 components with a fragmentation of 0.17 and 0.36, respectively. While in the Animal Husbandry domain, only 2 components were observed with a fragmentation of 0.03. Thus, the social networks of farmers in Crop Production domain and Crop Protection domain were more scattered when compared to that in Animal Husbandry domain [15].

The social network of the farmers in the three domains did not present a good structure for imparting information and that the communication between farmers from different settlements could be improved by means of integrating facilitators considering the spatial

Table 3. Cohesion values of the social network of farmers of registered farmers of m4agriNEI

Particulars	Measures	Crop production	Crop protection	Animal husbandry
COHESION	Average geodesic distance	3.81	2.87	2.996
	Density	0.071	0.073	0.095
	Components	8	11	2
	Fragmentation	0.17	0.36	0.03

distribution of the farmers and motivating the adherence of farmers in seeking agricultural information from m4agriNEI.

4. CONCLUSION

Information is one of the most important inputs of livelihood sustenance and communication networks play an important role in sharing this information in rural society. Efficient flow of information related to farming ensures that social learning process in the community gets going and results in adoption of innovations. The present study explored the nature of communication networks related to agriculture and allied sectors in terms of three information domains - Crop production, Crop protection and Animal Husbandry. The social network of Crop Production domain and Crop Protection domain was clearly sparse in nature with fragmented components while the social network of Animal Husbandry domain was tightly knit. The social network can be improved with the involvement of more farmer coordinators at the field level in disseminating information. The information networks at the grassroots, if plotted carefully, can act as an important input to mobile phone based AAS of m4agriNEI in reaching client system more efficiently. By understanding the information and social networks of the farmers on receiving and accepting the AAS, agricultural and allied extension professionals can promote a strategy for fast diffusion and adoption of innovations on agricultural and allied practices. The present study commends that capacity building on effective communication of scientific AAS by actors having higher centrality scores will significantly enhance the effective and efficient flow of information in the social networks of farmers.

COMPETING INTERESTS

Authors have declared that no competing interests exist.

REFERENCES

1. Prabha D, Arunachalam R. Pattern of mobile agro advisory services offered by public service provider among the farmers of Tamil Nadu. International Journal of Agriculture Sciences. 2017;22(9): 4254–56.
2. Ansari MA, Pandey AK. Empowering and enabling farmers: A case study of e-chaupal in Uttarakhand. Proceedings of international conference on development communication in the era of globalization at Chennai, India; 2013.
3. Rashid AT, Elder L. Mobile phones and development: An analysis of IDRC-supported projects. Electronic Journal of Information Systems in Developing Countries. 2009;36(2):1-16.
4. Wasserman S, Faust K. 2nd ed. Social network analysis, Cambridge University Press; 1994.
5. Hanneman RA, Riddle M. Introduction to social network methods, riverside, CA: University of California, riverside, 2005. Accessed 2 July 2017.
   Available:http://faculty.ucr.edu/hanneman/
6. Bodin Ö, Norberg J. Information network topologies for enhanced local adaptive management. Environmental Management. 2006;35(2):175–193.
7. Borgatti SP. Centrality and AIDS. Connections. 1995;18:112–114.
8. Spielman DJ, Davis K, Negash M, Ayele G. Rural innovation systems and networks: Findings from a study of Ethiopian smallholders. Agric Hum Values. 2011;28: 195–212.
9. Moschitz H, Stolze M. Organic farming policy networks in Europe: Context, actors and variation. Food Policy. 2009;34: 258–264.
10. Newman M. Networks: An introduction. 2nd ed. Oxford University Press; 2010.
11. Isaac ME, Erickson BH, Quashie-Sam SJ, Timmer VR. Transfer of knowledge on agroforestry management practices: The structure of farmer advice networks. Ecol Soc. 2007;12:32.
12. Nooteboom B, Stam E, editors. Collaboration, trust, and the structure of relationships. In: Micro-foundations for innovation policy. Amsterdam: Amsterdam University Press; 2008.
13. Ganesan M, Kavitha Karthikeyan, Suma Prashant, Jayalakshmi Umadikar. Use of mobile multimedia agricultural advisory systems by Indian farmers: Results of a survey. Journal of Agricultural Extension and Rural Development. 2013;5(4):89-99.
14. Madan Singh R, Roy Burman, Sharma JP, Sangeetha V, Iquebal MA. Constraints

faced in mobile based agro-advisory services and strategy for enhancing the effectiveness of mKRISHI. Indian Research Journal of Extension Education. 2015;15(2):119-122.

15. Prabha D, Arunachalam R. Farmers preferences for mobile agro advisory services. Journal of Extension Education. 2017;29(1):5811-17.

Peer-review history:
The peer review history for this paper can be accessed here:
http://www.sciencedomain.org/review-history/24052