J. Agr. Sci. Tech. (2012) Vol. 14: 51-64

Spatial Patterns of Agricultural Development: Application of the Composite Index Approach (A Case Study of Fars Province)

G. Abdollahzadeh[1], Kh. Kalantari[2*], A. Asadi[2], R. Fisher[3], and Zh. Daneshvar Ameri[2]

ABSTRACT

The interest for the spatial dimensions of agricultural development has been recently increased. This paper aimed at redefining the spatial patterns of agriculture to formulate appropriate strategies based on regional potentials. A Composite Agricultural Development Indicator (CADI), which is useful for the identification of spatial structure, has been developed. The developed composite Index (CI) includes five dimensions of Agricultural Development: (1) social-cultural, (2) structural-farming, (3) technical-management, (4) economical-financial, and (5) infrastructural-services and consists of 87 indicators selected at the county level. Indicators were normalized according to a coherent framework and using the division by means technique and were combined via weightings derived from Analytical Hierarchical Process (AHP) and Principal Components Analysis (PCA). The evaluation of agricultural development based on desired CADI was used to map the spatial development patterns at county level. Province counties are compared and ranked in order to show the spatial gap between them. Then, spatial development patterns were divided into three zones based on CADI. Results showed that the nature of spatial agricultural development firstly depends on the service and infrastructural development and secondly on utilization of natural and physical endowments.

Keywords: Agricultural development, Agricultural development indicators, Agricultural spatial development, Composite index, Spatial patterns.

INTRODUCTION

Similar to so many other developing countries, the spatial economy of Iran is characterized by an uneven spatial pattern of economic activities (Sharbatgholei, 1999; Noorbakhsh, 2005; PBOIRI, 2005b). The problem of spatial inequality emerged when efficiency-oriented sectoral policies came into conflict with the spatial dimension of development (Atash, 1988). Due to this conflict, an extreme imbalance development was created in Iran (Kalantari, 1998; UPARCI, 1991). Agricultural spatial and national growth imbalances are highlighted in the Five Year Development Plan of Iran's government as weaknesses which Iran's economy and its agricultural structure need to overcome in order to ensure continued sustainable economic and agricultural progress (PBOIRI, 2005a). The fact is that all national policies are likely to have some impact either directly or indirectly upon agricultural sector. Iran's government national spatial strategy goal is to achieve more equitable development in all branches of economy, as indicated in the Five Year Development Plan, with sustainable development identified as a key objective (PBOIRI, 2005a). However, Agricultural

[1] Department of Extension and Education, Gorgan University of Agricultural Sciences and Natural Resources, Gorgan, Islamic Republic of Iran.
[2] Department of Agricultural Management and Development, Faculty of Agricultural Economics and Development, University of Tehran, Karaj, Islamic Republic of Iran.
[*] Corresponding author, e-mail: khalil_kalantari@yahoo.com
[3] Australian Mekong Resource Centre, School of Geosciences, University of Sydney, Sydney, Australia.

[DOR: 20.1001.1.16807073.2012.14.1.13.3]

Development (AD) policy in Iran, which has been based on the modernization approach in the past decades, has brought about negative impacts such as uneven development, poverty and environmental degradation (Rezaei-Moghaddam *et al.,* 2005). The concern for uneven development problem was the major contributing factor for the loss of faith in this path for the development of agriculture sector (Kalantari and Rostami, 2004).

The low level of development and the recent concern to increase agricultural production have led to several studies concerned with various aspects of AD in Iran. However, most of the work on the theme has been done by economists and is based on farm-level data obtained from farm surveys. Economic studies have focused on the efficiency of resource allocation and development pattern differences between small and large farms while ignoring the spatial scale of AD. Although these studies have made important contributions to the understanding of issues related to AD in Iran, they have shed little light on the spatial variations of AD and the factors affecting such variations. The few studies by geographers restricted to some parts of Iran, are marred by limitations of the methods, variables and indicators used, and are limited mainly to the identification of AD patterns. It is important to have in mind that agriculture is unique and the most essential activity in every society and depends on natural and physical conditions of the area (Heston, 1993). Recently published policy documents such as general policies, strategies and goals of the Fourth Five-Year Economic, Social and Cultural Development Plan of Iran (PBOIRI, 2005a) and the National Document for the development of agricultural and natural resources sector in the Fourth Five-Year Development Plan (APERI, 2005a) have placed increasing emphasis on spatial planning as a means to achieve development balance. Moreover, spatial distribution of agricultural activities in Iran is unknown. National and provincial governments have begun to respond to these developments by preparing integrated regional and spatial development strategies for their territories (APERI, 2005b). As an integral part of spatial planning, identification of spatial development pattern can be very powerful both in the planing process and targeting and implementation of interventions to manage spatial imbalances in AD. Hence, the identification of AD patterns at spatial scale and their generating factors can help to regulate spatial policymaking if development programs are focused on removing the constraints which adversely affect development in potentially good areas. Considering the negative impacts such as uneven development caused by the conventional development strategies of AD (Karami, 1993), this paper is concerned with the identification and interpretation of spatial AD patterns by employing composite index approach using data from Fars Province of Iran.

As a main agricultural production center in Iran, the Fars Province counties have different agricultural attributes/characteristi cs in different proportions. Agricultural production in these counties includes a variety of activities and the obtained diverse results make it much more difficult to evaluate their development. The composed index methodology in this paper, weighted individual indicators based on principal components and weighted AD dimensions based on AHP, and captured these county-level differences in a CI. This allows a clearer comparison of AD levels for these counties. High or low levels of each characteristic (sub-indicator) can be identified, spatial patterns can be mapped, proposal of possible strategies, which can be used to develop the country and reduce the spatial imbalances, can be provided and policy recommendations can be made. New information on the spatial pattern of AD (the spatial dimension of agricultural activities) can contribute to development planning, policymaking and implementation. Development planners need information on the spatial distribution of agricultural activities to formulate relevant policies.

The main purpose of this study was to map patterns of spatial AD by designing and developing an approach for constructing CADI. In this research, we first developed an approach to construct CADI. Then we analysed the main results of the AD disparities based on the collected data from agricultural census 2001 and Fars Provincial statistical yearbooks 2002-2006. This was done to provide evidence of the differences between counties in order to identify driving forces of such disparities by focusing on socio-economic, natural, physical and local characteristics. Therefore, questions to be answered were as follows:

What is the spatial pattern of AD in Fars Province?

What are the causes of AD disparities emergence in Fars Province?

The rest of the paper's plan is as follows. First, a brief review on conceptual aspects of AD dimensions is discussed. Then the hierarchical method to construct CI of AD is presented. This is followed by the application of the approach to assess the AD in the study area (Fars Province) in Iran. By such an application it may be possible to interpret determinants of AD to formulate some reduction of regional disparities in policies.

Conceptual Framework

The process of AD is a complex subject consisting of a large number of interrelated social, physical, economic, cultural and political factors (Olujenyo, 2006). Wharton (1998) has noted that AD is influenced by external factors which often cannot easily be altered in the short run. For example, the development of infrastructure and the rate of population growth can have a profound effect on the direction and rate of AD. Since production of agricultural goods strongly depends on natural settings, socio-political and agro-technical conditions (Cowell and Clift, 1996), standardization of evaluation methods or management advice is considerably more restricted than, e.g. for industrial production processes. Some scholars state that, the quality, capability and performance of farmers in agriculture are fundamental indicators of the level of the agricultural sector's efficiency, productivity, development and sustainability (Maalouf *et al.,* 1991). Others stress on technology absorption in agriculture, which is a principal sector of the economy of most regions could be considered as a primary objective of any developmental effort (Feder and Umali, 1993; Feder *et al.,* 1985). Moreover agricultural activities can be evaluated on national, regional and local spatiotemporal scales. On each of these scales, there are different sociological, biophysical, economic, and other performance components of interest (Wolf and Allen, 1995). This vindicates that there are little consensus on the meaning and concept of AD. Also agricultural production represents a highly complex system composed of manifold interacting parameters of both environmental conditions and human activities. This dynamic network of numerous, often unpredictable parameters, hides different components drawbacks (Von Wiren-Lehr, 2001). To address the complex question of the dimensions of AD at regional scale, physical and nonphysical aspects have been developed by geographer and economics sequences. Although the natural and physical characteristics of the agro region, including climate, land, water and soil are critical determinants of the economic performance and yield of cropping system, these elements concern natural endowment and cannot explain differences in development management for agricultural practice (Kalantari, 2001). Therefore, most of these indicators had little validity for analysing AD. We shall try to develop an indicators framework that meets physical, nonphysical and other related factors tied together in an assessment plan. To design the assessing indicators framework, we have organized AD dimensions as fallows.

[DOR: 20.1001.1.16807073.2012.14.1.13.3]

Social-cultural Dimensions

Farming is a social and cultural activity; these factors directly affect the AD and shape the nature of farming, in other words, they determine the farm and farming structures. Therefore, the social and cultural environment in which the farming operates is of significance. These include: farmer family size and structures, farm labour force, farmer population density, emigration rate, degree of solidarity among farmers, the attitudes of farmers, satisfaction by the farming job, position of farmer in rural, religious and racial characters, gender inequalities, ownership patterns and systems, land size, cooperative culture in crop farming, farming systems, and innovation acceptance level.

Structural-farming Dimensions

AD is a result of favoured physical and structural conditions. This includes: land structure, land accessibility, intensity of farming, farming systems structure, land fragmentation and consolidation that make various opportunity to achieve development.

Technological-management Dimensions

The effect of technological components on AD is immediate in several aspects. Irrigation and drainage systems, soil conservation methods, farm machinery, crop rotation, cultivating and harvesting techniques, new biochemical varieties such as: fertilizers, pesticides and seeds are used more effectively. The management condition used in this technology is the most important because AD is largely determined by decisions taken at the farm level which can be partly influenced by government policy, as factors beyond the control of farmers. These include: technical knowledge and tillage practices.

Economical-financial Dimensions

These include a number of services that are essential for new AD activates such as productivity, efficiency, growth rate, regional gross domestic production, farmers income per capita in farm and nonfarm sectors, crop insurance systems, amount of loans, price incentives, transportations, marketing, storage, packaging cost, sale unions and credit accessibility and investment in farm revival.

Infrastructure-services Dimensions

These terms refer to the road network (at rural and farm levels), electricity and energy, and some organization related farming practices such as: rural services centers, agriculture production cooperatives, researches, extension and educational institutes, marketing organizations, financial institutions, farm location and machinery services provided to farmers. All these services play an important role to help farmers to improve their production.

There are few studies focusing on AD at spatial scale based on an indicators framework. One good example of the application of indicators in AD is an index system of sustainable development constructed by Xu *et al.* (2006) which included five supporting systems consisting of 95 factors that are selected as basic indices at the provincial level. Assessment was done for the five supporting systems and divided the whole country into nine AD regions (first-level), and 22 sub-regions (second level). Also Fanfani and Brasili obtained a new geography of agriculture for the identification of principal macro-agricultural areas by choosing thirty AD indicators and carrying out the PCA and cluster analysis. In Iran, an attempt to analyze and construct CI of AD at provincial scale was made by Kalantari and Rostami based on 11 indicators and using the principal component method (2004). The indicators were integrated graphically into

CI and numerical measures of AD level. CI was graphical representations of AD level of a province in comparison with other provinces. Results showed that nine provinces were identified as being highly developed and the remaining 19 provinces were classified as of medium level of development or underdeveloped. Spatial analysis of agricultural extension and education activities undertaken by Kalantari *et al.* (2006) employed a framework with 133 indices that were classified into seven fields. Some other scholars have studied agricultural inter and intra regional developments in Iran using indicators methods and confirmed that focusing on a special region caused uneven development of agriculture based on some cash crop (Alirezaee *et al.,* 2007). As result, the two prevailing limitations of these studies in constructing CI of AD is ignoring conceptual and analytical framework to describe the process of selecting indicators for each dimension and obtaining the weights, As result, the prevailing limitations of these studies in constructing CI of AD is ignoring conceptual and analytical framework to describe the process of selecting indicators for each dimension and obtaining the appropriate weights. Since aggregating AD indices has not reached a universal consensus, methodological improvements are necessary first to clarify explicitly all underlying assumptions and second to take advantage of the latest innovative research related to AD. Therefore, to avoid missing data in aggregating process it is important to develop a methodology to combine diverse dimensions and indicators that could provide better insights into patterns of development.

METHODOLOGY

The procedure of calculating CADI is divided into two main parts. The first part is selecting proper AD indicators that belong to each sub-index and then computing the sub-index. The second is deriving the weights of sub-indices and combining these weights with the sub-indices to obtain the final CI. Providing an explicit conceptual framework for the CADI before the selection of indicators, and the usefulness of multivariate analysis (Nardo *et al.,* 2005) (PCI and AHP) to weight the individual indicators allow to reduce the number of individual indicators by aggregating them into a Composite Agricultural Development Index (CADI) and will enable comparisons of counties in specific dimensions regarding AD performance. Furthermore, understanding the concept and interpretation of generalized application of CADI is simple and a useful tool for performance monitoring in the development process. The employed approach to construct CADI comprises nine steps hierarchically. These steps contain the information regarding the seven parts which, according to Krajnc and Glavic (2005) must be fulfilled to compare performance of companies along all the three dimensions of sustainability; economic, environmental, and societal. Hierarchically, nine steps were followed in this research, which are summarized in Figure 1.

Selection of Indicators

Good indicators provide key information on a physical, social or economic system and they allow analysis of trends and cause-and-effect relationships (Veleva and Ellenbecker, 2001). Indicators should be selected on the basis of their analytical soundness, measurability, regional coverage, relevance to the phenomenon being measured and relationship to each other (Saltelli, 2006). Other important selection criteria include validity, reliability, comparability, simplicity, and data availability (Morris, 1979). Besides, an important issue to select indicators in agricultural sectors, is considering the two concepts of inter-regional disparity and inter-regional diversity. Differences in initial resource endowments, largely of natural or

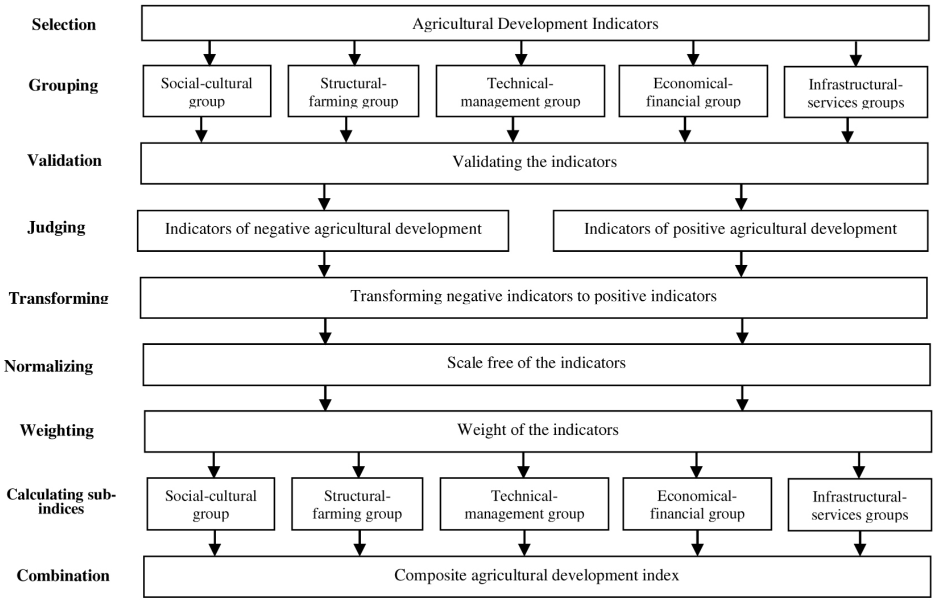

Figure1. (Adopted from Krajnc and Glavic (2005) and revised by authors).

physiographic character, leading to territorial specialization and division of labor through exploitation of the resource advantages-comparative as well as absolute constitute the basis and substance of inter-region diversity which is a concomitant of development. In this regard, some indicators concerning land productivity and profitability implied diversity, and they should be incorporated into other indicators such as; mechanization, using fertilizers and pesticides. Inter-regional disparity, on the other hand, denote the failure of a region to exploit the development potential of its initial resource endowment, its latent comparative and absolute resource advantages, relative to another comparable region, and is therefore, comprised of factors which are not natural or physiographic, but human, institutional and historical-socio-political and/or economic-technological. Essentially, inter-regional disparity is a consequence of the relative failure of a region to convert the initial resource endowments into economic resources, i.e., capital resource and producing further resource (Kalantari, 2001). Therefore in the evaluation process of AD, diversity-oriented indicators should be separated from disparity-oriented indicators. Because of the limitations of related access to data, we selected 87 indicators in five dimensions based on the conceptual framework to analyze agricultural development levels.

Grouping of Selected Indicators

Selection of indicators should be fulfilled in grouping framework. Let's first list the components affecting AD. The conceptual framework of main dimensions of ADs includes: Social-cultural, d= 1, structural-farming, d= 2, Technological-management, d= 3, Economical-financial, d= 4 and Infrastructure-services, d= 5 groups of indicators (Figure 1).

Validation of the Indicators

In any case, the methodology underlying the elaboration and development of indicators should fit scientific standards, which implies a procedure of validation (Girardin *et al.,* 1999). At this stage, the relevance and applicability of the indicators to main research goal, in Iran's condition have been investigated by 57 agricultural science experts and informants selected from academic members of Iranian faculties of agriculture to judge about validity of indicators based on mentioned objectives.

Judging the Indicators

Indicators have positive and negative impact on AD so for avoiding of bias in the final result, positive and negative indicators should be discriminated. These two types of indicators are also denoted at this stage.

Transforming the Indicators

In this section, indicators that have a negative impact on AD should be converted to positive indicators. There are two methods for changing negative indicators to positive ones; converting the value of the indicators and subtracting from the absolute value (Kalantari, 2001). We employed the first method by using the following formula:

$$[X_{ij}] = \frac{1}{Y_{ij}} \quad (1)$$

where $[X_{ij}]$ is the indicators with positive value, Y_{ij} is value of the negative indicator j for county i.

Normalizing the Indicators

As each index uses different measurement scales, an elimination of scale bias should be made. There are many methods for making the indicators scale-free. These include: ranking, standardized score, Re-scaling, distance to a reference, categorical scales, indicators above or below the mean and division by mean (Nardo *et al.,* 2005). The method of dividing by mean was used to remove the scale biases. As Kalantari (2001) pertinently remarks, "If the observation for each indicator is divided by the mean, one can get rid of the bias of scale without affecting the relative position of the region in the series. The transformation does not disturb the "dispersion" of the variables, since the coefficient of variation of the original series is retained as the standard deviation or the coefficient of variation of the transformed series." We adopted the division by mean as follows:

$$Z_{ij} = \frac{X_{ij}}{\bar{X}_i} \quad (2)$$

where $[Z_{ij}]$ is the normalized indicator matrix with scale free value, X_{ij} is the value of indicator j for county i and $\bar{X}_j$ is the mean value of indicator *j*.

Weighting the Indicators

After the elimination of scale bias, a common practice in constructing CI is to assign a weight to each sub-indicator, and then use certain aggregation functions to calculate CI for a set of individual indicators. In the context of spatial unit comparisons, the multivariate method of ‘Principal Components’ is suggested for computing CIs. In the present study, principal components method was used to derive weighs for each of the indicators in the sub index. Then, the weights for AD dimensions were derived through AHP. The agricultural experts and informants were asked to perform pair wise evaluation of five dimensions separately in terms of relative degree of importance. In this step we conducted a survey of 67 agricultural experts and informants who had served in 6 faculties of agriculture. Of 57 experts who responded to the questionnaire, three persons failed to maintain a consistency in the priority order and the pair wise comparison for AD dimensions.

Each mean value of a pair wise comparison was arranged in the square matrix form as shown in Table 1, Structural-farming dimensions, for instance, was 3.922 times more important than Social-cultural in Iran according to experts’ assessment. The weights for AD dimensions were calculated

Table 1. Matrix of pair wise comparisons by AD dimensions.

	1	2	3	4	5	weight
1	1	0.255	0.268	0.289	0.344	0.065
2	3.922	1	0.535	0.464	0.515	0.153
3	3.733	1.869	1	1.374	1.516	0.292
4	3.457	2.157	0.727	1	0.397	0.207
5	2.907	1.940	0.660	2.522	1	0.283
	λ_{max}= 5.24		*CI*= 0.06		*CR*= 0.054	

by Expert Choice software and are presented in Table 1. The weight for the technical-management dimension was the highest (0.292), followed by infrastructural-services, economical-financial, structural-farming and social-cultural. In other words, most of the agricultural experts in Iran considered nonphysical components more significant than natural endowments ones. Also the calculated consistency ratio as determined by equation (3) and (4) was used to analyze the consistency of the responses, which shows how different the consistency of a reply given is from the consistency of randomized reply. This was 0.054, implying that the results were reliable.

The consistency index is defined as;

$$Consistency\ index = \frac{\lambda_{max} - n}{n - 1} \quad (3)$$

where $\lambda_{\max}$ is the principal eigenvalue of the square matrix of pair wise comparisons and n is the number of AD dimensions. The consistency ratio is a proportion of the random index to consistency index calculated as fallows;

$$Consistency\ ratio = \frac{Consistency\ index}{Random\ index} \quad (4)$$

where random index depends on the size of the matrix (Table 2) . If the value of consistency ratio is less than 0.07, the responses will be considered to be consistent (Saaty and Kearn, 1985).

Calculating Sub-indices

In order to obtain a sub-index (IS) for each AD dimension, d, the Pattern of Development C_d, was calculated as shown in equation (5) (Bhatia and Rai, 2004):

$$C_d = \left[\sum_{d=1}^{k}\left(\frac{(Z_{ij} - Z_{oj})^2}{CV_j}\right)\times W_i\right]^{\frac{1}{2}} \quad (5)$$

where Z_{ij} is the matrix of normalized indicators, Z_{oj} is the highest value for indicator j, CV_j is the coefficient of variation of the j^{th} indicator in X_{ij} and W_j is factor loading of the first principal component vector relating to the j^{th} indicator as weight. Then sub-index (IS_d) for each AD dimension is derived as follows;

$$IS_d = \frac{C_d}{\overline{C} + 3S_d} \quad (6)$$

where $\overline{C}$ = Mean of C_d and S_d is standard deviation of C_d.

Smaller values of IS_d will indicate high levels of development whereas higher values of IS_d will indicate low levels of development (Ibid).

Combining the Sub-indices into the CADI

Finally, the AD sub-indices are combined into the CADI, as follows (equation 7).

$$CADI = \sum_{d=1}^{n} W_d IS_d \quad (7)$$

$$\sum_{d=1}^{n} W_d = 1,\ W \geq 0$$

where W_d is the weight of each dimension

Table 2. Distribution of *RI* by matrix size (n×n)

Size of matrix (n)	1	2	3	4	5	6	7	8	9	10	11
Random index	0.00	0.00	0.58	0.90	1.12	1.24	1.32	1.41	1.45	1.49	1.51

Sources: Satty and Kearn (1985).

[DOR: 20.1001.1.16807073.2012.14.1.13.3]

derived by AHP, which represents how much each sub-index increases the CADI. These weights reflect the given importance to the five dimensions of the AD. Finally, spatial AD is mapped by classification techniques of GIS based on CADI.

RESULTS AND DISCUSSION

Using the counties as the basic analytical unit, we will apply the proposed methodology to compare and rank all 22 counties with reference to the sub-indices for each dimension in the first part and then to combine sub-indices to construct the final CI in the second part. The results are presented in Table 3.

From the point of view of social-cultural sub-index it is found that Fasa is at the top and Darab is at the bottom of the ranking scale, while this county is at the top in terms of cultural-farming dimension. Marvdasht which is located in the center of the province emerges as the most developed county of Fars regarding technical-management and infrastructural-services dimensions followed by Shiraz as the center of the province which takes the second position. This county is famous for its fertile lands, modern irrigation systems and production of cash crops. Besides, Shiraz has the highest rank in terms of economical-financial and Marvdasht is placed in the second position. It is sufficient here to note that both of these counties have the highest level of development for CADI, on the other extreme, Khorambid and Mohr are the least developed ones regarding CADI. Mohr is a remote county and has mostly infertile sandy soils and low rainfall with scarce underground water while a large extent of Khorambid is covered by stone mines and it has small arable land. Also these counties do not have a favorable physical base and a developed system of irrigation and mechanization. It is apparent that the unrestricted indicators such as arable land, cash crop and horticulture land cultivation, credit, and farm electricity consumption tend to have very high coefficients of variation and also tend to exaggerate the difference between the region with the highest value and the region with the lowest value. But even with the restricted indicators we find a disparate distribution. For example, the deposit of agricultural bank in Shiraz County is 51.2% higher than in the lower county. The spatial pattern of agricultural development based on the CADI is presented in Figure 1. We chose three classifications that identify the most important agricultural macro-areas. A classificatory scheme is adopted which divides counties into three development categories: high, medium and low. The three macro areas have a very different number of counties: Category 1 (highly developed area) covers the two counties confirmed in the previous section to be in the central region and far more developed than any other region and is named urban marketing area; Category 2 (medium developed area) has five counties which are named peripheral agricultural area and Category 3 (low developed area) includes 15 counties which are named arid and mountain area. The main characteristics of the three macro agricultural areas are as follows.

Category 1

It includes the two highest counties (Shiraz and Marvdasht), located in the center of the province. It is the smallest category in terms of surface. These counties have the highest rank in all dimensions. It is clear that the counties having the highest infrastructural/services/financial conditions have achieved substantial levels of development in agriculture. The distribution of agro-industrial units, which are almost exclusively located in urban areas, may be one factor responsible for such development. Most such units are located in this area. Not only accessing transportation infrastructures but also their proximity to the main urban markets is a vital factor causing such disparities. Closeness to the input and output markets (Shiraz as the center of the province) and relatively high transportation costs due to the vastness of the province, and better infrastructure and services in this area are the major factors responsible for this uneven distribution. This category represents the biggest urban areas of Fars with remarkable food consumption (46.6% population) (SCI, 2006) and also covers a main part of arable cultivated land (26.8%) (SCI, 2003). This cluster represents the "core" of provincial agriculture. It can be stated that urban and industrial development benefits agriculture by giving an impetus to the rational use of land, labor, and capital (Timmer, 2002; Johnston and Kilby, 1975; Mellor, 1966). It facilitates the marketing of agricultural products through better transport systems, information flow, and choice of alternatives (Griffin, 1973). Farm products command higher prices in relatively more urbanized and industrialized regions, making investment in farming profitable (Delgado *et al.,* 1994). If the spatial requirements for agriculture are considered in this way, it appears that the economically more developed regions, such as the Shiraz and Marvdasht, offer comparative advantages for the development of intensive agricultural production such as glasshouse horticulture and intensive animal husbandry. These favorable conditions have contributed to the rapid growth of intensive production in these regions. Spatial development strategy must emphasize ecological protection, increase the input of agricultural resources, improve rural development, and promote science, technology, and management. Because of ecological concern in these regions, the government should support the development and implementation of sustainable farming practices in agriculture through financial motivation, legal obligations, pressure on the governmental organizations, training experts needed to implement this strategy, rendering information and technological services, imposing environmental fines for non-compliance with environmental regulations and norms, cooperation with international organizations and through other means.

Category 2

This category includes five counties that are located in south-eastern and middle and north-western part of the province. Most of counties in this category are small in terms of surface and agriculture and are supported by physical factors only at a moderate degree. This large cluster represents the "peripheral" of provincial agriculture. Despite the advantages of fertile land and sufficient ground water, marketing chain (storage, processing) is undeveloped. This category shows the smallest percentage of cash cropping (sugar beet) and a high level of major crops (wheat, corn, barley) (SCI, 2003). Also farming is the main profession since there are a higher number of young people with respect to the other categories with the highest number of semi-illiterate persons engaged in agricultural activities (SCI, 2006). This category occupies nearly two thirds of the total area of province (Figure 2), therefore, achieving AD in these regions is very important to ensure long-term provincial production. A number of actions are required in order to increase the level of AD in this category. First, there is an urgent need for expanding irrigation resources and fertilizer supply and for improving credit facilities in order to allow small farmers to benefit from the availability of physical inputs. Further, though expensive, expansion of irrigation facilities in these areas where they are presently inadequate, will increase productivity.

Category 3

This category is constituted by 15 counties from the northern part of the province and also from south having a very large area, mainly arid and semi arid. Natural constraints are a serious factor affecting agriculture development in counties of this category. The

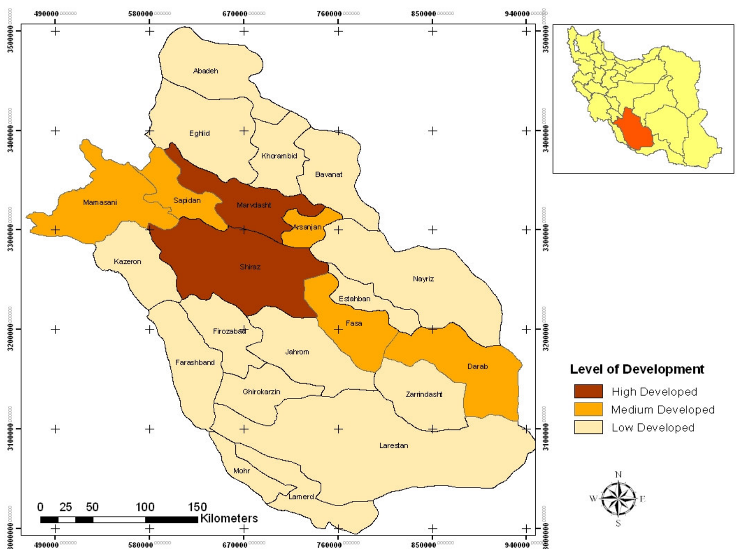

Figure 2. Classifying levels of AD in Fars province (source; paper findings).

mountainous terrain in the north (Abadeh and Eghlid) and arid and semi-arid conditions in the south (Lar, Lamer, Zarindasht, Ghirokarzin and Mohr) cause low levels of AD. Any effort to promote agriculture would remain a cost prohibitive proposition in the mentioned areas. Some southern counties encounter harsh climatic and drought conditions greatly limiting the scope of agriculture (MPB, 1994). Apart from physical and natural constraints, this category is hardly characterized by traditional agriculture; mainly with less use of modern technology such as breed seeds, irrigation systems and machinery (SCI, 2003). In southern counties (Lamerd and Mohr), agriculture has less importance because of benefiting from the linked oil refinery and petrochemical industries, with 3.09% of the total population, while northern counties benefit from an existing stone mine industry which covers some share of subsistence rural households (SCI, 2006).

According to this scheme (Figure 2; Categories 1, 2 and 3), it is necessary to improve the level of AD by increasing the input of science and technology, and adjusting its internal structure to develop intensive, commercial and green agriculture. Efforts must be made to improve the capacity of development by investment in physical factors such as; extension and education services, transport infrastructures, and financial services. This is due to the fact that AD is closely related to local physical conditions.

Also the central/sector-oriented nature of Iran's political/administrative structure is influenced the pattern of AD of Iran. On the other hand, the centralized planning system and decision-making is influenced the pattern of AD of Iran. Paying more attention to industrial development and policy shift within the agricultural sector, from subsistence farming to mechanized and commercial farming had a significant implication for the pattern of AD in Iran. The significance of urban-industrial development in this analysis suggests that a decentralized policy of urban-industrial development will benefit agriculture. It will also help the transfer of population from agriculture to nonagricultural activities. A part of the labor force in rural area, with some retraining, can be profitably used for the promotion of modernized cottage industry, producing simple but widely needed goods.

CONCLUSIONS

This paper has examined the spatial pattern variations in the agricultural structure of Fars province by the application of a tool suggested for the assessment of the AD from a general and quantitative perspective. It purposes of a CADI that displays performance of agricultural regions along all the five dimensions of development; social-cultural, structural-farming, technical-management, economical-financial and infrastructural-service in order to provide a good guidance for decision-making. Attempts have been made to compile the information on how the indices were formulated using the nine steps, namely, selection, grouping, validation, judging, transforming normalizing, weighting, calculating and combining sub-indices. According to classifying CADI, three macro agricultural areas were identified in which two counties were identified as being highly developed (Category 1), while five other counties were considered as belonging to the medium level of development (category 2) and the remaining 15 counties were classified as underdeveloped (Category 3). The highly developed agricultural area which is characterized by modern agriculture and proportion of advantages of physical and economical factors represents the specific situation to quick and cheap access to urbanized market and, where the more labor force engaged in non-farm activities. The other two macro areas are mainly mountainous, arid and semi-arid regions or peripheral areas, characterised by poor endowment of natural and agricultural resources. However, less developed areas are subjected to desert and harsh climate conditions which greatly limit the scope for AD and there is substantial scope for increasing agricultural production in some regions based on spatial relative advantages. The results show that AD will be based not only on structural agricultural characteristics, but also on natural resources, human resources and on the relation between agriculture and the general economic development. Therefore, paying more attention to the industrial development and policy change within the agricultural sector, from subsistence farming to mechanized and commercial farming has a significant implication for the pattern of AD. One final note, we can recommend that the usage of multidimensional and holistic CI for analyzing AD is extremely important. More specifically, it is a prerequisite for every judgment about development condition, resource allocation, planning appropriate development policies, and executing those approaches to reach AD.

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الگوهای فضایی توسعه کشاورزی: کاربرد رهیافت شاخص ترکیبی (مطالعه استان فارس)

غ. عبدالله‌زاده، خ. کلانتری، ع. اسدی، ر. فیشر، و ژ. دانشور عامری

چکیده

اخیراً توجه به مطالعات ابعاد فضایی توسعه کشاورزی رو به افزایش بوده است. هدف این مقاله بازتعریف الگوهای فضایی کشاورزی به منظور تدوین استراتژی‌های مناسب مبتنی بر قابلیت‌های منطقه‌ای می‌باشد. یک شاخص ترکیبی توسعه کشاورزی که برای شناسایی ساختار فضایی مفید است توسعه داده شده است. شاخص ترکیبی توسعه داده شده شامل پنج بعد توسعه کشاورزی (۱) اجتماعی–فرهنگی، (۲) ساختاری–زراعی، (۳) فنی–مدیریتی، (۴) اقتصادی–مالی، و (۵) زیرساختی–خدماتی است که ۸۷ شاخص که در سطح شهرستان انتخاب شدند بودند را در بر می‌گیرد. شاخص‌ها بر اساس چارچوب منطقی با بهره‌گیری از روش تقسیم بر میانگین نرمال شده و از طریق وزن‌دهی مستخرج از دو روش تحلیل سلسله مراتبی و تحلیل مولفه‌های اصلی ترکیب شدند. ارزیابی توسعه کشاورزی بر اساس شاخص ترکیبی مورد نظر، در سطح شهرستان به منظور ترسیم الگوهای فضایی توسعه به کار گرفته شد. شهرستان‌های استان مقایسه و سپس رتبه‌بندی شدند تا شکاف‌های توسعه فضایی بین آنها نشان داده شود. سپس الگوهای فضایی توسعه بر اساس شاخص ترکیبی توسعه کشاورزی به سه دسته تقسیم شدند. نتایج نشان داد که ماهیت توسعه فضایی کشاورزی در گام اول وابسته به توسعه زیرساختی و خدماتی و در گام دوم برخورداری از مواهب طبیعی و فیزیکی است.

[DOR: 20.1001.1.16807073.2012.14.1.13.3]