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# Models and their regional distribution patterns of ecological farming in northwest China

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**ABSTRACT**

*Based on statistic analysis and cluster analysis, this paper studied on the eco-farming models and their differentiations of 15 counties in Northwest China which could supply six eco-farming type construction priorities in the region, as well as the principles of eco-farming construction. From the result it could provide useful methods and ideas of eco-farming construction in the region. Moreover, the analysis of variance was done to verify the results from cluster analysis .*

**Keywords**: ecological farming model; region distribution; northwest China

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## INTRODUCTION

Northwest China is composed of five provinces and autonomous regions, Shaanxi, Ningxia, Gansu, Qinghai and Xinjiang. It is well known that it has been an effective approach and an inevitable choice of sustainable agricultural development in China to develop ecological farming, and in different regions, ecological farming models, proposed and constructed following the principle of coordinated and all round development and depending regional realities, are the centers and embodiment of ecological farming development and the indispensable part of regional systematic development and closely related and coordinated with regional systematic developments as a whole, and their objectives are to realize sustainable social, economic and ecological developments under the condition of promoting integrated resource exploitation and effective environmental conservation. Therefore, to study types and models and their distribution characters of ecological farming in different pilot counties (cities) is helpful to find out main directions of regional ecological farming construction, pinpoint liming factors and main problems of regional ecological farming constructions to be solved , and promote similar regions to learn from one another and China to construct ecological farming.

**Principle**

**1. Main ecological farming models and their regional distributions in Northwest China**

**1.1 Ecological farming Models**

The classification of ecological farming models is fundamental for the research, extension and adoption of ecological farming as well as standard formulation and evaluation of ecological farming. Because most ecological farming models are summarized depending on practical experiences, many scientific workers commonly classify ecological farming models by listing them in terms of their distributing region or introducing them in terms of their practical applications [1]. In the recent years, some scholars try to systematically analyze, generalize and classify typical examples of ecological farming models. Qi Xinshan et al. put it forward to classify ecological farming models into cities, counties, township, towns, village and farm households that practice ecological farming in terms of regional zonation or administration division; plain, mountain, hilly, waters, grassland, courtyard and suburban ecological farming models in terms of natural, social and economic conditions; single product ecological and multi-product ecological farming models in terms of product type; crop planting based, forest and fruit tree combined, fishery based farm based and enterprise based ecological farming models in terms of agricultural categorization; multi-tier energy

utilization, integrated energy utilization, energy cyclic utilization, self-cleaning energy utilization, and additional energy utilization ( ring add rings to biological chains or remove rings from biological chains, and symbiosis) models of ecological farming in terms of energy utilization). Li Xin Ping et al. simplified the previously described classifications, proposing that ecological farming could be classified into cities, counties and townships(towns), villages and farm households practicing ecological farming in terms of the three factors, administration division size and natural, social and economic conditions, and major products or industries; plain, mountain, hilly, waters, grassland, courtyard based, coastal and suburban ecological farming models in terms of geographical, social and economical conditions; professional ecological farming models specializing in single products or industries and integrated models specializing in two or more than three products or industries in terms of main product or industry and product or industry number. Li Jincai et al. classified ecological farming models of China into four models, multi-tier energy utilization models, symbiotic models, resource exploiting models and environment management oriented models, and tourism oriented models in terms of its agricultural development characteristics, social and economic developments and resource conditions. Qiu Jianjun and Ren Tianzhi et al adopted the classification proposed by. Li Jincai et al. in the Researches on Standard Systems and Their Important Technical Standards of Ecological Farming. Currently, how to classify ecological farming models is still under discussion and needs time to get well answered [2], and the basic types and their fundamentals of ecological farming models are shown in table 1.

**Table 1 Basic types of ecological farming models**

| Type code | Basic type of ecological farming model | Example ( fundamentals ) |
|---|---|---|
| $Y_1$ | Crop planting based type | Model incorporating composted straws into soil |
| $Y_2$ | Forest and fruit tree combined type | Model practicing fruit tree and grass intercropping |
| $Y_3$ | Animal raising based type | Model integrating pig raising-biogas generation-fruit trees |
| $Y_4$ | Courtyard based type | Model integrating hygienic toilets and manure composting |
| $Y_5$ | Enterprise based type | Models exploiting process side-products and organic wastes |
| $Y_6$ | Environmental conservation oriented type | Model afforesting countryside and rehabilitating polluted lands |
| $Y_7$ | Tourism oriented types | Tourism model of Yangling Sci-tech Town |

The types of ecological farming that the study proposed were basic types, but they did not exclude classifications of ecological farming models in terms of other purposes [3].

The above core classification of ecological farming models showed that ecological farming models could be classified into seven types, i.e., seven basic types. Of course, because the classification was not absolute, the different basic types sometimes interacted with and overlapped one another in production practices so that they could be extended to include such non-agricultural industries as processing and tourism to form more widely covering compound types.

### 1.2 Regional distributions of the main types of ecological farming models

The ecological farming models of the five provinces and autonomous regions in Northwest China were classified depending on on-site survey and statistical analysis results on them and the requirements of the basic types of ecological farming models [4]. The classification symbols included region, numerical number and type, and the basic types of ecological farming models are shown in table 1. For example, SYL1-Y1 is the crop-planting based model in Yangling of Shaanxi, which has the numerical number of 1. Table 2 presents main ecological farming models and their types in Yangling.

**Table 2 Ecological farming models and their types in Yangling**

| Ecological farming model | Basic types |
|---|---|
| Model incorporating composted straws into soil | SYL1-$Y_1$ |
| Model practicing fruit tree and grass intercropping | SYL2-$Y_2$ |
| Model integrating pig raising-biogas generation-fruit trees | SYL3-$Y_3$ |
| Courtyard based Model | SYL4-$Y_4$ |
| Enterprise based Models | SYL5-$Y_5$ |
| Environment conservation oriented Model | SYL6-$Y_6$ |
| Tourism-oriented model | SYL7-$Y_7$ |

## EXPERIMENTAL SECTION

### METHODS

### 1. Proportions and coverage of the types of the different ecological farming models

Depending on the data of main ecological farming models and their types in the different provinces and autonomous regions in northwest China [5], the percentages or proportions of the different types of the different ecological farming models in the different regions were calculated, that is to say, the percentages of the numbers of individual types of the ecological farming models to the total number of the models (Yij) in the individual regions by the

following formula:

$$Yij=\frac{\text{Numberof Type j of the ecologicalfarmingmodelin regioni}}{\text{numberof the ecologicalfarmingmodelsin Regioni}}\times 100\%$$

In which, i=1, 2,…, 11, standing for regions 1 to 11, and j=1, 2, …, 7, standing for types 1to 7 of the ecological farming models, i.e., crop planting based ecological farming model, forest and fruit free combined ecological farming model, animal raising based ecological farming, courtyard based ecological farming model, enterprise based ecological farming model, environmental conservation oriented ecological farming, and tourism oriented ecological farming model.

Therefore, Yij can indicate how important type j of the ecological farming models is in region i to some extent. Furthermore, the coverage of the different ecological farming models in different regions (Ci) can be calculated and the coverage are defined as the percentages of the numbers of the types of the practiced ecological farming models to the total numbers of the types of the ecological farming models in different regions. In the study, the total number of the types of the ecological farming models was seven and then Ci was expressed by the following equation:

$$Ci=\frac{\text{the number of the types of the practiced ecological farming models in region i}}{7}$$

**2. Ecological farming models examined by similarity clustering analysis**

As described above, ecological farming models and their types are closely correlated with social, economic and environmental conditions in different regions [6]. Thus, the proportions of the different types of ecological farming models in different regions ($y_{ij}$) as original variables can be analyzed by similarity clustering analysis to reveal regions with similar types of ecological farming models as well as social, economic and environment characters of these regions, which can provide scientific basis for promoting and expanding ecological farming construction[7] . In the study, the unweighted pair-group method with arithmetic means (UPGMA) was adopted [8].

Herein, $x_{ij}=\frac{y_{ij}-\overline{y_j}}{S_{ij}}$, in which i and j means the same as described before; $\overline{y_j}=\frac{1}{11}\sum_{i=1}^{12}y_{ij}$ in which $Y_{ij}$ stands for the average proportion of Type j of ecological farming models; $S_{ij}=\sqrt{\frac{1}{12-1}\sum_{i=1}^{12}\left(y_{ij}-\overline{y_j}\right)^2}$ in which $S_{ij}$ stands for the standard deviation of the proportion of Type j of ecological farming models [9].

So far, the distance between two regions can be expressed as the MINKOWSKI distance of $d_{ij}(q)$ of which the formula is as follows:

$$d_{ij}(q)=\left[\sum_{k=1}^{m}\left|x_{ik}-x_{jk}\right|^q\right]^{1/q}$$

In which, the distance coefficient can be expressed as a euclidean distance, i.e., q=2.

Then, $d_{ij}(2)=\sqrt{\sum_{k=1}^{7}\left(x_{ik}-x_{jk}\right)^2}$

Then the inter-class distance can be expressed as $D_{pq}^2=\frac{1}{n_p n_q}\sum_{X_i\in G_p}\sum_{X_j\in G_q}d_{ij}^2$ and the recursion formula can be expressed as $D_{ir}^2=\frac{n_p}{n_r}D_{ip}^2+\frac{n_p}{n_r}D_{iq}^2$

In the formulae, np and nq stands for the region numbers of Gp and Gq , respectively, nr stands for the region number of Gr , the new group by merging Gp and Gq, and that nr=np+nq. By computer programming and program running, the cluster analysis results of the proportions are presented as follows (Figure 1):

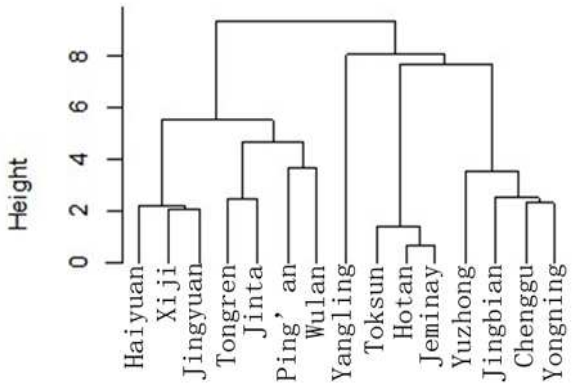


**Figure 1 cluster analysis results of the ecological farming models in northwest China**

In the study, the distance coefficient of $D^2_{ij}$=17 was set as the threshold in light of the actual conditions and then the ecological farming models in northwest China could be classified into six types(table 3):

**Table 3 types of the ecological farming models in northwest China**

| type | region | remark |
|---|---|---|
| Type 1 | Hiayuan,Xiji and Jingyuan | |
| Type 2 | Tongren and Jingta | |
| Type 3 | Pingan and Wulan | |
| Type 4 | Yangling | |
| Type 5 | **T**oksun,Hotan and Jeminay | |
| Type 6 | Yuzhong,Jingbian, Chenggu and Yongning | |

## RESULTS AND CONCLUSION

### 1. Results

#### 1.1 Proportions (percentages) and coverage of the types of the ecological farming models in the different regions

**Table 4 Proportions (percentages) and coverage of the types of the ecological farming models in the different regions**

| Regin | Crop-planting dominated model | Forest and fruit tree combined model | Anima raising based model | Courtyard based model | Enterprise based model | Environmental conservation oriented model | Tourism oriented model | Model number | coverage/ % |
|---|---|---|---|---|---|---|---|---|---|
| 1 ( Yangling ) | 10.4 | 26.4 | 26.8 | 10.6 | 15.5 | 2.5 | 7.8 | 7 | 100 |
| 2 ( Chenggu ) | 42.0 | 8.4 | 9.8 | 0 | 20.8 | 9 | 10 | 6 | 85.7 |
| 3 ( Jingbian ) | 25.1 | 18.9 | 6.5 | 0 | 25.1 | 19.3 | 5.1 | 6 | 85.7 |
| 4 ( Ping'an ) | 49.4 | 0 | 30.6 | 9.8 | 5.2 | 5 | 0 | 5 | 71.4 |
| 5 ( Tongren ) | 67.1 | 0 | 12.5 | 5.6 | 4.3 | 10.5 | 0 | 5 | 71.4 |
| 6 ( Wulan ) | 37.4 | 8.4 | 30.8 | 0 | 15.8 | 5 | 2.6 | 6 | 85.7 |
| 7 ( Yongning ) | 32.0 | 22.4 | 15.9 | 0 | 14.8 | 9.9 | 5 | 6 | 85.7 |
| 8 ( Haiyuan ) | 30.5 | 21 | 25.6 | 2.5 | 5.3 | 13.1 | 2 | 7 | 100 |
| 9 ( Xiji ) | 41.1 | 18.9 | 16.5 | 0 | 3.1 | 19.3 | 1.1 | 6 | 85.7 |
| 10 ( Yuzhong ) | 47.4 | 5.1 | 7.3 | 3.8 | 15.4 | 14.1 | 6.9 | 7 | 100 |
| 11 ( Jingyuan ) | 43.4 | 19.2 | 17.1 | 5.1 | 5 | 10.2 | 0 | 6 | 85.7 |
| 12 ( Jinta ) | 55.8 | 4.9 | 15.2 | 0 | 4 | 20.1 | 0 | 5 | 71.4 |
| 13 ( Hotan ) | 36 | 20.5 | 25.5 | 0 | 5 | 3 | 10 | 6 | 85.7 |
| 14 ( Toksun ) | 28.5 | 25.6 | 23.4 | 0 | 7.5 | 5 | 10 | 6 | 85.7 |
| 15 ( Jeminay ) | 37.4 | 15.4 | 27.3 | 0 | 5.7 | 3.2 | 11 | 6 | 85.7 |
| average | 38.9 | 14.3 | 19.3 | 2.5 | 10.2 | 9.9 | 4.8 | 6 | 85.7 |

1.1.1 Minimum proportions of the different types of the ecological farming models in the different regions

It can been seen from table 4 that the minimum proportion of the types of the crop planting based models appeared in

Yangling of Shaanxi , equal to 10.4%; the minimum proportion of the types of the forest and fruit tree combined models appeared in Ping'an and Tongren of Qinghai, equal to zero ; The minimum proportion of the types of the animal raising based models appeared in Dingbian of Shaanxi, equal to 6.5%; The minimum proportion of the types of the courtyard based models appeared in Chenggu and Jingbian of Shaanxi,Wulan,Yongning,Xiji,Jinta, Hotan,Toksun and Jeminay, equal to zero; and the minimum proportion of the types of the enterprise based models appeared in Xiji of Ningxia, equal to zero, the minimum proportion of the types of the environmental conservation oriented models appeared in Yangling of Shaanxi, equal to 2.5%, the minimum proportion of the types of the tourism oriented models appeared in Pin'an and Tongren of Qinghai, Jingyuan,Jinta , equal to zero. These results showed that Yangling was located in economically well developed central Shaanxi and thus its crop planning as one traditional industry was somewhat shrunk; Pin'an traditionally had well developed crop planting and animal husbandry in addition to its gentle climates and thus its forestry and fruit prodouction were its weaker industries; Jingbian suffered water scarcity thus not suitable for animal raising; the minimum proportions of the types of the courtyard based models appeared in Chenggu and Jingbian of Shaanxi,Wulan,Yongning,Xiji,Jinta, Hotan,Toksun and Jeminay equal to zero, because stereotyped thinking mentality dominated in the counties, a point of view that the study held. The minimum proportion of the types of the enterprise based models was zeron in Xiji , mainly because the county had a remote geographical location and lacked attention to the model. The minimum proportion of the types of the environmental conservation oriented models was 2.5% in Yangling and this needed thinking over because Yangling had conditions for improving its environments. The minimum proportions of the types of the tourism oriented models were zero in Pin'an, Tongren,Jingyuan, Jinta because the counties had remote geographical locations, suffered lacks of tourism resources, and dominated by stereotyped thinking mentalities[12]. It follows that it was because of their lacks of proper attentions instead of their local conditions that not all the regions put emphasis on the adoption of some types of the ecological farming models, and hence it was necessary for the regions to make more efforts to improving and promoting these types of the ecological farming models.

1.1.2 Maximum proportions of the different types of the ecological farming models in the different regions

It also can seen from table 4 that the maximum proportions of the types of the crop planting based models appeared in Tongren of Qinghai, equal to 67.1%; the maximum proportions of the types of the forest and fruit tree combined models appeared in Yangling of Shaanxi, equal to 26.4%; the maximum proportions of the types of the animal raising based models appeared in Wulan of Qinghai, equal to 30.8%; the maximum proportions of the types of the courtyard based models appeared in Yangling of Shaanxi ,equal to 10.6%; the maximum proportions of the types of the enterprise based models appeared in Jingbian of Shaanxi, equal to 25.1%; the maximum proportions of the types of the environmental conservation oriented models appeared in Jinta of Ningxia, equal to 20.1%; and the maximum proportions of the types of the tourism oriented models appeared in Jeminay of Xinjiang ,equal to 11%. the explanation for these results were that Jeminay of Xinjiang had well developed crop planting models as its traditional industry because of its gentle climate and rich, abundant water resources and poor transportation accesses, but because the county had such a high proportion of the model, it should develop and construct new ecological farming models; Yangling of Shaanxi had well developed forest and fruit tree combined models because it had the most suitable climate for Kiwi to grow; Wulan in Qinghai had well developed animal raising based models because the county had large grasslands and abundant underground water; Yangling of Shaanxi had well developed courtyard based models because it had advantageous geographical location and well developed transportation accesses; Jingbian of Shaanxi had well developed enterprise based ecological farming models because it had many enterprises related to its rich and abundant reserves of petroleum and natural gas; Jinta of Ningxia had well developed environmental conservation oriented model despite its poorly developed environment, transportation and economic conditions and this fully indicated that with proper efforts, one region with poor environmental conditions and backward transportation and economic conditions could conserve its environment well; and Jeminay of Xinjiang had greatly developed tourism oriented model because it had Kanas Lake and gentle climate in addition to its newly opened railway access. The maximum proportions of the different types of the ecological farming models indicated the clear directions in which the different regions should take to develop their ecological farming [13].

1.1.3 Coverage of the different types of the ecological farming models in the different regions

It can be seen from table 4 that the coverage of the different types of the ecological farming models in Yangling of Shaanxi,Haiyuan of Ningxia and Yuzhong of Gansu appeared the highest , reaching 100%, indicating to some extent that in the three counties had fully and systematically developed ecological farming models. In different regions, of course, the coverage of the different types of the ecological farming models depended on local social, economical and eco-environmental conditions, but was inseparably related to local governmental managements and administrations [14].

1.1.4 Coverage of the different types of the ecological farming models in the different provinces and autonomous regions of Northwest China

On average, the types of the different ecological farming models numbered 6 in the different province and autonomous regions of Northwest China and their average coverage was 85.7%. The proportion of the types of the crop planting based models was the highest, reaching 38.9%, followed by the proportion of the types of the animal raising based models, 19.4%, and this indicated that the two types of the models were the crucial points of ecological farming constructions in the different provinces and autonomous regions and that accorded with local realities of northwest China. The coverage of the types of the courtyard based models was the lowest, amounting to only 2.5%, which indicated that the model was not evenly developed and new types of the different ecological farming models needed to be developed with strengthened efforts.

### 1.2 Regional distribution characters of the six types of the ecological farming models revealed by clustering analysis

**Table 5 Average coverage and proportions (percentages) of the different types of the ecological farming models**

| Model Class | Coverage /% | Crop planting based model | Forest and fruit tree combined model | Animal raising based model | Courtyard based model | Enterprise based model | Environmental conservation oriented model | Tourism oriented model |
|---|---|---|---|---|---|---|---|---|
| type 1 | 90.5 | 42.5 | 19.7 | 19.7 | 2.5 | 4.5 | 14.2 | 1.0 |
| type 2 | 71.4 | 61.5 | 2.5 | 13.9 | 2.8 | 4.2 | 15.3 | 0 |
| type 3 | 78.6 | 43.4 | 4.2 | 30.7 | 4.9 | 10.5 | 5 | 1.3 |
| type4 | 100 | 13.2 | 26.4 | 26.8 | 10.6 | 15.5 | 2.5 | 7.8 |
| type 5 | 85.7 | 34.0 | 20.5 | 25.4 | 0 | 6.1 | 3.7 | 10.3 |
| type 6 | 89.3 | 36.6 | 13.7 | 9.9 | 1.0 | 19.0 | 13.1 | 6.8 |

So far, average coverage and proportions (percentages) of the different types of the ecological farming models can be seen in table5 [15]. The average coverage and proportions (percentages) of the different types of the ecological farming models (table 5) showed that:

1.2.1 Average coverage of the first type of the ecological farming models

The first type of the ecological farming models appeared in three counties and the coverage of the type averaged 90.5%, ranking the second; the coverage of the first type of the crop planting based models and the tourism oriented models appeared the highest and lowest, reaching 42.6% and 1.0%, respectively. It follows that of the three counties, two, located in Gansu, were mountainous counties with poor natural conditions and inconvenient transportation accesses and as a result their traditional crop planting based models as well as their traditional industries were relatively well developed. Haiyuan, for instance, had relatively well developed traditional animal raising based models and animal husbandry. However, such regions had poorly developed newly emerging industries [16], and it was fortunate that these regions began paying attention to developing environmental conservation oriented models.

1.2.2 Average coverage of the second type of the ecological farming models

The second type of the ecological farming models appeared two counties located in Tongren of Qinghai and Jinta of Gansu. The coverage of the second types of the different ecological farming modes was 71.4%. The two counties had favorable geographical locations, and Jinta, for instance, was a plain country where crops could be easily farmed so that it had well developed crop planting but because of its poor transportation accesses it had unevenly developed newly emerging industries and low coverage of the different ecological farming models. These were typical characters commonly found in underdeveloped regions.

1.2.3 Coverage of the third type of the ecological farming models

The third type of the ecological farming models appeared in two counties separately located in Ping'an and Wulan of Qinghai. The coverage of the third type of the ecological farming models was 78.6%. Herein, the coverage of the third type of the crop planting based models appeared the highest, reaching 45.6% and among the types, the coverage of the third type of the animal raising based models ranked the highest, reaching 30.7%. Located in the middle reaches of the Nieshui River, Pin'an was spring wheat, potato, oil crops and vegetable producers because of its fertile lands, abundant water resources, sufficient sunshine and gentle climates. In the recent years, the county had quickly developed such newly emerging industries as greenhouse vegetable production, freshwater fishery and this was why it had well developed crop planting based models and animal raising based models. Situated in continental hinterland, Wulan had favorable climate and unique natural resources, such as farmlands, grasslands, forests, shrubs, wild animals and plants, medicinal plants, surface and underground water resources and that a great majority of its farmlands could get access to irrigation , so that it had well developed crop planting based models. Currently, Wulan had a grassland area of 7.118 million Mu and more than 190 animal and plant species and its major domestic animals were sheep, goat, yak and camel. Wulan produced semifine wools and goat cashmere as high quality materials for fur articles and as a result it had well developed animal raising based models. But because of its extensive economic growth the

County developed the models unevenly.

1.2.4 Coverage of the fourth type of the ecological farming models

The fourth types of the ecological farming models appeared only in Yangling located in the plain part of central Shaanxi and the coverage of the fourth type of the ecological farming model was 100%. Herein, the coverage of the fourth type of the animal raising based models appeared the highest, reaching 26.8%, and the coverage of the fourth type of the environmental conservation oriented models appeared the lowest, amounting to 2.5%; and the coverage of the other types of the ecological farming models stayed around the average coverage of the types of the ecological farming models. Because of its favorable geographical location, convenient transportation accesses and favorable climate and as the only state level demonstration zone of agricultural High Tech Industries in China, Yangling had plentiful of demonstration projects of various agricultural industries and this was why its coverage of the different types of the ecological farming models was 100% and that the different models were evenly developed. The composition of the ecological farming models that Yangling developed was ideal for northwest China.

1.2.5 Coverage of the fifth type of the ecological farming models

The fifth type of the ecological farming models appeared in three counties located in Xinjiang. Against the class, the coverage of the fifth type of the ecological farming models was 85.7%. herein, the coverage of the fifth type of the crop planting based model appeared the highest , reaching 34.0% and the coverage of the fifth type of the courtyard based model appeared the lowest equal to zero, which indicates that the different types of the ecological farming models were not evenly developed; furthermore, the proportions of the newly emerging enterprise based models and the environmental conservation oriented models were lower and the proportions of the traditional animal raising based model were higher[17]. Because all the three counties were located in Xinjiang, their types of the ecological farming models were typical of Xinjiang, hence typical of geographically remotely located regions.

1.2.6 Coverage of the sixth type of the ecological farming models

The sixth type of the ecological farming models appeared in four counties, Yuzhong and Jingyuan of Gansu, Chenggu of Shaanxi and Yongning of Ningxia. The coverage of the sixth type of the ecological farming models was 89.3%, the coverage of the sixth type of the crop planting based models being the highest of 36.6% and the coverage of the sixth type of the courtyard based models being the lowest of 1.0%. The common characters of these counties were favorable geographical locations and convenient transportation accesses. For example, Yuzhong was located in the suburban of Lanzhou and Yongning was located in the suburban of Yinchuan. Thus such regions had well developed enterprise based models and although they had higher coverage of the crop planting based model but did not have too high a proportion of the crop planting based models. The reason for this was that their favorable geographical locations help newly models develop; however, they had so poorly developed courtyard based models that they needed more efforts to develop the models.

The analysis described above shows that in northwest China, the average coverage of the different types of the ecological models was 86%, indicating that there exist diverse ecological farming models and the different regions have clear development directions and understand the problems imperative to solve in accordance with their regional environments and realities. The clustering analysis resulted showed that type one regions were opposite to type two regions. Type 1 regions had unfavorable natural conditions, inconvenient transportation accesses and Type 2 regions had favorable geographical locations despite its inconvenient transportation accesses. Type 1 regions had well developed traditional models, but slowly developing newly emerging models; and type 2 regions had very well developed crop planting based models because of their favorable natural conditions and poorly developed newly emerging models because of their poor transportation accesses [18]. The two counties categorized into type three, located in Qinghai, had well developed animal husbandry since ancient times and as a result they had well developed animal raising based models as well as crop planting based model, but lowly developed other models. Yangling as the only type 4 region and the only state demonstration zone of agricultural High-tech Industries of China had evenly developed ecological farming models because of its very favorable geographical location, convenient transportation accesses and advantageous technical conditions so that it could be an ideal development model of demonstrative significance. Type 5 regions were opposite to type 6 regions. Type 5 regions had very slowly developing enterprise based model[19] and poor consciousness of environmental conservation because of its remote geographical locations, but being situated near big cities, type 6 regions had relatively well developed enterprise based models but did not developed them well enough so they needed further stepping up their efforts to improve the models.

## CONCLUSION AND DISCUSSION

It was concluded depending on the results on the ecological models and their distribution patterns in the fifteen

counties of northwest China that the ecological farming models of the counties could divided into six types and possessed some common characters and distribution patterns, i.e., in the counties of Northwest China with well developed economies and favorable natural conditions, the proportions of traditional ecological farming models were lower and the proportions of newly emerging ecological farming models were increasing and that these proportions were not well coordinated; and for example, the environmental conservation and tourism oriented models were slowly developing and the courtyard- and enterprise-based models were poorly developed . But the regions with unfavorable natural conditions presented an opposite situation that the proportions of traditional ecological farming models were higher and the proportions of newly emerging ecological farming models were lower and that the different models were very unevenly developed. Considering that it adopted the statistic analysis and cluster analysis to effectively solve its research problems, the study provided highly practical research methods for similar research problems and thinking approaches for ecological farming development and environmental conservation.

In future , backward regions should make more efforts to improve their developments of newly emerging ecological farming models, information and transportation accesses and human resources qualities and their governmental also should reinforce their investments and guidance so that the conditions for developing newly emerging ecological farming models would be created. Regions with relatively economically well developed economies should step up investments for environmental conservation oriented models.

In the meantime, it would be necessary to give top priority to taking the rationality and integrity of alternative ecological farming models, that is to say, interpreting the models into index systems for which further in-depth researches need stepping up.

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