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Best soil comanagement practices for two watersheds in Germany and Iran using game theory-based approaches

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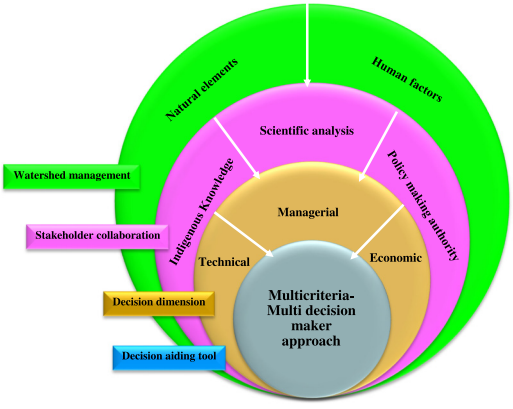
HIGHLIGHTS

- Collaborative management facilitates identification of key stakeholders.
- Game theory based methods simplified the analysis of stakeholders' conflict.
- Technical preferences and key stockholders were dissimilar in Iran and Germany.

GRAPHICAL ABSTRACT



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ABSTRACT

Collaborative management is increasingly applied to indicate environmental and socio-economic negotiations in every corner of the world. The engagement of multiple stakeholders accompanying experience, science, and economy probing skills is expected to unravel such issues. However, the collaborative approaches to manage existing issues at watershed scale have not been adequately applied. Therefore, the present study has exemplified the establishment of a comanagement framework for the soil management for two case studies i.e., Schleswig-Holstein State of Germany and Galazchai Watershed of Iran using a stakeholder oriented approach applying game theory based methods. Due to management perspectives, different stakeholder groups were involved to investigate effective soil conservation practices. Farmers, consultants, and service providing companies in Germany and residents, policy making institutions and executive organizations in Iran were detected as key stakeholders. The Condorcet and Fallback bargaining methods were used to diagnosis agreement point. Based upon the results, the developed case study in Germany demonstrated close relation among farmers and consultants (53%) in contrast with service providing companies. The same situation was observed among residents and policy makers in Iran. Besides, the tendency to implement mechanical practices among

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farmers in Iran was about 60% (149 of 243), however, in Germany 86% of farmers prefer to use managerial practices.

1. Introduction

Over past decades natural resources were based on state-oriented and top bottom solutions i.e., technical, funding or inhabitation facilities. Through such approaches, policy making and technical experts were supposed to have main roles in problem diagnosis and solving by strict plans on land use, water allocation, soil management and water pollution (Pahl-Wostl et al., 2012; Chervier et al., 2017). Thereupon, state-driven solutions failed in deliberation of sophisticated natural phenomena. Therefore, update version for socio-economic elements cognition was established. In this vein, the innovative approach focused on stakeholder engagement in planning, implementation, policy making review and monitoring processes (McGinnis and Ostrom, 2014).

Natural resources instinct emphasizes the need for integrated and collaborative comportments for sustainable management. Collaborative approaches has been found to be a drastic methodology to provide stakeholder involvement and multi-dimensional analysis of common resources (Biddle and Koontz, 2014; Inam et al., 2015). Such a claim is confirmed in various studies on natural disaster management (Seaberg et al., 2017), soil and water conservation (Bewket and Sterk, 2002), environmental problems (Israngkura et al., 2006), sediment control (Gajbhiye et al., 2014), watershed management (Koontz and Jens, 2014), land claims (Cundill et al., 2013) and water pollution control (Üçler et al., 2015; Thomas, 2017). All results verified durability of success and promotion of management acceptance. However, simplicity and transparency of method caused significant public acceptance. Therefore, stakeholder friendly methods were in priority. Despite mentioned merits, in some cases comanagement encountered barriers including perspective change of stakeholders over the time, change in priorities due to new entrants to the community and variability of socio-economic conditions (Cundill et al., 2013; Hasler, 1993). Besides, realizing in which condition bottom-top (comanagement) manner helps to solve environmental and economic issues simultaneously, was also found difficult (Meynen and Doornbos, 2004).

Impressive and passive stakeholders individually or in groups depending on intended issue will be different. Likewise, the cultural context, the extent of development in target community, and the method of decision making are significant elements in determination of stakeholders (Halbe et al., 2018). Development of a collaborative framework creates an appropriate context to coordinate multiple needs, interests and subjective perceptions and finally leads to knowledge examine and problem solving decision (Pahl-Wostl et al., 2007). Based on numerous studies (Carter et al., 1999; Morrison, 2003; Winz et al., 2009; Metcalf et al., 2010; Hare, 2011; Chervier et al., 2017) there are profound obstacles to execute collaborative modeling in both developing and developed countries. Barriers could be generated because of limited skills and knowledge of stakeholders (e.g., agencies, residents, implementers, and consultants), relatively high expenses and time-consuming of procedure (Halbe et al., 2018). Because collaborative approaches in natural resources management eventuate benefits in long term periods, hence, convincing of supporter organizations and other participators decelerate progress pace. Finally, after formulation of model and selection of proper alternatives, adaption of results in complex system of nature would be difficult. However, the merits of such a prosperous approach alleviate all hindrances (Voinov and Bousquet, 2010; Adhami et al., 2018; Mustonen and Feodoroff, 2018).

In addition to mentioned merits of collaborative management in problem solving procedure, facilitation of Best Management Practices (BMPs) suggestion, design, and implementation are reported as well (Gianotti and Duane, 2016). The lag time between implemented BMPs and measurable improvements in agricultural and natural resources fields often occurs at rates incompatible with political agendas. Thereby, policy makers frequently have to make decisions without complete data (Biddle and Koontz, 2014). Stakeholder participation as a live archive of experimental data, evaluates efficiency of practices and economic aspects simultaneously. Prosperity of collaborative management in BMPs presentation and accomplishment was reported frequently (Campbell et al., 2011; Rashid and Sahu, 2014). Such a success includes participation of both agricultural and natural field's users. On the other hand the most of the studies focused on the effective variables on BMPs adaption. Camboni and Napier (1995) summarized findings from the social science literature on conservation practice adoption in the United States with a list of important variables such as farmers' knowledge, attitudes, and behaviors. However Knowler and Bradshaw (2007) analyzed decisions to adopt conservation tillage and concluded that, with the exception of social capital, it is impossible to find any universal variables to explain adoption. Some different studies introduced different effective variables viz. landholder demographics such as age and land tenure (Kabii and Horwitz, 2006) and education and farm size (Rubas, 2004). Despite surveys on impressive factors that effect on BMPs adaption, effective stakeholder analysis in different social conditions rarely was considered. Depending on dealing issue, stakeholder selection and collaborative modeling ill differ.

Conceptual modeling of collaborative management as the core of planning procedure should be taken in account (Gupta et al., 2012). Initialization of stakeholder involvement is considered to goal specification (Halbe et al., 2018). Depending on administrating method, the model will be different (Hare, 2011). Various factors influence method selection and management framework design, i.e. problem intense, number of stakeholder groups, level of conflict and enthusiasm of stakeholders in participation (Beall King and Thornton, 2016).

Game theory based voting support methods are known as powerful methods in conflict resolving in environment management (Madani, 2010; Teasley and Mc Kinney, 2011; Üçler et al., 2015; Shi et al., 2016; Adhami et al., 2018). Such methods comprising multi-objective-multi-decision makers, simplify decision making proceeding. Besides, being apprehensible for public and applicable in diverse condition enhances reasons of its application. In cases that the severity of problem is high or some aspects of issue cause drastic outcomes, investigation of urgent obstacle is essential. However, in situations, which the deterioration of the problem from all aspects has the same weight or sufficient sources is accessible, the satisfaction of all stakeholders is difficult (Sheikhmohammady et al., 2010; Adhami and Sadeghi, 2016). Game theory based methods provide proper algorithms for each of referred situations. It should be note that game theory is a mathematical tool for analyzing and resolving problems related to conflicting interests. The solution could be achieved using different algorithms viz. Condorcet, Borda scoring, Fallback bargaining, which try to solve problem, by prioritization, feasibility, and optimization approaches. Condorcet method ignores the minority of the society and highlights the alternatives that the majority of the society elect it. Fallback bargaining tries to satisfy all stakeholders. Whilst Borda scoring stands at the middle (Madani et al., 2011; Adhami and Sadeghi, 2016).

Exploring literature on collaborative approaches on natural resources governance, examination on multifarious dimensions such as mutual trust between governing authorities and participators (Emerson et al., 2012), collaboration effectiveness (Mandarano, 2008; Biddle and Koontz, 2014), member diversity (Koontz and Johnson,

2004; Inam et al., 2015), technical and financial conflicts (Bidwell and Ryan, 2006) and merits of new collaboration approaches (Gianotti and Duane, 2016) were accomplished. However, limited research has compared stakeholder selection and comparison of collaborative modeling in different natural and cultural circumstances. In addition to the survey of collaborative management, which is not common in Iran, the comparison of such a process in two countries was investigated as well. Nonetheless, two practicable methods, which are useful in different social conditions were examined. Additionally, application of two different methods, which are practicable in various cultural background and environmental knowledge levels to achieve agreement are reported rarely.

Based upon above explanation, the present study proposes a collaborative management process in two developing and developed countries to address fundamental differences of mentioned approach. Methodological framework consists of qualitative survey and afterward analysis of broad point of views to attain an agreement which would be the base of design and implementation. Current process was done in three main steps: a) stakeholder analysis b) individual interview and c) prioritization of BMPs applying game theory based methods. In order to find out ultimate decision for the future to inhibit soil management issues, the game theory based methods were applied. Conforming annotated condition, the Condorcet and the Fallback bargaining methods were used to prioritize managerial practices from diverse perspectives. The Condorcet method highlighting most urgent factors tends to ignore nonsignificant aspects. Whilst, the Fallback bargaining procedure, during the bargaining, persuades stakeholders to retreat up to unanimous alternative (Adhami and Sadeghi, 2016). It has been therefore hypothesized that the game theory based approach of collaborative decision making facilitates better management of the study watersheds leading to appropriate mitigation of soil-related issues.

2. Materials and methods

In the current study, two surveys were conducted and compared. The first survey was accomplished in the Schleswig-Holstein State of Germany suffering from soil compaction (Götze et al., 2016). Groups who (indirectly or directly) affect or can be influenced by soil compaction were asked to prioritize solution alternatives. The Galazchai Watershed, West-Azerbaijan, Iran with high soil erosion potential (Sadeghi et al., 2015) was also considered as second case study.

2.1. Study areas

2.1.1. Schleswig-Holstein State

The study area in Germany contained Schleswig-Holstein State in north of the Germany which covers an area of 15,700 km^2. The mean annual temperature and precipitation are 7.9 °C and 748 mm, respectively. Based on the Köppen-Geiger climate classification, the climate is warm and temperate. Schleswig-Holstein comprises 15 districts vs. four urban

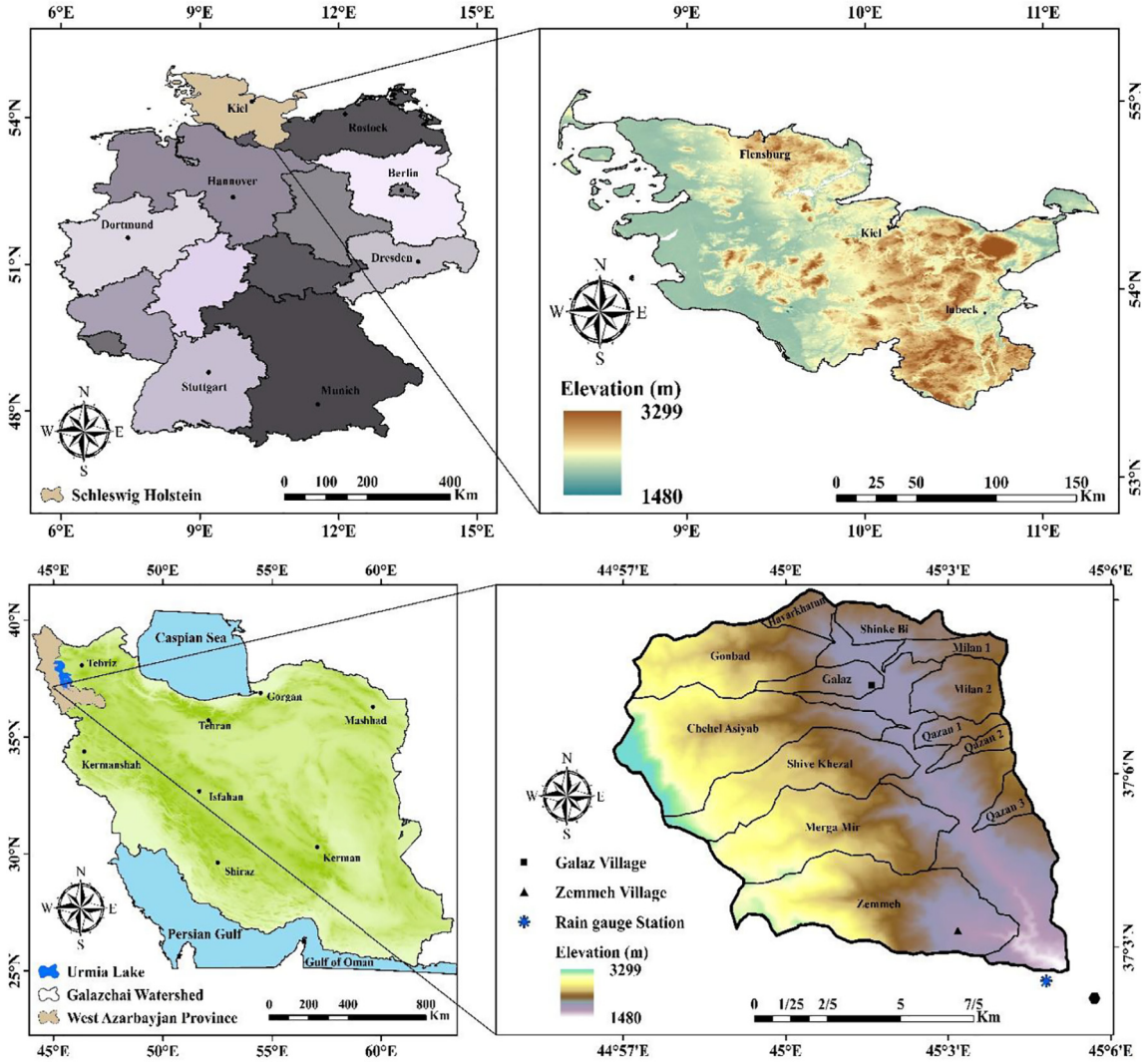

Fig. 1. Geographical location of Schleswig Holstein State in Germany (Up) and Galazchai Watershed in Iran (Down).

and 11 rural limited areas (Fig. 1). The economy mostly contains agriculture, transport, shipbuilding, and tourism. Schleswig-Holstein has a flat-hilly landscape which strongly formed by glaciation. Various land cover types are found in this federal state. Urban surfaces (12.5%), forests (8.63%), agricultural and semi natural areas (75%) cover the most area of mentioned state (Ma et al., 2019). The most part of farmlands suffer from soil compaction (LLUR, 2015).

2.1.2. Galazchai Watershed

The second study area located in West Azerbaijan Province, Iran. Galazchai covering 103 km^2 located in northwest of Iran. This watershed is steep and vulnerable in front of soil erosion and flooding (Adhami et al., 2018). Average slope, elevation, precipitation, and temperature of the watershed are 32%, 2390 m, 479 mm and 11.6 °C, respectively. Based on the Amberje climate classification, the climate is cold-semiarid. The area is composed of Precambrian old rocks and mostly metamorphic type. Agricultural lands, range lands, and forest cover 9.7, 87.4, and 5.3 km^2, respectively. The watershed contains two main villages of Galaz and Zemmeh and the economy mostly depends on agriculture and livestock (Fig. 1).

In order to facilitate comprehension of study procedure, methodological diagram is presented in Fig. 2.

2.2. Stakeholder selection

Once addressed issue was selected, it is essential to determine which key stakeholders should be engaged in decision making process. Mentioned procedure is coined stakeholder analysis. Stakeholder analysis is selection and division of them based on their roles, rights, interests, and effects (Inam et al., 2015). In the present study a complete framework developed by Freeman (2010) was selected which consists of four distinct steps viz. (i) a broad list of all stakeholders; (ii) classification of stakeholders based on their roles; (iii) prioritization of stakeholders according to their attributes; and (iv) final selection of them on the basis of power and interest. Freeman's framework was applied because of wide selection of stakeholders and then examining them based on their common attributes, roles, and interests and finally based on their relation with the study issue. This method widely covers all stakeholders and because of classification and prioritization, distinguishes key stakeholders acceptably (Yumantoko, 2019; Song and Hu, 2019).

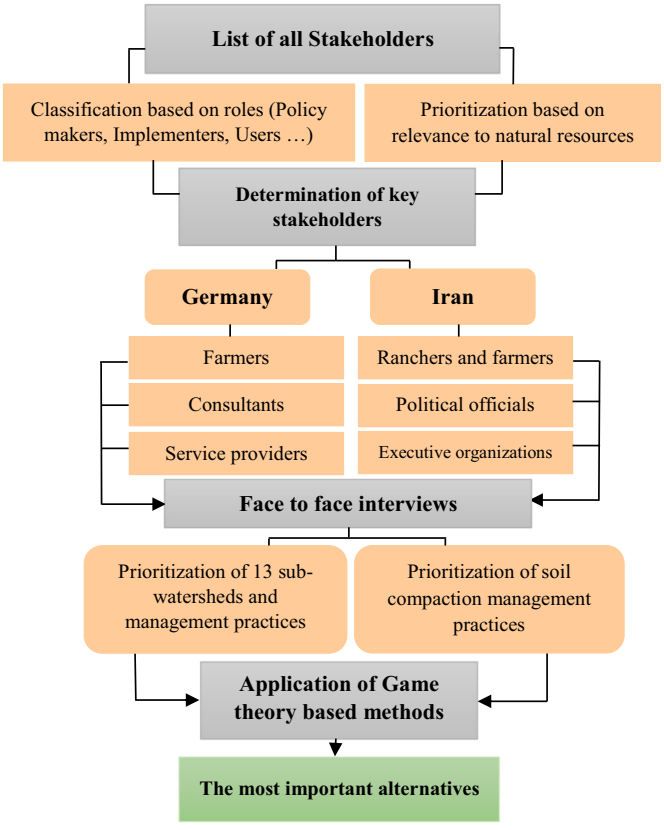

Fig. 2. Methodology flow chart of best soil comanagement practices for two watersheds in Germany and Iran using game theory-based approaches.

The list of all stakeholders was supported by academic literature and local knowledge. Afterward, stakeholders based on their roles were categorized in some groups covering: policy making institutes, consultants, residents, farmers, ranchers, service providers, implementers, and experts of execution organizations. It should be mentioned that the list of stakeholders during the procedure of analysis was modified. Then, the roles of stakeholders of final list were identified by details. The involved stakeholders in the present study were categorized in four major groups based on Directive (2003) criterion viz. policy makers, users, implementers and experts. During third step some of mentioned categories were combined based on their attributes and reformed the list. Stakeholder analysis clarified some administrative differences of two case study. As an instance, in Germany, political sector rarely interfere in natural resources management, however, in Iran the role of this group is more impressive than those other stakeholders. On the other hand, in Germany, service companies are considered as one of the most impressive stakeholders. Inverse in Iran such companies are managed by executive organizations and possess no role in decision making proceeding.

In Schleswig-Holstein State project, three groups of stakeholders were determined as the most impressive groups among, farmers (users, 150 persons), consultants (experts, 22 persons), and service providers (implementers, 13 service providers). In the Galazchai Watershed three different groups named residents including ranchers and farmers (users, 284 persons), political officials (policy makers, 7 persons), and executive organizations (experts, 6 persons) were chosen.

2.3. Stakeholder interview and information collection

Stakeholder initialization is supposed as a central step in collaborative management. It could be accomplished using various methods and guidelines such as involving through group meetings or individual interviews (Reed, 2008; Reed et al., 2009). Group meetings attract lower attention among stakeholders compared to individual survey according to different reasons (Videira et al., 2009). Stakeholders cannot display their real opinions openly in front of other members or their supreme in organization (Inam et al., 2015). Probability of controversy through members who have close relationship with each other especially in local communities is the second reason. The difficulty of traveling to a common place to hold a group meeting in large watersheds and developing countries is additional barrier (Burgin et al., 2013). Because of above mentioned reasons, after the finalization of stakeholder selection, potential stakeholders were contacted and key questions were asked through conducting individual interviews.

The State Office for Agriculture, Environment, and Rural Areas of Schleswig-Holstein (LLUR) has carried out nationwide evaluations of the potential susceptibility of soils to compaction on the basis of the statistical land use data related to arable and grassland sites (Agricultural and Environmental Atlas of Schleswig-Holstein, 2017). The results are available as large-scale maps (1:2000) of compaction sensitivity (VE) for arable and grassland use. An initial first expert report on the use-related compaction of agricultural soils in Schleswig-Holstein was commissioned in 2015 to diagnosis the actual impact of soil compaction on agricultural land (GWS-Nord, 2015). By evaluating compaction sensitivity maps and interviewing farmers, consultants, service providers and agricultural organizations and institutions, the report provided a

first impression of the extent of the problem on agricultural and forestry land. The survey estimated the proportion of land compaction caused by land use at around 22% for arable land and around 15% for grassland, and predominantly noted an increasing trend towards arable land. The main cited causes were arable farming with late clearing crops (i.e., maize, sugar beet) and excessively high internal tyre pressures. However, representative statements were not possible due to the small number of persons or institutions surveyed (37 actors). Based on the findings of the aforementioned study, the LLUR therefore in 2017 decided to increase the data density within the framework of an "Extended Survey of Consultants, Contractors and Practitioners for the Concern of Agricultural Areas of Soil Compaction under Consideration of Regional Priorities and Problems" to increase the number of farms. The inclusion of 150 farms spread across the whole of Schleswig-Holstein, 22 agricultural consultants and 13 contractors and machinery rings in the survey provided a broad data density and representation. In addition, the contents of the survey were significantly expanded with regard to the status of the technology used to the possible optimization measures (Agricultural and Environmental Atlas of the State of Schleswig-Holstein, 2017).

Based on differences among management approaches in two study cases, different schemes were elected to gather opinions of stakeholders. In Germany, due to close communication among farmers, consultants and contractors, identification of possible solutions was straightforward. However in Iran all decisions about ranch lands are up to governmental organizations and disparity of opinions is obvious. Thereupon, in the first case study (Germany) the list of impressive management practices was collected according to consultant and contractor's feedback and reflection of farmer's interest and needs. Thereby, stakeholders were asked to prioritize 21 managerial measures to mitigate soil degradation (soil compaction).

Unlike developed countries, because of poor connection of residents, policy makers and experts, management practices were not defined in the second case study (Iran) and individual stakeholder presented his own priority. Stakeholders were asked to consider their own reasons and openly express their opinions. The following types of questions were asked during the interview to lead stakeholders in formulating individual collaboration:

1- Which parts of watershed are more important?
2- What kinds of practices do you think can be adopted to improve socio economic status of the watershed?
3- What kinds of practices do you think can be adapted to solve environmental problems?
4- Prioritize the areas and management practices based on your own opinion.

The received information from the stakeholders was gathered and in order to identify premier practices, two group decision making approaches were applied.

2.4. Game theory based methods application

Two majority based Condorcet and maximal satisfying Fallback bargaining methods were applied in the present study to not only compare the results, but also find the solution considering two different conditions.

2.4.1. Condorcet

The Condorcet method attempts to identify an option that has been dominant over the remaining options in the pairwise comparisons. Priority arrangement of stakeholders provides fundamental context of one by one comparison. Current process highlights the alternative that is most important for majority of society. In the other words, whole involved community do not prefer Condorcet winner, but the winner solves major portion of problem, thereby, assures the majority of them (Elkind et al., 2011; Burgman et al., 2014). Imagine below rows are the preferences of three voters from high to low level:

A B C
B A C
C B A

Due to above arrangement the Condorcet matrix frames compromise framework.

$$\begin{bmatrix} & A & B & C \\ A & - & B & A \\ B & B & - & B \\ C & A & B & - \end{bmatrix}$$

Based upon pair comparisons, the presence of each alternative emphasizes dominant of that case to other one. The winner is identified according to the number of presences of candidates (Adhami and Sadeghi, 2016). Candidate with the symbol of "B" with scores of 4 is winner.

2.4.2. Fallback bargaining

The Fallback bargaining procedure conducts to realize those alternatives that gain the agreement of all voters. The purpose of this method is maximizing of all voter satisfaction (Mahjouri and Bizhani-Manzar, 2013). Initially all voters express the arrangement of their desires, afterwards, they retreat in lockstep to the point which all are in agreement. The steps in which agreement occurs reflects difference of opinions, needs and interests. Although this method decreases the individual satisfaction of stakeholders but the general conflicts decrease (Madani et al., 2011).

3. Results and discussion

3.1. Stakeholders preference in Schleswig Holstein State

Farmers, consulters, and contractors as three effective categories of stakeholders in Schleswig-Holstein State expressed their experiment and knowledge due to prioritization of management practices to combat soil compaction. Results of interviews are summarized in Table 1.

As it is observable in Table 1, there is a serious conflict in effectiveness of presented practices among involved stakeholders. The perfect match in arrange of alternatives among three groups is 14% (three identical alternatives of whole 21 ones). In order to investigate obvious consensus or disagreement among mentioned groups, practices were categorized in three classes. Towards that, the most important alternative gained 21 and the least important one earned one through applying factor scoring method. Then, the first class practices replaced between 14 and 21, the second class had scores between 7 and14, and the third class got 1 to 7. Such a classification was applied only for clarifying the agreement among stakeholders. Table 2 presents achievements.

According to results presented in Table 2, correspondence among farmers and consultants is about 53% that is the most similar among three groups of stakeholders. However, the resemblance of farmers and service providers is 14% and the least similarity of study groups. Finally the correspondence of consultants and service providers is about 29%.

Farmers and consultants priorities reflect remarkable awareness of farming issues and proper transition of scientific knowledge. In Germany, governmental organizations possess scientific research results and transfer the knowledge to natural resources users such as farmers. Accordingly, consultants are supposed as facilitators in participation procedure. On the other hand, consultants in close relation with farmers, find out technical and executive barriers and transfer them to governmental organizations. Thereupon, managerial decisions are made based on natural and manmade problems. During such a path, legislation and inspection duties cover needs, interests, and standpoints of farmers. However, the most significant disagreement of farmers and

Table 1
Priority of management practices based on stakeholder collaboration in the Schleswig-Holstein State,Germany.

Farmers	Consultants	Contractors
Use of a tyre pressure regulating system	Use of a tyre pressure regulating system	Drag hose manure application
Fixed tramlines (Controlled Traffic Farming)	Use of crawlers/tape drives	Adjustment of the field lengths to the harvesting capacities
Enlargement of the working widths	Use of wide, terra, twin tires	Purposeful limitation of vehicle weights
Combination of operations, fewer crossings	Fixed tramlines (Controlled Traffic Farming)	Use of a tyre pressure regulating system
Driving only on “dry” field	Drag horse manure application	Avoiding of using machinery when it is not necessary
Use of wide, terra, twin tires	Avoiding of using machinery when it is not necessary	Regular liming to PH Class C
Purposeful limitation of vehicle weights	Purposeful limitation of vehicle weights	Adjusting the vehicle load capacity during harvesting according to the water content of the soil
Use of crawlers/tape drives	On land ploughing	Equal load distribution
Drag hose manure application	Crab steering	Drag horse manure application
Regular liming to PH Class C	Enlargement of the working widths	Combination of operations, fewer crossings
Avoiding of using machinery when it is not necessary	Combination of operations, fewer crossings	Enlargement of the working widths
Equal load distribution	Regular liming to PH Class C	Use of overloading wagons
Use of overloading wagons	Use of overloading wagons	Trailed instead of mounted/semi-mounted units
Trailed instead of mounted/semi-mounted units	Use of vehicles with articulated joint and additional axles	Crab steering
Adjusting the vehicle load capacity during harvesting according to the water content of the soil	No tillage/conservation soil tillage	Fixed tramlines (Controlled Traffic Farming)
Crab steering	Trailed instead of mounted/semi-mounted units	Use of crawlers/tape drives
No tillage/conservation soil tillage	Equal load distribution	No tillage/conservation soil tillage
Use of vehicles with articulated joint and additional axles	Reduction of plough depth	On land ploughing
Adjustment of the field lengths to the harvesting capacities	Adjusting the vehicle load capacity during harvesting according to the water content of the soil	Use of vehicles with articulated joint and additional axles
Reduction of plough depth	Driving only on “dry” field	Adjustment of the field lengths to the harvesting capacities
On land ploughing	Adjustment of the field lengths to the harvesting capacities	Reduction of plough depth

*Isochromatic cells in each column have equal priority.

consultants is due to different aims. Service providers consider economic benefits of their own companies and the sustainable development and farmer's livelihood are situated in second priority.

3.2. Stakeholders preference in the Galazchai Watershed

In the Galazchai Watershed residents, policy making and executive organizations were identified as key stakeholders. Due to lack of collaborative management history in the Galazchai Watershed, there were no coherent list of stakeholder's issues and interests. Consequently, they were asked to suggest useful alternatives and prioritize them. Some 94 managerial measures were collected. Out of 94 proposed practices, 14 possessed three groups of stakeholder's agreement (Adhami et al., 2018). Table 3 presents the arrangement of 14 practices.

Similar to the results of Germany (Table 1), the discrepancy between stakeholders in the Galazchai Watershed is also quite recognizable. Presence of some representatives of each village in policy making organizations named “Village Council Committee” decreases the conflicts of residents and policy making stakeholders. However, organizational goals of executive section (which is also implementation responsible)

Table 2
Three categories of management practices priority based on stakeholder collaboration in the Schleswig-Holstein State, Germany.

Stakeholders	Farmers	Consultants	Contractors
First priority	Use of a tyre pressure regulating system Fixed tramlines (Controlled Traffic Farming)	Use of a tyre pressure regulating system Use of crawlers/tape drives Use of wide, terra, twin tires Drag horse manure application	Driving only on "dry" field Use of a tyre pressure regulating system Purposeful limitation of vehicle weights
Second priority	Enlargement of the working widths, Combination of operations, fewer crossings, Driving only on "dry" field, Use of wide, terra, twin tires, Purposeful limitation of vehicle weights, Use of crawlers/tape drives, Drag horse manure application, Regular liming to PH Class C, Avoiding of using machinery when it is not necessary, Equal load distribution, Use of overloading wagons	Avoiding of using machinery when it is not necessary Purposeful limitation of vehicle weights On land ploughing Crab steering working	Use of a tyre pressure regulating system Avoiding of using machinery when it is not necessary Regular liming to PH Class C Adjusting the vehicle load capacity during harvesting according to the water content of the soil Drag horse manure application Equal load distribution Combination of operations, fewer crossings Enlargement of the working widths Use of overloading wagons Trailed instead of mounted/semi-mounted units
Third priority	Trailed instead of mounted/semi-mounted units, Adjusting the vehicle load capacity during harvesting according to the water content of the soil, Crab steering, No tillage/conservation soil tillage, Use of vehicles with articulated joint and additional axles, Adjustment of the field lengths to the harvesting capacities, Reduction of plough depth, On land ploughing	Combination of operations, fewer crossings Regular liming to PH Class C Use of overloading wagons Use of vehicles with articulated joint and additional axles No tillage/conservation soil tillage Trailed instead of mounted/semi-mounted units Equal load distribution Reduction of plough depth Adjusting the vehicle load capacity during harvesting according to the water content of the soil Driving only on "dry" field Adjustment of the field lengths to the harvesting capacities	Crab steering Fixed tramlines (Controlled Traffic Farming) Use of crawlers/tape drives No tillage/conservation soil tillage On land ploughing Use of vehicles with articulated joint and additional axles Adjustment of the field lengths to the harvesting capacities Reduction of plough depth

Table 3
Priority of management practices based on stakeholder collaboration in the Galazchai Watershed, Iran.

Residents	Executive organizations	Policy makers
1-Rangeland rehabilitation	Improvement of financial facilities to protect rangeland (delay in livestock entry)	Improvement of financial facilities to protect rangeland (delay in livestock entry)
2-Management of pasture scheduling	Monitoring of rangeland rehabilitation	Rangeland rehabilitation
3-Vegetation increasing in stream bed as roughness amplification to reduce water velocity and erosion	Government control on number of livestock in rangeland	Monitoring of rangeland rehabilitation
4-Grain providing at the start of spring to prevent of livestock entry in rangeland	Inspection of steep lands plough method	Government control on number of livestock in rangeland
5-Monitoring of rangeland rehabilitation	Development of exploitation and processing of herbal medicine in rangeland	Management of pasture scheduling
6-Improvement of financial facilities to protect rangeland (delay in livestock entry)	Management of pasture scheduling	Tourism development in Chehel Asiyab sub-watershed
7-Government control on number of livestock in rangeland	Rangeland rehabilitation	Preventing of rangeland conversion to farmland
8-Tourism development in Chehel Asiyab sub-watershed	Preventing of rangeland conversion to farmland	Grain providing at the start of spring to prevent of livestock entry in rangeland
9-Preventing of rangeland conversion to farmland	Tourism development in Chehel Asiyab sub-watershed	Vegetation increasing in stream bed as roughness amplification to reduce water velocity and erosion
10-Tourism development in Gonbad sub-watershed	Tourism development in Gonbad sub-watershed	Tourism development in Zemmeh sub-watershed
11-Tourism development in Zemmeh sub-watershed	Tourism development in Zemmeh sub-watershed	Development of exploitation and processing of herbal medicine in rangeland
12-Tourism development in Shinke Bi sub-watershed	Tourism development in Shinke Bi sub-watershed	Tourism development in Gonbad sub-watershed
Development of exploitation and processing of herbal medicine in rangeland	Grain providing at the start of spring to prevent of livestock entry in rangeland	Inspection of steep lands plough method
Inspection of steep lands plough method	Vegetation increasing in stream bed as roughness amplification to reduce water velocity and erosion	Tourism development in Shinke Bi sub-watershed

*Isochromatic cells in each column have equal priority.

are clearly independent of resident's interests. Level of conflict in developing countries symbolizes top-bottom management path and ignorance of needs of stakeholders with less power (Inam et al., 2015).

3.3. Prioritization of management practices

3.3.1. Prioritization of management practices in Schleswig Holstein State

To achieve the goal of the present study, i.e. selection of the most effective management practices the Condorcet and Fallback bargaining methods were applied. Condorcet scores of soil management practices based on stakeholder collaboration in the Schleswig-Holstein State, Germany are summarized in Table 4.

Condorcet method performing a comparative approach, introduced the most effective practice due to stakeholder's opinion. "Use of a tyre pressure regulating system" with the highest score (Metcalf et al., 2010), is considered as the most important factor in soil compaction restrain. On the opposite side, "Reduction of plough depth" with the least score (3) is supposed to have seldom role in compaction control. It becomes clear that a large proportion of the farmers tend to implement measures that are not directly associated with additional costs in practice. Outcomes specifies that up to 86% of farmers because of high cost, strong intervention, and less experience of new techniques prefer to implement managerial practices instead of applying technical measures. On the contrary, service companies are interested in usage of purely technical solutions, particularly, use of 'tyre pressure control system'. Consultants ranked "use of tyre pressure control system" at the top of the list. This practice assessed to be significantly helpful (86%) in current situation.

According to important criterion for stakeholders, the Condorcet winner due to less expense, high practically efficiency and being technical case was mentioned as top measure. It could be comprehended from Table 4 that reduction of plough depth despite no cost, because of soil compaction level and crop type is not effectual, thereby, earned the least score.

Implementation of high scored measures resulted by Condorcet method will satisfy majority of stakeholders and ignore the minority. Satisfying all stakeholders requires another method in which stakeholders have to relinquish their high priorities to achieve compromise. The Fallback bargaining method pursues such aim and was applied to determine Pareto space. Table 5 exhibits Fallback bargaining method's outcome.

Based on the results of Fallback bargaining method, "using tyre pressure control system" was identified as stakeholder's first consensus. In addition to foresaid solution, "Fixed tramlines (Controlled Traffic Farming)" gained the same attention. However, both of them attract every three group's consideration in 4th depth (step of bargaining), but it could be concluded that the 12th practice at the first depth was elected by two groups. Whilst, in case of the 19th practice, it took up to a third depth to be agreed upon by the two groups. Anyway, these two alternatives have the potential to satisfy all decision makers.

Outcomes of game theory based methods comprising to mathematical group decision making approaches are substantive and empirical. However, stakeholder's consensus in this context agreed with the results of Götze et al. (2016).

Usually because of effectiveness synergy of management measures, a combination of some practices is selected to solve environmental problems. In order to facilitate measure selection, 21 presented practices were categorized in three priorities. Besides, such procedure helps to comfortable comparison of applied methods. Condorcet scores were used to classify alternatives in three classes based on factor scoring

Table 4
Condorcet score of soil management practices based on stakeholder collaboration in the Schleswig-Holstein State, Germany.

	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21
1	–	1&2	1&3	1&4	1	1&6	1&7	8	9	10	1&11	12	1&13	1&14	1&15	1&16	17	1&18	19	20	21
2	1&2	–	3	4	2	2	2	8	9	10	2	12	13	2	2&15	2&16	17	2	19	2&20	21
3	1&3	3	–	4	3	3	3	8	9	10	3	12	13	3	3	3	17	3	19	3	3&21
4	1&4	4	4	–	4	4	4	8	9	4	4	12	4&13	4	4	4	4&17	4	19	4	4
5	1	2	3	4	–	5&6	5&7	8	9	10	5&11	12	13	5&14	15	5&16	17	5&18	19	20	21
6	1&6	2	3	4	5&6	–	7	8	9	10	11	12	13	6	15	16	17	6&18	19	20	6&21
7	1&7	2	3	4	5&7	7	–	8	9	10	11	12	13	7	15	7	17	7&18	19	7&20	7&21
8	8	8	8	8	8	8	8	–	9	10	8	12	8	8	8	8	17	8	19	8	8&21
9	9	9	9	9	9	9	9	9	–	9&10	9	12	9	9	9	9	17	9	19	9	9
10	10	10	10	4	10	10	10	10	9&10	–	10	12	10&13	10	10	10	17	10	19	10	10
11	1&11	2	3	4	5&11	11	11	8	9	10	–	12	13	11	15	11	17	11&18	19	11&20	11&21
12	12	12	12	12	12	12	12	12	12	12	12	–	12	12	12	12	12	12	12	12	12
13	1&13	13	13	4&13	13	13	13	8	9	10&13	13	12	–	13	13	13	13	13	19	13	13
14	1&14	2	3	4	5&14	6	7	8	9	10	11	12	13	–	15	16	17	18	19	20	14&21
15	1&15	2&15	3	4	15	15	15	8	9	10	15	12	13	15	–	15&16	17	15	19	15&20	21
16	1&16	2&16	3	4	5&16	16	7	8	9	10	11	12	13	16	15&16	–	17	16	19	16	16&21
17	17	17	17	4&17	17	17	17	17	17	17	17	12	13	17	17	17	–	17	17&19	17	17
18	1&18	2	3	4	5&18	6&18	7&18	8	9	10	11&18	12	13	18	15	16	17	–	19	20	18
19	19	19	19	19	19	19	19	19	19	19	19	12	19	19	19	19	17&19	19	–	19	19
20	20	2&20	3	4	20	20	7&20	8	9	10	11&20	12	13	20	15&20	16	17	20	19	–	20&21
21	21	21	3&21	4	21	6&21	7&21	8&21	9	10	11&21	12	13	14&21	21	16&21	17	18	19	20&21	–
Score	**13**	**16**	**22**	**29**	**6**	**6**	**11**	**29**	**33**	**30**	**13**	**40**	**29**	**3**	**16**	**13**	**34**	**9**	**37**	**15**	**16**

*Red numbers show the highest (winner) and the lowest (loser) scores.

Table 5
Fallback bargaining matrix of soil management practices based on stakeholder collaboration in the Schleswig-Holstein State, Germany.

	1st	2nd	3rd	4th	5th	6th	7th	8th	9th	10th	11th	12th	13th	14th	15th	16th	17th	18th	19th	20th	21st
1	0	0	0	0	1	1	1	1	1	1	1	1	1	2	3	3	3	3	3	3	3
2	0	0	0	0	0	0	0	0	0	1	2	2	2	3	3	3	3	3	3	3	3
3	0	0	0	0	0	1	1	1	1	2	2	2	2	3	3	3	3	3	3	3	3
4	0	0	1	1	1	2	2	2	2	2	2	2	2	3	3	3	3	3	3	3	3
5	0	0	0	0	0	0	0	0	0	1	1	1	1	2	3	3	3	3	3	3	3
6	0	0	0	1	1	1	1	1	1	1	1	1	1	1	2	2	3	3	3	3	3
7	0	0	0	1	1	1	1	1	1	1	1	1	1	1	3	3	3	3	3	3	3
8	0	0	1	2	2	2	2	2	2	2	3	3	3	3	3	3	3	3	3	3	3
9	0	0	1	2	2	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3
10	0	1	1	1	1	2	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3
11	0	0	0	1	1	1	1	1	1	1	1	1	1	2	3	3	3	3	3	3	3
12	2	2	2	**3**	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3
13	1	1	1	1	1	1	2	2	2	2	2	2	2	3	3	3	3	3	3	3	3
14	0	0	0	1	1	1	1	1	1	1	1	1	1	1	2	2	2	2	2	3	3
15	0	0	0	0	0	0	0	0	0	1	2	2	2	3	3	3	3	3	3	3	3
16	0	0	0	0	0	1	1	1	1	1	1	1	1	2	2	3	3	3	3	3	3
17	1	1	2	2	2	2	2	2	3	3	3	3	3	3	3	3	3	3	3	3	3
18	0	1	1	1	1	1	1	1	1	1	1	1	1	1	2	2	2	2	3	3	3
19	0	1	2	**3**	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3
20	0	0	0	1	1	1	1	1	1	1	2	2	2	2	2	2	3	3	3	3	3
21	0	0	0	1	1	2	2	2	2	2	2	2	2	2	2	2	2	2	2	**2**	3

*Red numbers show the earliest (winner) and the latest (loser) depth of agreement.

roles (The highest score (40)-The least score (3)/3). In Fallback bargaining method, there was no consensus before depth 4, then all agreements happened between depths 3 and 21. Accordingly, alternatives with 3 points in depths 3–9 replaced in the first class, in depths 9–15 introduced as second class and in depths 15–21 made third class of priority. The results of practice classification are presented in Table 6.

3.3.2. Prioritization of management practices in the Galazchai Watershed

As mentioned former, all 94 suggested practices were not proposed by each three groups of stakeholders. Presence of some unrelated and irrational suggestions proposed by residents caused a basic filtering due to socio-environmental aims. However, after removing such alternatives, there were 14 practices, which attract the attention of three groups of stakeholders as well. Like what applied in the first case study (Germany), the game theory based methods were used to prioritize management measures with different procedures. The results of Condorcet and Fallback bargaining application are also presented in Tables 7 and 8, respectively.

Based on the results of Table 7, "Rangeland rehabilitation" with 25 and "Tourism development in Shinke Bi sub-watershed" with 0 point were identified as the winner and loser, respectively. Additionally, "Rangeland rehabilitation" and "Management of pasture scheduling" alternatives achieving 3 points (agreement of the three participant groups) more early than other candidates were known as agreed options. Comparing the results of Tables 7 to 8, it could be concluded that this two above said practices not only are common among all stakeholders, they dominant other measures as well. Thereby, it is clear that rehabilitation of pastures by various managerial practices such as management of time scheduling satisfy all voters. Overgrazing, removal of vegetation cover and soil erosion are the most important issues in the Galazchai Watershed. These problems affect resident's livelihood and threaten biodiversity. Nevertheless, lack of adequate awareness about other groups of stakeholder's goals, raises natural resources destruction. Therefore, the collaborative approach provides a framework to accompany scientific researches with experience and native information. A large number of stakeholders declared that collaboration modeling was useful for increasing awareness, understanding of conflicts, and knowing how outcomes work (Inam et al., 2015).

3.4. Differences and similarities between case studies

Different socio-economic conditions request appropriate collaborative method. It seems difficult to ignore a part of society to fulfill purely environmental purposes in a situation that collaboration is not properly known. In such cases, the Fallback bargaining method conveys manager to the options with all stakeholders support. However, participants experience in-group decision making process facilitates election of practices which involves maximum stakeholder's opinion. Table 9 shows classification of the management practices in the Galazchai Watershed to quick compromise of methods.

Variety of BMPs that were proposed by stakeholders demonstrates specific and narrow goals, which improves collaboration quality. Biddle and Koontz (2014) believe that explicit goals help stakeholders to comprehend the issue properly and suggest useful solutions. This matter is clearly observable in Schleswig-Holstein case. The project centralizing on soil compaction on agricultural lands leads participants to profound contemplate and effective coordinate. Compare this to developing countries dealing environmental, social, and economic problems with low level of trust to governmental authorities. As results of Carter et al. (1999) acknowledge, a prosperous collaboration in a developing country needs clear understanding of existing issue and achievable useful outcomes. Complexity of environmental system creates ambiguous percept for unprofessional and unskilled participators (Reed, 2008).

In addition to aforementioned explanations, exploring the results clarifies some distinct differences in land management context through different case studies:

1- Fundamental diversity of management practices, invalid suggestions and inapplicable proposes in Iran, demonstrated lack of knowledge

Table 6
Classification of soil management practices using Condorcet and Fallback bargaining methods based on stakeholder collaboration in the Schleswig-Holstein State, Germany.

	Method	
Priority	Condorcet	Fallback bargaining
First	Use of a tyre pressure regulating system Use of wide, terrain and twin tyres Combination of operations, fewer crossings Enlargement of the working widths Purposeful limitation of vehicle weights Use of crawlers/tape drives Drag hose manure application Fixed tramlines (Controlled Traffic Farming)	Enlargement of the working widths Purposeful limitation of vehicle weights Use of a tyre pressure regulating system drag hose manure application Fixed tramlines (Controlled Traffic Farming)
Second	Regular liming to PH-class C Avoidance of empty runs on the field Use of overloading wagons On land ploughing	Driving only on “dry” ground Regular liming to PH-class C Avoidance of empty runs on the field Use of wide, terrain and twin tyres Uniform load distribution Adjusting the vehicle load capacity during harvesting according to the water content of the soil Combination of operations, fewer crossings Trailed instead of mounted/semi-mounted units Use of crawlers/tape drives Use of overloading wagons
Third	Driving only on “dry” ground Uniform load distribution No tillage/conservation soil tillage Adjusting the vehicle load capacity during harvesting according to the water content of the soil Trailed instead of mounted/semi-mounted units Reduction of plough depth crab steering Adjustment of the field lengths to the harvesting capacities Use of vehicles with articulated joint and additional axles	No tillage/conservation soil tillage Reduction of plough depth crab steering Adjustment of the field lengths to the harvesting capacities Use of vehicles with articulated joint and additional axles On land ploughing

in policy making process and insufficient experience in partnership, decision making and implementation. However, in Germany permanent contact among consultants who are representatives of decision maker organizations and users in addition to informing farmers about rules, transition of user's issues occurs. However, different studies confirm such a result. In this context, Inam et al. (2015) discussed about lack of collaborative management in developing countries and also Leach et al. (2002) claimed that success in stakeholder participation needs time and repetition to generate trust and knowledge.

2- Differences in point of views among stakeholders in Iran caused various proposed management practices. Economic barriers of residents, natural resources conservation, and environmental development goals motive conflicting suggestions. Discrepancy in needs postpone achieving an agreement. In the Galazchai Subwatershed, local community's information about scientific aspects of the watershed management was the main cause of the mentioned discrepancy. As Rhoads et al., (1999) believe, social interaction between scientists and nonscientists requires a considerable investment of time and energy on the part of the scientist to develop personal relationships with nonscientists based on trust and mutual exchange of information. This procedure certainly facilitates consensus achievement.
3- Land management in Iran because of variety in land use supposed to be more intricate than Germany. Rangelands as main biodiversity source are considered one of major livelihood source as well (Adhami et al., 2019). Additionally, agricultural lands and orchards require different management approaches. In farm lands management, experts focus on soil protection and harvest yield. In contrary, rangeland management contains soil protection, flood control, biodiversity conservation, sufficient forage production which guarantee proper socioeconomic condition of rural communities. Pandey and Singh (2016) also agreed with the importance of rangelands in facilitation of better conservation of soil and water.
4- It was discovered that there is a belief in rural communities of Iran that technical and mechanical treatments are more effective. Quick response in mechanical practices provides such a belief. However in Germany managerial practices because of economic limitations attract less attention of farmers.
5- The last and the most substantial point is that engaging key stakeholders simplifies perfect perception of multi dimension problems

Table 7
Condorcet score of soil management practices based on stakeholder collaboration in the Galazchai Watershed, Iran.

	1	2	3	4	5	6	7	8	9	10	11	12	13	14
1	–	1	1	1	1	1&6	1	1	1	1	1	1	1	1
2	1	–	2	2	2&5	6	2&7	2	2	2	2	2	2	2
3	1	2	–	3	5	6	7	3	3	3	3	3	3	3
4	1	2	3	–	5	6	7	4	4	4	4	4	4	4
5	1	2&5	5	5	–	5&6	5	5	5	5	5	5	5	5
6	1&6	6	6	6	5&6	–	6	6	6	6	6	6	6	6
7	1	2&7	7	7	5	6	–	7	7	7	7	7	7	7
8	1	2	3	4	5	6	7	–	8	8	8	8	8	8
9	1	2	3	4	5	6	7	8	–	9	9	9	9	9
10	1	2	3	4	5	6	7	8	9	–	10&11	10	13	10&14
11	1	2	3	4	5	6	7	8	9	10&11	–	11	11&13	11
12	1	2	3	4	5	6	7	8	9	10	11	–	13	14
13	1	2	3	4	5	6	7	8	9	13	11&13	13	–	13
14	1	2	3	4	5	6	7	8	9	10&14	11	14	13	–
Score	**25**	**20**	**16**	**14**	**22**	**24**	**19**	**12**	**10**	**4**	**6**	**0**	**7**	**3**

*Red numbers show the highest (winner) and the lowest (loser) scores.

Table 8
Fallback bargaining matrix of soil management practices based on stakeholder engagement in the Galazchai Watershed, Iran.

	1st	2nd	3rd	4th	5th	6th	7th	8th	9th	10th	11th	12th	13th	14th
1	2	**3**	3	3	3	3	3	3	3	3	3	3	3	3
2	0	**3**	3	3	3	3	3	3	3	3	3	3	3	3
3	0	0	3	3	3	3	3	3	3	3	3	3	3	3
4	0	0	2	3	3	3	3	3	3	3	3	3	3	3
5	1	2	2	2	3	3	3	3	3	3	3	3	3	3
6	2	2	2	2	2	3	3	3	3	3	3	3	3	3
7	1	2	2	2	2	2	3	3	3	3	3	3	3	3
8	0	0	2	2	2	2	2	3	3	3	3	3	3	3
9	0	0	2	2	2	2	2	2	3	3	3	3	3	3
10	0	0	1	2	2	2	2	2	2	3	3	3	3	3
11	0	0	1	2	2	2	2	2	2	2	3	3	3	3
12	0	0	1	1	1	2	2	2	2	2	2	3	3	3
13	0	1	1	2	2	2	2	2	2	2	2	2	3	3
14	0	1	1	1	2	2	2	2	2	2	2	2	**2**	3

*Red numbers show the earliest (winner) and the latest (loser) depth of agreement.

and thereby, realizing the solution situates in the shortest possible time. Internal relations of stakeholders which absolutely need each other cause basic solving of issue. Collaborative ring was significantly complete in Germany. Policy making organizations were responsible to subside farmers and propagate update knowledge by consultants. Mutually farmers supposed to adapt scientific policies to receive financial protection.

Table 9
Classification of soil management practices using Condorcet and Fallback bargaining methods based on stakeholder collaboration in Galazchai Watershed, Iran.

	Method	
Priority	Condorcet	Fallback bargaining
First	Rangeland rehabilitation Management of pasture scheduling Monitoring of rangeland rehabilitation Improvement of financial facilities to protect rangeland (delay in livestock entry) Government control on number of livestock in rangeland	Rangeland rehabilitation Management of pasture scheduling Vegetation increasing in stream bed as roughness amplification to reduce water velocity and erosion Grain providing at the start of spring to prevent of livestock entry in rangeland Monitoring of rangeland rehabilitation
Second	Vegetation increasing in stream bed as roughness amplification to reduce water velocity and erosion Grain providing at the start of spring to prevent of livestock entry in rangeland Tourism development in Chehel Asiyab sub-watershed Preventing of rangeland conversion to farmland	Improvement of financial facilities to protect rangeland (delay in livestock entry) Government control on number of livestock in rangeland Tourism development in Chehel Asiyab sub-watershed Preventing of rangeland conversion to farmland
Third	Tourism development in Gonbad sub-watershed Tourism development in Zemmeh sub-watershed Tourism development in Shinke Bi sub-watershed Development of exploitation and processing of herbal medicine in rangeland Inspection of steep lands plough method	Tourism development in Gonbad sub-watershed Tourism development in Zemmeh sub-watershed Tourism development in Shinke Bi sub-watershed Development of exploitation and processing of herbal medicine in rangeland Inspection of steep lands plough method

4. Conclusion

The present study proposed a transparent procedure for the initialization of stakeholder involvement in land management in Germany and Iran. Certainly one of the most important phases in environmental studies is monitoring and assessment. However, the purpose of the present study was introducing two practicable methods, which facilitate achieving an agreement among different stakeholders and various needs. Besides, comparison of two basically different societies with different cultures, economy, knowledge, and experiments in collaborative management was conducted as well. Current paper therefore aimed to collaborative management approach through prioritization models under the special economic, social, and natural conditions and restrictions of time and expertise. The results emphasized that collaborative management despite being time-consuming process, addresses complicated issues and multi dimensions of case problems. Besides, such approaches develop key stakeholder identification, which could effect on management manner and facilitate integrated management. Game theory based prioritization methods provide an excellent framework for group decision making and various stakeholders are engaged to share their opinions and promote their experience and knowledge. Proximity of academic groups, consultants, and executive organizations in Germany cased farmer's awareness of useful and update managerial methods. Besides, such a communication reinforces fast transfer of scientific findings to executive operations. However, in Iran, lack of strong relation among research and implementation reduces the speed of information sharing. In addition, unilateral decisions of executive organizations in Iran decrease public acceptance of BMPs and subsequently economic benefit of investments. As a result, in long term, the current problem intensifies and common resources such as soil and water will diminish. Based on above explanation, a fundamental review seems to be essential not only in stakeholder selection but also in magnitude of the relation among involved users.

The Condorcet and Fallback bargaining methods including a simple and practical structure cause holistic understanding of the complex system that advance to participation. In order to distinguish how satisfaction of all stakeholders is different from high priority alternatives causes dilemma in planning step. Thereby, analyzing selected cases applying proper and professional methods simplifies schematization. In addition to implied merits, the ease of applied methods ensures the dynamism of the management framework. Since the type and number of involved groups in decision making, stakeholder's mentality and the

intensity of the problem can change over time, thereby, game theory based prioritization methods could be re-run easily. The results confirmed that the Condorcet method helps to diagnosis most popular alternative or the most urgent case. However, the Fallback bargaining method tries to have the support of all stakeholders.

Analysis of conflicts in the Galazchai Watershed specified kind of contradiction among economic and environmental indices. Residents as representatives of economic development and governmental organizations as candidates of sustainable development responsible try to achieve their own aims. Intensity of conflict encourages stakeholders to fall back in lockstep to achieve a consensus. Of course bargaining maximizes the minimum satisfaction of bargainers with condition that others satisfaction meet maximum level, simultaneously. On the contrary, in a mature and well-informed society, conflict decreases, accordingly, happening of the agreement needs less fall back. However, implementation of dominant alternatives will not irrigate minority of the society. Although, the hypothesis of the current research was confirmed. But, in order to judge about effectiveness of mentioned methods in real condition with elected managerial measures, monitoring and consequent evaluation is recommended.

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Declaration of Competing Interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

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