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The agricultural specialists' attitudes toward alternative sustainable agricultural paradigms: A Galileo method analysis

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Abstract

In an attempt to provide an agenda for sustainable agricultural development, the aim of this paper is to use Galileo methodology to illustrate the attitudes of Agricultural Organization (Jehad-e-Keshavarzi) specialists of two southern province of Iran towards the basic premises of Ecological Modernization (EM) and De-Modernization (DM) based sustainable agricultural paradigms. Data were collected from 189 agricultural specialists using a systematic random sampling method. Cognitive maps of attitude toward the two sustainable agricultural development paradigms were developed. It is concluded that there is a great distance between present and ideal agriculture of Iran. While present Iran's agriculture is more close to the premises of DM, agricultural specialists portray the future agricultural polices around EM-based agricultural paradigm.

Key words: Galileo method, Ecological Modernization, De-Modernization, Sustainable agricultural development paradigms, Iran.

Introduction

The universal desire for conservation of environment and sustainable agriculture has raised the interest in academic research on the role and impact of attitudes of different stakeholders [1]. The original interest in the attitude concept has rested on the fundamental assumption that favorable or unfavorable attitudes are important predictors of the ways in which people behave toward environment and sustainable agriculture. Social scientists have a growing interest in the relationship between attitudes and behavior [2,3]. The environmental social scientists have developed several theories to study the relationship between attitudes of people and their actions [4,5]. Attitude refers to the degree to which a person has a favorable or unfavorable evaluation or appraisal of the behavior in question [6]. Although, in some cases attitudes and actions are disparate, but there is a tendency for attitudes and behavior to become consistent. Study of agricultural specialists' attitudes towards alternative sustainable agricultural paradigms is proactive and can generate guidelines for future planning and development of agriculture.

Agricultural development has been based on Modernization theory in the late decades. However, analysis of development policies shows that this theory has produced negative impacts such as uneven development, poverty and environmental degradation. Interest in development and environmental issues has increased dramatically in the past decade, not just among experts but also in the general public. Two competing sustainable agricultural development paradigm have been developed based on general tenets of Ecological Modernization (EM) and De-Modernization (DM) theories [7]. Attitudes of agricultural specialists toward these two competing paradigm is a major determinants of future directions agriculture will take. In this regard, the purpose of this paper is to depict the attitudes of Agricultural Organization (Jehad-e-Keshavarzi) specialists' of two southern province of Iran about the basic premises of EM- and DM-based sustainable agricultural theories in an attempt to provide a conceptual framework for sustainable agricultural development.

Defining Demodernization and Ecological Modernization Theory

The works of "theorists of counter-productivity" have been very influential within the environmental movement in the 1970s. They claimed that modern large-scale mega-technology should be seen as one of the main causes of environmental disruption instead of a factor which can contribute to its solution [8]. Thus, a movement away from modern industrial technology is a precondition of an improvement of society's environmental quality. These theorists maintain that a radical goodbye to advanced, complex technologies remains the only viable and feasible strategy for conquering the ecological crisis. Bahro expresses this very clearly by his use of the term "industrial disarmament" to summarize his program of reform [9]. The core of the counter-productivity ideas focused rather strongly on the normative and prescriptive analyses of the changes and transformations necessary to maintain society's resource base [8]. Because of their insisting on the partial or total dismantling of the industrial system, the counter-productivity stream of thought has been referred to as DM theorists.

EM Theory was first developed in the early 1980s primarily in a small group of western European countries. EM has often been used as "a synonym for strategic environmental management,

industrial ecology, eco-restructuring" [10]. EM theorists identify the institutions of modernity not only as the main causes of environmental problems, but also as the principal instruments of ecological reform. At the same time, these institutions are themselves transformed through the process of ecological restructuring [8]. The basic claim of EM is that modern society possesses a capability to carry through an institutional reflexivity and to build a capacity in society enabling it to handle its ecological crisis [11].

Comparison of EM and DM on Key Issues

A comparison of the core features of EM theory and DM theory is presented in Table 1 [7]. A brief comparison of key EM and DM concepts will follow:

•*De-industrialization (industrial disarmament) versus hyper-industrialization*: The most important difference between DM and EM is their view about industrialization. The view of de- or anti-modernists is strong rejection of modernity and modernization as relevant categories for environmental reform. The EM approach stands in direct opposition of DM theory, in its conviction that the only possible way out of the ecological crisis is by going further into the process of modernization, towards what Huber calls hyper- or superindustrialization [9]. Super-industrialization involves addressing environmental problems primarily through the transformation of production via the development and application of more sophisticated technologies [12].

•*Traditional technology versus modern technology:* Technology is not only judged for its role in causing environmental problems, but also valued for its actual and potential role in curing and preventing them [8,11]. EM involves the invention, innovation and diffusion of new clean (or cleaner) technologies that demonstrate improved environmental and economic performance [7]. Whereas DM theorists stress the all- negative influence on nature of modern and scientific technological projects. They maintain that a radical goodbye to advanced, complex technologies - often coupled with economic sobriety - remains the only viable and feasible strategy for conquering the ecological crisis [9].

•*Social economy versus ecological economy:* Economization of ecology is central to EM. The 'ecological economy' is based on 'increasing efficiency and maintaining substance'. Economic and market dynamics and economic agents gain in importance: producers, customers, consumers, credit institutions, insurance companies, the utility sector and business associations increasingly turn into social carriers of ecological restructuring, innovation and reform [8]. Bahro argued against the industrial system and said that a future green government would invest funds in the alternative sector - what is now called the social economy- of co-operatives and neighborhood enterprise [13].

•*Rejecting important role of state versus strong modern environmental state:* The integration of environmental policy goals into all policy areas of government is considered as central to a programme of EM [12]. DM theorists believe a necessary 'withering away' of the state should go hand in hand with decentralization of both production and government structures [9]. They argued that the emergence of the modern state has a vested interest in depleting natural resources [14].

Globalization has been a factor helping to promote EM. Transnationalization and globalization change the social dynamics behind environmental reforms. The nation-state is no longer the only level of analysing and influencing environmental policy making [7].

•*Radical environmentalism versus reform ideology (Moderate environmentalism):* The concept of EM describes a partial shift from anti-systemic demodernization to reform ideologies [15]. Where 'moderate environmentalism' assumes that the environmental crisis can be resolved by modifying attitudes, changing laws, government policies, corporate behavior and personal lifestyles, radical environmentalism is different in insisting on the need for fundamental alterations in values and structures and for demanding deep and systematic changes in philosophy and tactics [16]. Contrary to DM, one of the core features of EM theory is emerging new positions, roles, and ideologies for environmental movements in processes of ecological transformation [8,11].

•*Not-changing discourses versus changing discourses:* One of the important features of EM theory that stands against DM theory, is changing discourses. New discursive practices and new ideologies emerge in political and societal arenas [8,11]. Based on EM, environmental protection is a positive sum game which is seen as a matter of efficiency in the use of resources [7]. Indeed, the term 'EM' was coined to provide a formula for the joint intersection between ecology and economy [17], so that economic growth and environmental protection can be reconciled. On the other hand, the DM theorists oppose these analyses. They argued that only the subordination of modern economic reason in major sectors of the economy to - among others - ecological reason will allow for an environmentally and socially benign development [7].

The Galileo

The Galileo is a set of procedures which model thought processes. This tradition draws heavily on theory and research primarily from sociology, psychometrics and physics as well as communications and is predicated on the work of Emile Durkheim, George H. Mead and empirical social psychologists like A.O. Haller and William H. Sewell [18]. The Galileo defines cognitive and cultural processes as changes in the relations among sets of cultural "objects" or concepts. The interrelationships among these objects are themselves measured by magnitude estimation pair comparisons, and the resulting dissimilarities matrices are entered into metric multidimensional scaling programs. The result of this work is that each of the cultural objects is represented as a point in a multidimensional Riemann or Metric space [18]. Cognitive and cultural processes may be defined within this framework as motions of these objects relative to the other objects within the space. Technically, Galileo may be considered as a fuzzy logic artificial neural network [19].

The "Galileo" study begins with the identification of locally appropriate concepts pertaining to the domain of study (in this case: agricultural specialists - EM- and DM-based sustainable agricultural theories interactions). In the second step, these concepts are then paired in a questionnaire format in the local language (in this case: Farsi). Respondents (in this study, agricultural specialists) are asked to use the distance between "black" and "white" (as they saw it in their own minds) as a measuring stick, in comparing each of the study concepts (paired on the form). Numerical "distances" between concepts (0 to 10) are evoked from the respondents such that a distance of zero represents concepts that are identical and concepts that are dissimilar are represented by large values. The third step in the

Table 1. Comparison of ecological modernization and de-modernization theories on key issues [7].

DM	EM
Industrial disarmament	**Hyper-industrialization**
✓ triangle of capitalism, industrialism and surveillance	✓ industrialism
✓ forces and relations of production	✓ organization of production and consumption
✓ indigenous and local structures	✓ ecological restructuring of capitalism
Traditional technology	**Modern technology**
✓ modern technology has uncertainty	✓ technology as central institution for ecological reform
✓ mega-technology causes environmental disruption, instead of its solution	✓ both causing and preventing of problems
✓ soft technology paths, traditional technology	✓ clean-up technology
Social economy	**Ecological economy**
✓ local independence from market world	✓ importance of economic and market dynamics
✓ unimportance of innovations and enterprenures	✓ importance of innovations and enterprenures
✓ local autarky	✓ green lead markets
✓ cell-tissue society	✓ modern society
✓ base communities	✓ market economy
Rejecting important role of state	**Strong modern environmental state**
✓ withering away of the state	✓ enabling state
✓ radical decentralization, decentralization of both production and government structures	✓ political modernization, trend towards decentralized flexible and consensual styles of national governance
✓ self government in local level, no role for international and supranational institutions with nation-state in reforms	✓ transnationalization, new role for international and supranational institutions with nation-state in reforms
Radical environmentalism	**Reform ideology**
✓ less positions, roles, and ideologies for environmental movements	✓ new positions, roles, and ideologies for environmental movements
✓ outside critical commentator	✓ inside critical participant
✓ dualistic, anti- systemic	✓ systemic
Not- changing discourses	**Changing discourses**
✓ no new discursive practices and new ideologies in political and societal arenas	✓ new discursive practices and new ideologies in political and societal arenas
✓ zero-sum game	✓ positive-sum game
✓ conflict between economy and environment	✓ no conflict between economy and environment
✓ no emancipation of ecology	✓ emancipation of ecology
✓ only ecological rationality	✓ economical rationality and ecological rationality
✓ normative and prescriptive analyses in preserving sustenance base	✓ intergenerational solidarity in preserving sustenance base

Source: Rezaei-Moghaddam *et al.*,[7]

Galileo analysis was the structuring of the 22 value concepts. To do this, Galileo first computes the average distance matrix between all concepts (with average values in the off-diagonal and zeros in the main diagonal) and then solves for the principal components of the centroid scalar product transformation of the average distance matrix. When the principal components weights are used as coordinates, the values can be plotted in three-dimensional space, identical to the use of extracted coordinates by other scaling procedures [20].

The results of this procedure make it possible to represent the respondents' attitudes and beliefs in a space called belief maps. This space provides a precise and holistic picture of the respondents' beliefs and attitudes. Concepts, which go together, are close together in this space, while those that don't go together are far apart. Belief maps are used to depict the spatial inter-relationships between systems of beliefs, as well as to depict changes in belief systems over time. A belief map depicts the way people view complex issues, relationships between the parts may have many dimensions, and a belief map displays as much of this complexity as is possible in two dimensions [21]. Another advantage of this model is that dozens or even hundreds of attitudes and beliefs can be pictured simultaneously in a single picture, which makes it possible to see the interrelationships among the beliefs and attitudes. This in turn is important since changing one attitude or belief often changes others. Galileo software will automatically calculate what connections need to be strengthened and which weakened to achieve the desired positioning [19].

Research Method

A conventional Galileo study was conducted. A measurement instrument was developed to estimate the separations among 22 concepts taken two at a time independently. These 22 concepts are defined in the next section. A pilot study of 30 agricultural specialists of *Kohghiloye-v-Boirahmad* province of Iran was used to test the measuring instrument. Appropriate changes were made in the instrument based on the pilot study. The study area included *Khuzestan* and *Fars*, two southern provinces of Iran. These two provinces are leading agricultural provinces not only in the south but also in the whole country. The population of the study included 948 agricultural specialists in the two selected provinces.

A systematic random sampling was used to randomly select 189 (82 from *Khuzestan* and 107 from *Fars*) specialists in these provinces. The sample size was determined based on the information obtained in the pilot study and the formula suggested by Scheaffer *et al.* [22].

Concepts and definitions: In this section a description of concepts used in this study is presented. These concepts are based on EM- and DM-based sustainable agricultural development. The concepts are presented, as polar type representing EM and DM. In addition, two concepts were added representing present and ideal agriculture of Iran. These concepts are used in Galileo analysis.

Hyper-industrialization (HIE) versus industrial disarmament (IDD): HIE is an EM-based concept which indicates that the only possible way out of the ecological crisis in agriculture is by going further into the process of modernization in this sector. Instead, IDD is a DM-based concept indicating that strong rejection of modernity and modernization (not application of modern agriculture tools) as relevant categories for environmental reform in agriculture.

Modern and clean-up technology (MTE) versus traditional technology (TTD): MTE as an EM-based concept implies to invention, innovation and diffusion of new clean technologies in agriculture that demonstrate improved environmental and economic performance. TTD as a DM-based concept implies the application of traditional technologies in agriculture and that the only feasible strategy for agricultural development is a radical goodbye to modern technologies.

Scientific knowledge (SKE) versus indigenous knowledge (IKD): SKE as an EM-based concept denotes that solution of different problems, due to application of new agricultural sciences, is possible by more scientific research and providing more appropriate scientific results. On the other hand, IKD is a DM-based concept that advocates application of indigenous knowledge of farmers for sustainable agricultural development.

Application of market and economic principles (ECE) versus not application of market and economic principles (NED): ECE is an EM-based concept that emphasizes on the role of producers, entrepreneurs, insurance companies, consumers/customers and suppliers as actors for environmental reform, using mainly economic arguments and mechanisms to articulate environmental goals for agricultural development. NED as a DM-based concept implies that economic arguments and mechanisms are not important to articulate environmental goals for agricultural development.

Strong modern environmental state (STE) versus radical decentralization (RDD): STE as an EM-based concept indicates the value of a bureaucratic state in attacking the most acute environmental problems of agriculture. RDD is meant withering away of the state and decentralization of both production and government structures.

Transnationalization (TRE) versus self-government in local level (LCD): TRE is an EM-based concept. This concept advocates that the nation-state is no longer the only level of analyzing and influencing environmental policy-making, rather globalization changes the social dynamics behind environmental reforms. LCD is a DM-based concept. This concept advocates that decentralized communities which control and self government would be at the local level, but the communities would share some authority for the maintenance of some national services with other communities around the country are more appropriate for sustainable agricultural development.

Moderate environmentalism (MEE) versus radical environmentalism (RED): MEE as an EM-based concept assumes that environmental crisis in agriculture can be resolved by modifying attitudes, changing laws, government policies, corporate behavior and personal life styles. RED is a DM-based concept that insisting on the need for fundamental alterations in values and structures and demanding deep and systematic changes in philosophy tactics for achieving sustainable agriculture.

Role of environmental movements (MVE) versus No role of environmental movements (NMD): One of the core features of EM is emerging new positions, roles and ideologies for environmental movements in agricultural development (MVE). NMD as a DM-based concept assumes no role for environmental movements in the process of agricultural development.

Both production and environmental protection (PEE) versus only environmental protection (OED), both ecological and economic rationality (ERE) versus only ecological rationality (ERD): Based on two EM concepts (PEE and ERE) ecological and economic rationality are seen as having their own legitimacy in agricultural development. So that economic growth and environmental protection can be reconciled. On the other hand, DM-based concepts (OED and ERD) say that only the subordination of economic rationality to ecological rationality in agricultural sector, will result in an appropriate agricultural development.

Present agriculture of Iran (PAG) versus ideal agriculture of Iran (IAG): PAG is the attitudes of agricultural specialists toward present status of agricultural system in Iran. IAG is the ideal agricultural system of Iran as perceived by agricultural specialists.

Results and Discussion

One of the strengths of the Galileo is the multitude of ways in which one can look at the data produced. We have selected three ways of analyzing the data. First, we provide the perceptual maps or plots for each province and for the aggregate of the two provinces. Second, our discussion continues with regard to two important concepts including Present Agriculture of Iran (PAG) and Ideal Agriculture of Iran (IAG). We then conclude with development of the Galileo to put together the concepts of each theory into the one main concept.

Cognitive maps: Fig. 1 presents the Galileo plots showing two cognitive maps for *Khuzestan* and Fars provinces separately. A map for the aggregate data set is presented in Fig. 2. We rotated the coordinates to best fit across the three samples to set three reference frames under a same standard (a same reference frame). Perceptual mapping programs are like cameras dangling on a string. They can make an accurate picture, but the direction the camera is facing at the moment the picture is snapped is determined by the shape of the space without any regard for conventional standards. Before we can compare any two "pictures" made by a perceptual mapping program, we must adjust for the arbitrary orientation of the pictures. Looking at Fig. 1A, we see that the specialists of *Khuzestan* province place Ideal Agriculture of Iran (IAG) more in the vicinity of the concepts of EM theory. This represents the

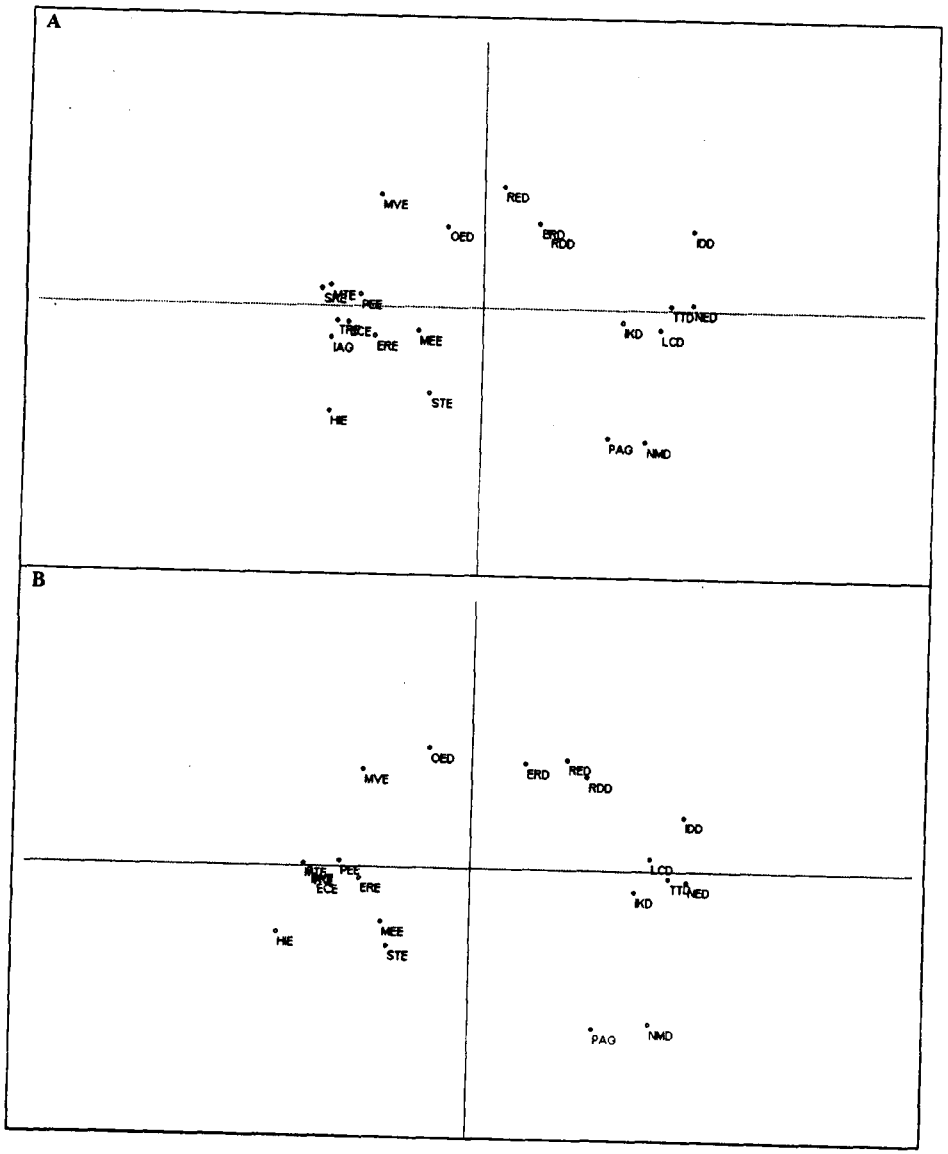


Figure 1. Cognitive map of Khuzestan (A) and Fars (B) provinces agricultural specialists' attitude toward DM and EM based agricultural paradigms.

· Overlapped concepts in Fig. 1B are: MTE, SKE, ECE, TRE and IAG.

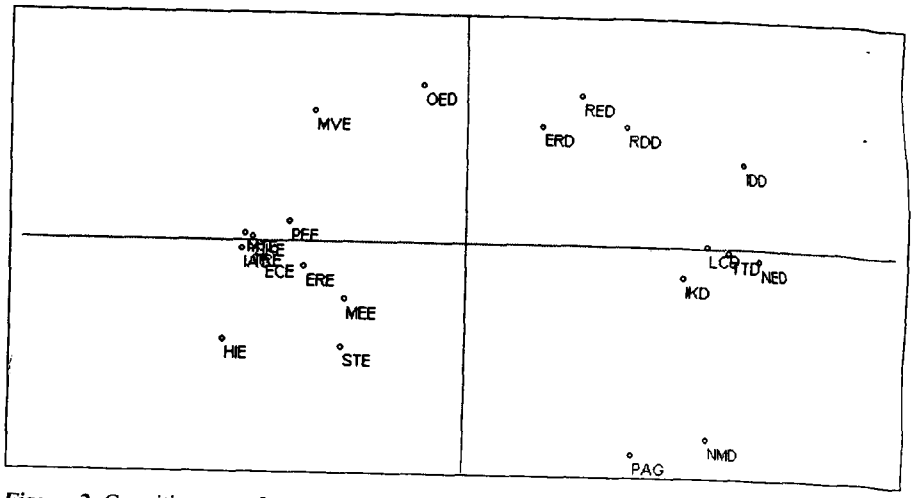


Figure 2. Cognitive map for aggregate data of Khuzestan and Fars provinces agricultural specialists' attitude toward DM and EM based agricultural paradigms.

* Overlapped concepts in Fig.2 are: MTE, SKE, ECE, TRE and IAG.

Table 2. Specialists' perceptions of the Distance between present agriculture of Iran and EM and DM concepts.

Concept	Khuzestan province (N=82)	Fars province (N= 107)	Total two provinces (N= 189)
HIE	7.41	7.27	7.33
IDD	4.59	4.65	4.62
MTE	7.10	7.23	7.17
TTD	3.60	3.83	3.73
SKE	6.70	6.49	6.58
IKD	3.62	3.93	3.79
ECE	6.63	6.26	6.42
NED	4.06	4.51	4.32
STE	5.33	5.39	5.37
RDD	6.09	6.18	6.14
TRE	6.39	6.68	6.56
LCD	3.90	3.91	3.90
MEE	6.12	5.39	5.71
RED	6.63	6.44	6.52
MVE	7.22	6.60	6.87
NMD	3.98	3.97	3.97
PEE	6.80	6.26	6.50
OED	6.77	6.62	6.68
ERE	6.55	6.28	6.40
ERD	5.89	6.35	6.15
IAG	7.66	7.00	7.29

importance of the premises of this theory. Instead, we see the concepts of DM theory as rather peripheral and far apart from Ideal Agriculture of Iran (IAG). Only Environmental Protection (OED) is the only concept of DM theory that is fairly close. As we see, the specialists of *Khuzestan* province put No role of environmental movements (NMD) and Indigenous Knowledge (IKD) very close to Present Agriculture of Iran (PAG).

The Agricultural specialists of *Fars* province put Ideal Agriculture of Iran (IAG) very close to the concepts of EM theory (Fig. 1B). As is shown in this Fig., Environmental Protection (OED) was slightly closed to Ideal Agriculture of Iran (IAG), compared to Fig. 1A. The other concepts of DM theory are far apart from Ideal Agriculture of Iran (IAG), even though they are slightly closer to Present Agriculture of Iran (PAG) among the specialists of *Fars* province than the other province. The agricultural specialists of two provinces as a whole put Ideal Agriculture of Iran (IAG) very close to the concepts of EM theory (Fig. 2). Hyper-industrialization (HIE) and only environmental protection (OED) are slightly more far apart than in Fig. 1A. We see the concepts of DM theory as rather peripheral and far apart from ideal Agriculture of Iran (IAG). In general, the plots are good enough to provide a rough approximation of the structure, and even though the attitudes of the agricultural specialists of *Khuzestan* and *Fars* provinces are slightly different, most of their attitudes about the overall structure of domain are substantially similar.

Mean matrix regarding present agriculture of Iran (PAG): Whereas the plots provide the best holistic view of the data, the most fundamental output of a Galileo analysis is what is called a means matrix. In the means matrix, the mean response (from all the respondents) is computed for every pair of concepts. Put another way, the means matrix reflects the mean distance perceived by the community in question [23]. Table 2 and 3 show the based agricultural development distances specialists perceive various concepts of EM and DM theories to be from two of our central concepts, Present Agriculture of Iran (PAG) and Ideal Agriculture of Iran (IAG). Table 2 reflects the distances estimated by agricultural specialists in Khuzestan and Fars provinces separately and as a whole from Present Agriculture of Iran (PAG).

The specialists of Khuzestan province consider Present Agriculture of Iran (PAG) to be closer to Traditional Technology (TTD), Indigenous Knowledge (IKD), Self-government in Local Level (LCD) and No Role of Environmental Movements (NMD). Not Application of Market and Economic Principles (NED) is also fairly close (4.06). These are concepts of DM theory. The specialists of Khuzestan province consider the greatest distances between Present Agriculture of Iran (PAG) and Hyper-industrialization (HIE), Role of Environmental Movements (MVE) and Modern and Clean-up Technology (MTE) as three important features of EM theory. Both Production and Environmental Protection (PEE), only Environmental Protection (OED), Application of Market and Economic Principles (ECE), Scientific Knowledge (SKE) and Radical Environmentalism (RED) are also fairly far apart (Table 2).

The specialists of Fars province expressed the greatest distances between Present Agriculture of Iran (PAG) and two central concepts of EM theory i.e. Hyper-industrialization (HIE) and Modern and Clean-up Technology (MTE) (Table 2). In their opinion, the lowest distances are between Present Agriculture of Iran (PAG) and Traditional Technology (TTD), Self-government in Local Level (LCD), Indigenous Knowledge (IKD) and No Role of Environmental Movements (NMD). As we know, these are important premises of DM theory.

Table 2 shows the closest distances in total two provinces are between Present Agriculture of Iran (PAG) and Traditional Technology (TTD), Indigenous Knowledge (IKD), Self-government in Local Level (LCD) and No Role of Environmental Movements (NMD). These are central concepts of DM theory. In Table 2, it is clear that the specialists of two provinces consider the greatest distances between Present Agriculture of Iran (PAG) and Hyper-industrialization (HIE) and Modern and Clean-up Technology (MTE) as two central premises of EM theory. In sum, the agricultural specialists of these provinces of Iran perceive the close distance of Present Agriculture of Iran (PAG) and major features of DM theory. Whereas they express the great distance between Present Agriculture of Iran (PAG) and central concepts of EM theory including Hyper-industrialization (HIE) and Modern and Clean-up Technology (MTE).

Turning to Table 2 which describes the distance between Present Agriculture of Iran (PAG) and Ideal Agriculture of Iran (IAG), it is clear that the agricultural specialists of Khuzestan and Fars provinces separately and as a whole, perceive the great distance between Present Agriculture of Iran (PAG) and Ideal Agriculture of Iran (IAG) (the mean distances are 7.66, 7.00 and 7.29 respectively).

Mean matrix regarding ideal agriculture of Iran (IAG): Table 3 shows the distances specialists perceive various concepts of EM- and DM-based agricultural development theories are from Ideal Agriculture of Iran (IAG). The agricultural specialists of Khuzestan province expressed the closest distances between two central concepts of EM theory i.e. Modern and Clean-up Technology (MTE) and Scientific Knowledge (SKE) and Ideal Agriculture of Iran (IAG). The distances of Both Production and Environmental Protection (PEE), Hyper-industrialization (HIE), Application of Market and Economic Principles (ECE), both Ecological and Economic Rationality (ERE) and Strong Modern Environmental State (STE) from Ideal Agriculture of Iran (IAG) are also low. These are the basic premises of EM theory. Instead, the greatest distances are between Ideal Agriculture of Iran (IAG) and Not Application of Market and Economic Principles (NED), Industrial Disarmament (IDD) and Traditional Technology (TTD) as three important concepts of DM theory. In their opinion, Indigenous Knowledge (IKD), Self-government in Local Level (LCD), No Role of Environmental Movements (NMD) and Radical Decentralization (RDD) are also fairly far apart to Ideal Agriculture of Iran (IAG).

In Table 3, it is clear that the specialists of Fars province consider Ideal Agriculture of Iran (IAG) to be closest distances to both Production and Environmental Protection (PEE), Scientific Knowledge (SKE), Modern and Clean-up Technology (MTE) and both Ecological and Economic Rationality (ERE). The mean distances of the other concepts of EM theory from Ideal Agriculture of Iran (IAG) are fairly low (Table 3). On the other hand, the agricultural specialists of Fars province expressed the greatest distances between Ideal Agriculture of Iran (IAG) and concepts of DM theory including Industrial Disarmament (IDD), Traditional Technology (TTD), Not Application of Market and Economic Principles (NED), No Role of Environmental Movements (NMD) and Self-government in Local Level (LCD). The only

Table 3. Specialists' perceptions of the distance between ideal agriculture of Iran and EM and DM concepts.

Concept	Khuzestan province (N=82)	Fars province (N= 107)	Total two provinces (N= 189)
HIE	2.33	3.50	2.99
IDD	8.23	7.83	8.01
MTE	1.51	2.55	2.10
TTD	8.07	7.42	7.70
SKE	1.71	2.51	2.16
IKD	7.62	6.95	7.24
ECE	2.37	3.13	2.80
NED	8.29	7.42	7.80
STE	2.41	3.60	3.08
RDD	7.32	6.20	6.68
TRE	2.70	3.20	2.98
LCD	7.56	7.07	7.28
MEE	2.59	3.49	3.10
RED	6.05	6.04	6.04
MVE	2.54	3.44	3.05
NMD	7.55	7.21	7.35
PEE	2.13	2.50	2.34
OED	3.68	3.34	3.49
ERE	2.39	2.94	2.70
ERD	6.06	5.95	6.00

feature of DM theory that is close to Ideal Agriculture of Iran (IAG) is Only Environmental Protection (OED).

Table 3 illustrates the agricultural specialists' perceptions of two provinces as a whole regarding the distance between Ideal Agriculture of Iran (IAG) and EM and DM concepts. They expressed the closest distances between Ideal Agriculture of Iran (IAG) and three central concepts of EM theory i.e. Modern and Clean-up Technology (MTE), Scientific Knowledge (SKE) and Both Production and Environmental Protection (PEE). As we see, the other concepts of EM theory especially Both Ecological and Economic Rationality (ERE), Application of Market and Economic Principles (ECE), Transnationalization (TRE) and Hyper-industrialization (HIE) are also fairly close to Ideal Agriculture of Iran (IAG). The greatest distance is between Industrial Disarmament (IDD) as the most important features of DM theory and Ideal Agriculture of Iran (IAG) (8.01). The total sample also perceive the great distances regarding the other concepts of DM theory such as Not Application of Market and Economic Principles (NED), Traditional Technology (TTD), No Role of Environmental Movements (NMD), Self-government in Local Level (LCD) and Indigenous Knowledge (IKD). As we see in Table 3, Only Environmental Protection (OED) is the only concept of DM theory that is close to Ideal Agriculture of Iran (IAG) (3.49).

***Cumulative DM and EM concepts: Advancement of Galileo method*:** An important purpose of this paper was to put together the 10 concepts of each EM- and DM-based agricultural development theories into two main concepts. The procedure used to achieve this required an advancement in Galileo methodology. We used the theory of automatic message generator. Indeed, EM and DM are compound messages, which are built up of 10 simple messages (Fig. 3). The assumption, which justifies representing concepts as vectors in space, of course, is that concepts behave like vectors and thus may be described by the algebra of vectors. In this case, this assumption required us to assume that messages will add (or more precisely, average) like vectors [18]. This algebra of vectors predicts that the 10 concepts of each EM and DM theories will move toward two points of convergence (Converged EM (CEM) and Converged DM (CDM)), which are the center of mass of the system. Since each of our points (HIE, IDD, MTE, ...) are usually represented as position vectors in the multidimensional space, the points CEM and CDM are given (from an elementary theorem of vector algebra) as

$$CEM=\frac{(HIE + MTE + SKE + ECE + STE + TRE + MEE + MVE + PEE + ERE)}{10}$$

$$CDM=\frac{(IDD + TTD + IKD + NED + RDD + LCD + RED + NMD + OED + ERD)}{10}$$

Finally, since the manifold is usually a Riemann manifold, it is convenient to represent each of the vectors as a tensor, which gives the position vectors of HIE, IDD and ... as $R^{\mu}_{(HIE)}$, $R^{\mu}_{(IDD)}$ and ..., and the points CEM and CDM as $R^{\mu}_{(CEM)}$ and $R^{\mu}_{(CDM)}$ so that

$$R^{\mu}_{(CEM)}=\frac{(R^{\mu}_{(HIE)}+R^{\mu}_{(MTE)}+....+R^{\mu}_{(ERE)})}{10} \quad (1)$$

$$R^{\mu}_{(CDM)}=\frac{(R^{\mu}_{(IDD)}+R^{\mu}_{(TDD)}+.....+R^{\mu}_{(ERD)})}{10} \quad (2)$$

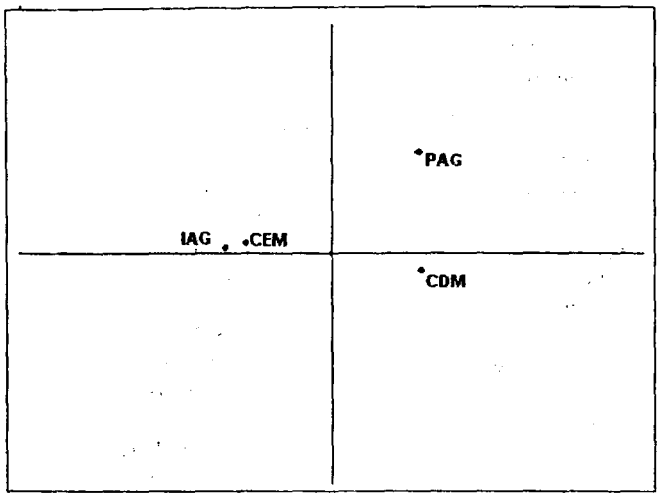
Since, this operation is not built into the Galileo software, we have computed them manually. For each dimension of the Galileo space, we calculated the mean of the 10 coordinates of the concepts of each EM- and DM-based agricultural development theories for aggregate data of two the provinces. These means are the coordinates of a point (CEM and CDM) which will be at the exact geometric center of the configuration of the concepts, and will thus be as close to all of them as possible. Clearly, the equations (1) and (2) can be generalized for number of n vectors to give a general equation for any categorical message as

$$R^{\mu}_{(C)}=\frac{\sum_{i=1}^{n} R^{\mu}_{(i)}}{n} \quad (3)$$

As is shown in Fig. 3, the ideal agriculture of Iran (IAG) is much more closer to CEM than to CDM. Therefore, EM-based agricultural development theory, as a compound of its basic premises is perceived to be a more viable path to sustainable agricultural development of Iran.

To Conclude: A Path to Sustainable Agriculture

The complex nature of the interrelation between agricultural production, the natural environment and the social system of stakeholders means that we are far from knowing which paths and systems will lead to sustainability. However, if one considers the proposition that plans and actions are to a great extent a consequence of attitudes, apprehension of stakeholders' attitudes regarding sustainable agriculture could provide guidelines for future course of actions. Stakeholders of sustainable agriculture include farmers, consumers, environmentalists, researchers and agricultural specialists. They all have their own realities with regard to sustainable agriculture. Consensus of these multiple realities is



CEM: Cumulative of EM based concepts
CDM: Cumulative of DM based concepts
IAG: Ideal agriculture of Iran
PAG: Present agriculture of Iran

Figure 3. Cognitive map of specialists' attitude with regard to cumulative DM and EM premises.

required in order to achieve sustainability. This study has deliberately focused on the attitudes of agricultural specialists because they are not only decisive decision makers with regard to sustainability they are also very influential in shaping others realities, particularly farmers. Cotgrove [24] suggests that a paradigm is dominant, not because it held by majority of people in a society, but because it is held by dominant groups who use it to legitimize and justify prevailing institutions.

It can be concluded that the present system of agriculture in Iran is far apart from ideal system of agriculture. This discrepancy is of great importance, because it illustrates that future agriculture is not like the present practices and there are major areas, which needs to be changed. A felt need can be assumed among agricultural specialists regarding changes toward a sustainable agriculture. Dissatisfaction with sustainability of Iran's agriculture has been expressed by others [25]. A study of wheat producers at national level revealed that the production systems of 51.3 percent of farmers are either unsustainable or very unsustainable [26]. Iran's agriculture has been criticized with regard to unsustainable use of inputs, resources and even for socio-economic unsustainability [7]. The present agriculture of Iran is close to DM-based agricultural paradigm. "Indigenous knowledge" is very close to present agriculture of Iran. DM proponents argue that modern science causes environmental disruption therefore emphasize on indigenous knowledge for agricultural development [7]. Present agriculture of Iran is also close to "traditional technology", "self-government in local level" and "no role for environmental movements". DM proponents stress the all-negative influence of modern technologies in agricultural development policies. So, they argue that the only viable and feasible strategy for agricultural development is a radical goodbye to modern and scientific technologies. DM proponents emphasize on the role of traditional technology for agricultural development. The assumption that farming systems, which are modern, mechanized and use synthetic chemicals are profoundly unsustainable has been questioned [27]. DM believes to withering away of the state and radical decentralization in agricultural development policies. Agricultural specialists perceive the ideal agriculture to be far apart from these DM concepts.

Then, what the ideal agriculture resembling remains to be answered. The ideal agriculture of Iran is close to three central concepts of EM theory i.e. "modern and clean-up technology", "scientific knowledge" and "both production and environmental protection". Contrary to proponents of DM-based agricultural development theorists, sustainable agriculture is perceived by specialists to be based on more scientific knowledge, modern environmentally friendly technology and multidimensionality. Multidimensionality implies that the ideal agriculture would seek to produce more while protecting the environment. Technology is essential for agricultural growth and development in processes of production. Application of new technologies has caused fundamental changes in the process of production and in farmers' lifestyles. Such views are understandable where progress in basic research and technology development has been linked to economic and social stimuli. The specialists' attitude do not support the DM assumption that modern technology causes negative environmental impacts and in that way raise doubts about its application. In fact, there is no assurance that organic farms will be sustainable. The so-called 'organic by neglect' producers have been criticized for unsustainability [28]. EM-based agricultural development policies should be based on the application of ecomodern (environmental) technologies in different stages of production. The general direction of development in this respect is symbolized by the shift from the remedial strategy involving end-of-pipe technology to preventive strategies involving clean-up technologies based on precautionary principle. Environmental technology is usually considered to comprise products and services developed for purposes of environmental improvement. The goal of the clean technology is to spur and define environmental innovative behaviour [11]. Improved cost effectiveness coupled with environmental improvement is the theme behind preventative environmental strategies through the implementation of cleaner technologies [29]. Cleaner production is an operational approach to the development of the system of production and consumption, which incorporates a preventive approach to environmental protection [30].

Specialists support the idea that one of the fundamental elements to increase food and productivity is more use of new agricultural sciences. Based on this perception, solution of different problems due to application of these sciences in agricultural practices is possible by more scientific research and providing more appropriate scientific results. This belief is supported by some researchers. The role of scientific knowledge has been emphasized for sustainable agricultural development. The concept of precision agriculture, based on information technology, is becoming an attractive idea. The hope of precision agriculture is that through more precise timing and usage of seed, agricultural chemicals and irrigation water that higher economic yields can occur while enhancing the economic production of field crops and protecting the environment. Maohua [31] argues that, the key restriction of less agricultural development and less food production in developing countries is obviously due to the backwardness of agricultural sciences and technology. Crosson and Anderson [32] argued that, (scientific) knowledge is the key resource, and increasing the supply of it on economical terms to farmers is the key policy issue in achieving global sustainable agriculture. The

argument rests on the notion that the supply elasticity of knowledge is greater than it is for land, water, genetic and climate resources, and that the elasticity of substitution of knowledge for natural resources generally is high. The critical role of scientific knowledge in agricultural development of Iran has been emphasized particularly in increasing production [7].

The other concepts of EM theory especially "both ecological and economic rationality", "application of market and economic principles", "transnationalization" and "hyper-industrialization" are also fairly close to ideal agriculture of Iran. Therefore, in ideal agriculture, ecological and economic rationality, are seen as having their own legitimacy in agricultural development. Then agricultural policies should be designed and evaluated according to both rationalities. Beus and Dunlap [33] view 'alternative approaches' in confrontation with environmental crisis that seeks protection of environment parallel to enhance of production. The concept of 'precision agriculture' is also an idea for reconciliation between economy and environment [31].

The new ecological economics position is important framework for sustainability and can help to challenge the neoclassical economics position. This perspective highlights that the economic system is the subsystem of the larger social system. Furthermore, both systems are subsystems of the parent (mother) ecosystem and are totally dependent upon it. This is important for understanding the system under investigation and the system that is the focus of the sustainable development process; the focal system is our common planet, the subsystems of which the economic and social systems are [34]. Roling [35] argued that neoclassical economics, with its arrogant reification of the market, is a serious threat to human survival, a pressure of the first order.

Specialists believe the concept of transnationalization is close to ideal agriculture of Iran. Transnationalization and globalization change the social dynamics behind environmental reforms. The nation-state is no longer the only level of analyzing and influencing environmental policy making. Briefly, this is the move away from relatively closed national economies with international links as a relatively minor feature [36].

According to specialists, the structure of production for agricultural development should be based on hyper-industrialization in this sector. One alternative way for agricultural development, due to characteristics of the present age, including increased population, decrease of area under cultivation and stringent need to food safety and quality is more industrialization and modernization of agricultural production in a way as to combine increase productivity with better environmental performance. This means more use of industry and technology in organization of production and consumption of agricultural production. Also, policy making in this sector, due to negative impacts of agricultural industrial practices, should be based on ecological restructuring of these practices (in order to achieve increased production and reduced degradation of environment). Based on agricultural specialists attitude this study pointed toward general directions of sustainable ideal agriculture of Iran.

However, further research is needed in order to take the multiple realities of other stakeholders into account and to provide a more complete picture of ideal sustainable agriculture. Furthermore, explanatory models are needed which could guide the transformation of present agriculture to the ideal agriculture.

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