

Original Research Article

<https://doi.org/10.20546/ijcmas.2019.811.144>

Constraints and Suggestions Expressed by Head Reach and Tail-End Farmers for Participation in Effective Canal Irrigation Management

Akkamahadevi Naik*, M. Shivamurthy and N. S. Shivalinge Gowda

Department of Agricultural Extension, University of Agricultural Sciences,
GKVK, Bengaluru- 560065, India

*Corresponding author

ABSTRACT

Present study was conducted in Krishna Command Area at Vijayapura, Kalaburagi and Yadgiri districts of Karnataka to identify the constraints and suggestions expressed by the head reach and tail-end farmers for participation in effective canal irrigation management. Data was collected through personal interview method from eight Water Users Cooperative Societies (WUCS) farmers. Results indicated that, major constraints expressed by the head reach farmers were inadequate training programmes conducted by WUCS, lack of knowledge on integrated crop management, lack of adequate fund from Govt. to improve irrigation structure and groupism and political interference. Similarly the major constraints expressed by the tail-end farmers viz., lack of cooperation and support from irrigation department, obstruction to water flow from upper reach, lack of adequate fund from Govt. to improve irrigation structure and groupism and political interference. These constraints can be overcome by implementing the suggestions as expressed by the head reach farmers like; conduct adequate training programmes on water management, providing information on integrated crop management practices, providing adequate fund from Govt. to improve irrigation structure and participation of farmers for conserving water. Similarly the suggestions expressed by the tail-end farmers were proper cooperation and support from irrigation department, coordination/understanding among the farmers to share water, providing adequate funds from Govt. to improve irrigation structure and giving equal importance given to all members of WUCS.

Keywords

Constraints,
Suggestions,
Farmers'
participation, Canal
irrigation
management

Article Info

Accepted:
10 October 2019
Available Online:
10 November 2019

Introduction

Rain fall is considered as one of the most supreme source of water, if it is timely and adequately received. But rainfall pattern in India is erratic, varies in different regions, irregular and prominently seasonal. Rainfall extremities in India badly affect the

agriculture. The uncertain nature of rainfall in India makes it essential to provide an insurance against crop failure through assured irrigation facilities, thus irrigation plays a crucial role in maintaining the food security in India. Out of the total area under irrigation, 40 per cent area irrigated by canals, 40 per cent by wells or tube wells and 12 per cent by tanks

and the rest 8 per cent of land are irrigated by other methods (Anon., 2017). Further, 25-30 per cent of water can be saved without reducing the yield by adopting efficient water management practices. But, it often happens that the water available in the command areas is prone to mismanagement at farm level. This is primarily due to the lack of knowledge of farmers on the exact water requirements & appropriate irrigation schedules and the availability of water in the canal is unequally shared among the farmers. The farmers at the head reach, because of their locational advantage use more irrigation water than their share. Consequently farmer at the tail-end location are deprived of their due share. This eventually leads to conflict among the farmers and there is a widening gap exists between the head reach and tail-end farmers. Thus filling the gap between these two is an emerging challenge in command areas. Efforts have been made to organize farmers in groups like Water Users Associations (WUAs). So that farmers themselves can solve their problems related to water sharing, repairing of field channels and collection of water taxes *etc.* Keeping these issues, the present study was conducted to identify the constraints and suggestions expressed by the farmers for effective water management.

Materials and Methods

The study was conducted in Vijayapura, Kalaburagi and Yadgiri, districts of Karnataka state, these districts were purposively selected, since these three districts have maximum net irrigated area and irrigated by Narayanpur Left Bank Canal (NLBC) in Krishna Command Area. Narayanpur Left Bank Canal consisting of five branch canals, however for the purpose of the study, two branches *viz.*, Shahapur Branch Canal and Indi Branch Canal were purposively selected, since these two branches comprise of maximum number of Water User Cooperative Societies under NLBC.

Based on the longest length, two distributories *viz.*, Shahapur Branch Canal (SBC D-6, 36km) and another one from Indi Branch Canal (IBC D-11, 39.38km) were purposively selected. Thus, from Distributory-6, Bommanalli, Wandurga, Chandlapur and Hemnur WUCS were randomly selected, and from Distributory-11, Kakkalmeli, Kulekumatagi, Belur and Ankalaga WUCS were selected. From each WUCS, 25 farmers were selected for the study. Thus, from each distributory *i.e.*, from IBC D-11, 50 farmers from head reach and 50 tail-end farmers were selected. Similarly, from SBC D-6, 50 head reach and 50 tail-end farmers were selected for the study. Thus, the total sample constitutes 200 farmers (*i.e.*, 100 head reach and 100 tail-end farmers). The details of the number of WUCS and farmers selected for the study are presented in Table 1.

Results and Discussion

The farmers were asked to state the constraints which they faced for participation in effective canal irrigation management. The constraints expressed by the head reach and tail-end farmers were noted and categorized in four groups namely constraints related to WUCS, water availability and utilization, Govt. policies and other constraints.

Constraints faced by the head reach farmers for participation in effective canal irrigation management

It is observed from Table 2 that, the major constraints faced by the head reach farmers were inadequate training programmes conducted by WUCS which ranks first followed by lack of technical guidance (Rank II), lack of awareness about the functions of WUCS (Rank III), lack of cooperation and support from irrigation department (Rank IV), lack of efforts by the officials to efficient distribution of water (Rank V) and

incapability of the committee to solve water disputes (Rank VI) were the major constraints related to WUCS. The reason might be that many training programmes conducted by irrigation department, were supply driven rather than demand driven training programmes and officials were not having technical knowledge for operating the irrigation structures.

Similarly constraints related to water availability and utilization like lack of knowledge on integrated crop management practices which stands first followed by growing more water consuming crops (Ranks II), obstruction to water flow from upper lateral farmers (Ranks III), lack of information on releasing water among the users (Ranks IV), lack of cooperation among the farmers to share the water (Ranks V) and poor maintenance of field channel (Ranks VI). Farmers are growing high water consuming crops like paddy and sugarcane and violate to follow the recommended cropping pattern and most of the upper lateral farmers keep the barriers to flow the water to their neighboring farmers field.

Lack of adequate fund from Govt. to improve irrigation structure (Rank I) followed by lack of grass root level planning (Rank II), not to follow warabandi schedule (Rank III), high water charges (Rank IV) and lack of transparency in planning and implementation (Rank V) were the major constraints related to Govt. policies.

When distributories and field channels under the repair and maintenance, farmers expect that Govt. has to sanction the fund for maintenance of irrigation structure but officials will expect that farmer has to take care of the repair and maintenance of the field channels and another reason might be that many farmers irrigate the land throughout a day without following warabandi schedule.

Regarding other constraints like groupism and political interference was ranks first, followed by lack of initiation and motivation among the farmers (Rank II), illiteracy of the farmers (Rank III), lack of free time to participate (Rank IV), lack of trust on office bearers (Rank V) and lack of motivation from village leaders (Rank VI). The possible reason might be that based on the background of the farmers, dominance and strong political groups in the villages, farmers get more water as compare to other farmers and most of the farmers hesitate to come forward to ask their justice on irrigation water and due to the low literacy level, farmers facing the difficulty to understand the rules and regulation of WUCS. The findings of the study are in conformity with the findings of Mohite *et al.*, (1992).

Constraints faced by the tail-end farmers for participation in effective canal irrigation management

It is observed from Table 3 that, the major constraints related to WUCS faced by the tail-end farmers were lack of cooperation and support from irrigation department stands first rank followed by incapability of the committee to solve water disputes (Rank II), lack of efforts by the officials to efficient distribution the water (Rank III), inadequate training programmes conducted by WUCS (Rank IV), lack of awareness about the functions of WUCS (Rank V) and lack of technical guidance (Rank VI).

The reason might be that office bearers complain on farmers that farmers not come forward to discuss with them regarding water issues and farmers will expect that officers should come and discuss to solve the water dispute, therefore there is lack of understanding/coordination between the higher authority and farmers, many societies were failed to equal distribution of water

among the farmers for that reason there might be always conflict between farmers.

Constraints related to water availability and utilization *viz.*, obstruction to water flow from upper reach farmers ranks first followed by lack of knowledge on integrated crop management practices (Rank II), lack of information on releasing water among the users (Rank III), poor maintenance of field channel (Rank IV), lack of cooperation among the farmers to share the water (Rank V) and growing more water consuming crops (Rank VI). Most of the upper reach/head reach farmers located first under the irrigation source, thus they utilize more water as compared to tail-end farmers.

Many times farmers were not aware about the information on water releasing date and time and other reason might be that farmers unable to maintain the irrigation structures due to the frequent destruction from users. They had attributed to lack of proper control on irrigation, especially at night time.

The constraints related to Govt. policies were lack of adequate fund from Govt. to improve irrigation structure which ranks first followed by high water charges (Rank II), not following of warabandi schedule (Rank III), lack of grass root level planning were ranked (Rank IV) and lack of transparency in planning and implementation (Rank VI).

This is due to the reason that Govt. not sanctioning fund on time for repair and maintenance of irrigation structure and farmers also expressed that high irrigation charges, in spite of paying water charge equally as the head reach farmers, they were not getting sufficient water and other reason like head reach farmers irrigate his field overnight without following warabandi schedule. The findings of the study are in

conformity with the findings of Gumaste *et al.*, (1993), Dhillon and Hansra (1995), Anand *et al.*, (1998), Golyanaik (2008), Umamaheshwara (2009) and Dabhi *et al.*, (2010).

Other constraints expressed by the farmers *viz.*, groupism and political interference stands first rank followed by lack of trust on office bearers (Rank II), lack of initiation and motivation among the farmers (Rank III), lack of free time to participate (Rank IV), illiteracy of the farmers (Rank V) and lack of motivation from village leaders (Rank VI). Due to the high political influence and groupism in the village, many tail-end farmers were not getting the justice to share equal amount of water. Majority of the upper reach farmers use motors and pump sets to draw out more water to their fields. The findings of the study are in conformity with the findings of Dhillon and Hansra (1995), Anand *et al.*, (1998), Singh (2000), Shah (2001) and Umamaheshwara (2009).

Suggestions expressed by the head reach farmers in effective canal irrigation management

The data from Table 4 observed that suggestions expressed by head reach farmers to overcome the constraints on participation in effective canal irrigation management.

Suggestions related to Water Users Cooperative Societies *viz.*, to provide adequate training programmes on water management which ranks first, followed by provide awareness about the functions of WUCS (Rank II), proper cooperation and support from irrigation department (Rank III), timely provide the technical guidance (Rank IV), committee leader has to take lead to solve water disputes (Rank V) and timely distribution of water (Rank VI).

Table.1 Selection of water users cooperative societies and respondents for the study

Sl. No.	District	Distributories	Taluk	WUCS	No. of respondents
1	Yadgiri	SBC D-6	Sorpur	Bommanalli	25
				Chandlapur	25
				Hemnur	25
			Shahapur	Wandurga	25
2	Vijayapura	IBC D-11	Sindagi	Kakkalameli	25
				Kulekumatagi	25
3	Kalaburagi		Jewargi	Belur	25
				Ankalaga	25
Total	3	2	4	8	200

Table.2 Constraints faced by head reach farmers in effective canal irrigation management in Krishna Command Area

(n1=100)

Sl. No.	Constraints	Always f (%)	Somewhat f (%)	Never f (%)	Rank
I. Related to WUCS					
1	Lack of technical guidance	65	29	6	II
2	Inadequate training programmes conducted by WUCS	77	15	8	I
3	Incapability of the committee to solve water disputes	26	33	41	VI
4	Lack of cooperation and support from irrigation department	53	32	15	IV
5	Lack of awareness about the functions of WUCS	62	26	12	III
6	Lack of efforts by the officials to efficient distribution of water	40	31	29	V
II. Related to water availability and utilization					
7	Obstruction to water flow from upper lateral farmers	53	36	11	III
8	Lack of information on releasing water among the users	42	30	28	IV
9	Poor maintenance of field channel	31	7	62	VI
10	Growing more water consuming crops	59	29	12	II
11	Lack of cooperation among the farmers to share the water	38	33	29	V
12	Lack of knowledge on integrated crop management practices	62	29	9	I
III. Related to Govt. policies					
13	High water charges	28	32	40	IV
14	Lack of grass root level planning	48	35	17	II
15	Lack of adequate fund from Govt. to improve irrigation structure	52	33	15	I
16	Not following of warabandi schedule	46	41	13	III
17	Lack of transparency in planning and implementation	4	29	67	V
IV. Other constraints					
19	Lack of motivation from village leaders	10	37	53	VI
20	Lack of free time to participate	36	21	43	IV
21	Groupism and political interference	56	32	12	I
22	Lack of initiation and motivation among the farmers	52	31	17	II
23	Illiteracy of the farmers	48	20	32	III
24	Lack of trust on office bearers	12	32	56	V

*f=frequency

Table.3 Constraints faced by tail-end farmers in effective canal irrigation management in Krishna Command Area

(n2=100)

Sl. No.	Constraints	Always	Somewhat	Never	Rank
		f (%)	f (%)	f (%)	
I. Related to WUCS					
1	Lack of technical guidance	47	30	23	VI
2	Inadequate training programmes conducted by WUCS	56	34	10	IV
3	Incapability of the committee to solve water disputes	77	18	5	II
4	Lack of cooperation and support from irrigation department	78	20	2	I
5	Lack of awareness about the functions of WUCS	51	41	8	V
6	Lack of efforts by the officials to efficient distribution the water	65	30	5	III
II. Related to water availability and utilization					
7	Obstruction to water flow from upper reach farmers	69	22	9	I
8	Lack of information on releasing water among the users	53	37	10	III
9	Poor maintenance of field channel	45	29	26	IV
10	Growing more water consuming crops	5	21	74	VI
11	Lack of cooperation among the farmers to share the water	30	42	28	V
12	Lack of knowledge on integrated crop management practices	56	26	18	II
III. Related to Govt. policies					
13	High water charges	68	22	10	II
14	Lack of grass root level planning	42	20	38	IV
15	Lack of adequate fund from Govt. to improve irrigation structure	83	13	4	I
16	Not following of warabandi schedule	54	32	14	III
17	Lack of transparency in planning and implementation	35	28	37	V
IV. Other constraints					
19	Lack of motivation from village leaders	21	38	41	VI
20	Lack of free time to participate	32	18	50	IV
21	Groupism and political interference	63	35	2	I
22	Lack of initiation and motivation among the farmers	47	31	22	III
23	Illiteracy of the farmers	25	32	43	V
24	Lack of trust on office bearers	58	32	10	II

*f=frequency

Table.4 Suggestions expressed by the head reach farmers in effective canal irrigation management in Krishna Command Area

(n1=100)

Sl. No.	Suggestions	Yes	No	Rank
		f (%)	f (%)	
I. Related to WUCS				
1	Timely provide the technical guidance	56	44	IV
2	Adequate training programmes on water management	71	29	I
3	Committee leader has to take lead to solve water disputes	51	49	V
4	Proper cooperation and support from irrigation department	57	43	III
5	Provide awareness about the functions of WUCS	69	31	II
6	Timely distribution of water	45	55	VI
II. Related to water availability and utilization				
7	Coordination/understanding among the farmers to share water	25	75	V
8	Providing prior information on releasing water	58	42	III
9	Proper maintenance of field channel	34	66	IV
10	Growing less water consuming crops	62	38	II
11	Provide information on integrated crop management practices	87	13	I
III. Related to Govt. policies				
12	Minimize water charge	38	62	V
13	Involve the farmers in planning stage	72	28	II
14	Adequate fund from Govt. to improve irrigation structure	85	15	I
15	Announcement to strictly follow the warabandi schedule	64	36	III
16	Transparency in planning and implementation	47	53	IV
IV. Other suggestions				
17	Motivation from the village leaders	61	39	IV
18	Participation is require to conserve water	91	9	I
19	Equal importance given to all members	76	24	III
20	Initiation and motivation from the farmers	42	58	V
21	Create awareness and interest on the educational programme	87	13	II

*f=frequency

Table.5 Suggestions expressed by the tail-end farmers in effective canal irrigation management in Krishna Command Area

(n2=100)

Sl. No.	Suggestions	Yes	No	Rank
		f (%)	f (%)	
I. Related to WUCS				
1	Timely provide the technical guidance	86	14	IV
2	Adequate training programmes on water management	91	9	III
3	Committee leader has to take lead to solve water disputes	79	21	VI
4	Proper cooperation and support from irrigation department	100	0	I
5	Provide awareness about functions of WUCS	83	17	V
6	Timely distribution of water	93	7	II
II. Related to water availability and utilization				
7	Coordination/understanding among the farmers to share water	95	5	I
8	Providing prior information on releasing water	76	24	II
9	Proper maintenance of field channel	38	62	V
10	Growing less water consuming crops	47	53	IV
11	Provide information on integrated crop management practices	62	38	III
III. Related to Govt. policies				
12	Minimize water charge	91	9	III
13	Involve the farmers in planning stage	80	20	IV
14	Adequate fund from Govt. to improve irrigation structure	97	3	I
15	Announcement to strictly follow the warabandi schedule	95	5	II
16	Transparency in planning and implementation	76	24	V
IV. Other suggestions				
17	Motivation from the village leaders	70	30	IV
18	Participation is require to conserve water	76	24	II
19	Equal importance given to all members	84	16	I
20	Initiation and motivation from the farmers	72	28	III
21	Create awareness and interest on the educational programme	65	35	V

*f=frequency

The results indicated that the adequate and need based training programmes and awareness on functions of WUCS help the farmers to take up appropriate measures to conserve irrigation water and timely distribution of water encourage the farmers to

irrigate their field crop at the critical stage thus farmers may get good yield and income.

Suggestions related to water availability and utilization *viz.*, majority of the farmers expressed to provide information on integrated crop management practices was ranked first followed by growing less water consuming crops (Rank II), providing prior information on releasing water (Rank III), proper maintenance of field channel (Rank IV) and coordination/understanding among the farmers to share water (Rank V).

The results indicated that majority of the farmers lacking knowledge on integrated crop management practices therefore more field visits and demonstrations to be conducted to the farmers, hence farmers can imbibe the knowledge on integrated crop management practices and grow less water consuming crops to save the water and team to supervise and monitor the repair works. The findings of the study are in conformity with the findings of Hasmukh and Lokesh (2016).

With respect to Govt. policies majority of the farmers suggested that adequate fund from Govt. to improve irrigation structure was ranks first followed by involve the farmers in planning stage (Rank II), announcement to strictly follow the warabandi schedule (Rank III), transparency in planning and implementation (Rank IV) and minimize water charge (Rank V). The results indicated that Govt. should sanction the adequate fund on time for repair and maintenance thus farmers involve in cleaning irrigation structure prior to monsoon, hence that helps all the farmers to get water and frequently held the group meetings therefore all the farmers discuss about the planning and implementation activities.

Other suggestion *viz.*, participation is require for conserving water which ranked first

followed by create awareness and interest on the educational programme (Rank II), equal importance given to all members (Rank III), motivation from the village leaders (Rank IV) and initiation and motivation from the farmers (Rank V). Conducting exposure visits for the farmers, thus they can learn the other water conservation practices and insist them to go for water saving technologies (drip/sprinkler irrigation method) and also it is necessary to consider all the members/farmers are equal in group for sharing available water. The findings of the study are in conformity with the findings of Mohan and Rameshkumar (2013).

Suggestions expressed by the tail-end farmers in effective canal irrigation management

The data from Table 5 revealed that suggestions expressed by the tail-end farmers to overcome the problems for participation in effective canal irrigation management.

Tail-end farmers were expressed suggestions related to WUCS *viz.*, proper cooperation and support from irrigation department which ranks first, followed by timely distribution of water (Rank II), adequate training programmes on water management (Rank III), timely provide the technical guidance (Rank IV), provide awareness about the functions of WUCS (Rank V) and committee leader has to take lead to solve water disputes (Rank VI). The results indicated that unequal distribution of water creates conflict among the farmers, therefore committee leader has to take the lead because in villages most of the farmers believe the village leader rather than office bearer. Timely distribution of water helps the tail-end farmers to get good yield. The officials should frequently visit the societies and discuss with farmers and provide awareness on WUCS function, hence the farmers come to know his/her responsibility as a member of WUCS.

Majority suggestions related to water availability and utilization were proper coordination/understanding among the farmers to share water was ranks first followed by providing prior information on releasing water (Rank II), provide information on integrated crop management practices (Rank III), growing less water consuming crops (Rank IV) and proper maintenance of field channel (Rank V). The results indicated that as discussed in earlier, the tail-end farmers receive less water compared to head reach farmers, therefore based on their mutual understanding the farmers as to share the water, hence everybody can access canal water. Majority of the farmers practicing the mono cropping system, therefore it is necessary to provide information on integrated crop management practices by conducting training programmes.

With respect to Govt. policies majority of the farmers suggested that adequate fund from Govt. to improve irrigation structure stands first followed by announcement to strictly follow the warabandi schedule (Rank II), minimize water charge (Rank III), and involve the farmers in planning stage (Rank IV) and transparency in planning and implementation (Rank V).

The results indicated that adequate supply of fund from the Govt. help the farmers to maintain the field irrigation channels prior to monsoon and one farmer as to irrigate at day time and neighboring farmers irrigate at night time that helps all the farmers to access the irrigation facility and water charges should be collected based on the farmers location and amount of water used.

Other suggestions like equal importance given to all members which ranks first followed by participation is require to conserve water (Rank II), initiation and motivation from the farmers (Rank III), motivation from the village leaders (Rank IV) and create

awareness and interest on the educational programme (Rank V). The results indicated that there should not be any discrimination based on their background, hence equal importance to be given to all the member of WUCS and all should come forward and take initiation to conserve the excess water by following appropriate water saving measures. The findings of the study are in conformity with the findings of Hasmukh and Lokesh (2016) and Mohan and Rameshkumar (2013).

It can be concluded that, the major constraints expressed by the head reach and tail-end farmers *viz.*, inadequate training programmes conducted by WUCS, lack of awareness about the functions of WUCS, lack of knowledge on integrated crop management practices, obstruction to water flow from upper reach farmers, lack of adequate fund from Govt. to improve irrigation structure and groupism and political interference. Therefore the important suggestions expressed by the farmers like to conduct adequate training programmes on water management followed by create awareness on the functions of WUCS, to provide information on integrated crop management practices and sanction adequate fund from Govt. to improve irrigation structure and equal importance to be given to all members of the WUCS.

References

- Anand, S. K., Srinivas, A. and Raju, M. S., 1998, Constraints faced by farmers in adoption of water management technologies in Sri Ram Sagar Project Command area. *Maharashtra. J. Extn. Edu.*, 14: 352-354.
- Anonymous, 2017, Irrigated agriculture development under drought and water scarcity, International Commission on Irrigation and Drainage (ICID.CIID).
- Dabhi, R. A., Soni, N. V. and Patel, J. K., 2010, Problems Faced By The

- Members Of Participatory Irrigation Management Society. *Guj. J. Extn. Edu*, 103-106.
- Dhillon, D. S. and HANSRA, B. S., 1995, People's Participation in Rural Development Programmes, Kurukshetra, 43 (4): 7-9.
- Golyanaik, R., 2008, People's participation in watershed development programme and its impact. *Ph.D. Thesis* (Unpub.), Univ. Agric. Sci. Bangalore.
- Gumaste, A. K., Patil, H. N. and Nirban, A. J., 1993, Constraints in utilisation of water under minor irrigation projects in Konkan. *Maharashtra. J. of Extn. Educ*, 12: 373-375.
- Hasmukh, P. D. and LOKESH, J., 2016, Study of Participatory Irrigation Management (PIM) system and its impact on Sustainable development of Tribal Community, (A case of Ver Medium Irrigation Project in Mandvi Taluka of Surat District in South Gujarat), Knowledge Consortium of Gujarat (KCG)-portal.
- Mohan, K. and Rameshkumar, P. R., 2013, Farmers' suggestions for Better Participatory Management of Tank Irrigation System. *J. Res. ANGRAU* 41 (3) 97-99.
- Mohite, S. M., Ankush, G. S. and Nandapurkar, G. G., 1992, Constraints in the use of canal irrigation water. *Maharashtra J. ExtnEdu*, 11: 263-267.
- SHAH, A. C., 2001, The Deprived in a Command Area of an Irrigation System, Development Support Centre, Ahmedabad.
- Singh, J. P., 2000, Economic Evaluation of Manchal Watershed. Manage, Rajendranagar, Hyderabad.
- Umamaheshwara, M. S., 2009, A study on community participation in irrigation tank management in Haveri district. *Ph.D. Thesis (Unpub.)*, Univ. Agric. Sci. Dharwad.

How to cite this article:

Akkamahadevi Naik and Shivamurthy, M. 2019. Constraints and Suggestions Expressed by Head Reach and Tail-End Farmers for Participation in Effective Canal Irrigation Management. *Int.J.Curr.Microbiol.App.Sci*. 8(11): 1227-1237. doi: <https://doi.org/10.20546/ijcmas.2019.811.144>