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Systematic Classification and Nutrient Analysis of Soil in the Dry-Hot Valley of Jinsha River

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----------ABSTRACT----------
Purpose: Dry-Hot Valley of Jinsha River does not have research about soil systematic classification and nutrient analysis. So, this research will fill up this blank, to help people and farmers to better understand the property, the classification, the fertility and management of the soils in Dry-Hot Valley of Jinsha River. Methods: through soil field investigating and sampling, indoor experiment treatment, data analysis, treatment and discussion. Results: this research finds that the soils of many towns in Dry-Hot Valley of Jinsha River is lacking organic matter, nitrogen, phosphorus and potassium, which are the major nutrient elements for plant growth. Conclusions: this suggests people and farmers need to apply organic matter, nitrogen, phosphorus and potassium fertilizers to soil and to stimulate plant growth.
KEYWORDS: Jinsha River hot-dry valley; soil classification; soil nutrient analysis

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I. INTRODUCTION

The Jinsha River is the upper reach of Yangtze River. The hot-dry valley of the Jinsha River (100° 30'E-103° 30', 25° 40'N-28° 15'), with an elevation <1500 m, winds through Yunnan and Sichuan provinces, southwest China. In this valley, climate is hot and arid with the mean annual temperature ranging from 20 to 27 ℃. The annual precipitation is 600–800 mm and distributed unevenly throughout the year: rain-fall between June and October accounts for 90% of all the precipitation. The potential evaporation is approximately three to six times as great as the precipitation [1].

Soil is the important foundation for survival and development of human beings [2]. There is no systematic classification and nutrient analysis of soil in Panxi national resources innovation and development experimental area, therefore, this study -- the soil systematic classification and nutrient analysis of Panxi national resources innovation and development experimental area can make up for this gap [3]. Soil systematic classification is to study and classify the different soil types in Dry-Hot Valley of Jinsha River systematically [4]. The nutrient analysis of Dry-Hot Valley of Jinsha River is to analyze soil main nutrient composition in different parameters in detail: soil water, soil pH, soil organic matter, soil ammonium nitrogen, soil available phosphorous and soil effective potassium. These are main soil nutritional composition parameters. To study these parameters can know the soil chemical fertility in detail [5]. Dry-Hot Valley of Jinsha River is also called Dry-Hot Valley of Jinsha River in short. It is the national planted development area. It has a lot of agricultural land and soil. It is important to study the area, the soil and the nutritional parameters [6]. To study the soil systematic classification and nutrient analysis of Panxi national resources innovation and development experimental area, is helpful to enrich the knowledge of soil science, can make people more clear understanding and knowing of different types of soil, and its nutrients [7]. So that people can have a comprehensive, systematic and detailed understanding of the soil, nutrients and their composition of Panxi national resources innovation and development experimental area [8]. This research has a guiding role in the use of agricultural soil in Dry-Hot Valley of Jinsha River.

Soil classification is an important method to deeply understand different soil types. Understand different soil types can help people use and manege soil correctly [9]. We can investigate the surface soil to classify different soil types. Topsoil properties are influenced by different factors like climate, vegetation and organic matter, topography and physiography, mineral soil constituents, surface processes, biological and human activity [10]. Because of the multiple functions of it, soil organic matter (SOM) is one of the most important component influencing topsoil properties - soil quality, soil health and soil biodiversity.

Water is a distinguished stress factor of soils and plant growth [11]. Soil water content is a major environmental factor in plant habitat and plant growth [12].

A well-recognized soil quality indicator is soil organic matter (SOM) content (SOMC), a soil component upon which agroecosystems and agricultural production are dependent [13]. In the upper soil layer

organic matter is constantly being created and decomposed. The humus pool of the soil is relatively stable [14]. Soil organic matter (SOM) is one of the most complex component of terrestrial ecosystems and serves many vital functions in terms of regulating the flow and supply of nutrients to plants, regulating water flow and water retention in soils and determining the physical attributes of soils. Hence, the maintenance and management of SOM is vital for the sustainability of croplands, grasslands, forests and wetlands [15].

This research is focusing on the classification and chemical fertility of soils in Dry-Hot Valley of Jinsha River. To let people know how is the classification and chemical fertility of soils in Dry-Hot Valley of Jinsha River. The practical problem is to know how is the classification and chemical fertility of soils in Dry-Hot Valley of Jinsha River. To classify the different soil types, and to determine the soil chemical fertility indexes, including:soil water content, pH, organic matter, ammonium nitrogen, available phosphorus, effective potassium. The purpose to know the fertility situation of different soil types is to find the way to apply suitable soil fertilization into soil to stimulate cultivation to grow better, to get more gains. Before we apply suitable soil fertilization, we should know the soil types and soil fertility situation well. Know and find the problem, and then solve the problem. The innovation of my work is to classify the different soil types in Dry-Hot Valley of Jinsha River, and to determine the soil chemical fertility indexes, including:soil water content, pH, organic matter, ammonium nitrogen, available phosphorus, effective potassium. The purpose to know the fertility situation of different soil types is to find the way to apply suitable soil fertilization into soil to stimulate cultivation to grow better, to get more gains. Before we apply suitable soil fertilization, we should know the soil types and soil fertility situation well. Know and find the problem, and then solve the problem.

The hypothesis of my work is to classify the different soil types in Dry-Hot Valley of Jinsha River, and to determine the soil chemical fertility indexes, including:soil water content, pH, organic matter, ammonium nitrogen, available phosphorus, effective potassium. The purpose to know the fertility situation of different soil types is to find the way to apply suitable soil fertilization into soil to stimulate cultivation to grow better, to get more gains. Before we apply suitable soil fertilization, we should know the soil types and soil fertility situation well. Know and find the problem, and then solve the problem.

II. MATERIALS AND METHODS

2.1 Experimental design

Go to field area in Dry-Hot Valley of Jinsha River to get soil samplings. Taking soil samplings to laboratory to do indoor treatment. Classifying different soils types. Measuring soil water content. Using TPY-6A soil nutrient tester to determine soil nutrients (pH, organic matter, ammonium nitrogen, available phosphorus, effective potassium).

2.2 Study area and sampling points

The research area was Dry-Hot Valley of Jinsha River. In each town has a soil sampling point. Each soil sampling point contains three different subsampling points Fig 1 and Fig2.

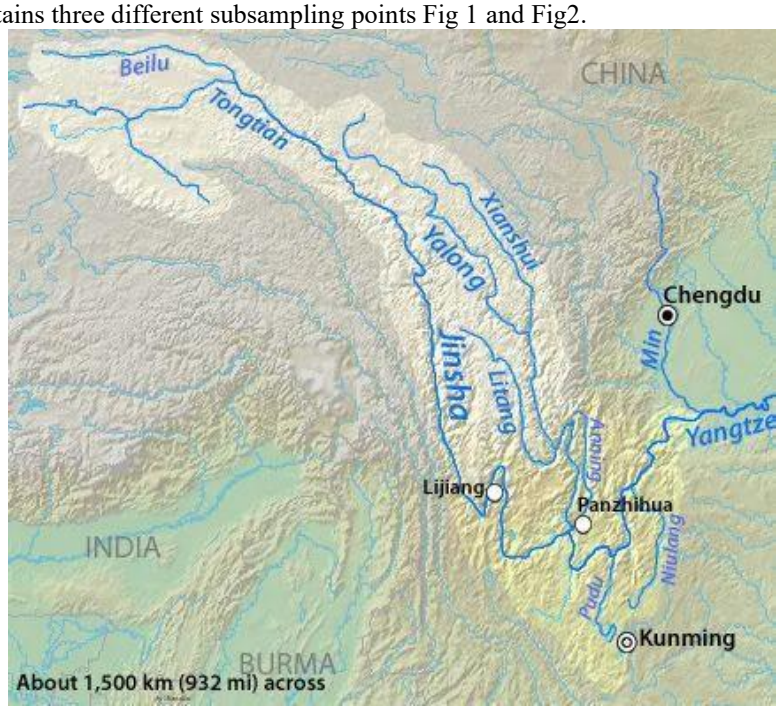


Figure 1. Study area and soil sampling points

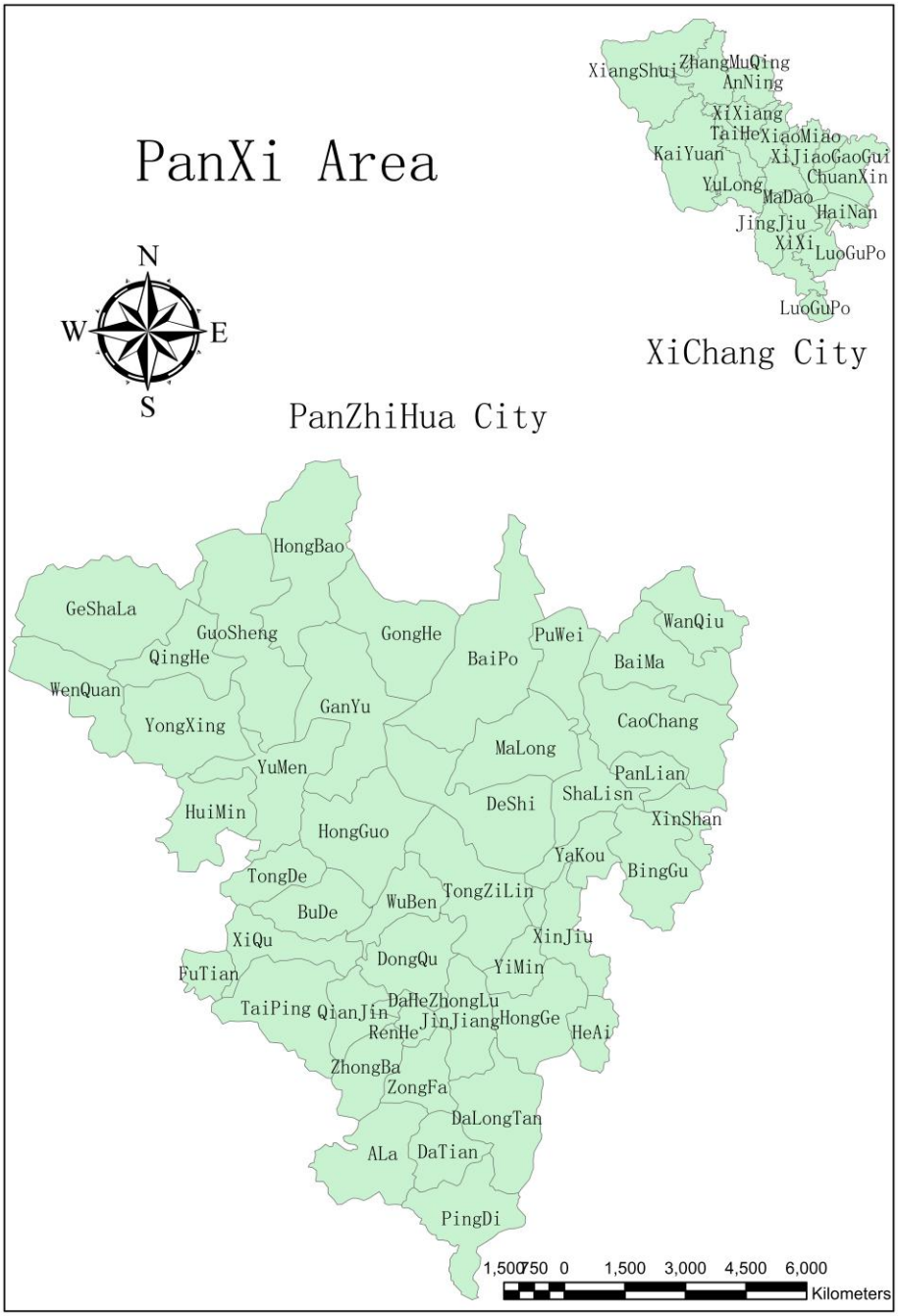


Figure 2. Dry-Hot Valley of Jinsha River: study area and soil sampling points in PanXi area

2.3 Soil sampling method

Field sampling of soil in Dry-Hot Valley of Jinsha River was carried out in each towns according to their administrative divisions.

Mixed soil sampling method was used. In each town administrative division, three representative sampling points are selected to collect soil samples and mix them to form a representative mixed soil sample, which represents the soil profile of the region.

2.4 Measuring items and treatment methods, specific analyses

The soil samples were fully mixed before the determination.

A certain amount of soil sample is weighed and placed in a ventilated place for natural air-drying. The soil water content is calculated by weighing for twice. The air-dried soils were ground, and the ground soils were screened with 100 meshes to prepare for the subsequent determination of nutrients.

The determination of nutrients (pH, organic matter, ammonium nitrogen, available phosphorus, effective potassium) was carried out by TPY-6A soil nutrient tester method.

2.5 Technology roadmap

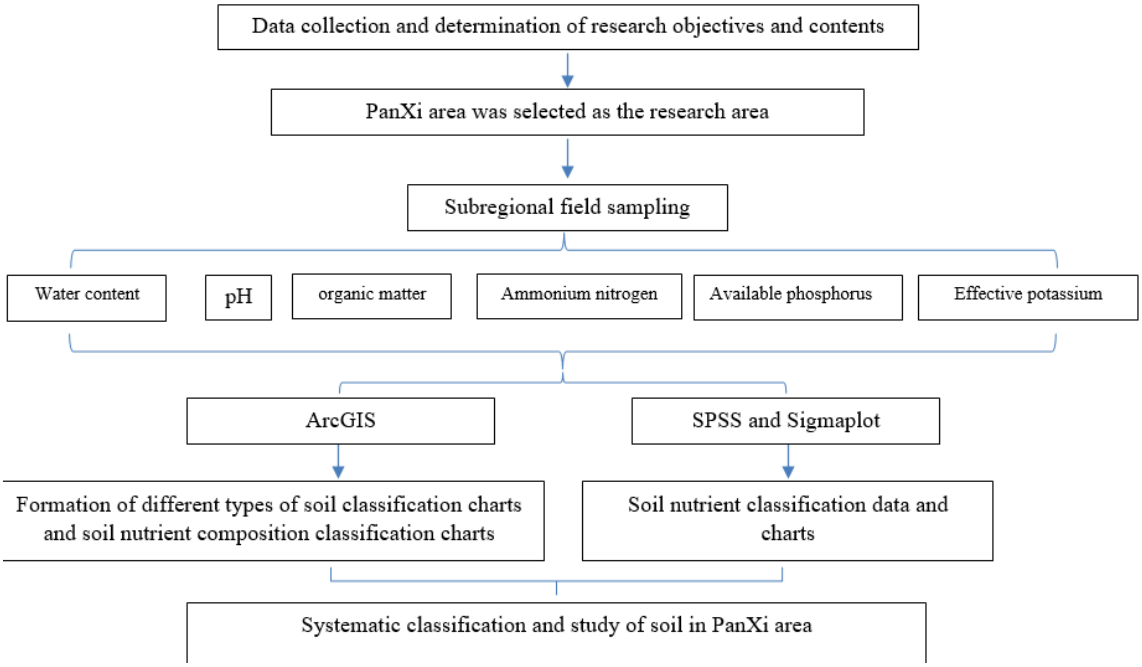


Figure 3. Technology Roadmap

2.6 Statistical analysis and data processing

The original data is processed by excel.

The sorted data are input into SPSS for data processing, and one-way ANOVA is used to calculate the average value and standard deviation to find the same subset for labeling.

According to the results, the single factor classification map was drawn in Sigma plot. Different lowercase letters were used to indicate the significant difference of soil samples at $P < 0.05$ level. The study area and soil sampling points map was drawn by ArcGIS.

III. RESULTS

3.1 Soil system classification in Dry-Hot Valley of Jinsha River

Table 1. Different soil types in Dry-Hot Valley of Jinsha River

City	County	Town	Soil Type
PanZhiHua	DongQu	Yingjiang	Brown soil
PanZhiHua	DongQu	Panzhihua Park	Yellow brown soil
PanZhiHua	DongQu	Airport Road	Stone-bone soil
PanZhiHua	DongQu	Airport Road	Lateritic red soil
PanZhiHua	DongQu	Baoanying Airport	Forest mossy soil
PanZhiHua	DongQu	Ashuda	Yellow soil
PanZhiHua	DongQu	Xiao Panzhihua	Black sand soil
PanZhiHua	DongQu	Nongnongping	Red soil
PanZhiHua	DongQu	Dadukou	Dark brown soil
PanZhiHua	DongQu	Xiangyangcun	Black sandy soil
PanZhiHua	DongQu	Wudaohe Zhujiabaobao	Mine sample
PanZhiHua	XiQu	Xinzhuang	Black Sandy Soil
PanZhiHua	XiQu	Qingxiangping	Yellow Sandy Soil
PanZhiHua	XiQu	Yuquan	Gravel Soil
PanZhiHua	XiQu	Hemenkou	Yellow Soil

PanZhiHua	XiQu	Taojiadu	Mineral Sandy Soil
PanZhiHua	XiQu	Geliping	Brown Soil
PanZhiHua	XiQu	Jinshatan	Red Soil
PanZhiHua	XiQu	Mosuohe	Black humus soil
PanZhiHua	RenHe	Renhe	Light brown soil
PanZhiHua	RenHe	Dahezhonglu	Yellow soil
PanZhiHua	RenHe	Datian	White sandy soil
PanZhiHua	RenHe	Pingdi	Lateritic red soil
PanZhiHua	RenHe	Jinjiang	Brown red soil
PanZhiHua	RenHe	Bude	Dark brown soil
PanZhiHua	RenHe	Tongde	Light brown soil
PanZhiHua	RenHe	Futian	Brown soil
PanZhiHua	RenHe	QianJin	Red Brown soil
PanZhiHua	RenHe	ZongFa	Red soil
PanZhiHua	RenHe	DaLongTan	Lateritic red soil
PanZhiHua	RenHe	ALa	Yellow soil
PanZhiHua	RenHe	ZhongBa	Black sand soil
PanZhiHua	RenHe	TaiPing	Black Forest mossy soil
PanZhiHua	RenHe	WuBen	Stone-bone soil
PanZhiHua	MiYi	DeShi	Dark brown soil
PanZhiHua	MiYi	YaKou	Yellow brown soil
PanZhiHua	MiYi	ShaLian	Red soil
PanZhiHua	MiYi	BingGu	Light brown soil
PanZhiHua	MiYi	XinShan	Dark brown soil
PanZhiHua	MiYi	PanLian	Brown soil
PanZhiHua	MiYi	BaiMa	Brown soil
PanZhiHua	MiYi	WanQiu	Yellow brown soil
PanZhiHua	MiYi	CaoChang	Lateritic red soil
PanZhiHua	MiYi	MaLong	Light red soil
PanZhiHua	MiYi	BaiPo	Yellow soil
PanZhiHua	MiYi	PuWei	Brown soil
PanZhiHua	YanBian	HeAi	Red brown soil
PanZhiHua	YanBian	HongGe	Brown soil
PanZhiHua	YanBian	YiMin	Yellow soil
PanZhiHua	YanBian	XinJiu	Light brown soil
PanZhiHua	YanBian	TongZiLin	Dark brown soil
PanZhiHua	YanBian	HongGuo	Light red soil
PanZhiHua	YanBian	GanYu	Red brown soil
PanZhiHua	YanBian	YuMen	Red soil
PanZhiHua	YanBian	HuiMin	Yellow soil
PanZhiHua	YanBian	YongXing	Light red soil
PanZhiHua	YanBian	QingHe	Light brown soil
PanZhiHua	YanBian	WenQuan	Light red soil
PanZhiHua	YanBian	GeShaLa	Brown soil
PanZhiHua	YanBian	GuoSheng	Yellow soil
PanZhiHua	YanBian	HongBao	Brown soil
PanZhiHua	YanBian	GongHe	Dark brown soil
XiChang	XiChang	XiJiao	Brown soil
XiChang	XiChang	XiaoMiao	Dark brown soil
XiChang	XiChang	XiXiang	Yellow brown soil
XiChang	XiChang	AnNing	Dark brown soil
XiChang	XiChang	ZhangMuQing	Light red soil
XiChang	XiChang	XiangShui	Dark brown soil
XiChang	XiChang	KaiYuan	Dark brown soil
XiChang	XiChang	TaiHe	Light brown soil
XiChang	XiChang	YuLong	Light brown soil
XiChang	XiChang	MaDao	Brown soil
XiChang	XiChang	GaoGui	Red soil

XiChang	XiChang	ChuanXing	Brown soil
XiChang	XiChang	HaiNan	Light brown soil
XiChang	XiChang	LuoGuPo	Brown soil
XiChang	XiChang	JingJiu	Lateritic red soil
XiChang	XiChang	XiXi	Light brown soil

In general, soil resource in Dry-Hot Valley of Jinsha River is abundant. Like Table 1 shows, there are many different soil types in Dry-Hot Valley of Jinsha River. For example, brown soil, red soil, yellow soil, etc. In DongQu county, the main soil types are: brown soil, yellow soil, red soil, mine sample, etc. In XiQu, the main soil types are: black sandy soil, yellow soil, brown soil and red soil, etc. In RenHe, the main soil types are: yellow soil, brown soil and red soil, etc. In MiYi, the main soil types are: brown soil, yellow soil and red soil, etc. In YanBian, the main soil types are: brown soil, yellow soil and red soil, etc. In XiChang, the main soil types are: brown soil and red soil, etc.

3.2 Soil water content, pH and organic matter

Table 2. Soil water contents, pH and organic matter in Dry-Hot Valley of Jinsha River

Town	Soil Water Content (%)±SD	Soil pH±SD	Soil organic matter (%)±SD
Yingjiang	15.52±0.91c	6.49±0.05a	1.7±0.1ab
Panzhihua Park	13.24±4.23c	7.09±0.02b	1.71±0.08ab
Airport Road	1.49±0.09ab	7.35±0.04b	1.88±0.15ab
Airport Road	0.08±0.03a	7.75±0.07c	1.59±0.07a
Baoanying Airport	3.97±0.21ab	7.73±0.02c	1.84±0.01ab
Ashuda	1.57±0.17ab	7.3±0.05b	1.59±0.09a
Xiao Panzhihua	0.73±0.07ab	6.39±0.05a	2±0.12ab
Nongnongping	5.44±1.87b	7.75±0.09c	2.06±0.09b
Dadukou	4.68±0.57ab	6.67±0.19a	1.94±0.08ab
Xiangyangcun	0.07±0.02a	6.66±0.12a	1.93±0.22ab
Wudaohe Zhujiabaobao	0.03±0.01a	6.62±0.08a	1.64±0.14a
Xinzhuang	1.03±0.07ab	8.7±0.01d	12.87±2.75bcd
Qingxiangping	0.67±0.04a	8.77±0.03d	3.56±0.38a
Yuquan	1.68±0.07bab	8.38±0.04bc	11.03±1.75ab
Hemenkou	9.51±0.32d	8.47±0.01c	9.17±2.91abc
Taojiadu	0.02±0.01a	8.29±0.03ab	17.98±1.42de
Geliping	5.33±0.22c	8.39±0.03c	26.47±1.47e
Jinshatan	3.12±1.59bc	8.38±0.02bc	17.06±0.51cd
Mosuohe	14.59±0.86e	8.23±0.03a	17.27±0.88cd
Renhe	2.17%±1.75%a	8.27±0.09ef	7.69%±1.90%b
Dahezhonglu	0.56%±0.14%a	8.33±0.08f	6.04%±0.57%ab
Datian	0.36%±0.48%a	8.15±0.05def	7.15%±0.44%c
Pingdi	1.51%±0.24%a	6.14±0.08a	12.57%±0.39%c
Jinjiang	2.66%±0.18%a	7.78±0.02bc	3.94%±0.35%a
Bude	2.23%±0.43%a	7.57±0.07b	12.41%±0.50%c
Tongde	0.94%±0.58%a	7.96±0.04cd	16.63%±0.89%d
Futian	1.61%±0.19%a	8.07±0.05de	5.37%±0.22%ab
QianJin	13.77%±5.47%b	8.21±0.03d	12.27%±28.09%bc
ZongFa	1.90%±0.17%a	7.61±0.02a	6.13%±16.60%a
DaLongTan	3.43%±0.06%a	7.97±0.15bc	3.20%±8.00%a
ALa	1.57%±0.06%a	8.04±0.04cd	2.93%±9.24%a
ZhongBa	0.37%±0.06%a	7.81±0.07b	10.13%±4.62%b
TaiPing	1.70%±0.1%a	8.04±0.04cd	14.40%±8.00%c
WuBen	0.40%±0.00%a	7.88±0.04bc	10.93%±4.62%bc
DeShi	5.78±0.51a	8.14±0.1a	3.47±0.07b
YaKou	8.94±0.17b	7.88±0.72a	2.65±0.14a

ShaLian	11.71±0.9c	6.96±0.64a	2.42±0.23a
BingGu	10.15±0.17bc	6.32±0.09a	2.20±0.23a
XinShan	4.57±0.23a	7.96±0.78a	2.67±0.14a
PanLian	11.26±0.68c	8.27±0.02a	3.45±0.17b
BaiMa	5.63±0.47c	6.10±0.02c	28.13±6.49ab
WanQiu	1.54±0.68b	6.01±0.09c	16.75±1.29a
CaoChang	1.46±0.16b	6.35±0.06d	15.97±3.01a
MaLong	0.05±0.05a	7.16±0.08e	43.00±11.48b
BaiPo	0.48±0.09a	4.57±0.11a	41.1±27.50b
PuWei	0.23±0.02a	5.46±0.04b	13.68±0.00a
HeAi	1.74±0.23a	7.55±0.13b	6.74±0.89d
HongGe	17.27±5.48ab	7.15±0.05a	5.22±0.29cd
YiMin	4.84±0.22ab	7.82±0.20c	2.33±0.93ab
XinJiu	3.71±0.23ab	8.16±0.04d	1.34±0.21a
TongZiLin	4.81±0.17ab	7.86±0.07c	3.91±1.53bc
HongGuo	7.27±0.11b	7.73±0.07bc	3.83±0.21bc
GanYu	1.13±0.20a	7.62±0.05bc	6.58±0.64d
YuMen	2.12±0.49ab	7.78±0.06bc	3.51±0.46abc
HuiMin	3.39%±0.19%ab	6.91±0.01c	6.74%±0.28%a
YongXing	7.12%±0.23%cd	5.46±0.08a	9.88%±0.38%a
QingHe	4.46%±1.17%bc	5.88±0.27ab	9.89%±0.68%a
WenQuan	8.03%±0.45%d	6.68±0.39bc	5.37%±1.21%a
GeShaLa	8.82%±1.14%d	6.27±0.52abc	6.05%±1.04%a
GuoSheng	1.93%±0.12%ab	6.45±0.11bc	4.67%±1.60%a
HongBao	2.49%±2.04%ab	6.35±0.04abc	8.59%±3.24%a
GongHe	0.78%±0.07%a	6.86±0.05c	8.19%±1.52%a
XiJiao	2.16	6.91±0.05b	2.57±0.32a
XiaoMiao	11.80	7.72±0.11d	3.57±0.21b
XiXiang	2.26	7.69±0.11e	2.37±0.31a
AnNing	3.19	6.55±0.22a	2.33±0.21a
ZhangMuQing	10.72	8.1±0.10e	3.40±0.26b
XiangShui	4.33	7.48±0.12cd	4.53±0.31c
KaiYuan	10.31	7.19±0.08bc	3.50±0.26b
TaiHe	17.12	7.50±0.06cd	5.37±0.25d
YuLong	12.20%±0.06%c	6.53±0.01a	13.18%±10.39%c
MaDao	16.56%±0.03%d	7.09±0.04c	10.52%±5.02%ab
GaoGui	2.87%±0.01%a	7.03±0.00bc	8.78%±8.71%ab
ChuanXing	4.22%±0.00%a	7.52±0.00d	7.66%±3.39%a
HaiNan	3.46%±0.03%a	6.58±0.01a	10.01%±3.50%ab
LuoGuPo	33.51%±0.49%e	7.00±0.04b	11.54%±0.64%bc
JingJiu	7.92%±0.11%b	6.56±0.02a	7.35%±3.93%a
XiXi	4.58%±0.09%a	7.54±0.02d	8.07%±1.66%ab

The letter marked in each column is to show the significance ($p<0.05$) of each data. Different letter shows significance.

Water content (%)	<1	1-5	5-10	10-15	>15
Grade	Extremely low	Low	Normal	High	Higher

Table 3. Soil water content (%) classification

Table 4 Soil pH grade

Grade	strong acid	acid	weak acid	neutral	Weak alkali	alkali	Strong alkali
pH value	＜4.5	4.5~5.5	5.5~6.5	6.5~7.5	7.5~8.5	8.5~9.0	＞9.0

Table 5 Soil organic matter (%) grade

Grade	1 (Extremely abundant)	2（Rich）	3（Middle-higher）	4（Middle-lower）	5（Lack）	6 (Extremely deficient)
Soil organic matter	＞4	3~4	2~3	1~2	0.6~1	＜0.6

Like Table 2 shows, the soil water contents in Dry-Hot Valley of Jinsha River are different in different towns. The values have varied wildly depended on different towns. It can be seen which town is full of water, which town is poor of water, campare with the soil water content classification Table 3. In general, many towns are lack of water. In DongQu, the following towns are extremely lack of water (water content <1%): airport road, xiao panzhihua, xiangyangcun, wudaohe zhujiabaobao. In XiQu, the following towns are extremely lack of water (water content <1%): qingxiangping, taojiadu. In RenHe, the following towns are extremely lack of water (water content <1%): dahezhonglu, datian, tongde, zhongba, wuben. In MiYi, the following towns are extremely lack of water (water content <1%): malong, baipo, puwei. In YanBian, the following towns are extremely lack of water (water content <1%): gonghe. Many towns are lack of water like table 2 shows. Thus, these towns need water irrigation to improve soil water content to increase plant growth. The statistics analyze of data shows many significances of each data.

Like Table 2 shows, the soil pH values in Dry-Hot Valley of Jinsha River are different in different towns. The values have varied wildly depended on different towns and different soil types. It can be seen the pH values in Dry-Hot Valley of Jinsha River is around 7, campare with the soil pH value classification Table 4. This means, the soil pH is around neutral in Dry-Hot Valley of Jinsha River in general. It does not need to modify the pH values in actual.

Like Table 2 shows, the soil organic matter values in Dry-Hot Valley of Jinsha River are different in different towns. The values have varied wildly depended on different towns and different soil types, campare with the soil organic matter value classification Table 5. In general, many towns are lack of organic matter. It means many towns need to apply organic matter fertilizer to improve organic matter content. The statistics analyze of data shows many significances of each data.

3.3 Soil Ammonium Nitrogen, Available Phosphorus and Effective Potassium

Table 6. Soil Ammonium Nitrogen, Available Phosphorus and Effective Potassium in Dry-Hot Valley of Jinsha River

Town	Soil Ammonium Nitrogen (mg/Kg)±SD	Soil Available Phosphorus (mg/Kg)±SD	Soil Effective Potassium (mg/Kg)±SD
Yingjiang	7.47±1.32a	30.6±1.3e	211±8.29f
Panzhihua Park	26.53±2.64c	17.93±4.81d	44.67±2.05c
Airport Road	16.53±0.66b	11.47±0.82bc	145±4.32e
Airport Road	7.07±1.15a	14.53±1.39cd	11.67±2.36a
Baoanying Airport	9.4±1.41a	13.8±0.85cd	12.67±2.05a
Ashuda	9.8±1.23a	8.67±0.52abc	14.33±0.94a
Xiao Panzhihua	17.53±1.84b	5.47±0.5a	282.67±4.5g
Nongnongping	8.13±0.38a	13.47±0.9cd	69.33±3.3d
Dadukou	7.87±0.38a	4.27±0.5a	29.33±2.36b
Xiangyangcun	22.47±0.47c	6.93±0.34ab	34.33±2.36bc
Wudaohe Zhujiabaobao	5.47±0.66a	3.67±0.29a	43.33±5.19bc
Xinzhuang	11.67±9.43a	64±3.27c	116.00±17.28ab
Qingxiangping	26.67±12.47a	31.8±3.48b	97.00±39.82ab
Yuquan	6.53±4.71a	68±3.27c	322±37.66c
Hemenkou	11.67±6.24a	18.8±0.98a	24.67±9.1a
Taojiadu	20±11.31a	12.33±1.75a	247±30.69c
Geliping	6.67±1.89a	11.47±0.9a	258±6.53c
Jinshatan	21.6±9.34a	11.07±0.47a	130.33±20.5b

Mosuohe	19.93±10.15a	31±2.08b	59±31.95ab
Renhe	15.67±3.29ab	27.27±0.57d	179.67±19.70abc
Dahezhonglu	24.80±1.39c	26.93±1.24d	250.00±47.46bcd
Datian	12.40±1.73ab	22.80±0.16c	158.00±26.94ab
Pingdi	10.00±1.63a	16.07±0.77ab	323.67±40.74d
Jinjiang	18.00±1.63bc	18.40±0.75b	333.00±54.70d
Bude	14.00±1.63ab	17.00±1.18ab	147.67±27.18ab
Tongde	13.67±1.69ab	24.60±1.39cd	291.00±31.28cd
Futian	9.33±2.81a	13.87±0.77a	71.67±9.17a
QianJin	12.00±4.00a	14.60±8.07ab	108.67±19.14b
ZongFa	8.00±6.93a	3.47±1.66a	97.67±9.24b
DaLongTan	8.00±4.00a	10.53±8.10ab	14.67±11.59a
ALa	14.67±11.55a	15.53±2.05ab	30.00±11.00a
ZhongBa	12.00±4.00a	14.33±3.23ab	94.67±23.69b
TaiPing	4.00±0.00a	16.20±2.00ab	45.67±8.50a
WuBen	8.00±6.93a	19.87±1.94b	117.33±7.77b
DeShi	15±0.82a	22.13±1.42c	53±11.58b
YaKou	15±1.41a	17.52±0.25b	188±12.36d
ShaLian	23±1.41a	7.75±0.23a	19±22.45a
BingGu	34±3.56b	15.79±0.37b	84±2.94c
XinShan	44±1.63c	20.66±0.41c	66±2.45bc
PanLian	21±4.55a	16.63±0.46b	11.2±0.68c
BaiMa	36.67±11.55a	23.93±3.10a	560.00±158.75bc
WanQiu	43.33±15.28a	16.73±6.11a	1320.00±336.45c
CaoChang	33.33±15.28a	15.07±9.51a	66.67±30.55a
MaLong	23.33±15.28a	13.47±0.31a	73.33±41.63a
BaiPo	43.33±15.28a	10.80±7.83a	546.67±50.33b
PuWei	53.33±20.82a	13.33±2.14a	313.33±41.63ab
HeAi	18.87±1.96a	9.43±0.21ab	17.23±14.64b
HongGe	15.33±1.86a	35.20±4.70e	34.63±15.01d
YiMin	16.00±4.00a	18.13±0.50c	2.63±2.31c
XinJiu	9.33±2.31a	7.40±0.20a	1.40±0.00a
TongZiLin	17.33±2.31a	12.47±0.31ab	14.13±11.24b
HongGuo	30.67±6.11b	34.87±20e	33.17±67.04d
GanYu	16.00±0.00a	28.53±0.46d	12.27±35.80b
YuMen	16.67±6.43a	12.80±0.40b	15.83 ±17.24b
HuiMin	2.53±0.74a	20.93±2.48a	38.13±17.85ab
YongXing	4.53±1.09a	19.40±2.07a	10.20±1.61a
QingHe	5.93±4.42a	20.80±2.14a	14.73±0.38ab
WenQuan	7.13±1.60a	16.80±1.02a	9.53±6.03a
GeShaLa	3.47±1.23a	21.57±2.13a	9.87±4.60a
GuoSheng	6.87±1.23a	17.30±2.34a	14.73±2.07ab
HongBao	7.47±0.47a	52.00±3.24b	45.67±9.46b
GongHe	7.13±2.07a	20.67±3.04a	86.93±17.60c
XiJiao	39.00±1.00c	36.63±4.07e	54.33±1.53c
XiaoMiao	55.0±4.58d	30.00±1.51bcd	34.00±5.29b
XiXiang	19.67±1.53b	30.23±2.97bcd	12.67±1.53a
AnNing	13.33±1.53a	22.63±1.24a	65.33±5.03e
ZhangMuQing	19.6±1.53b	5.07±0.42ab	16.00±4.16a
XiangShui	18.33±1.53ab	27.53±1.03abc	206.6±5.51f
KaiYuan	23.33±2.08b	34.10±1.30de	214.3±1.53f
TaiHe	18.33±2.08ab	30.97±0.78cde	20.67±3.51a

YuLong	11.87±6.32a	12.00±0.49a	34.67±1.70a
MaDao	6.80±3.32a	12.07±2.05ab	138.00±55.37b
GaoGui	44.13±24.53bc	13.27±1.81abc	19.33±7.93a
ChuanXing	17.33±1.89ab	16.73±1.57abc	243.33±44.97c
HaiNan	13.33±1.25ab	23.07±0.38d	101.67±2.87ab
LuoGuPo	51.53±3.85c	12.80±1.30abc	85.00±11.22ab
JingJiu	9.37±0.97a	18.33±1.88cd	96.67±10.62ab
XiXi	2.70±0.24a	17.67±2.32bcd	71.67±29.80ab

The letter marked in each column is to show the significance ($p<0.05$) of each data. Different letter shows significance.

Table 7 Soil Ammonium Nitrogen (mg/Kg) grade

Grade	1（Extremely abundant）	2（Rich）	3（Middle-higher）	4（Middle-lower）	5（Lack）	6（Extremely deficient）
Concentration	＞150	120~150	90~119	60~89	30~59	＜30

Table 8 Soil Available Phosphorus (mg/Kg) grade

Grade	1（Extremely abundant）	2（Rich）	3（Middle-higher）	4（Middle-lower）	5（Lack）	6（Extremely deficient）
Concentration	＞40	20~39	10~19	5~9	3~4	＜3

Table 9 Soil Effective Potassium (mg/Kg) grade

Grade	1（Extremely abundant）	2（Rich）	3（Middle-higher）	4（Middle-lower）	5（Lack）	6（Extremely deficient）
Concentration	＞200	150~149	100~149	50~99	30~49	＜30

Like Table 6 shows, the soil ammonium nitrogen values in Dry-Hot Valley of Jinsha River are different in different towns. The values have varied wildly depended on different towns and different soil types, compare with the soil ammonium nitrogen value classification Table 7. In general, many towns are extremely lack (<30 mg/kg) of ammonium nitrogen. It means these towns need to apply nitrogen fertilizer to improve soil ammonium nitrogen value. The statistics analyze of data shows many significances of each data.

Like Table 6 shows, the soil available phosphorus values in Dry-Hot Valley of Jinsha River are different in different towns. The values have varied wildly depended on different towns and different soil types, compare with the soil available phosphorus value classification Table 8. In general, many towns are lack of available phosphorus. It means these towns need to apply phosphorus fertilizer to improve soil available phosphorus value. The statistics analyze of data shows many significances of each data.

Like Table 6 shows, the soil effective potassium values in Dry-Hot Valley of Jinsha River are different in different towns. The values have varied wildly depended on different towns and different soil types, compare with the soil effective potassium value classification Table 9. In general, many towns are extremely lack (<30 mg/kg) of effective potassium. It means these towns need to apply potassium fertilizer to improve soil effective potassium value. The statistics analyze of data shows many significances of each data.

IV. DISCUSSIONS

The innovation of my work is to classify the different soil types in Dry-Hot Valley of Jinsha River, and to determine the soil chemical fertility indexes, including:soil water content, pH, organic matter, ammonium nitrogen, available phosphorus, effective potassium. The purpose to know the fertility situation of different soil types is to find the way to apply suitable soil fertilization into soil to stimulate cultivation to grow better, to get more gains. Before we apply suitable soil fertilization, we should know the soil types and soil fertility situation well. Know and find the problem, and then solve the problem [15].

In general, soil resource in Dry-Hot Valley of Jinsha River is abundant. There are many different types of soils distributing in different sites in Dry-Hot Valley of Jinsha River. For example like Table 1 shows, there are many counties and towns in Dry-Hot Valley of Jinsha River, including: DongQu, XiQu, RenHe, MiYi, YanBian and XiChang; Yingjiang, Panzhihua Park, Airport Road etc. The different soil types including: brown soil, yellow brown soil, stone-bone soil, lateritic red soil, forest mossy soil etc. The soil types in Dry-Hot Valley of Jinsha River are abundant[16].

Many towns are lack of water like table 2 shows. The values of soil water contents are usually very low. Some soils even reach almost 0%. That means the soils are lack of water. Thus, these towns need water irrigation to improve soil water content to increase cultivation growth. The statistics analyze of data shows many significances of each data [3].

Like Table 2 shows, the soil pH values in Dry-Hot Valley of Jinsha River are different in different towns. The values have varied wildly depended on different towns and different soil types. This means, the soil pH is around neutral in Dry-Hot Valley of Jinsha River in general. It does not need to modify the pH values in actual of many soils. However, some soil pH value reaches nearly 5. It is a weak acid soil. It should apply some alkali soil fertilizer to improve the soil pH value. Because almost all cultivations like to grow in neutral soil. The pH value in neutral is more suitable for cultivation growth [5-7, 17-19].

Like Table 2 shows, the soil organic matter values in Dry-Hot Valley of Jinsha River are different in different towns. The values have varied wildly depended on different towns and different soil types, campare with the soil organic matter value classification Table 5. In general, many towns are lack of organic matter. The value of soil organic matter is very low. Some soil even reaches to 1%. The soil fertility is very poor. It means many towns need to apply organic matter fertilizer to improve organic matter content. The higher values of soil organic matter in soil, means the better soil fertility situation to cultivation growth and the higher fertility situation of soils. The higher fertility of soil, means the bigger gains of cultivation. The statistics analyze of data shows many significances of each data [8, 10-12, 20].

Like Table 6 shows, the soil ammonium nitrogen values in Dry-Hot Valley of Jinsha River are different in different towns. The values have varied wildly depended on different towns and different soil types, compare with the soil ammonium nitrogen value classification Table 7. In general, many towns are extremely lack (<30 mg/kg) of ammonium nitrogen. Many towns the ammonium nitrogen values even low to 2 mg/kg. It means these towns need to apply nitrogen fertilizer to improve soil ammonium nitrogen value. The higher soil ammonium nitrogen value, means the higher soil chemical fertility. And the cultivation in higher fertility situation can growth better to get more gains. The statistics analyze of data shows many significances of each data[13].

Like Table 6 shows, the soil available phosphorus values in Dry-Hot Valley of Jinsha River are different in different towns. The values have varied wildly depended on different towns and different soil types, compare with the soil available phosphorus value classification Table 8. In general, many towns are lack of available phosphorus. Many towns soil available phosphorus values even low to 3 mg/kg. It means these towns need to apply phosphorus fertilizer to improve soil available phosphorus value. The higher soil available phosphorus value, means the higher soil chemical fertility. And the cultivation in higher fertility situation can growth better to get more gains.The statistics analyze of data shows many significances of each data[14].

Like Table 6 shows, the soil effective potassium values in Dry-Hot Valley of Jinsha River are different in different towns. The values have varied wildly depended on different towns and different soil types, compare with the soil effective potassium value classification Table 9. In general, many towns are extremely lack (<30 mg/kg) of effective potassium. Many towns soil effective potassium values even low to 1 mg/kg. It means these towns need to apply potassium fertilizer to improve soil effective potassium value. The higher soil effective potassium value, means the higher soil chemical fertility. And the cultivation in higher fertility situation can growth better to get more gains. The statistics analyze of data shows many significances of each data[15].

V. CONCLUSIONS

The innovation of my work is to classify the different soil types in Dry-Hot Valley of Jinsha River, and to determine the soil chemical fertility indexes, including:soil water content, pH, organic matter, ammonium nitrogen, available phosphorus, effective potassium. The purpose to know the fertility situation of different soil types is to find the way to apply suitable soil fertilization into soil to stimulate cultivation to grow better, to get more gains. Before we apply suitable soil fertilization, we should know the soil types and soil fertility situation well. Know and find the problem, and then solve the problem.

Soil types and soil nutrients were analyzed in Dry-Hot Valley of Jinsha River:

1. Dry-Hot Valley of Jinsha River have different soil types in different towns. There are many different soil types. Mainly are like, for example: red soil, yellow soil and brown soil, etc.
2. The water content in many towns are low and extremely low. So, it needs water irrigation to replenish water.
3. The organic matter content in many towns are low and extremely low. So, it needs apply organic matter fertilizer to enrich organic matter.
4. The nitrogen values in many towns are low and extremely low. So, it needs apply nitrogen fertilizer to improve nitrogen.
5. The phosphorus values in many towns are low and extremely low. So, it needs apply phosphorus fertilizer to increase phosphorus.

6. The potassium values in many towns are low and extremely low. So, it needs apply potassium fertilizer to increase potassium.

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