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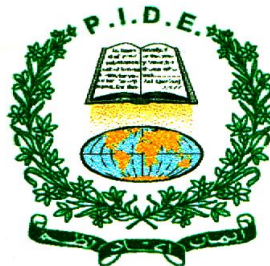
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GIS OF POVERTY MAPPING ANALYSIS FOR PAKISTAN

By

NABEELA ARSHAD

Study submitted to the Asian Development Bank under RETA
6073: "Developing Tools for Assessing the Effectiveness of
ADB Operations in Reducing Poverty"
TA No. 6042: REG/Poverty Mapping in Selected DMCs



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Pakistan Institute of Development Economics
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ABSTRACT *

The report presents the results of Poverty Mapping Analysis for Pakistan with the help of Geographical Information System (GIS) under the project titled RETA 6073 undertaken in various countries like China, Philippines, Indonesia, and Pakistan. The Poverty Mapping GIS has been developed using two data sets namely Pakistan Socio Economic Survey 2001 and Population Census 1998. Therefore, two sets of maps are presented using predictors from the above mentioned datasets. The objective is to map poverty incidence and its indicators at district level to compare the similarities and differences between the two datasets. The indicators are: family size, dependency ratio (young, old and total), population density, literacy, formal education, work status, occupational and industrial choice, access to credit, region (urban/rural), asset ownership, housing quality, and access to facilities like water, electricity, gas and sanitation.

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1. INTRODUCTION

Geographic Information Systems (GIS) are a plausible way of analysis and presentation of data. GIS has been applied to almost every sector world wide including the social sector for effectively presenting the results of various analyses. Spatial representation and analysis of poverty indicators is becoming an increasingly important tool for addressing its driving social, economic and environmental factors, which are difficult to characterize with conventional tools. Representation of the poverty indicators on a spatial domain is referred to as poverty mapping and it is useful for pinpointing the high poverty incidences. Poverty mapping exercise can not only answer the question where the poor are located, but also explains the interrelationships among the influencing factors to know the reasons for them to be poor. Spatial analysis of poverty has been used in various policy and research applications in addition to providing visual representation of spatial relationship between variables by national governments, non-government organizations, and research organizations through out the world.

2. DATA AND METHODOLOGY

Poverty mapping depends on data generated by geographical information systems (GIS) by fixing various values to specific locations on a digital map. The Spatial locations of the poor help integrate data from different sources such as censuses, household surveys, and socio-economic surveys etc. GIS techniques provide four key functions in poverty mapping (Bigman and Deichmann, 2000):

1. integration of multiple databases from different sources;
2. analysis of spatial associations between variables;
3. inclusion of spatially generated explanatory variables into the multivariate analysis of determinants of poverty, including natural capital and infrastructure, and access to public

services and products and labour markets; disaggregated poverty measures can serve as an explanatory variable for other outcomes;

4. policy comparison and formulation through mapping or monitoring.

Many recent studies have highlighted the usefulness of geography and spatial variables as important determinants of poverty. There are a number of methods available in literature and practice for spatial location of the poor; however, most of these are still under research and development. For this study a method named as Household-level method developed in Hentschel et al. and Elbers, Lanjouw and Lanjouw (2001); presented in Deichmann (1999) and World Bank (2000) has been used. This method requires at least two data sets; household level census data and a representative household survey corresponding approximately to the same time period as the census.

For this study the household level data set namely Pakistan Socio Economic Survey (2001) and Population Census 1998 has been used. Although the two data sets have a gap of approximately two years yet the results are quite close. The sample size of Pakistan Socio Economic Survey (PSES) is approximately 4200 households which covers 79 districts in all the four provinces of Pakistan out of which mapping has been done on 43 districts based on the criteria of selecting the districts where more than 30 households were interviewed. Rests of the districts in the survey were not considered for mapping due to low number of households thus not being representative. The poverty predictors have been obtained through Poverty Predictor Modeling prepared by the domestic consultant for Pakistan. The maps being presented have been prepared on many dimensions like Basic Demographic Indicators, Employment Indicators, Population Vaccinated, Education, Credit, Expenditure, Income, and other socio-economic and household characteristics.

3. SOFTWARE AND TECHNICAL DETAIL

ArcView™¹ GIS version 3.3 has been used for the mapping based on Digital Atlas of Pakistan (DAP)² with district boundaries. Digital Atlas of Pakistan is a comprehensive 1:1,000,000 scale vectorized base map of Pakistan. It consists of geographic attributes and textual data that can be processed through the ArcView GIS software. The back end database has been stored in Microsoft Access and linked with ArcView GIS through ODBC connectivity. The data is organized in three tables. The description of variables in each table of poverty mapping database is attached at Annexure (i).

4. MAPS

Two sets of maps are produced by districts from each data set. One set is labeled as MAP S1, MAP S2, ...and are prepared from the sample household survey data. The other set is labeled as MAP C1, MAP C2, ... and are prepared from the Population Census 1998 data. The maps prepared during the poverty mapping exercise are included in this report at Annexure (ii).

4.1 Maps using PSES 2001 Dataset

- Poverty and Household Characteristics (Poverty Incidence, Family Size, Education of Head of Household, Education of Spouse of Head of Household, Dependency Ratio, Young Dependency Ratio (less than ten years of age) and Old Age Dependency Ratio (more than 65 years of age), Monthly Expenditure of a Household and Transfer Income).
- Credit Indicators at Household Level (Credit Taken, Single Loan, Household Indebtedness, Amount paid so far, Amount Outstanding, Give any gift bribe, and Amount paid to lender)

¹ Environmental Systems Research Institute, (ESRI)

² Digital Atlas of Pakistan, Copyright © 2003 Pakistan Resources Development Services (Pvt.) Ltd. All Rights Reserved.

- Infrastructure Indicators at Household Level (Percentage having Own Home, Pucca (Cemented) Home, Up to Three Rooms, Up to Single Room, Access to Drinking Water inside House, Electricity, Gas and Telephone)
- Occupational Distribution³ of Head of Household (Legislative, Professional, Technical/Professional, Clerks, Service, Agriculture, Crafts & related, Plant and Machine Operators and Elementary Occupations)
- Industrial distribution of Head of Household (Agriculture, Mining, Manufacturing, Electricity Gas & Water, Construction, Wholesale and Retail Trade, Transport Storage & Communication, Finance Real Estate and Business, Community and Social Services)

4.2 Maps using Population Census 1998 Dataset

- Basic Demographic Indicators ((Total Population, Sex Ratio, Population Density, Share of Urban population, Share of Female Population, Family Size, Young Dependency Ratio, Old Dependency Ratio, Total Dependency Ratio, and Population Growth Rate (1981-1998))
- Employment Indicators (Percentage of Population above 10 years Working, Looking for Work and Laid Off)
- Population Vaccinated (Total Population less than 10 years, Percentage Vaccinated, Percentage Not Vaccinated and Percentage who Do Not Know)
- Literacy Rate and Educational Attainment (Population, Literacy Rate, Less Than Matric, and Above Matric)
- House Ownership (Total Households, Percentage of Houses Owned, Percentage of One Room Houses and Percentage of Three Rooms Houses)
- House Conditions (Percentage of Pucca (Cemented) Houses, Water, Electricity, Latrine)

³ For sample based maps, the data for occupational choice and industrial choice of head of households are mapped where as for census data the occupational and industrial choice of total work force is mapped. [see MAP S8-MAP S15 for sample data and MAP C13-MAP C15 for census data].

As noted above there are a number of common variables between the two data sets used for the poverty mapping exercise and correspondingly maps prepared on these dimensions given a clear comparison of the poverty level estimated from the two sources of data. In addition to this a number of maps have also been made on other variables available in these data sets for providing a better understanding of poverty incidence and its influencing factors.

5. CONCLUSIONS

The maps, drawn on the basis of Survey data and Census data, indicate the similarities and differences in poverty incidence and poverty predictors at district level. The results indicate that household level indicators are better predictors of poverty at district and at national level. The maps also show that the poverty is concentrated in the central part of the country, in lower part of Punjab and in Baluchistan province. This also shows that geographical proximity can be important predictor of poverty and the efforts to reduce poverty can focus on extremely poor districts like Muzaffargarh, Bannu, Dera Ismail Khan and Dera Ghazi Khan, Focusing on these districts in terms of creating employment opportunities will help to reduce poverty in these districts. It can also generate spill over effects on neighbouring districts. However, there is a need to study these districts in more detail.

Annexure (i): Description of Variables in Poverty Mapping Database

Table Name : PSES2001

S.No.	Variable	Description
1	distnewid	District ID
2	Sno	Serial No.
3	Districts	District Name
Poverty and Household Characteristics		
4	HH_no	Number of Households
5	Poverty	Poverty Incidence
6	Family Size	Average Household Size
7	Head Age	Age of Head of Household
8	Head Education	Education of Head of Household
9	Spouse Age	Age of Spouse
10	Spouse Education	Education of Spouse
11	DEPEN	Total Dependency Ratio
12	DEPENY	Young Dependency Ratio (<10 years)
13	DEPENO	Old Age Dependency Ratio (65+)
14	Monthly Expenditure	Average Monthly Expenditure
15	Transfer Income	Transfer Income
Credit Indicators at Household Level		
16	Credit taken	Percentage of Households Taken Credit
17	Single loan	Percentage of Households Taken Single Loan
18	HH Indebtedness	Average Household Indebtedness
19	Amount paid so far	Average Amount Repaid by the Household
20	Amount outstanding	Average Outstanding Household Loan
21	Give any gift bribe	Percentage of Households Given any Gift/ Bribe
22	Amount paid to lender	Average Amount of Gift/Bribe Paid to Lender
Infrastructure Indicators at Household Level		
23	Own Home	Percentage of Households having Own Home
24	Pucca Home	Percentage of Households having Cemented (Pucca) Home
25	Upto 3 Rooms	Percentage of Households Living in Houses Having up to 3 Rooms
26	Upto Single Room	Percentage of Households Living in Houses Having a Single Room
27	Drinking water in House	Percentage of Households Having Source of Drinking Water Inside the House
28	Electricity	Percentage of Households Having Access to Electricity

Table Name : PSES2001 ...Continued

S.No.	Variable	Description
29	Gas	Percentage of Households Having Access to Gas
30	Telephone	Percentage of Households Having Access to Telephone
Occupational Distribution of Head of Household by District		
31	Legislative	Percentage of Household Heads Working as Legislatives
32	Professional	Percentage of Household Heads Working as Professionals
33	Professional_Techn	Percentage of Household Heads Working as Technical Professionals
34	Clerks	Percentage of Household Heads Working as Clerks
35	Service	Percentage of Household Heads Working as Service Workers
36	Agriculture	Percentage of Household Heads Working as Agriculture Workers
37	Crafts_related	Percentage of Household Heads Working in Crafts and Other Related Occupations
38	Plant_machine operators	Percentage of Household Heads Working as Plant/Machine Operators
39	Elementary occupations	Percentage of Household Heads Working in Elementary Occupations
Industrial Distribution of Head of Household by District		
40	Field40	Percentage of Household Heads Working in Agricultural Sector
41	Mining	Percentage of Household Heads Working in Mining Sector
42	Manufacturing	Percentage of Household Heads Working in Manufacturing Sector
43	Electricity_gas_water	Percentage of Household Heads Working in Electricity Gas & Water Sector
44	Construction	Percentage of Household Heads Working in Construction Sector
45	WRT	Percentage of Household Heads Working in Wholesale & Retail Trade Sector
46	TSC	Percentage of Household Heads Working in Transport, Storage and Communication Sector
47	FREB	Percentage of Household Heads Working in Finance, Real Estate & Business Sector
48	CSS	Percentage of Household Heads Working in Community and Social Services Sector

Table Name : Census98

S.No.	Variable	Description
1	Distnewid	District ID
2	District	District Name
Basic Demographic Indicators		
3	TotalPopulation	Total Population
4	SexRatio	Sex Ratio
5	populationDensity	Population Density
6	Shareofurbanpopulation	Percentage Share of Urban Population
7	ShareofFemalepopulation	Percentage Share of Female Population
8	Householdsize	Average Household Size
9	YoungDependency	Young Dependency Ratio (<10 years)
10	OldDependency	Old Age Dependency Ratio (65+)
11	Dependency	Dependency Ratio
Employment Indicators		
12	PopGrowthRate_81_98	Population Growth Rate 1981_98
13	PercentofPop10plusworking	Percentage of Working Population Above 10 years of Age
14	PercentofPop10pluslookingfor	Percentage of Population Looking for Work Above 10 years of Age
15	PercentofPop10pluslaidoff	Percentage of Population Laid Off Above 10 years
Population Vaccinated		
16	totalpopulationLT_10	Population Under 10 Years of Age
17	vaccinatepercent	Percentage of Vaccinated Population Under 10 Years of Age
18	notvaccinatepercent	Percentage of Not Vaccinated Population Under 10 Years of Age
19	Donotknowvaccinatepercent	Percentage of Population Not Sure about Getting Vaccinated
Literacy Rate and Educational Attainment by Districts		
20	Population10	Population Aged 10 Years and Above
21	LiteracyRate	Literacy Rate Among Population Aged 10 Years and Above
22	LTMatric	Percentage of Population Less Than Matric (10 Years & Above)
23	Matric	Percentage of Population Matric & Above (10 Years & Above)
House Ownership By Districts		
24	TotalHouse	Total Households
25	HousesOwnedpercentage	Percentage of Households having Own Home

Table Name : Census98

...Continued

S.No.	Variable	Description
26	OneRoompercentage	Percentage of Households Living in Houses Having a Single Room
27	ThreeRoompercentage	Percentage of Households Living in Houses Having up to 3 Rooms
House Conditions By Districts		
28	PuccaHousespercentage	Percentage of Households having Cemented (Pucca) Home
29	Waterpercentage	Percentage of Households having Access to Water
30	Electricitypercentage	Percentage of Households having Electricity
31	Latrinepercentage	Percentage of Households having Latrine

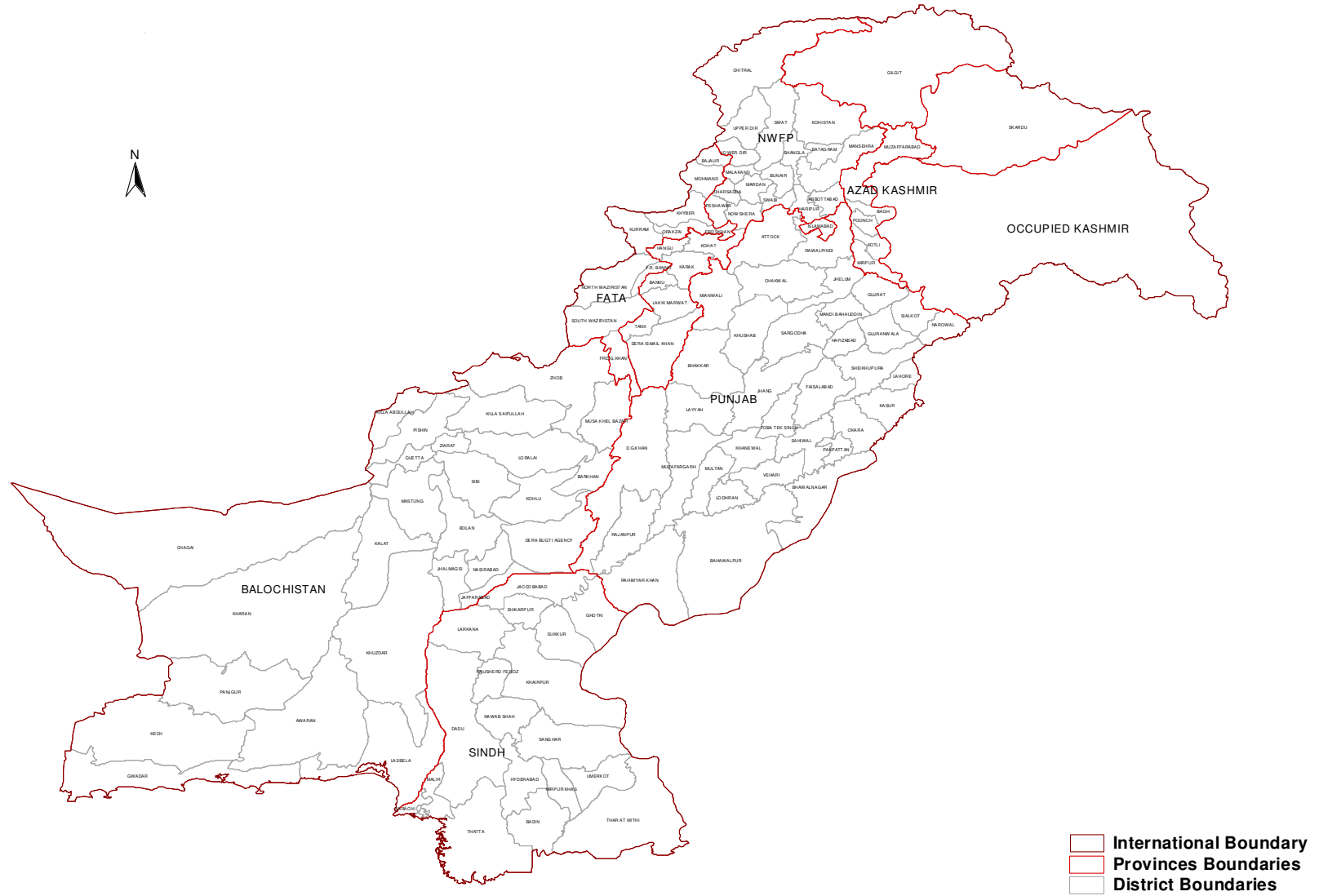
Table Name: Table789-Census 98

S.No.	Variable	Description
1	DISTNEWID	District ID
2	DISTRICT	District Name
Industrial Distribution of the Work Force by Districts		
3	INDUSTRI	Total Work Force
4	AGRICULT	Percentage of Household Heads Working in Agricultural Sector
5	MININGPE	Percentage of Household Heads Working in Mining Sector
6	MANUFACT	Percentage of Household Heads Working in Manufacturing Sector
7	EG_WPERC	Percentage of Household Heads Working in Electricity Gas & Water Sector
8	CONSTRUC	Percentage of Household Heads Working in Construction Sector
9	W_RTPERC	Percentage of Household Heads Working in Wholesale & Retail Trade Sector
10	TS_COMNP	Percentage of Household Heads Working in Transport, Storage and Communication Sector
11	FI_REPER	Percentage of Household Heads Working in Finance, Real Estate & Business Sector
12	C_SSPERC	Percentage of Household Heads Working in Community and Social Services Sector
Occupational Distribution of the Work Force By Districts		
13	LEGISLAT	Percentage of Household Heads Working as Legislatives
14	PROFESSI	Percentage of Household Heads Working as Professionals
15	TECHNICA	Percentage of Household Heads Working as Technical Professionals
16	CLERKSPE	Percentage of Household Heads Working as Clerks
17	SERVICEP	Percentage of Household Heads Working as Service Workers
18	SKILLEDA	Percentage of Household Heads Working as Skilled Agriculture Workers
19	CRAFTSET	Percentage of Household Heads Working in Crafts and Other Related Occupations
20	PLANTMAC	Percentage of Household Heads Working as Plant Machine Operators
21	ELEMENTA	Percentage of Household Heads Working in Elementary Occupations
22	SPOVERTY	Survey Based Poverty Head Count Index
23	CPOVERTY	Census Based Poverty Head Count Index

Annexure (ii): MAPS

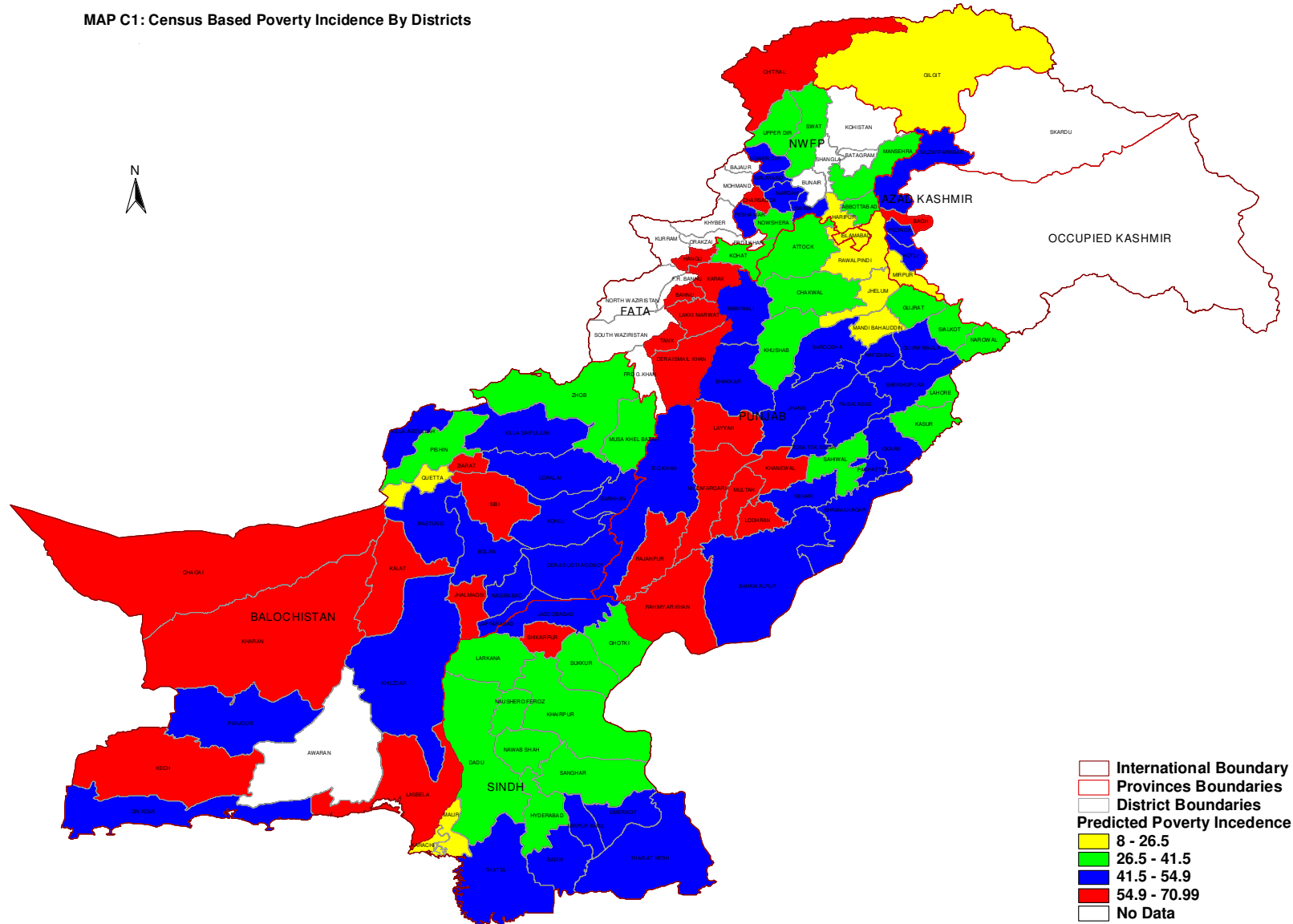
- 1. Maps using Population Census 1998 Dataset (MAP 1, MAP C1 to MAP C27)**
- 2. Maps using PSES 2001 Dataset (MAP S1 to MAP S26)**

MAP 1: Thematic Map of Pakistan Showing Province and District Boundaries



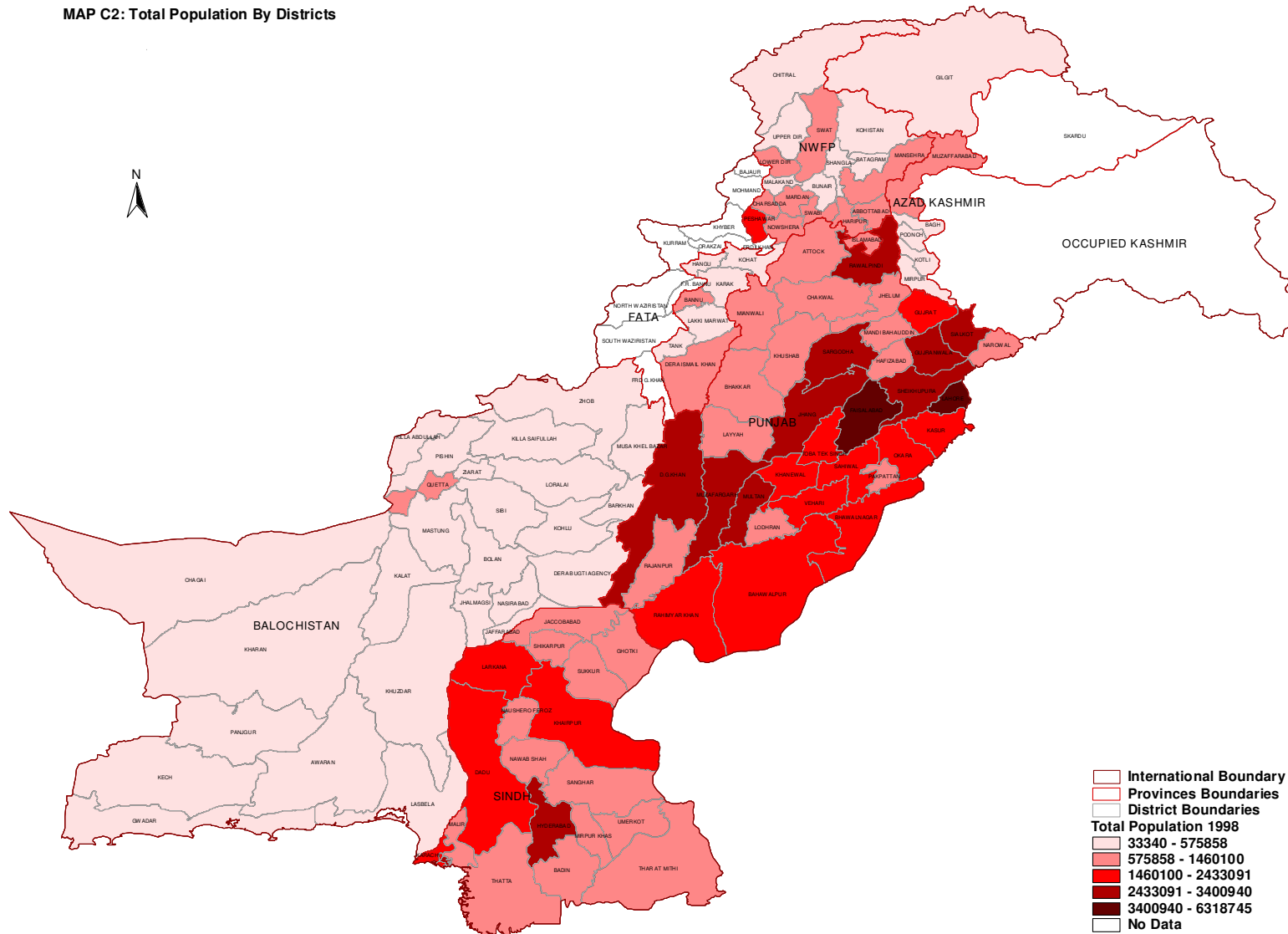
Source: Population Census of Pakistan 1998

MAP C1: Census Based Poverty Incidence By Districts



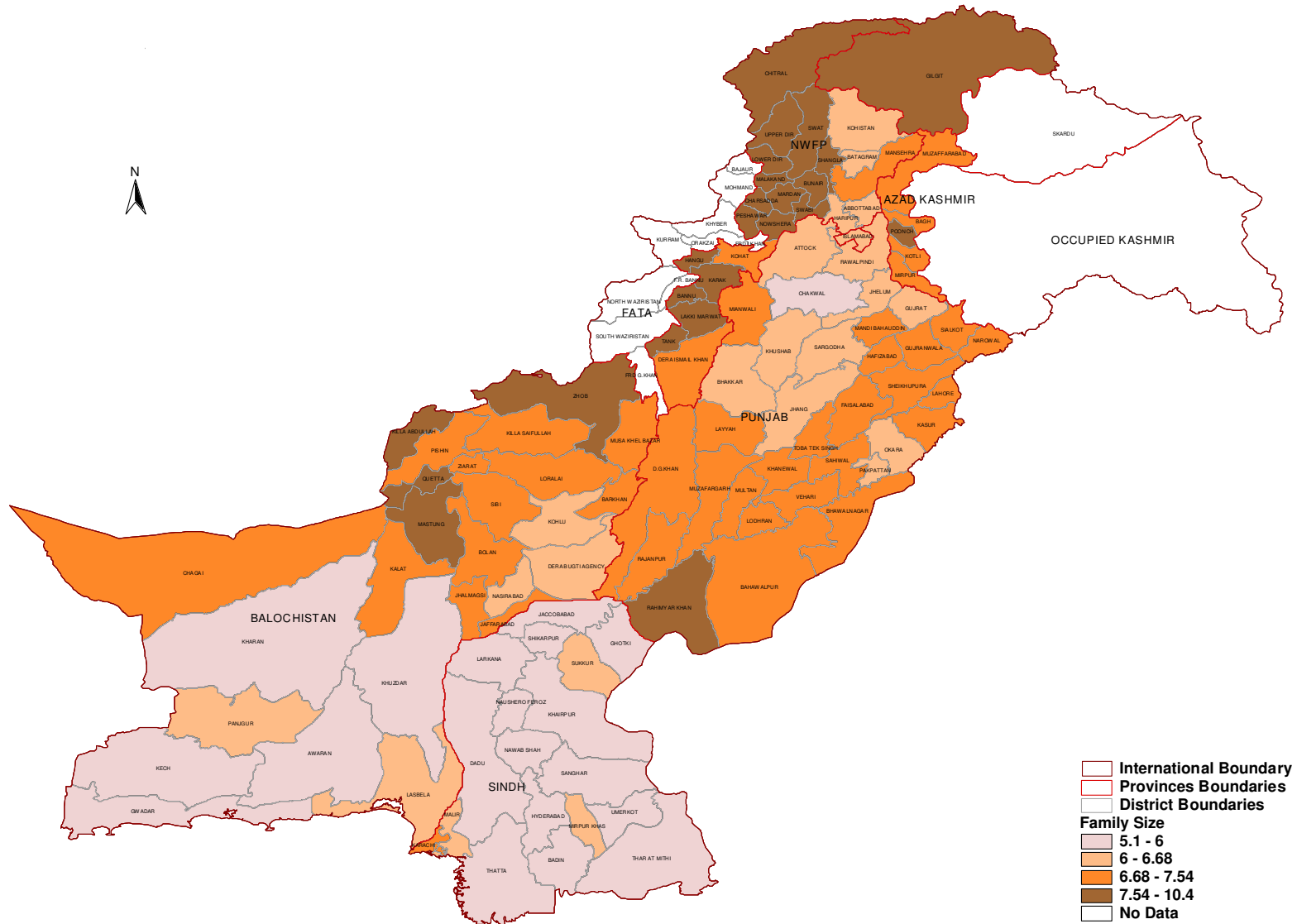
Source: Population Census of Pakistan 1998

MAP C2: Total Population By Districts



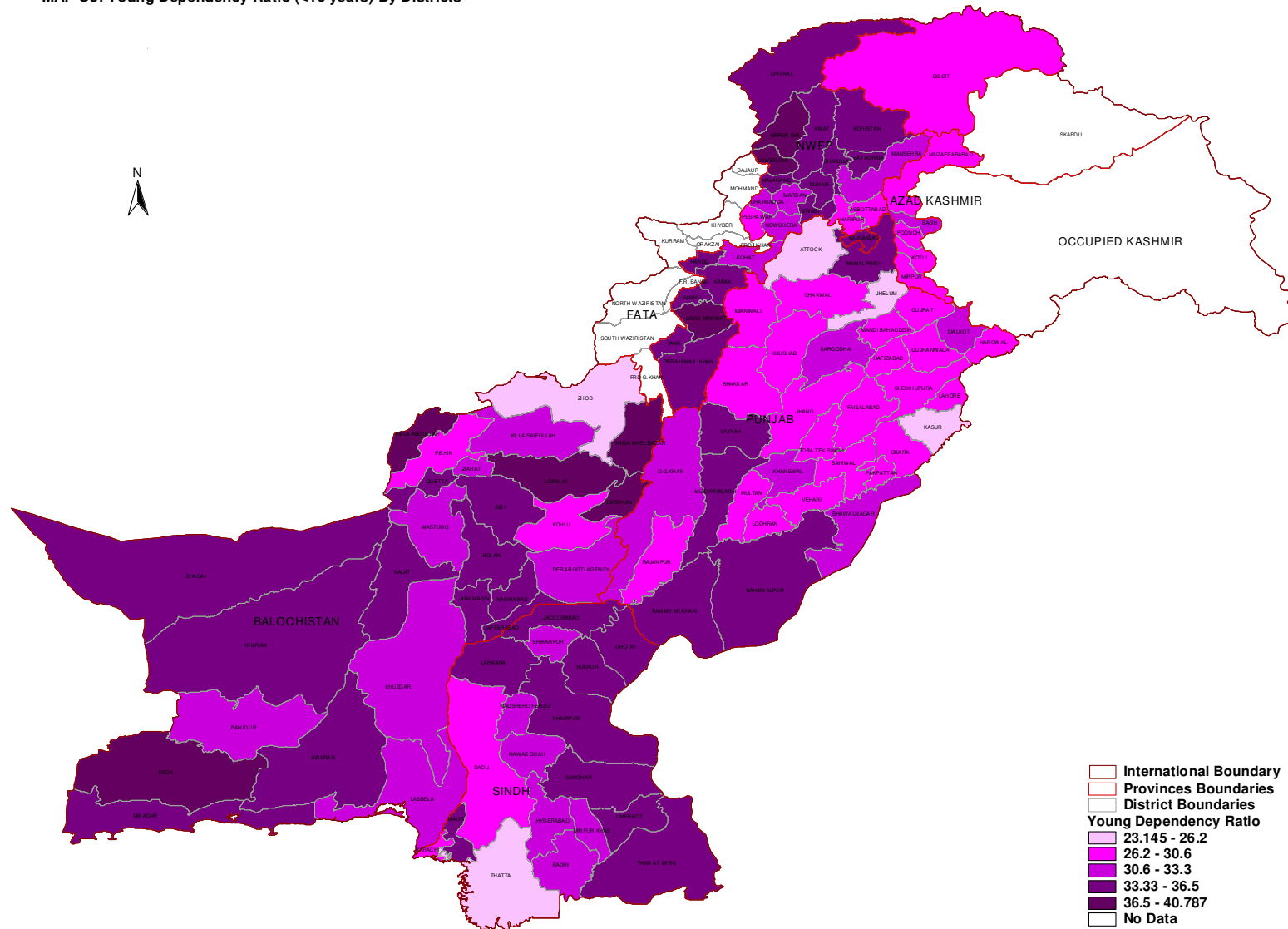
Source: Population Census of Pakistan 1998

MAP C4: Average Household Size By Districts



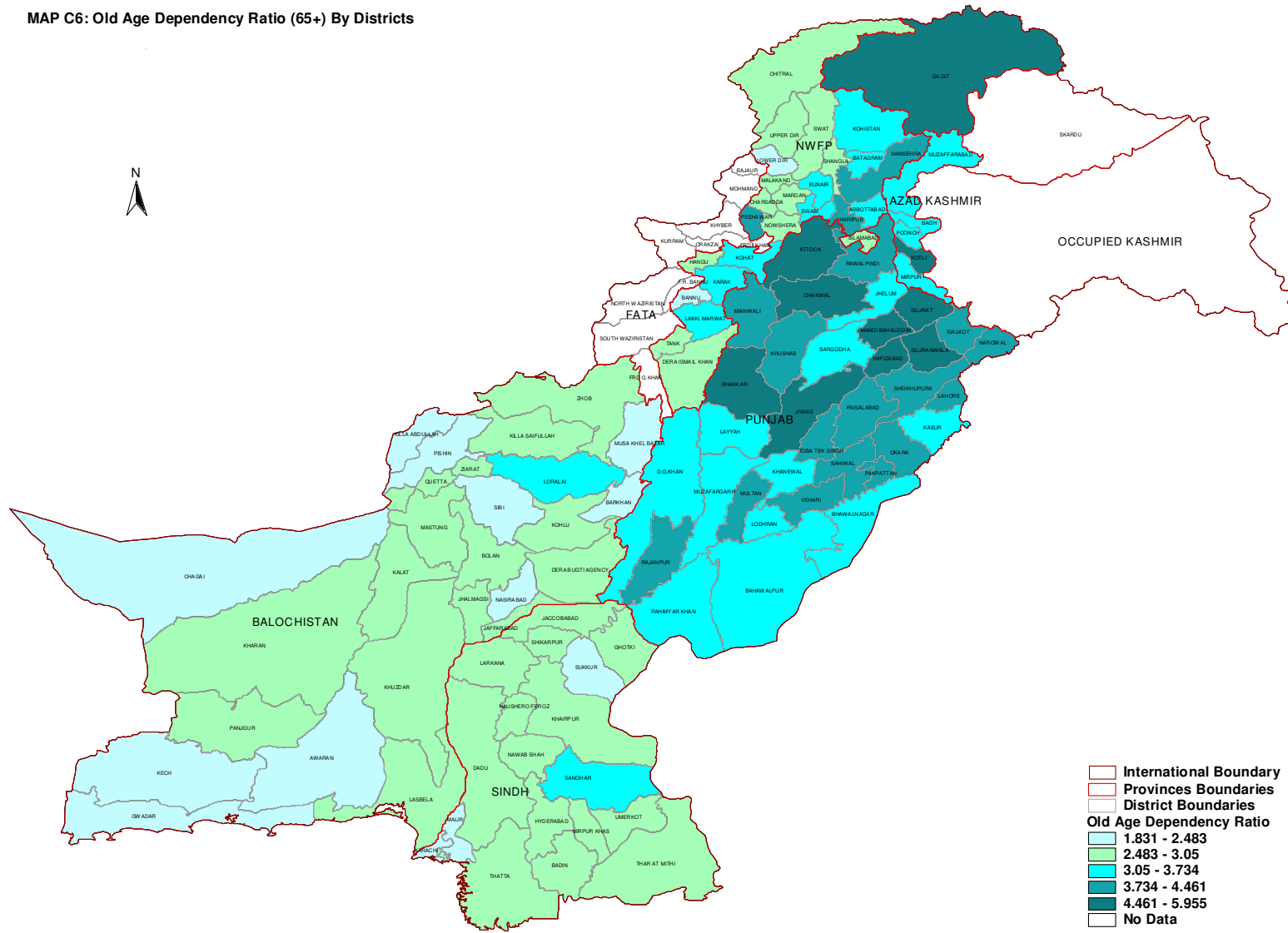
Source: Population Census of Pakistan 1998

MAP C5: Young Dependency Ratio (<10 years) By Districts



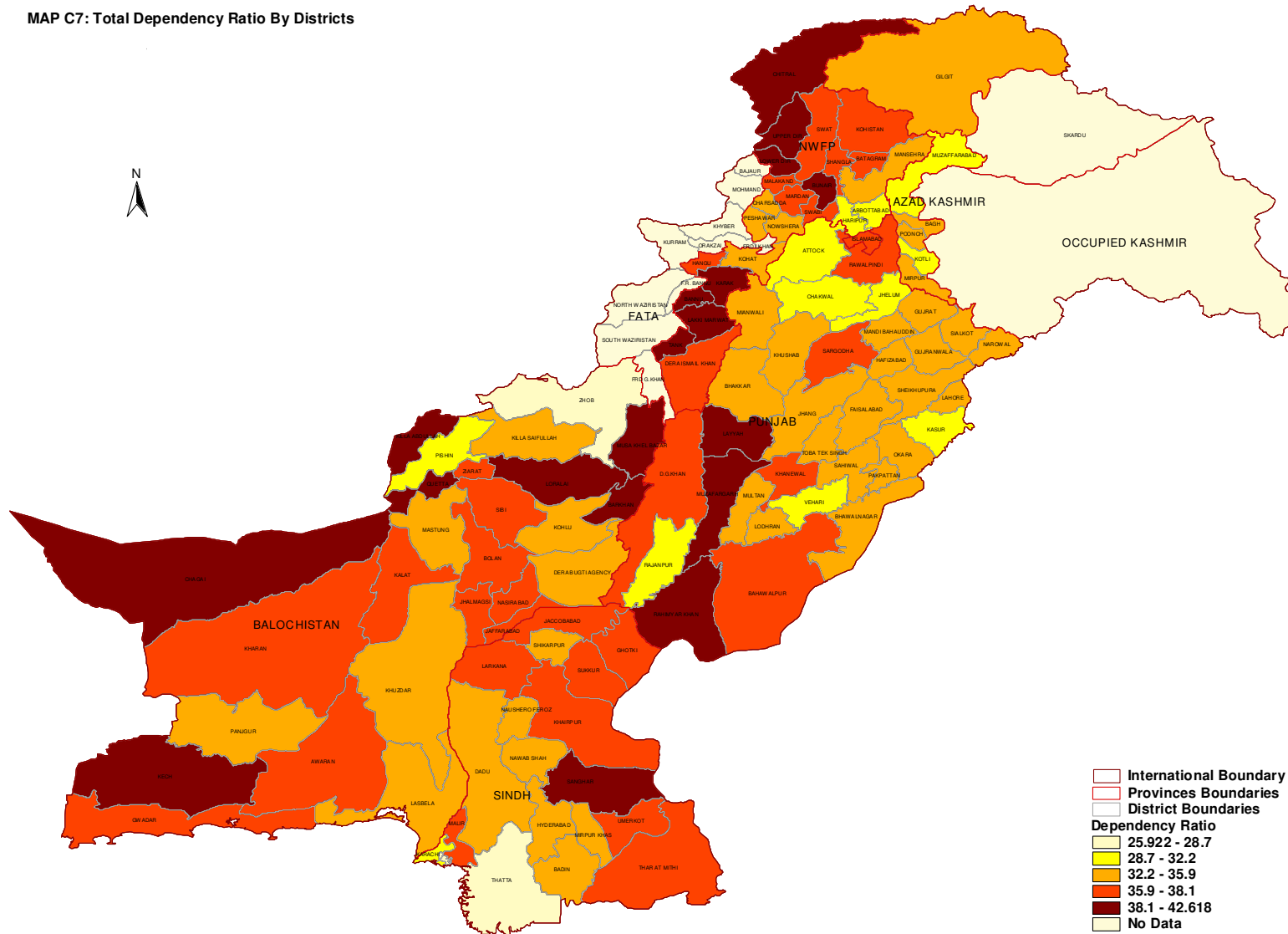
Source: Population Census of Pakistan 1998

MAP C6: Old Age Dependency Ratio (65+) By Districts



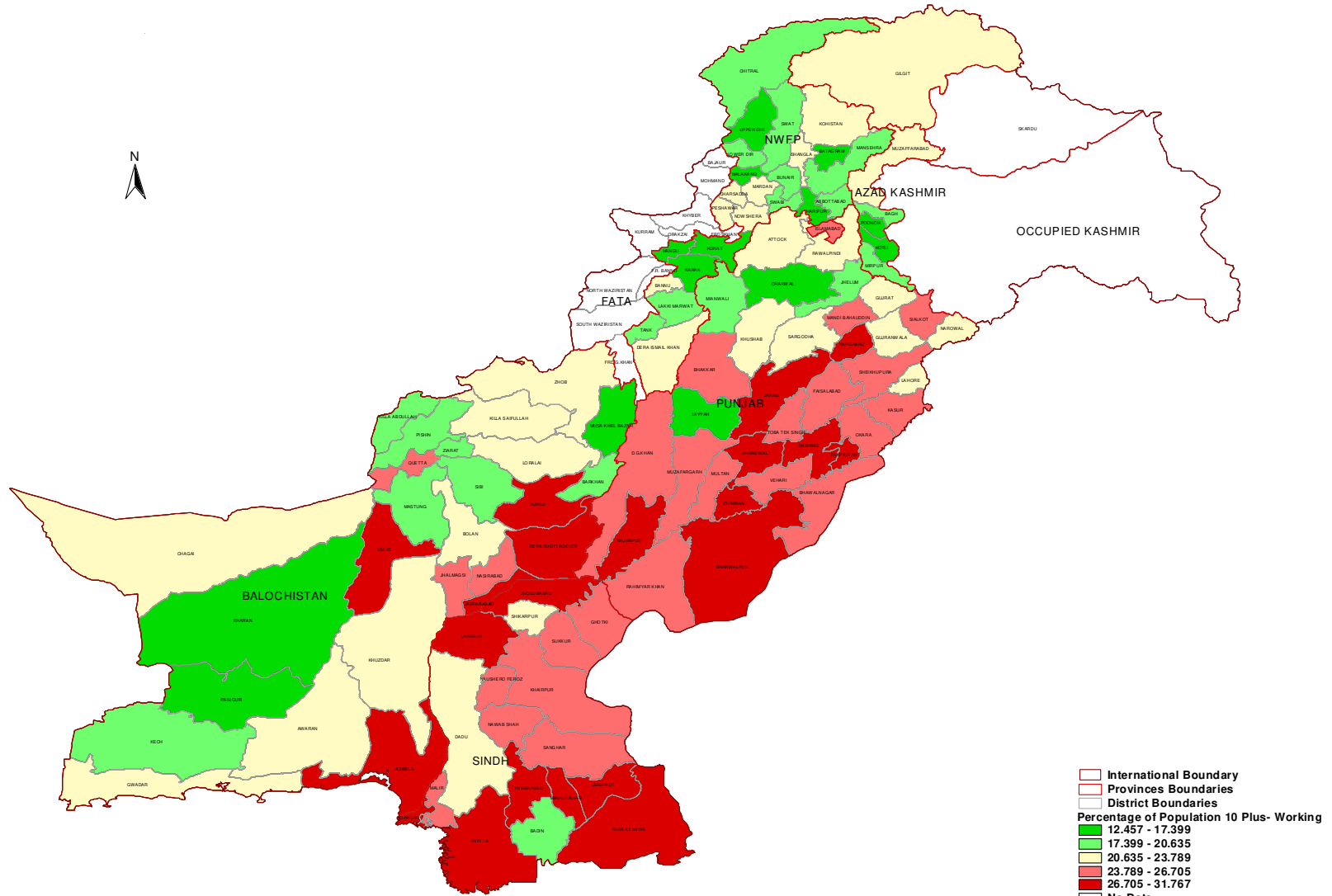
Source: Population Census of Pakistan 1998

MAP C7: Total Dependency Ratio By Districts



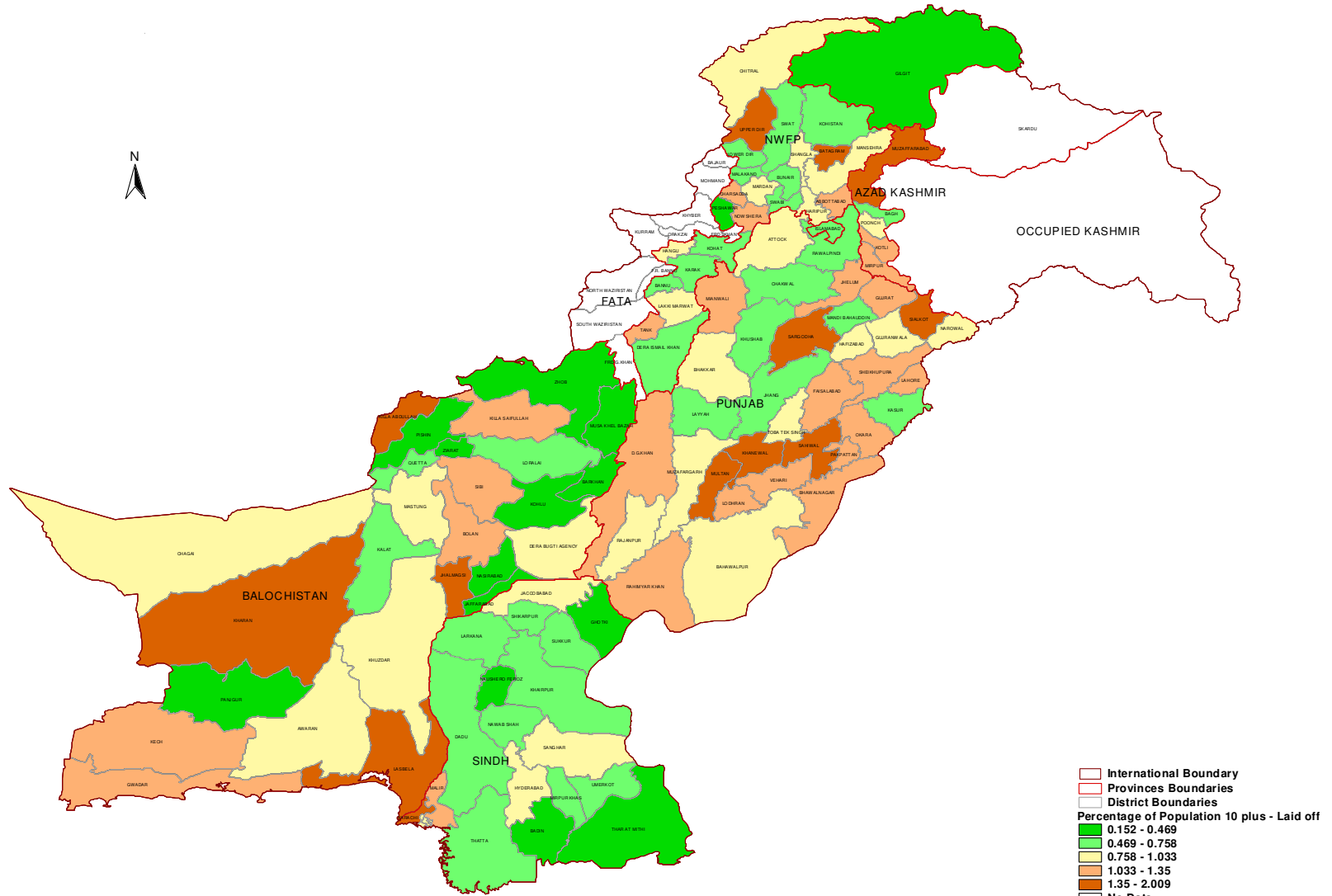
Source: Population Census of Pakistan 1998

MAP C8: Percentage of Working Population Above 10 years of Age By Districts



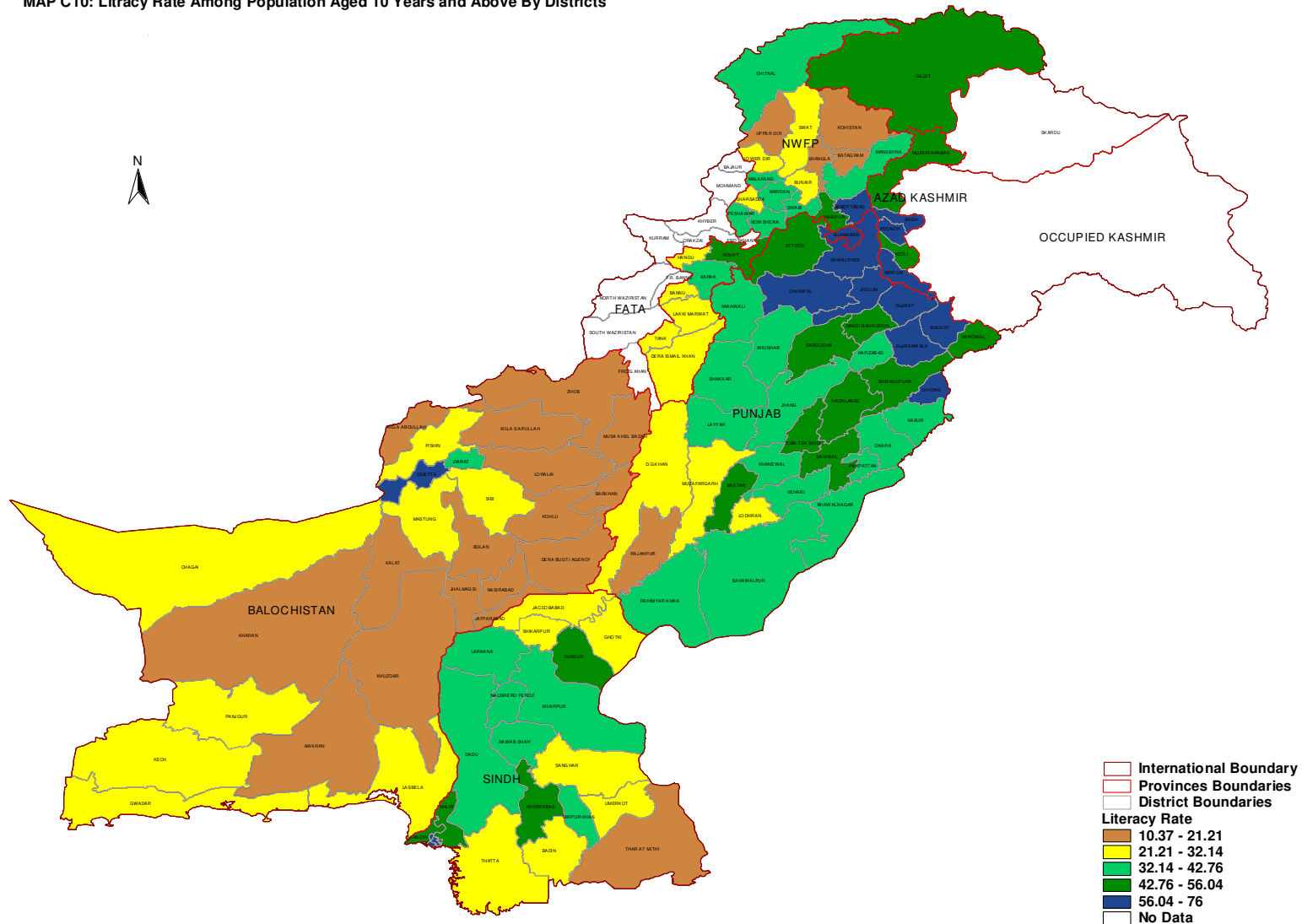
Source: Population Census of Pakistan 1998

MAP C9: Percentage of Population Laid Off Above 10 years of Age By Districts



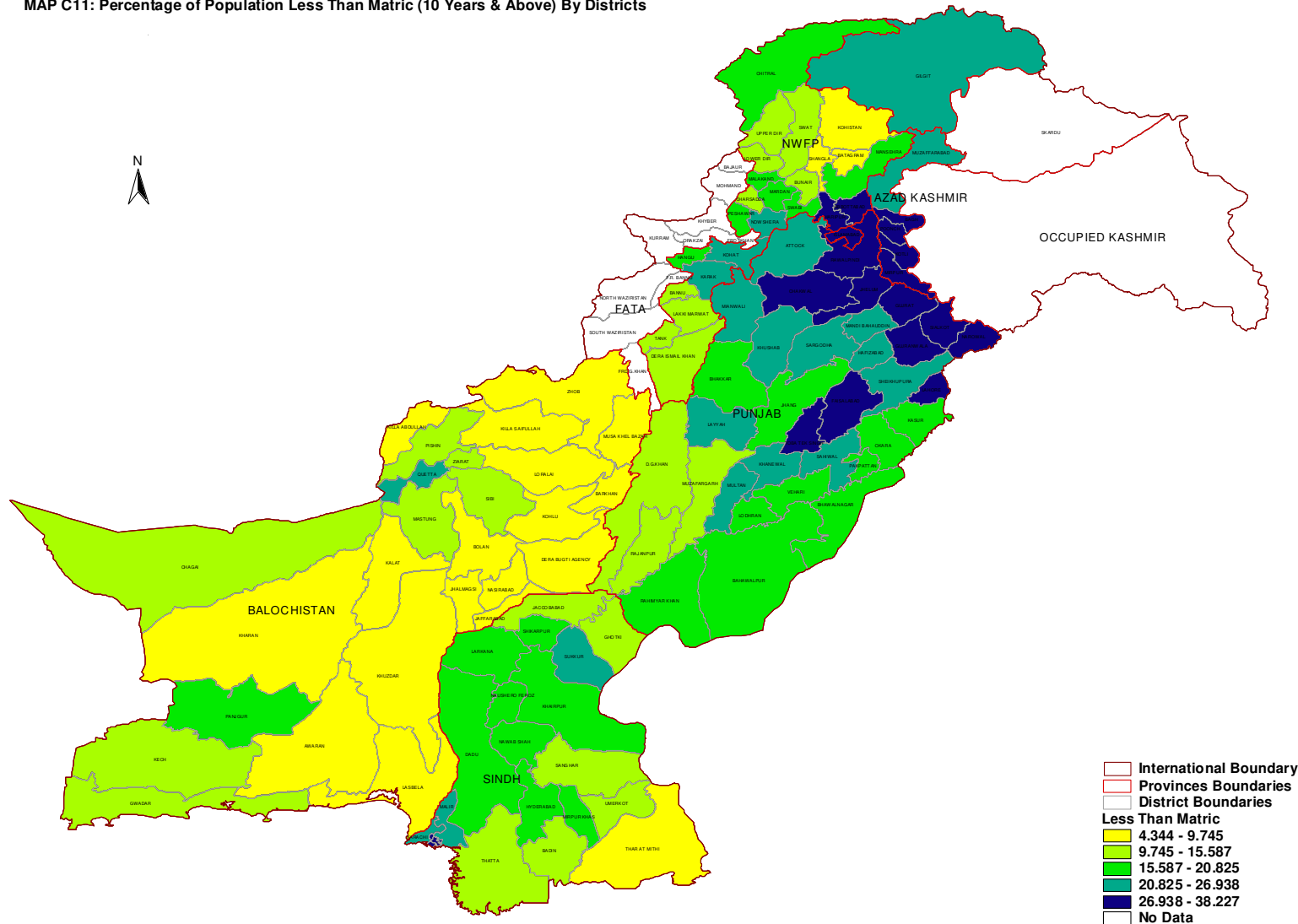
Source: Population Census of Pakistan 1998

MAP C10: Literacy Rate Among Population Aged 10 Years and Above By Districts



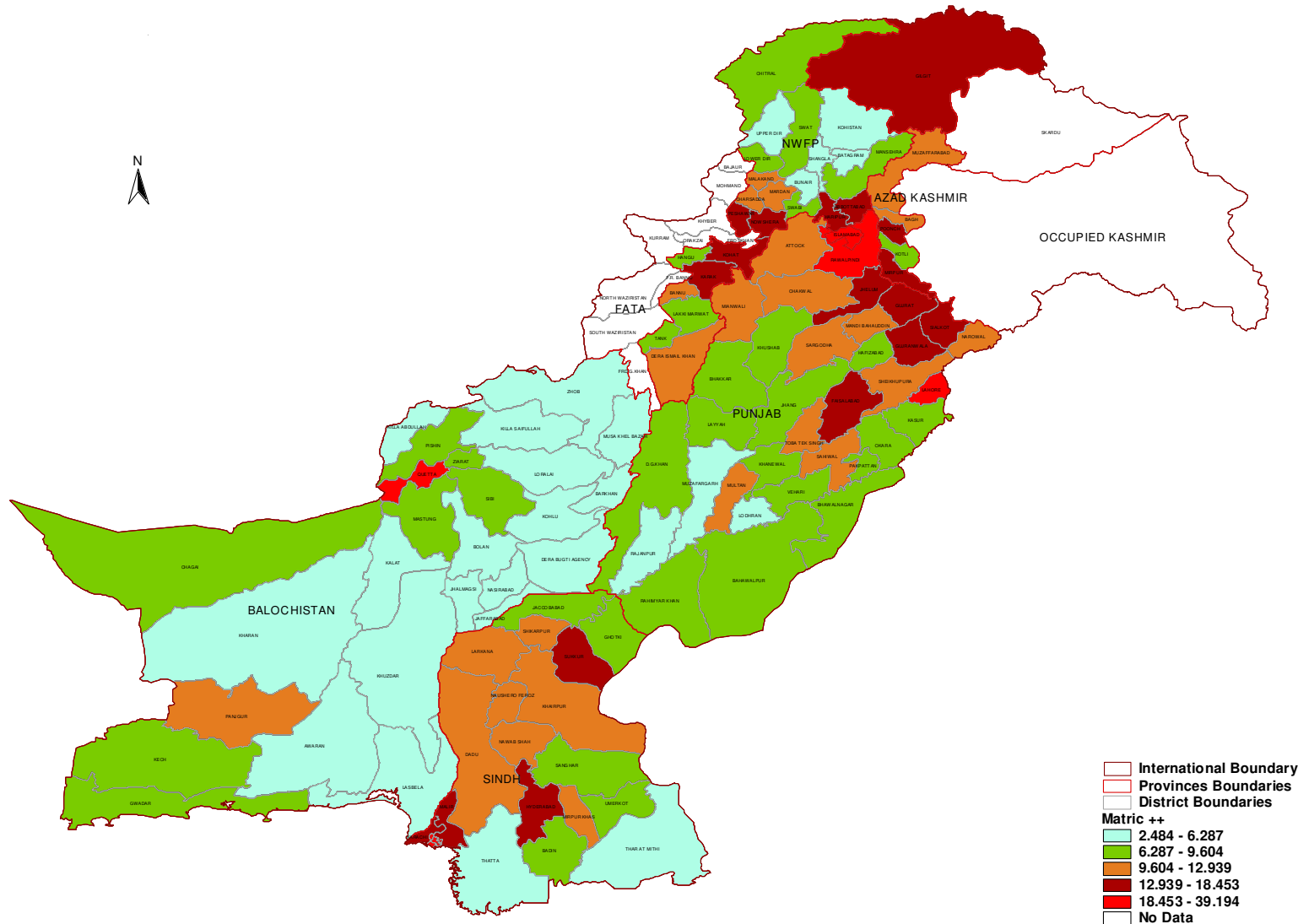
Source: Population Census of Pakistan 1998

MAP C11: Percentage of Population Less Than Matric (10 Years & Above) By Districts



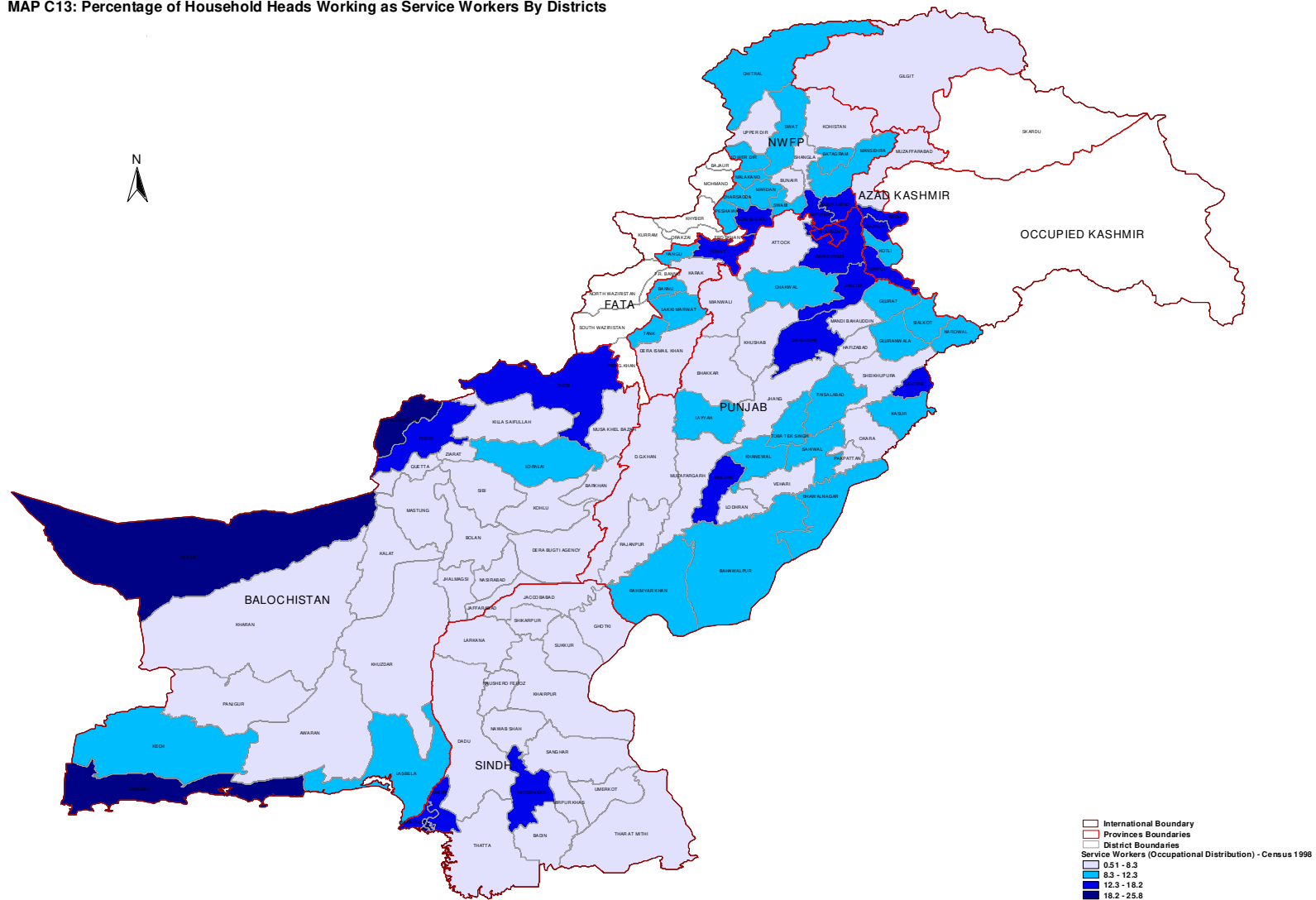
Source: Population Census of Pakistan 1998

MAP C12: Percentage of Population Matric & Above (10 Years & Above) By Districts



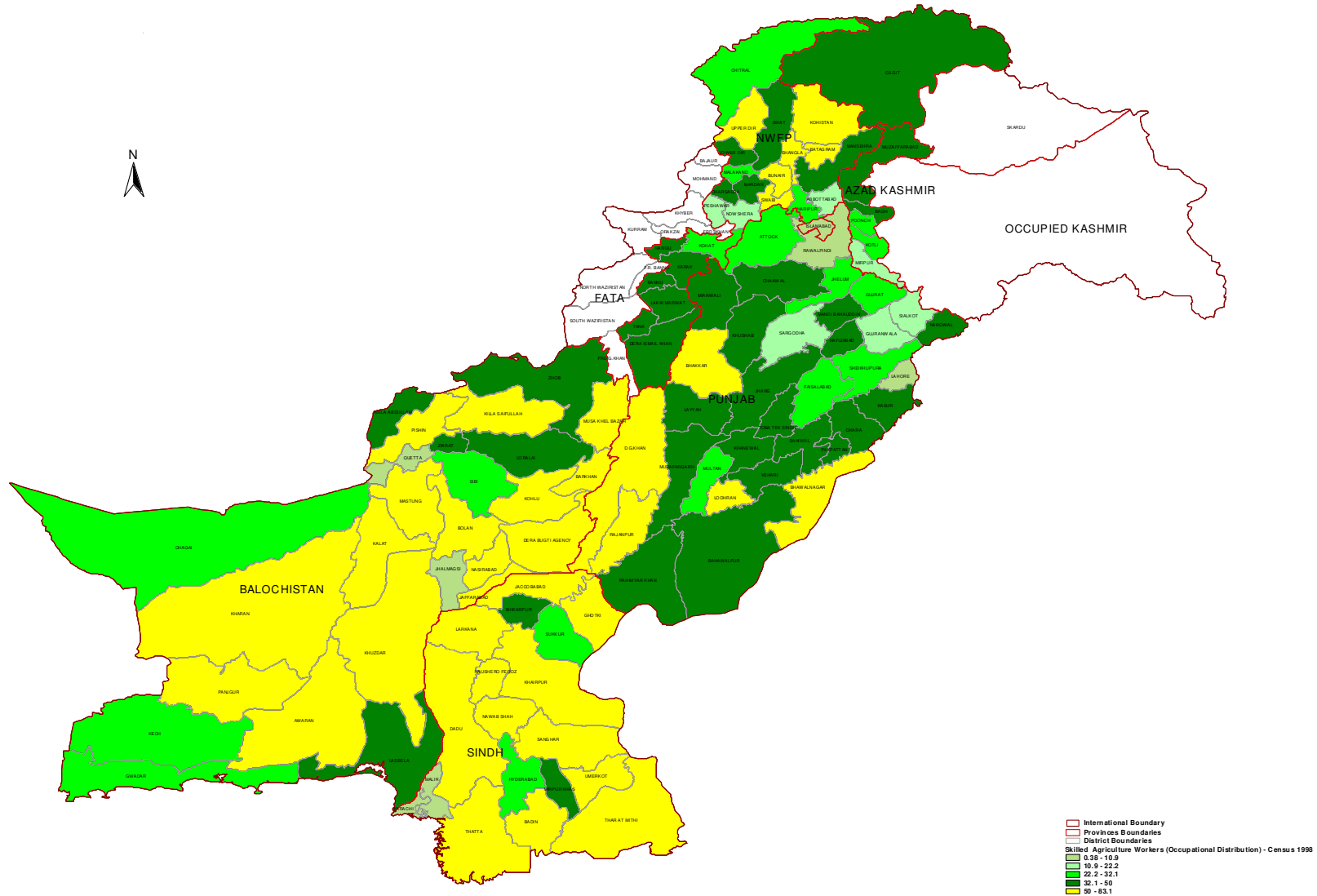
Source: Population Census of Pakistan 1998

MAP C13: Percentage of Household Heads Working as Service Workers By Districts



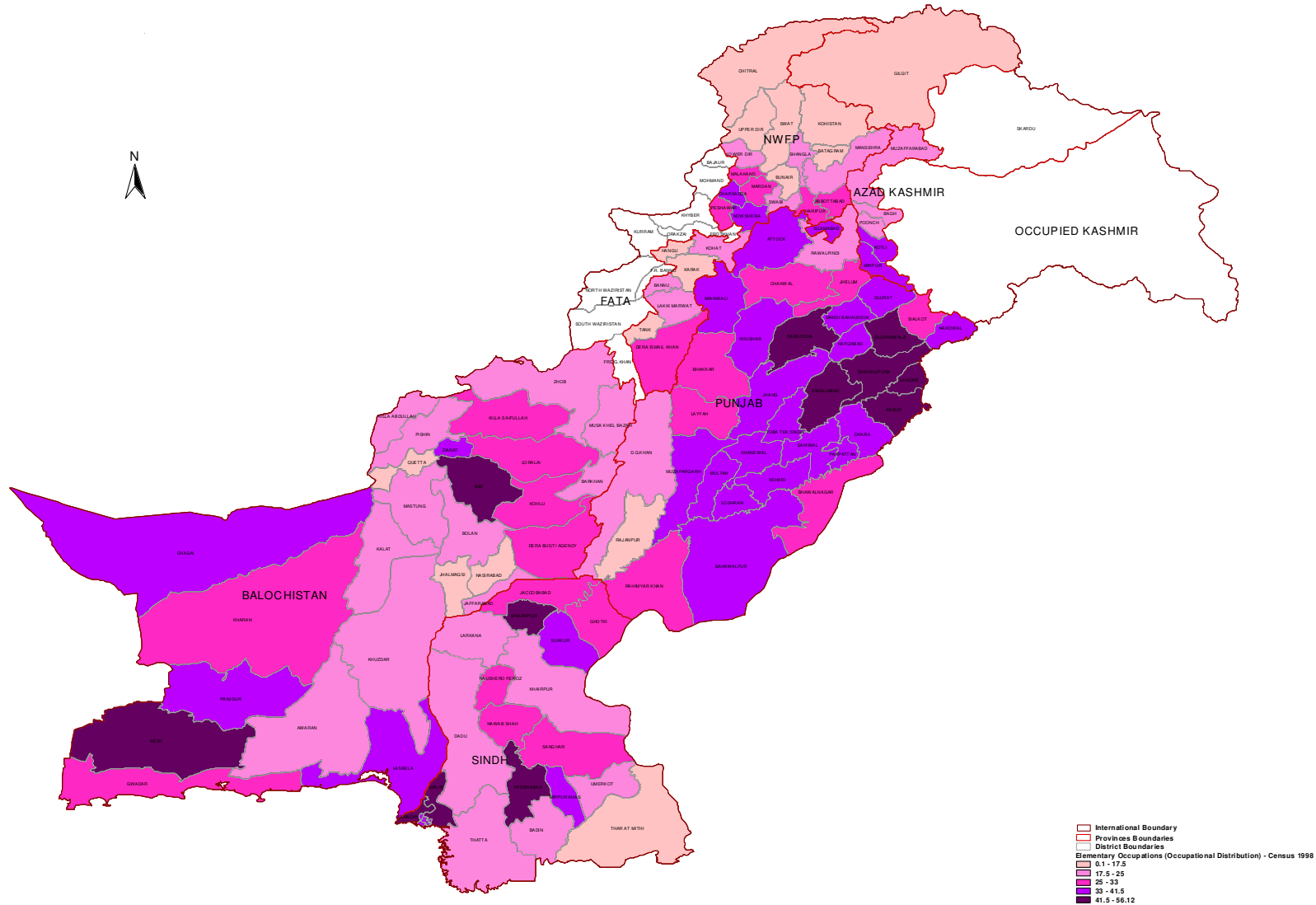
Source: Population Census of Pakistan 1998

MAP C14: Percentage of Household Heads Working as Skilled Agriculture Workers By Districts



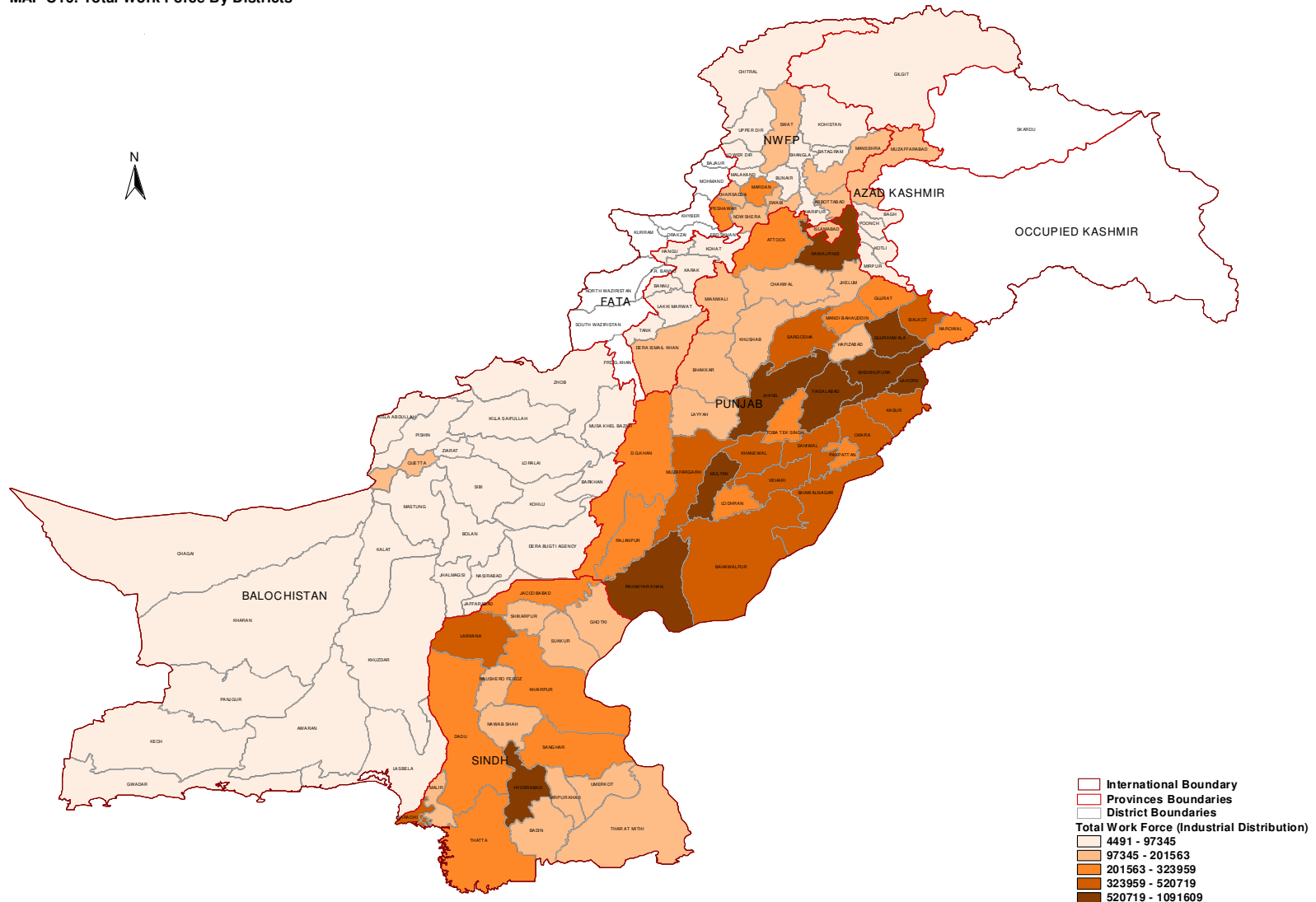
Source: Population Census of Pakistan 1998

MAP C15: Percentage of Household Heads Working in Elementary Occupations By Districts



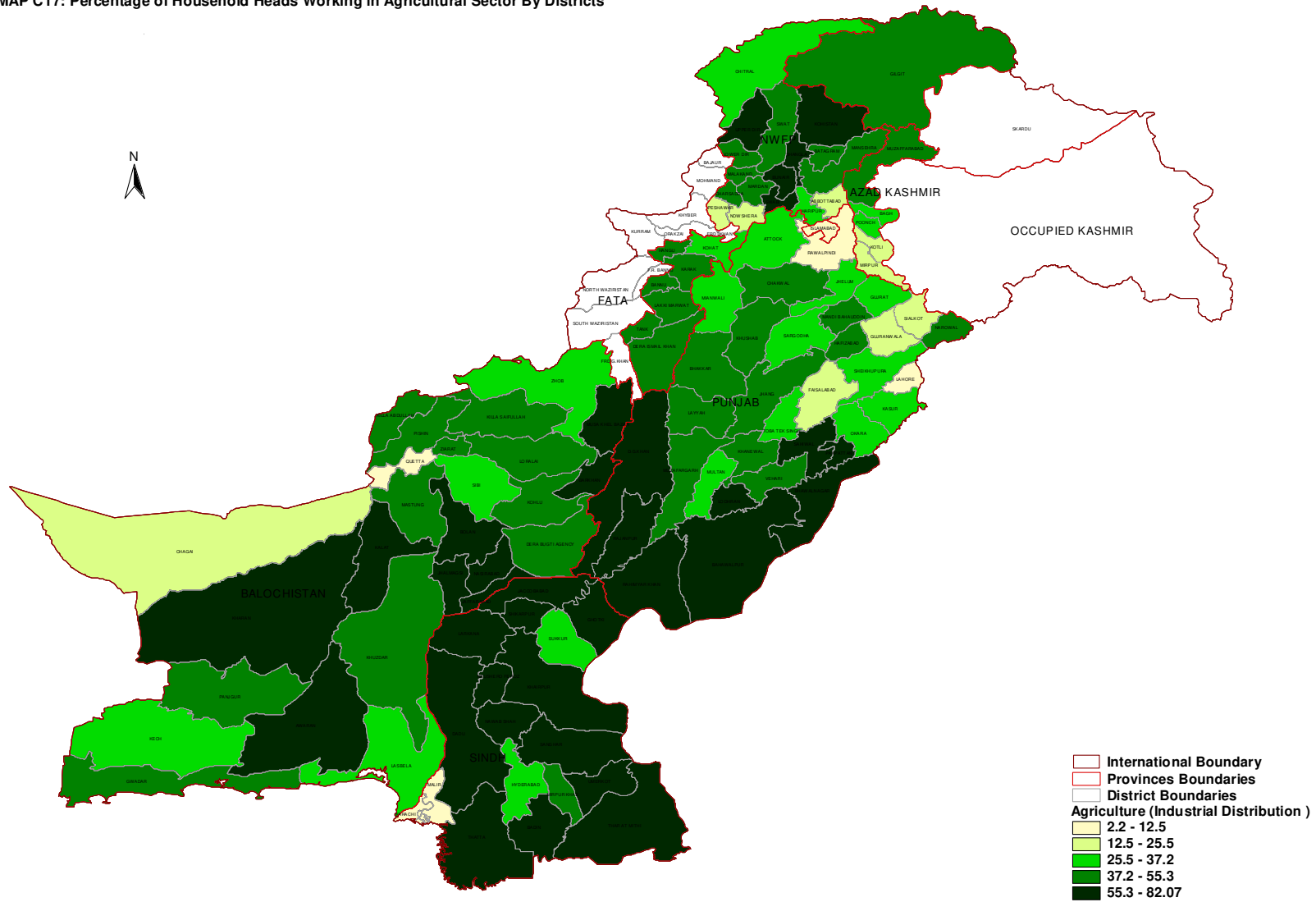
Source: Population Census of Pakistan 1998

MAP C16: Total Work Force By Districts



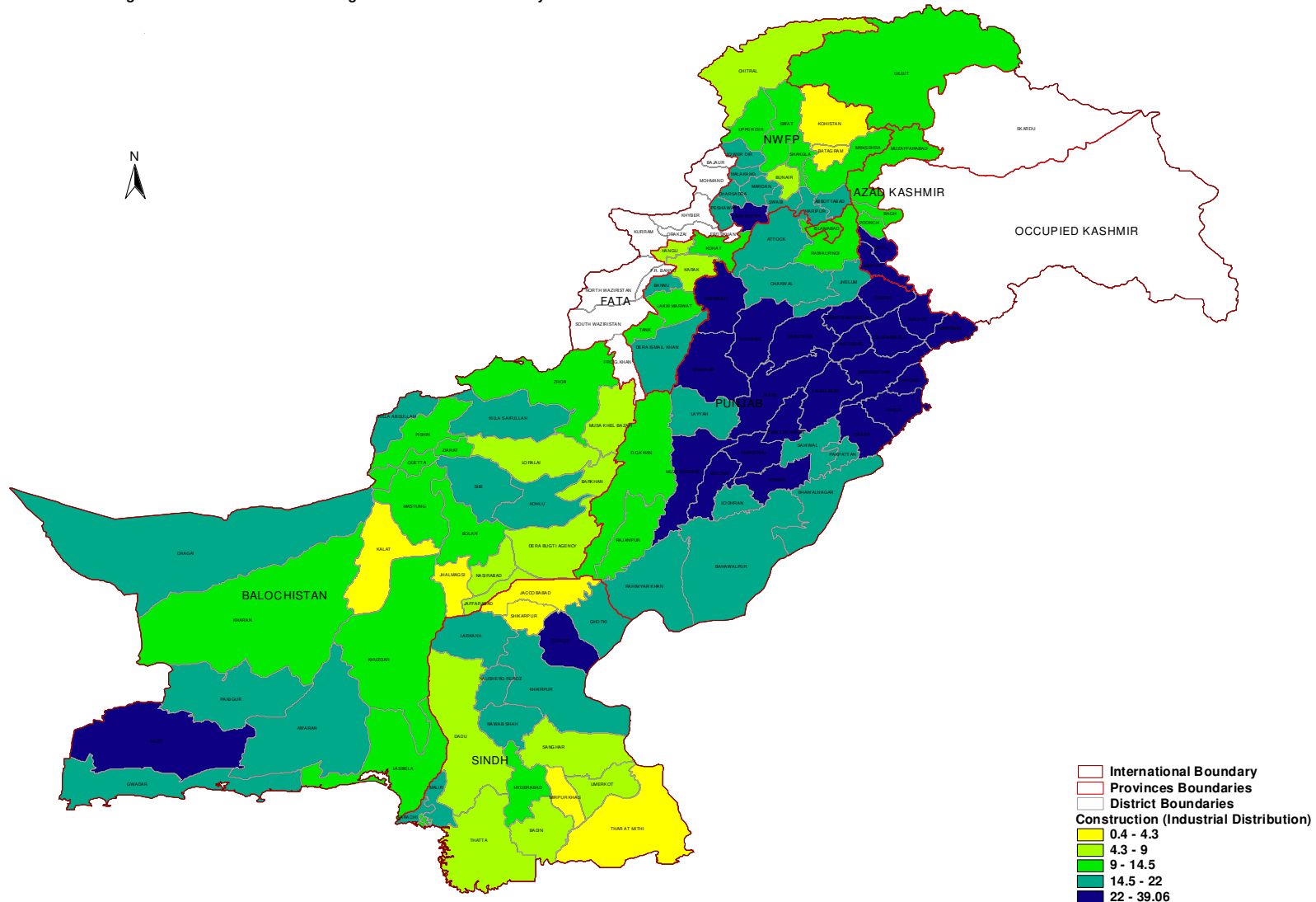
Source: Population Census of Pakistan 1998

MAP C17: Percentage of Household Heads Working in Agricultural Sector By Districts



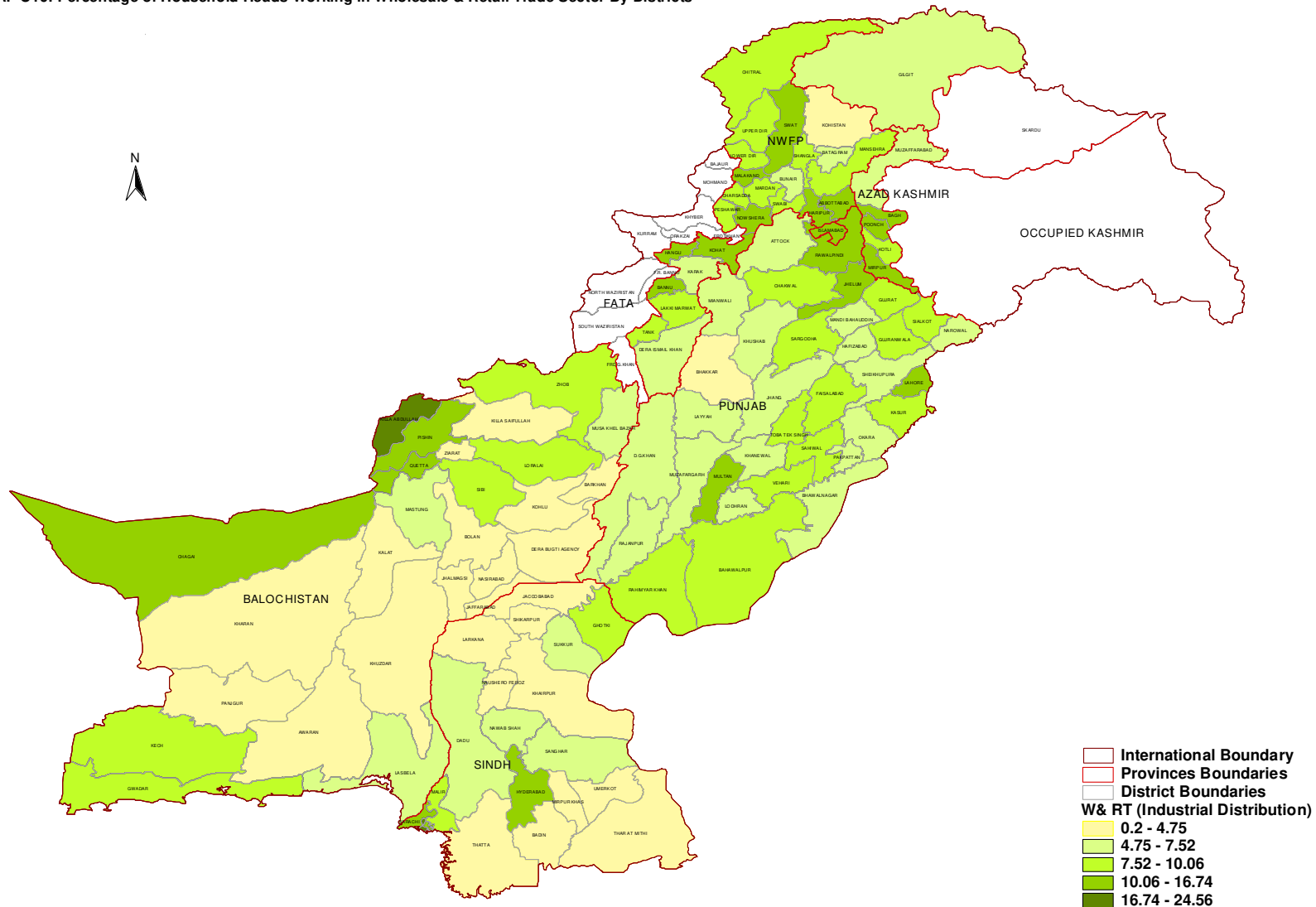
Source: Population Census of Pakistan 1998

MAP C18: Percentage of Household Heads Working in Construction Sector By Districts



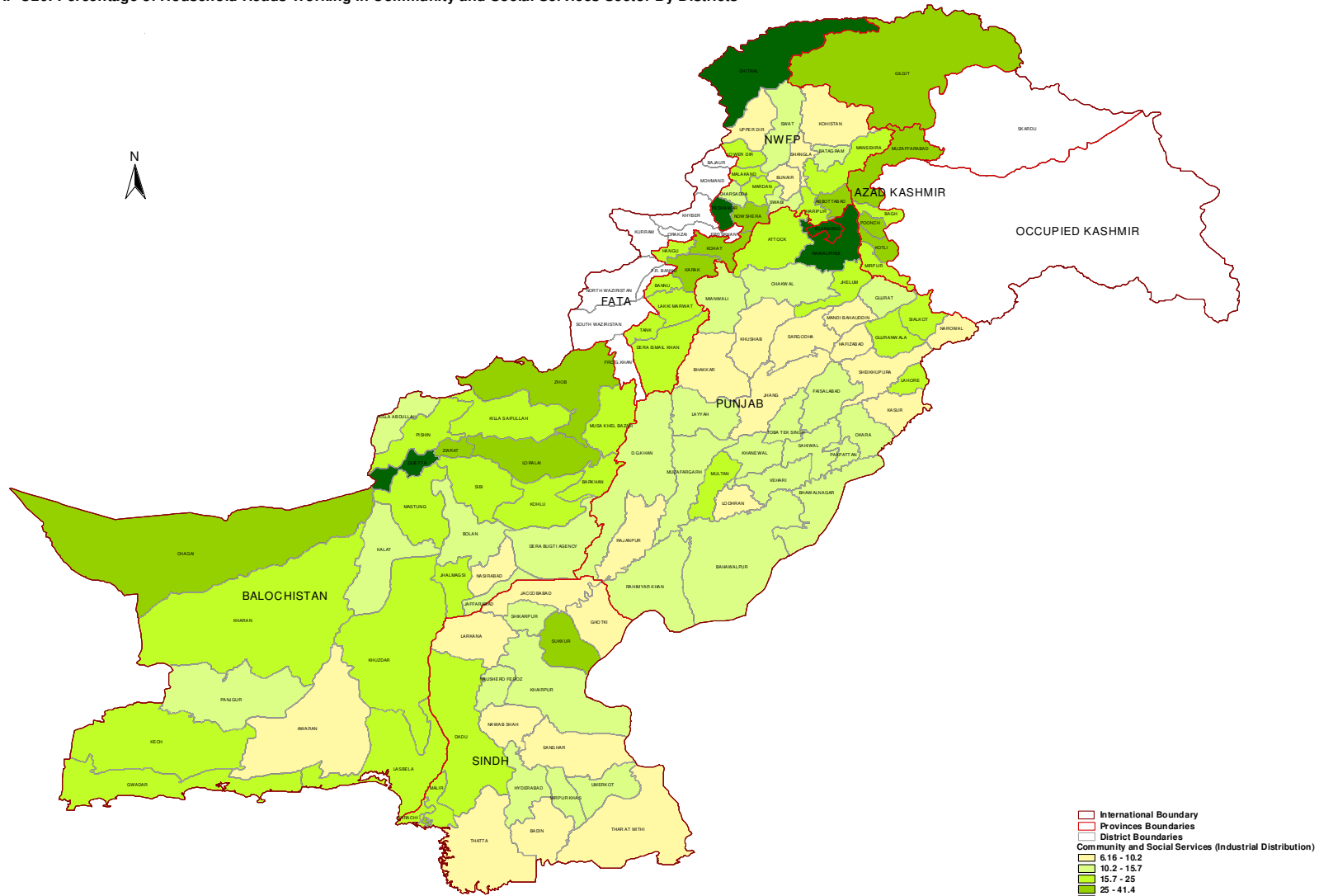
Source: Population Census of Pakistan 1998

MAP C19: Percentage of Household Heads Working in Wholesale & Retail Trade Sector By Districts



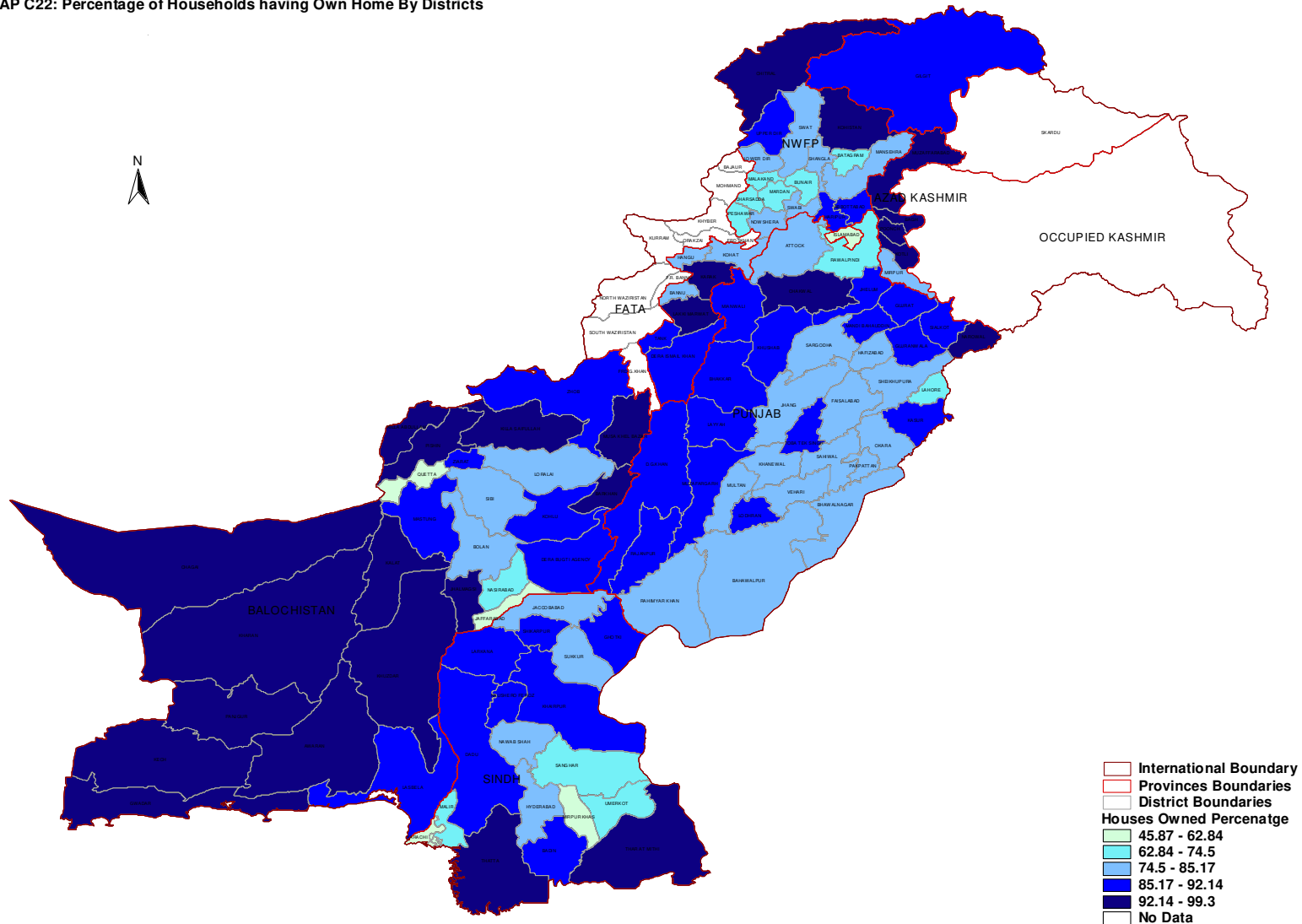
Source: Population Census of Pakistan 1998

MAP C20: Percentage of Household Heads Working in Community and Social Services Sector By Districts



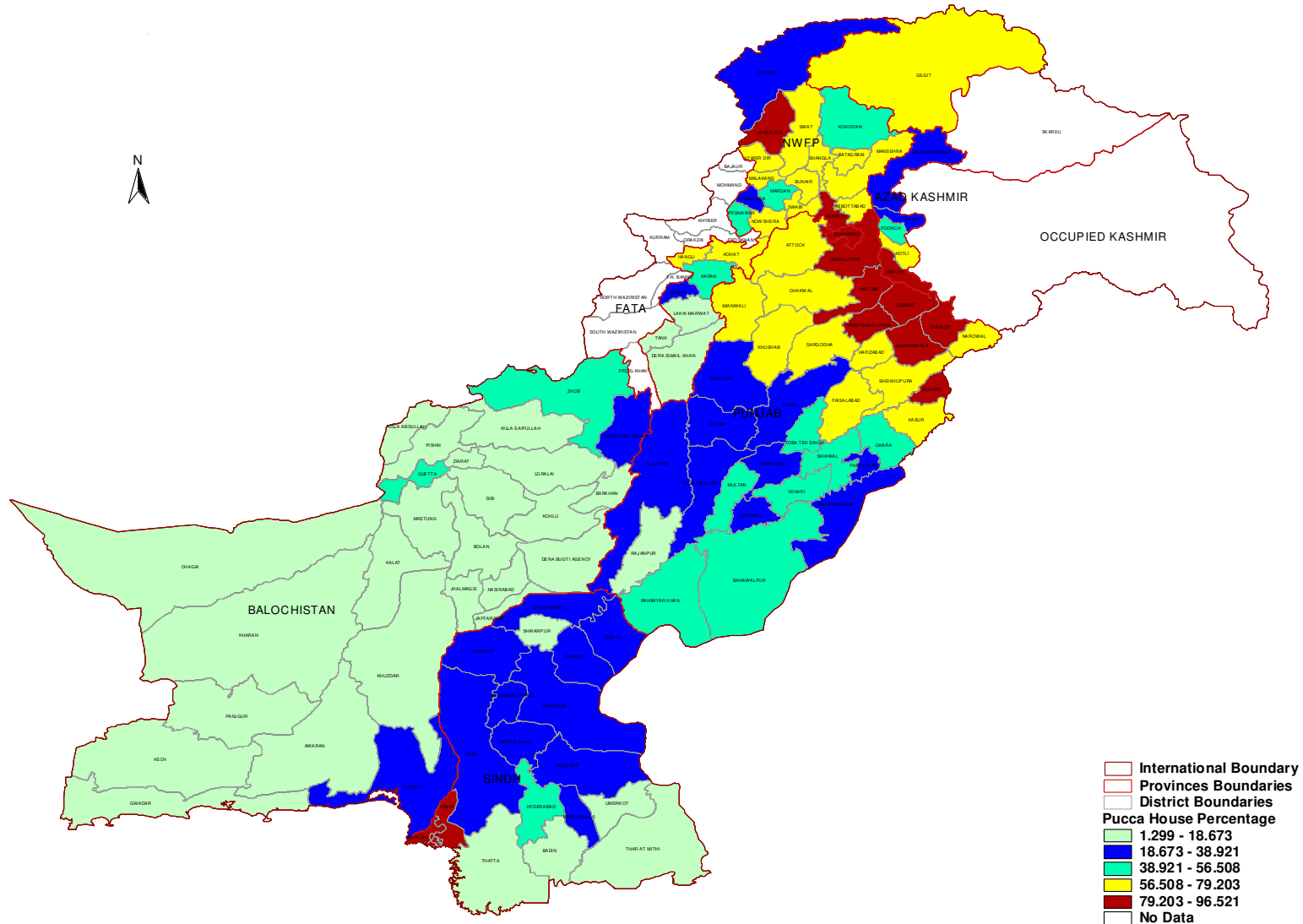
Source: Population Census of Pakistan 1998

MAP C22: Percentage of Households having Own Home By Districts



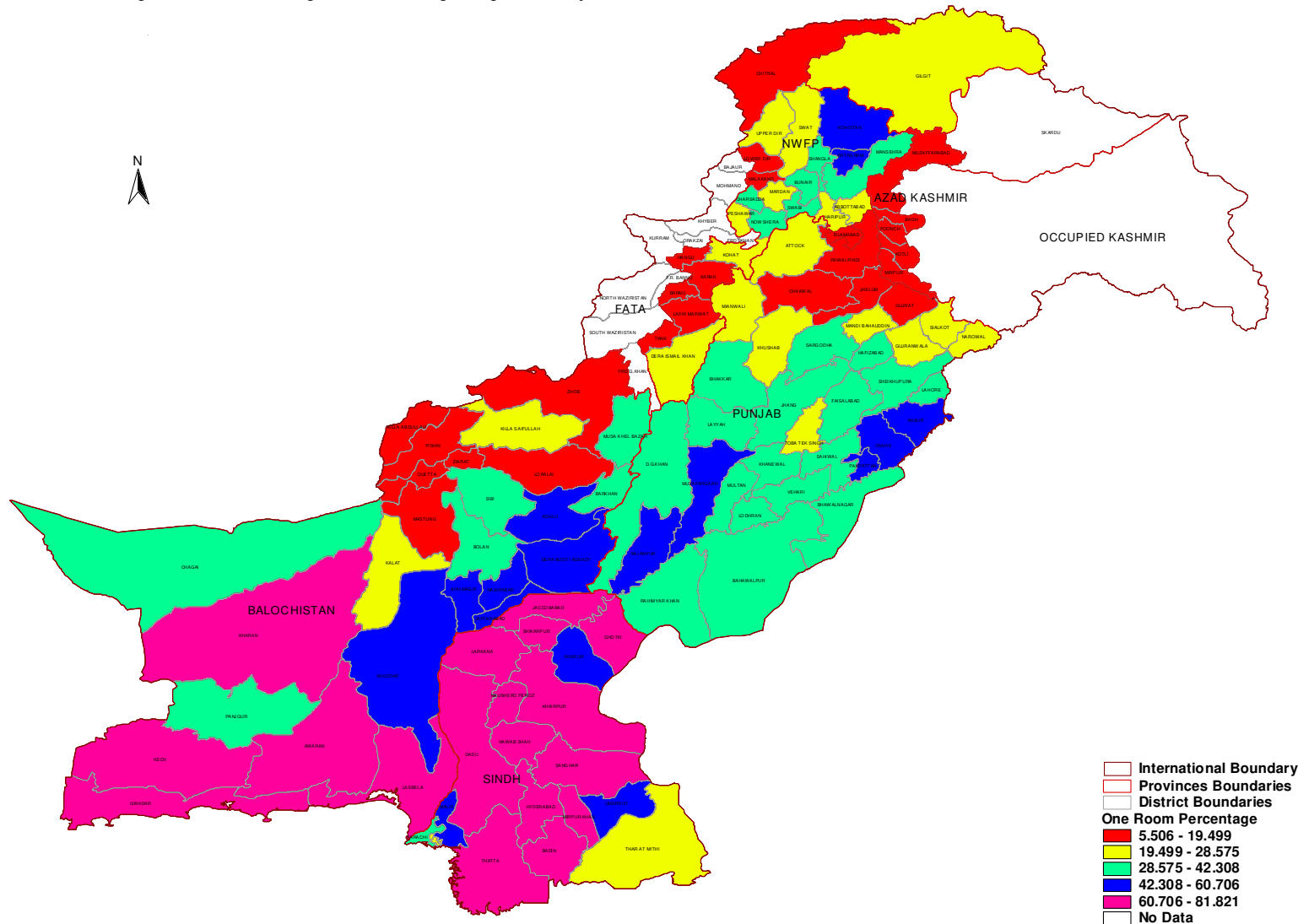
Source: Population Census of Pakistan 1998

MAP C23: Percentage of Households having Cemented (Pucca) Home By Districts



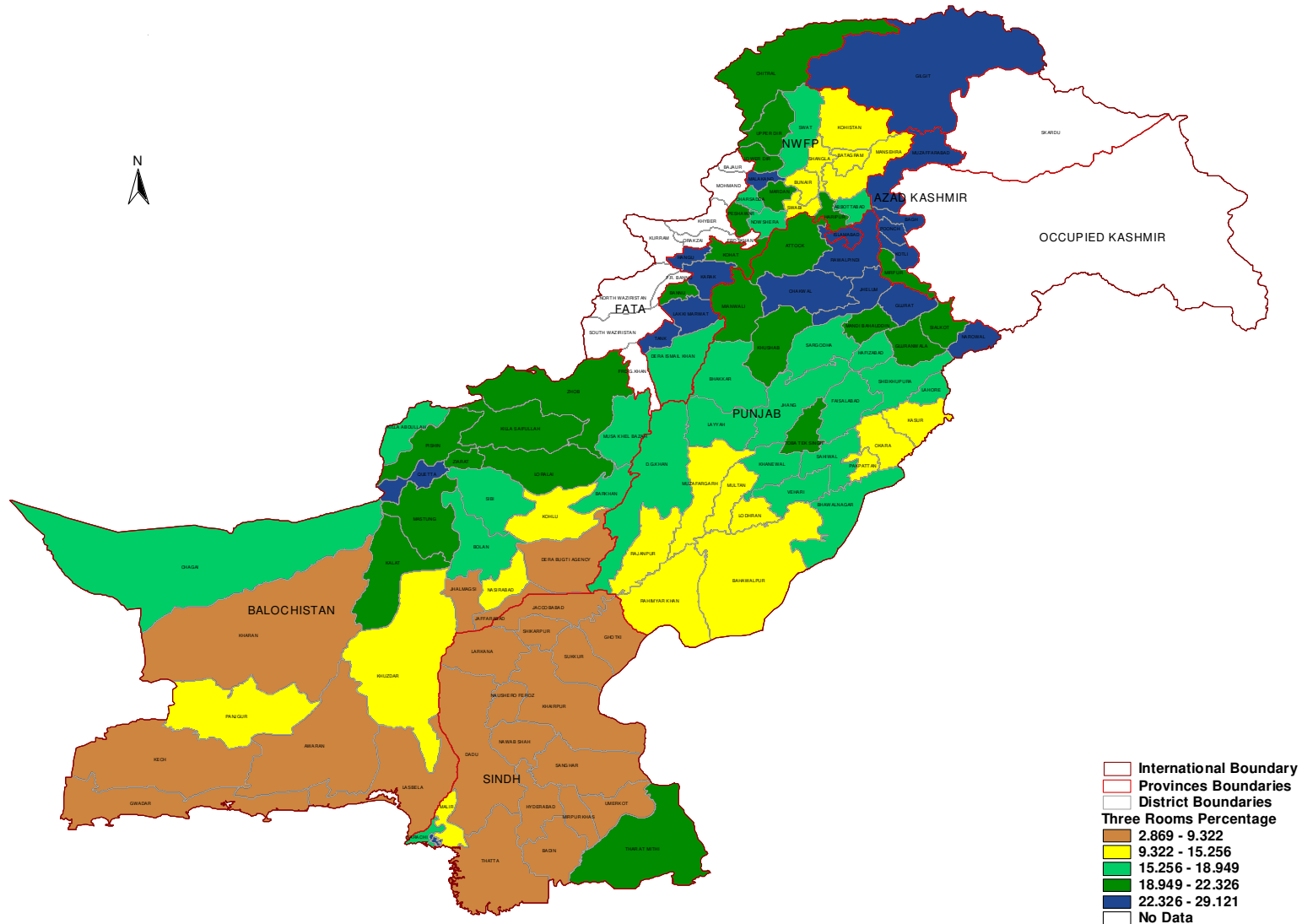
Source: Population Census of Pakistan 1998

MAP C24: Percentage of Households Living in Houses Having a Single Room By Districts



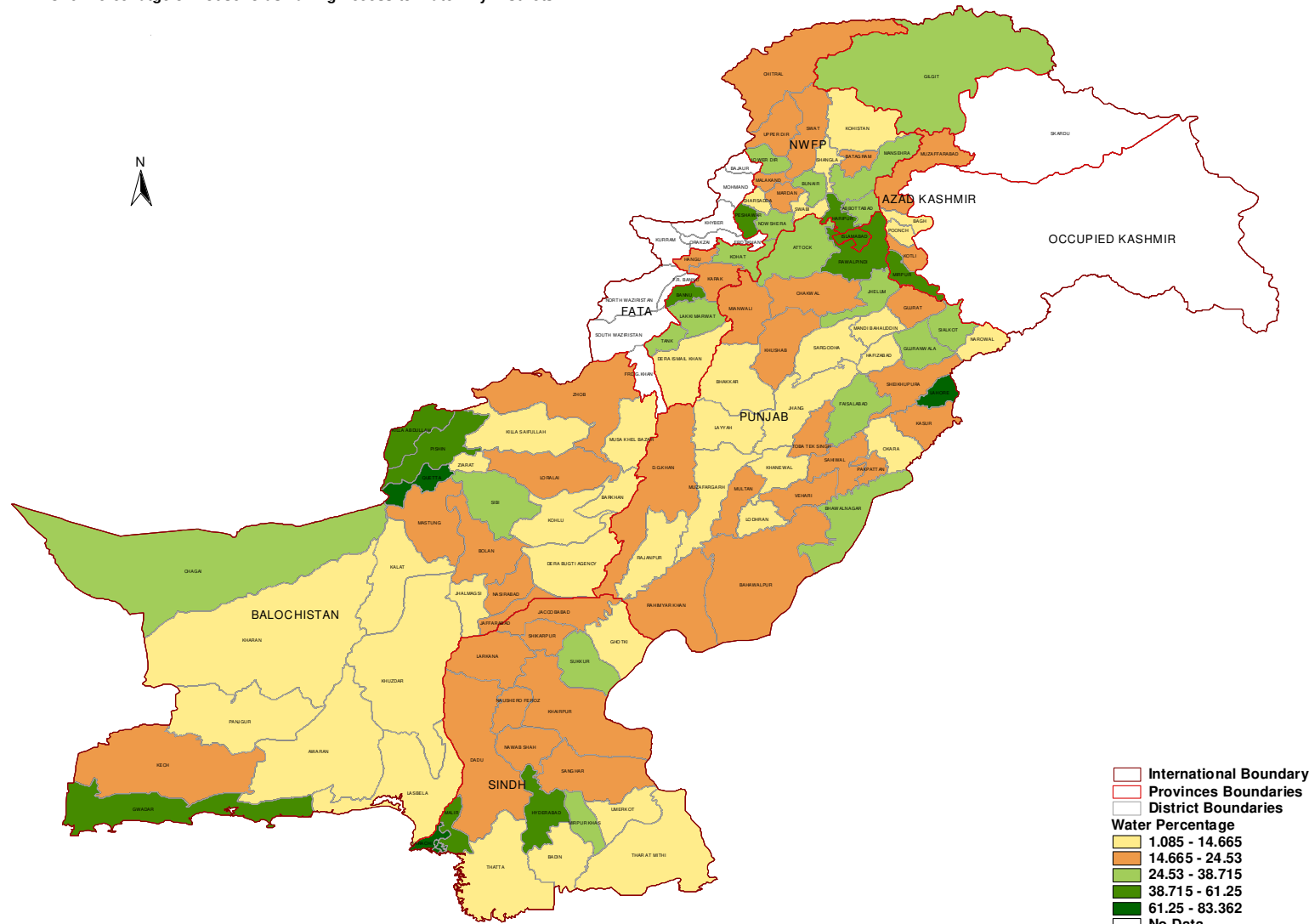
Source: Population Census of Pakistan 1998

MAP C25: Percentage of Households Living in Houses Having upto 3 Rooms By Districts



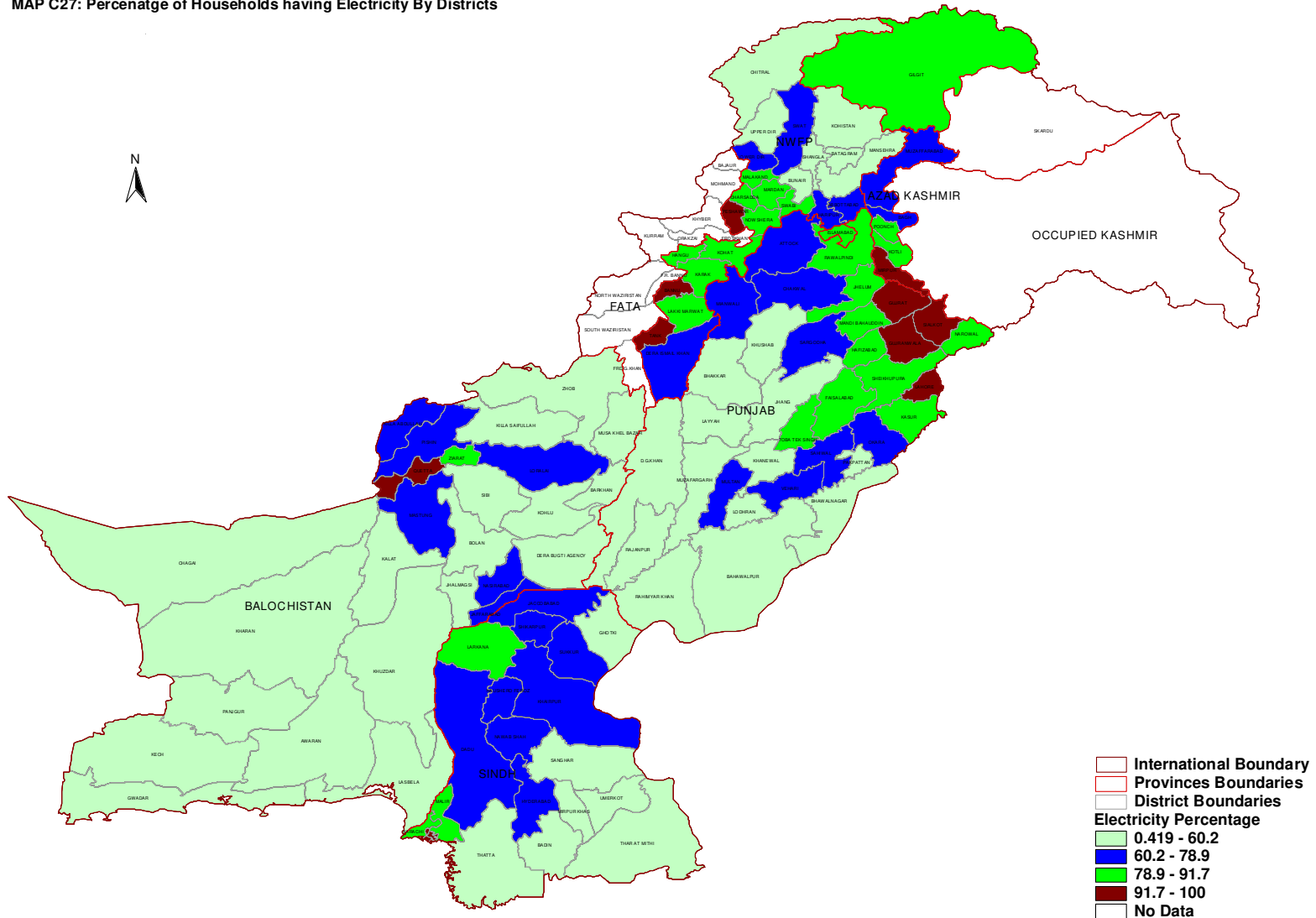
Source: Population Census of Pakistan 1998

MAP C26: Percentage of Households having Access to Water By Districts



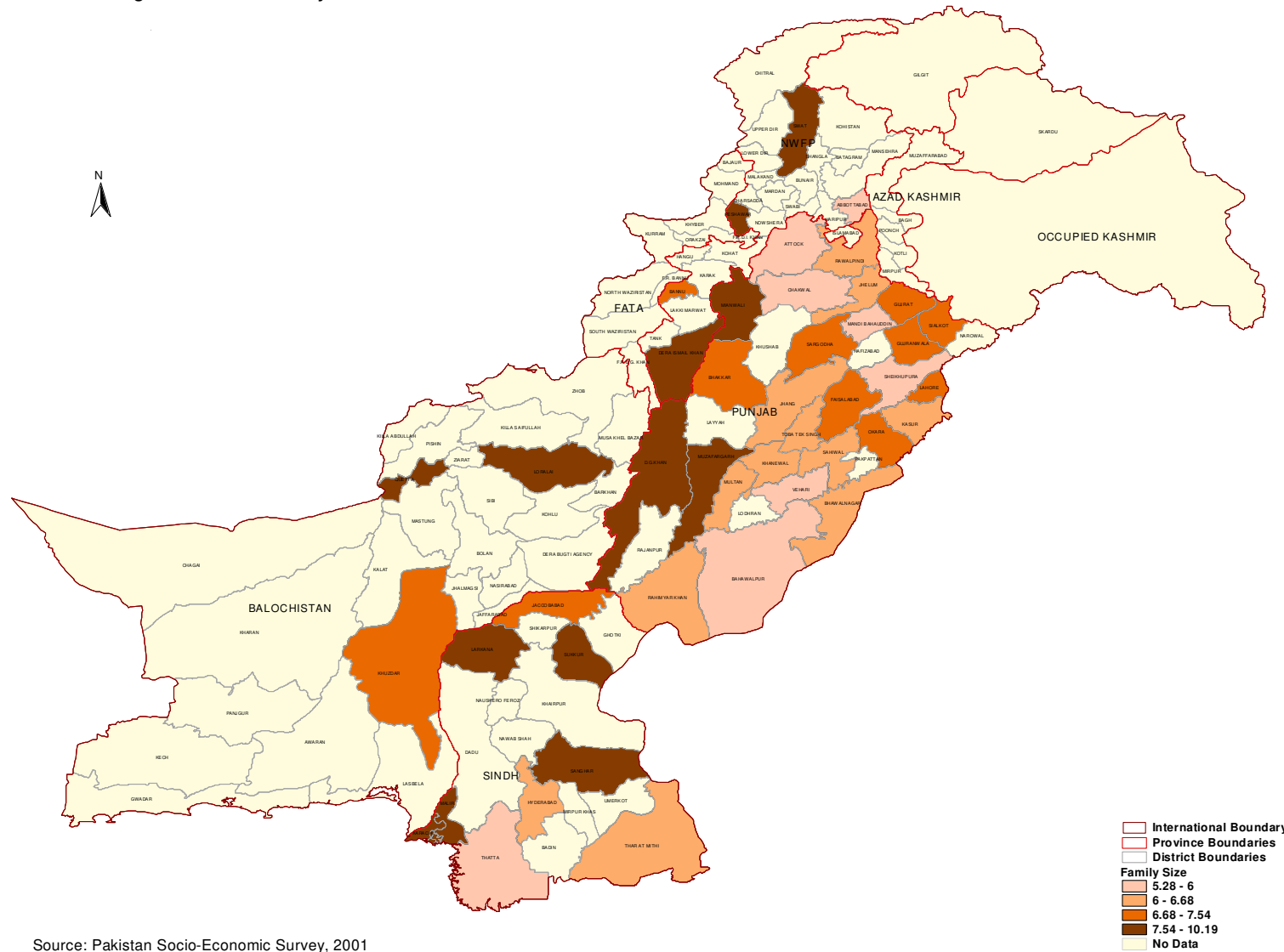
Source: Population Census of Pakistan 1998

MAP C27: Percentage of Households having Electricity By Districts



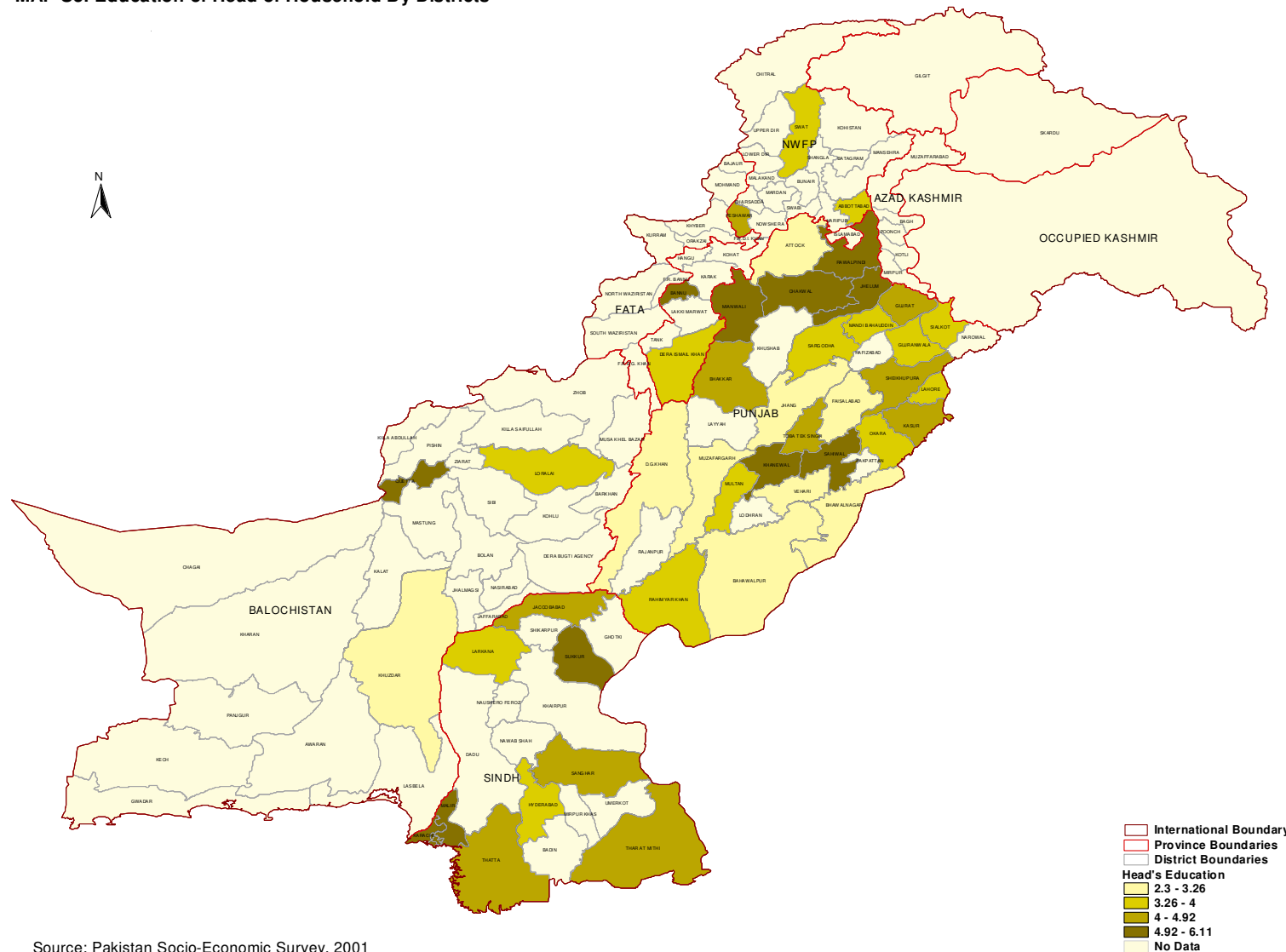
Source: Population Census of Pakistan 1998

MAP S2: Average Household Size By Districts



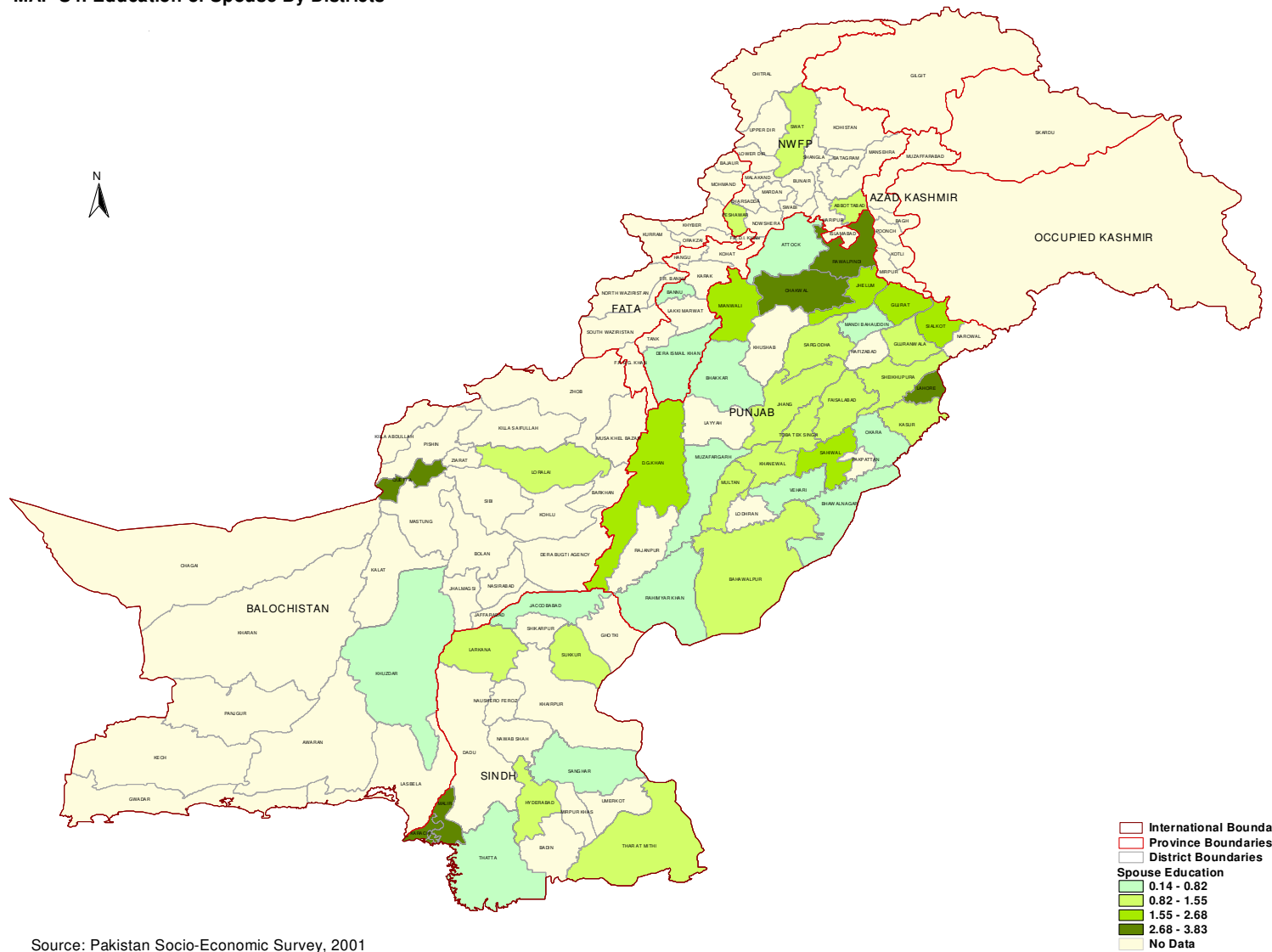
Source: Pakistan Socio-Economic Survey, 2001

MAP S3: Education of Head of Household By Districts



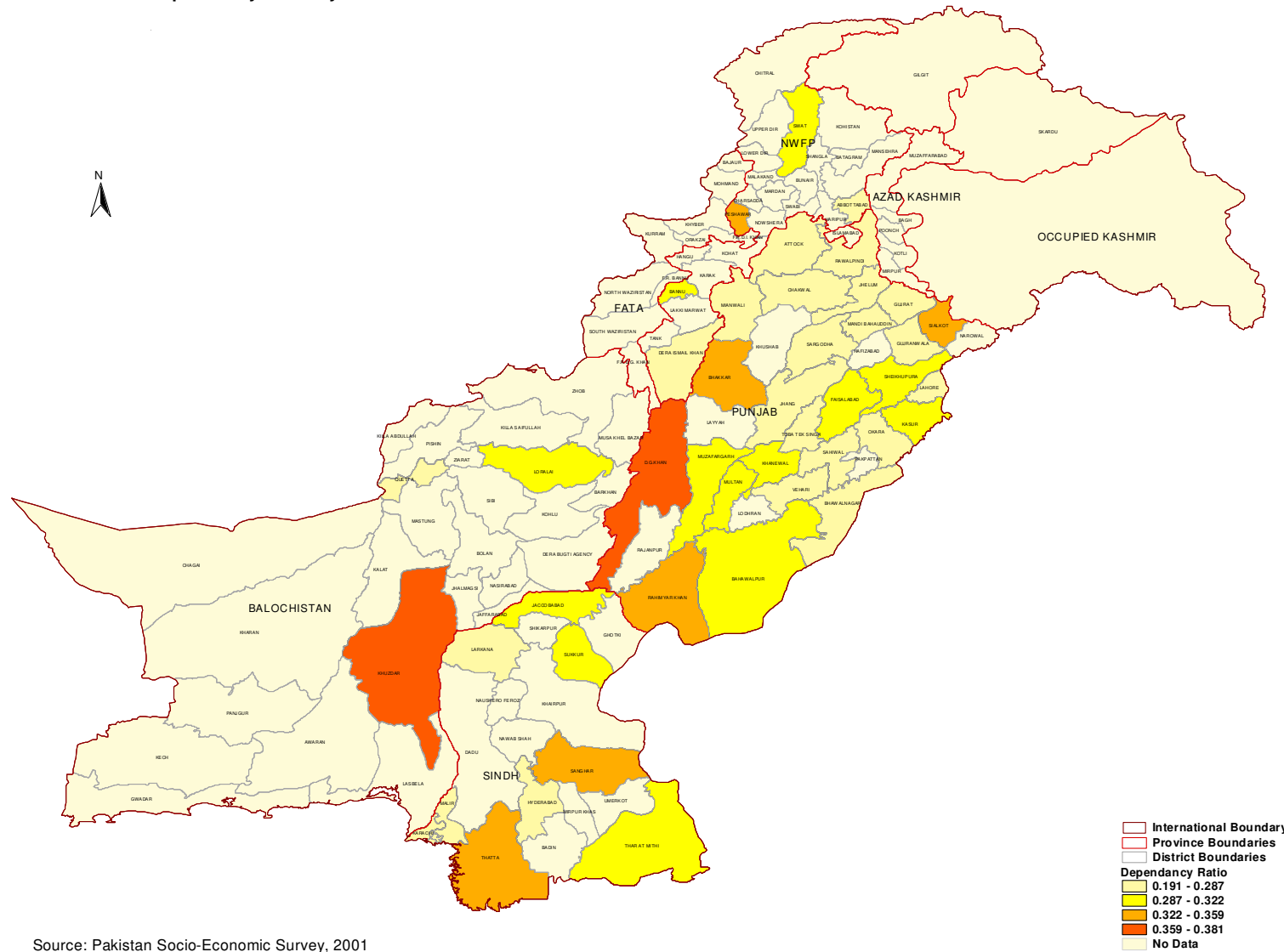
Source: Pakistan Socio-Economic Survey, 2001

MAP S4: Education of Spouse By Districts



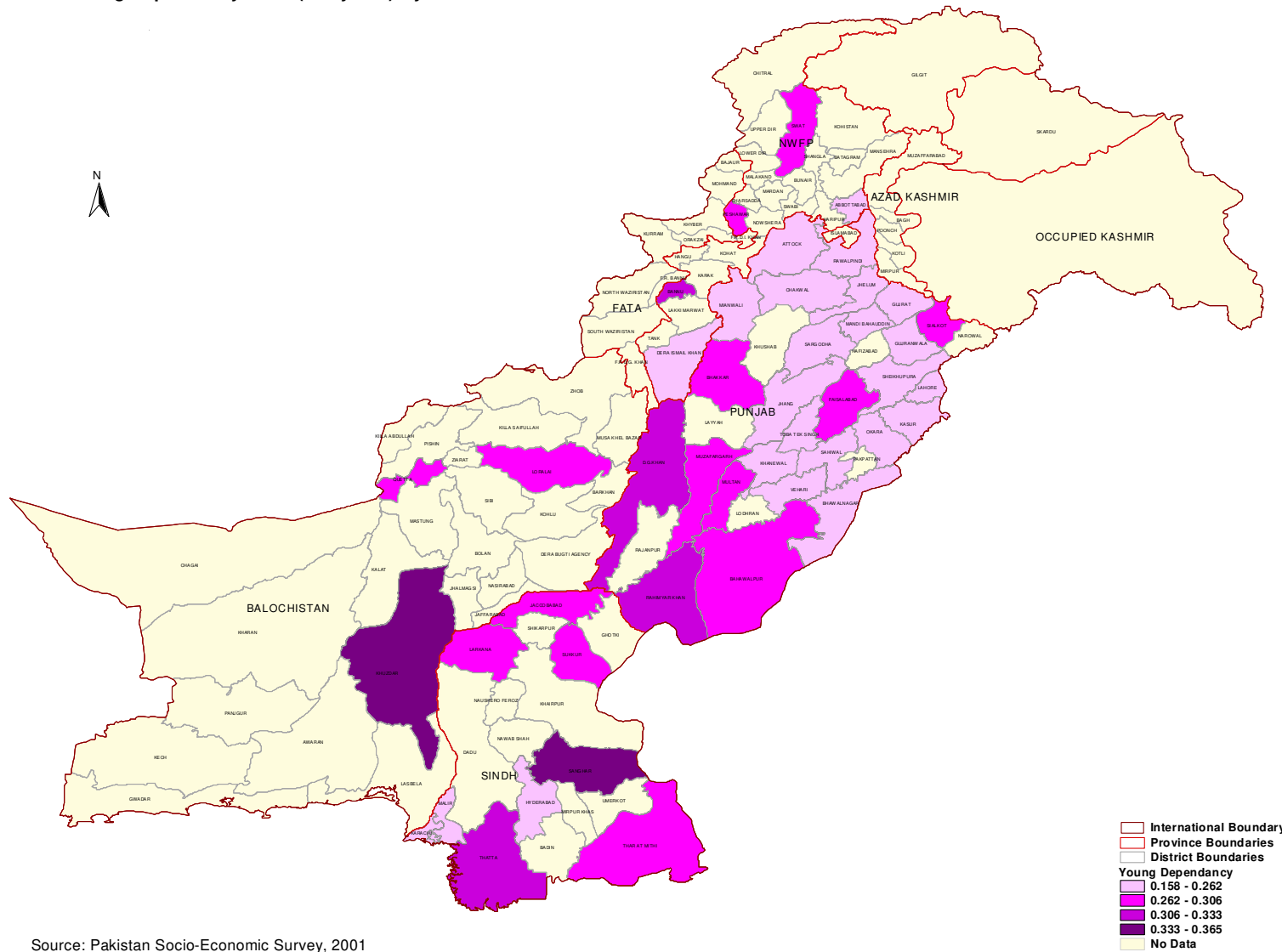
Source: Pakistan Socio-Economic Survey, 2001

MAP S5: Total Dependency Ratio By Districts



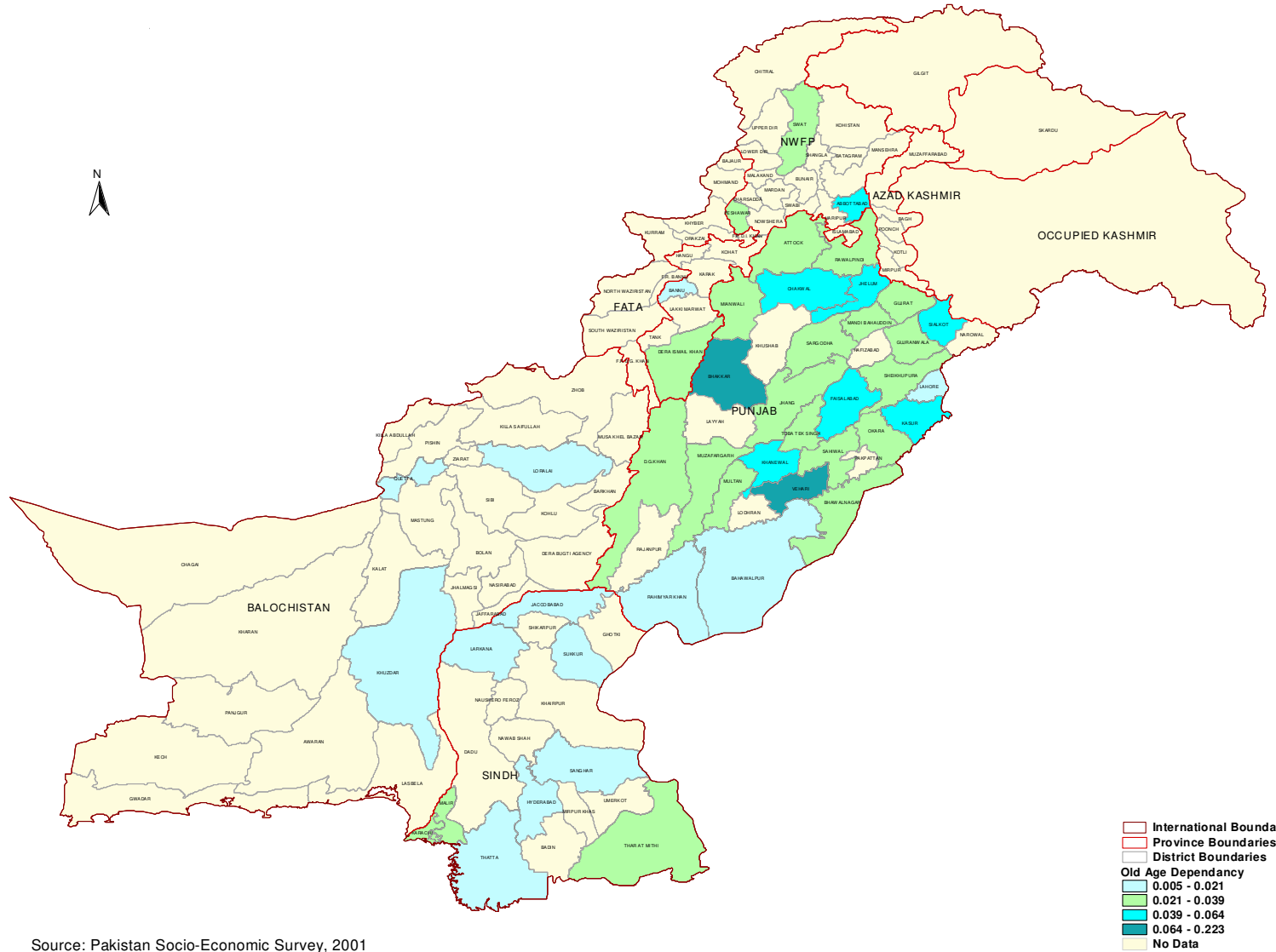
Source: Pakistan Socio-Economic Survey, 2001

MAP S6: Young Dependency Ratio (<10 years) By Districts



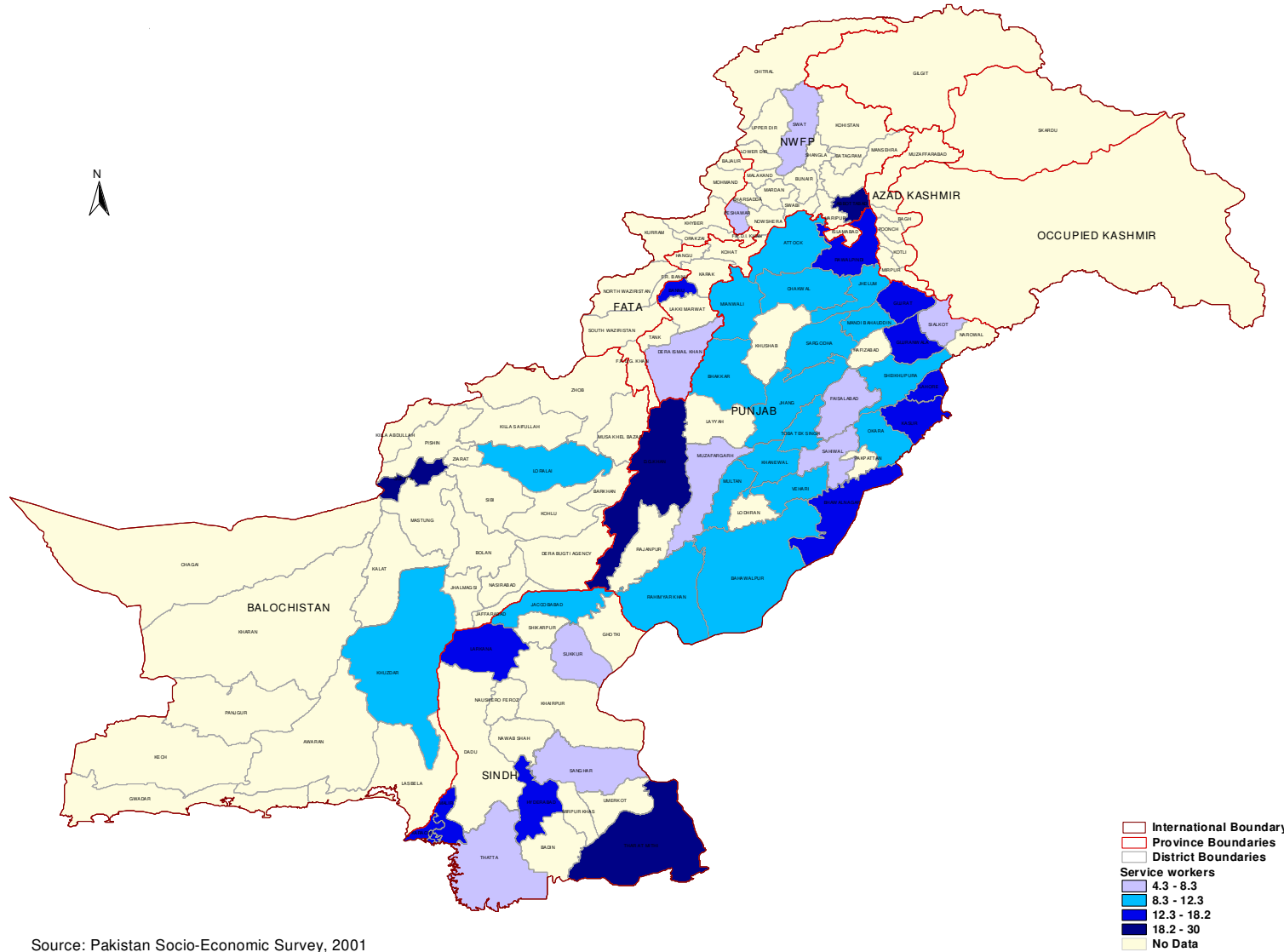
Source: Pakistan Socio-Economic Survey, 2001

MAP S7: Old Age Dependency Ratio (65+) By Districts



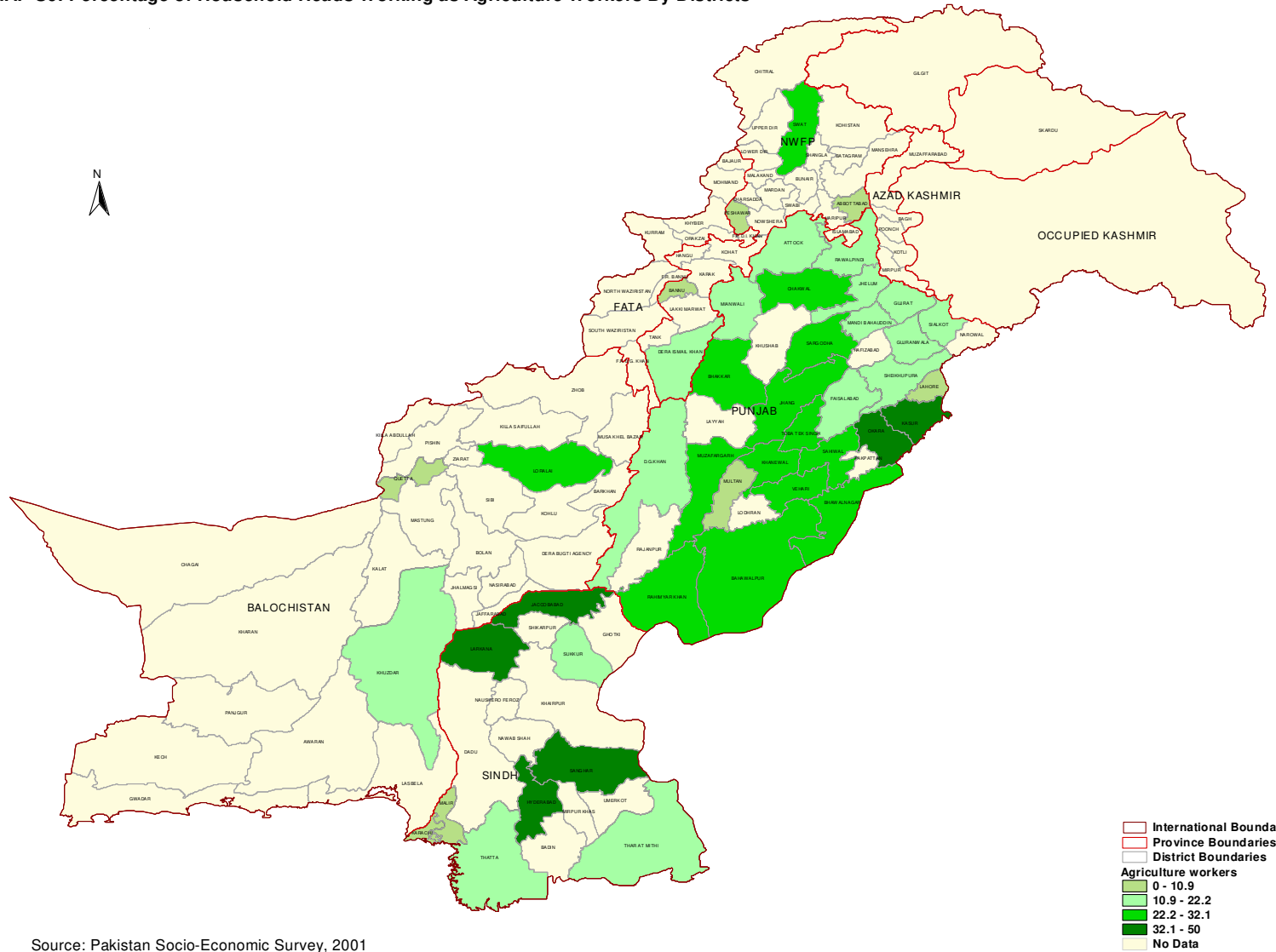
Source: Pakistan Socio-Economic Survey, 2001

MAP S8: Percentage of Household Heads Working as Service Workers By Districts



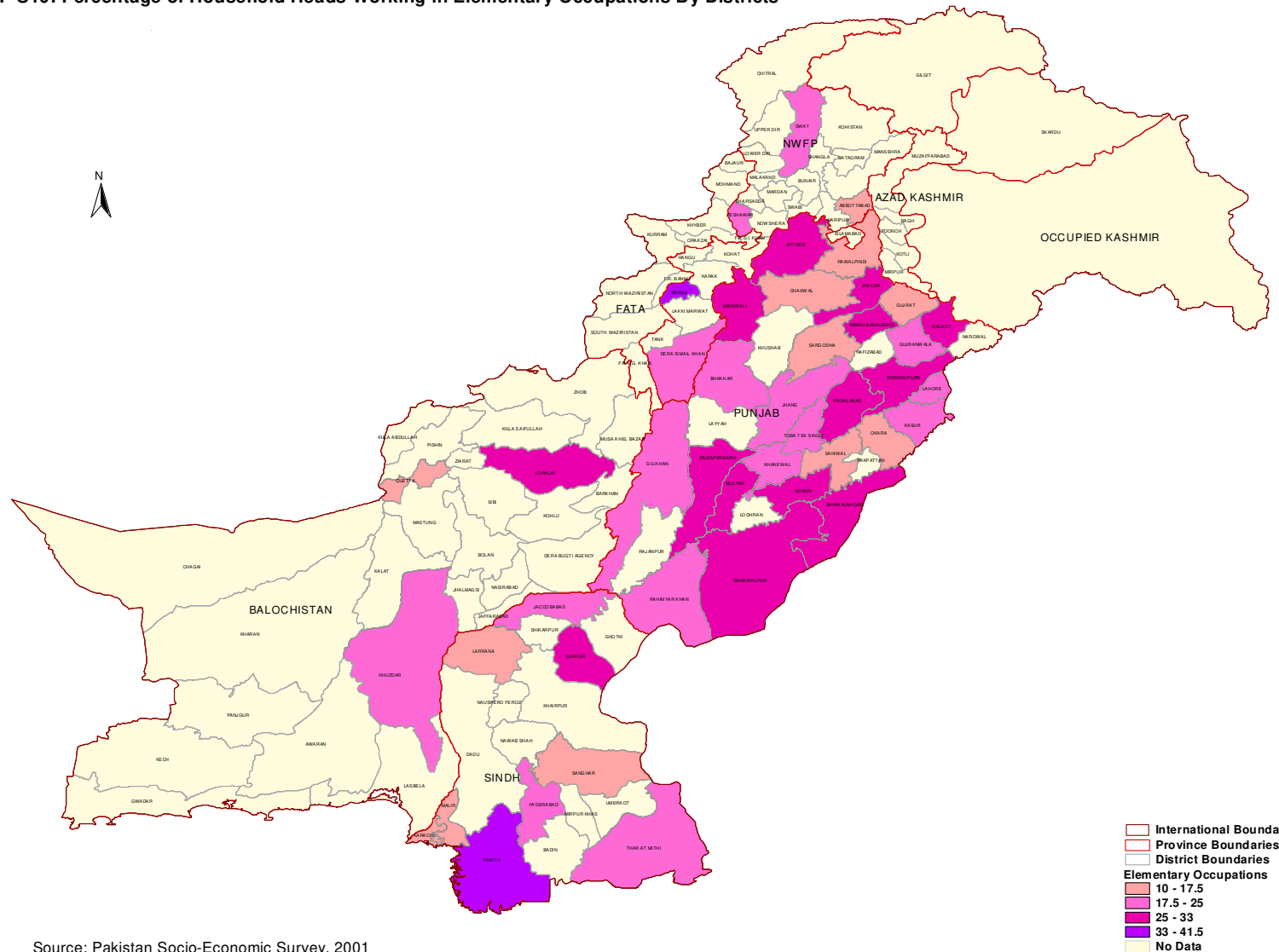
Source: Pakistan Socio-Economic Survey, 2001

MAP S9: Percentage of Household Heads Working as Agriculture Workers By Districts



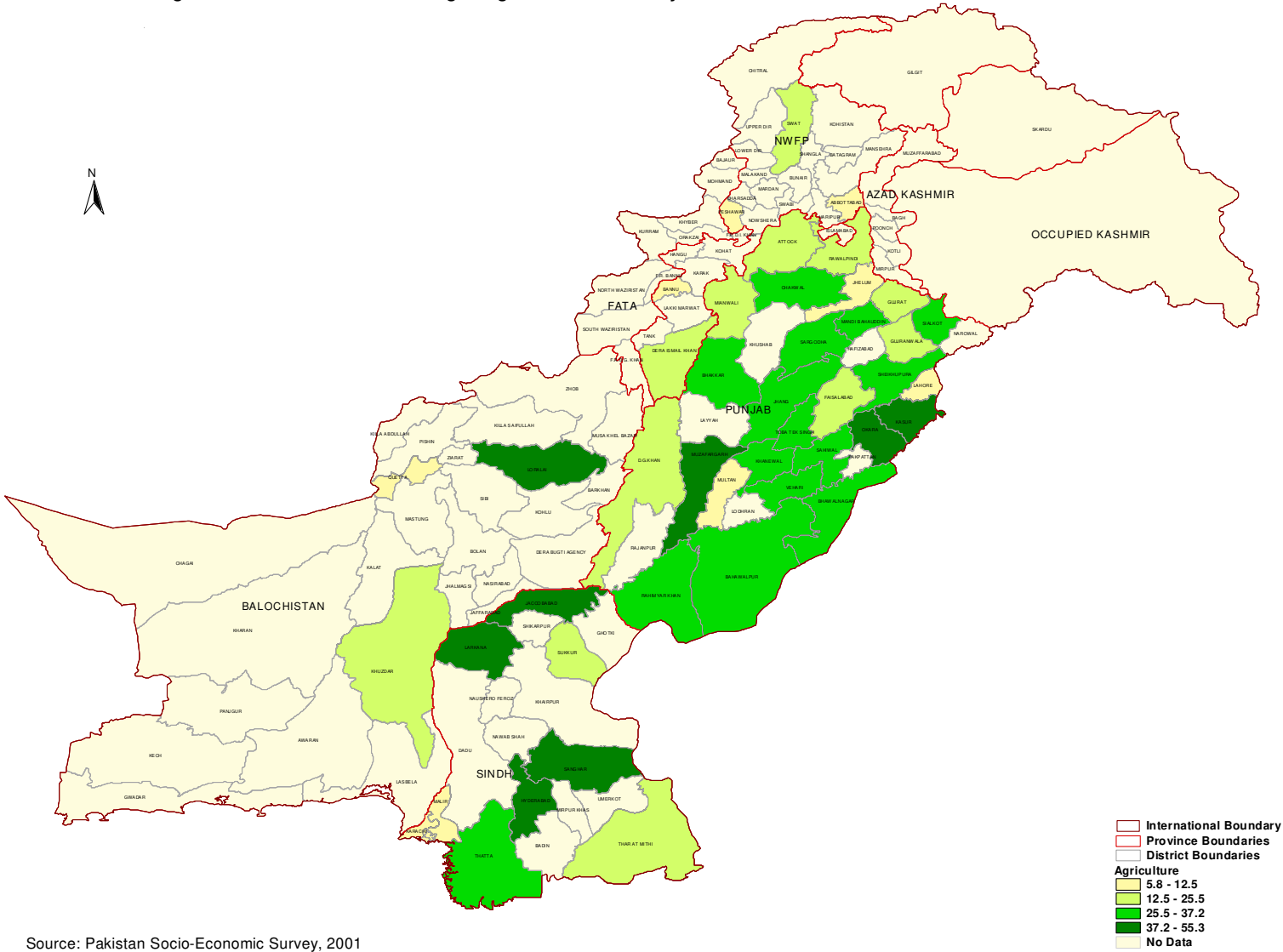
Source: Pakistan Socio-Economic Survey, 2001

MAP S10: Percentage of Household Heads Working in Elementary Occupations By Districts



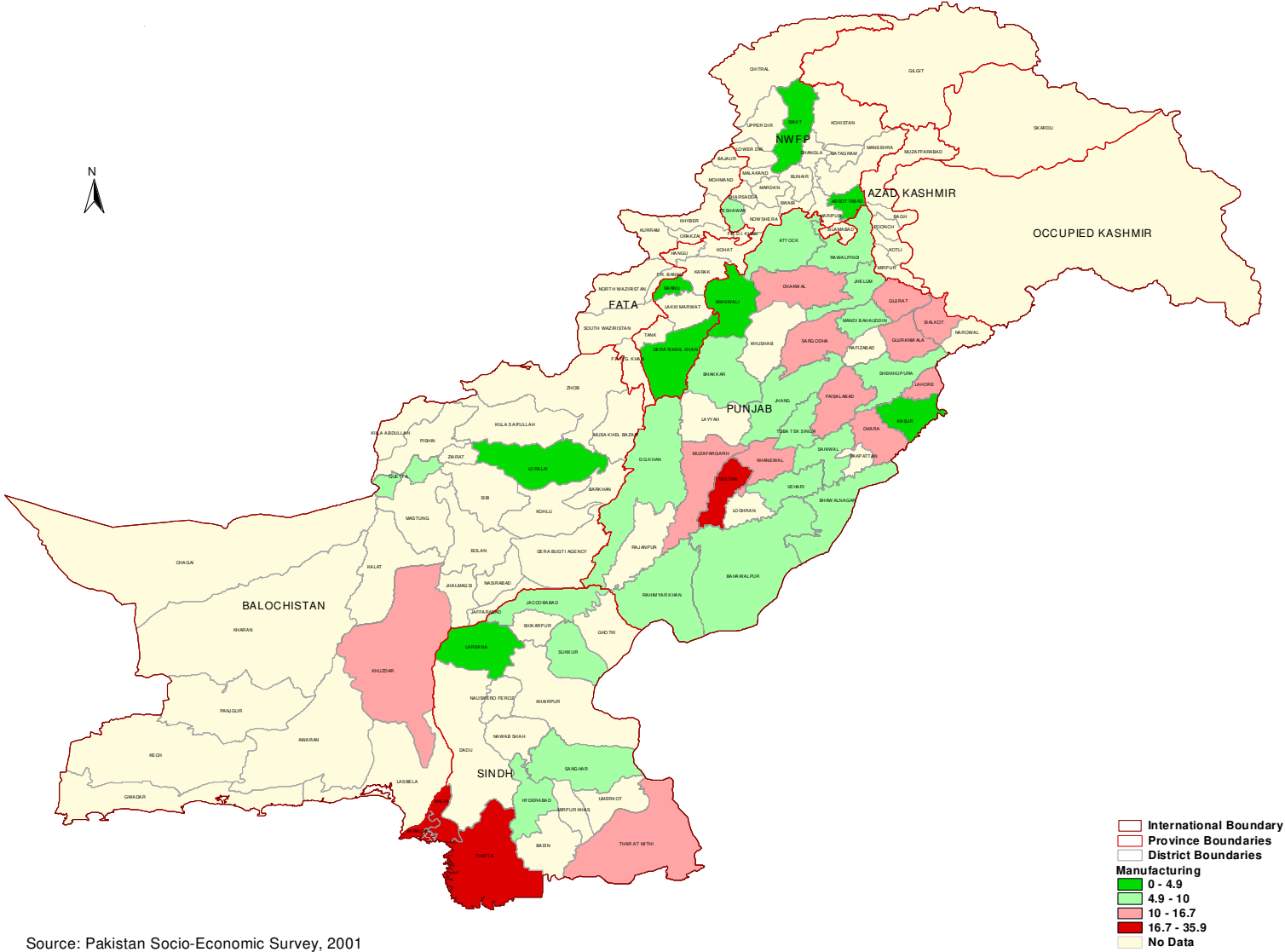
Source: Pakistan Socio-Economic Survey, 2001

MAP S11: Percentage of Household Heads Working in Agricultural Sector By Districts



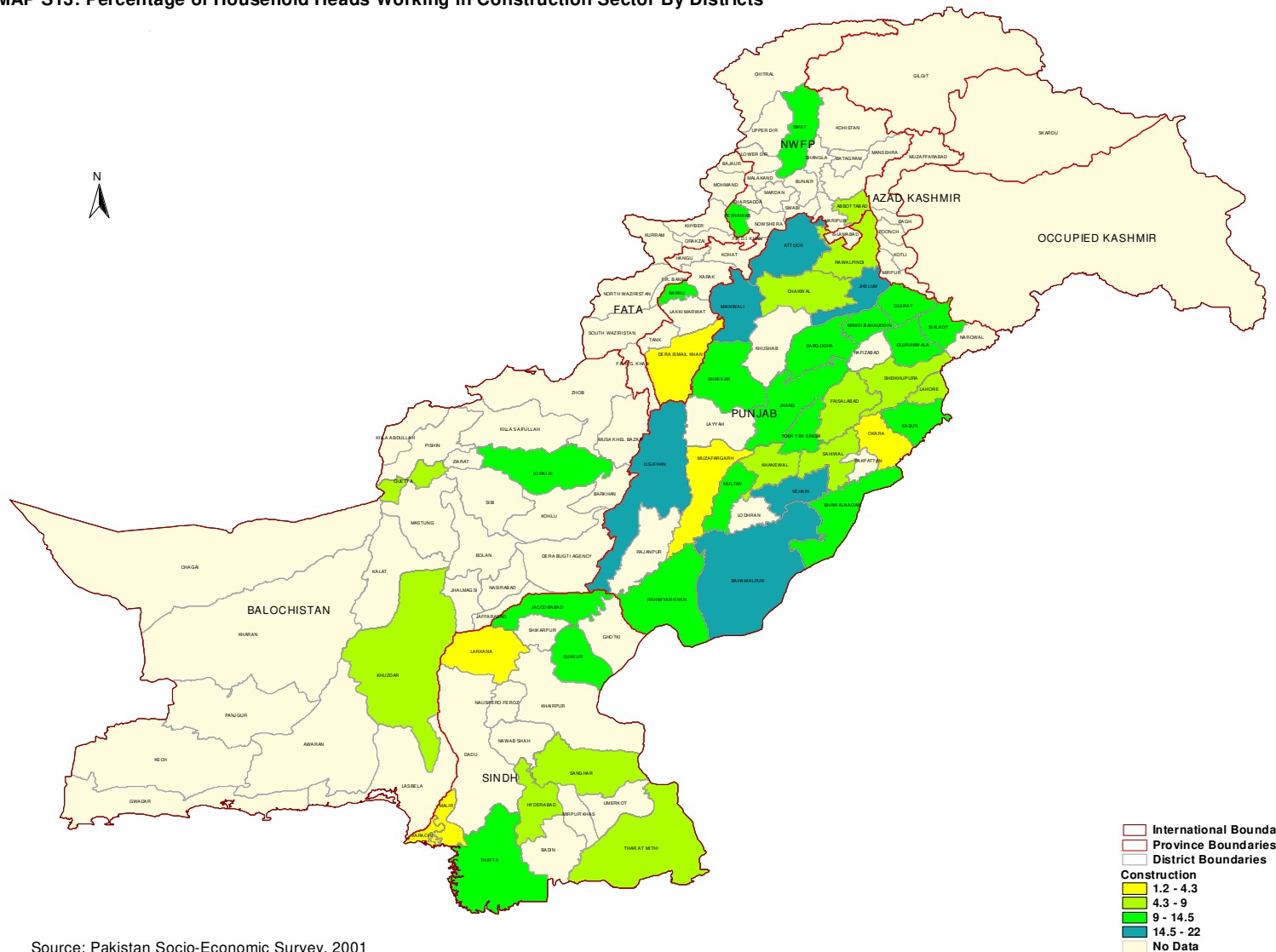
Source: Pakistan Socio-Economic Survey, 2001

MAP S12: Percentage of Household Heads Working in Manufacturing Sector By Districts



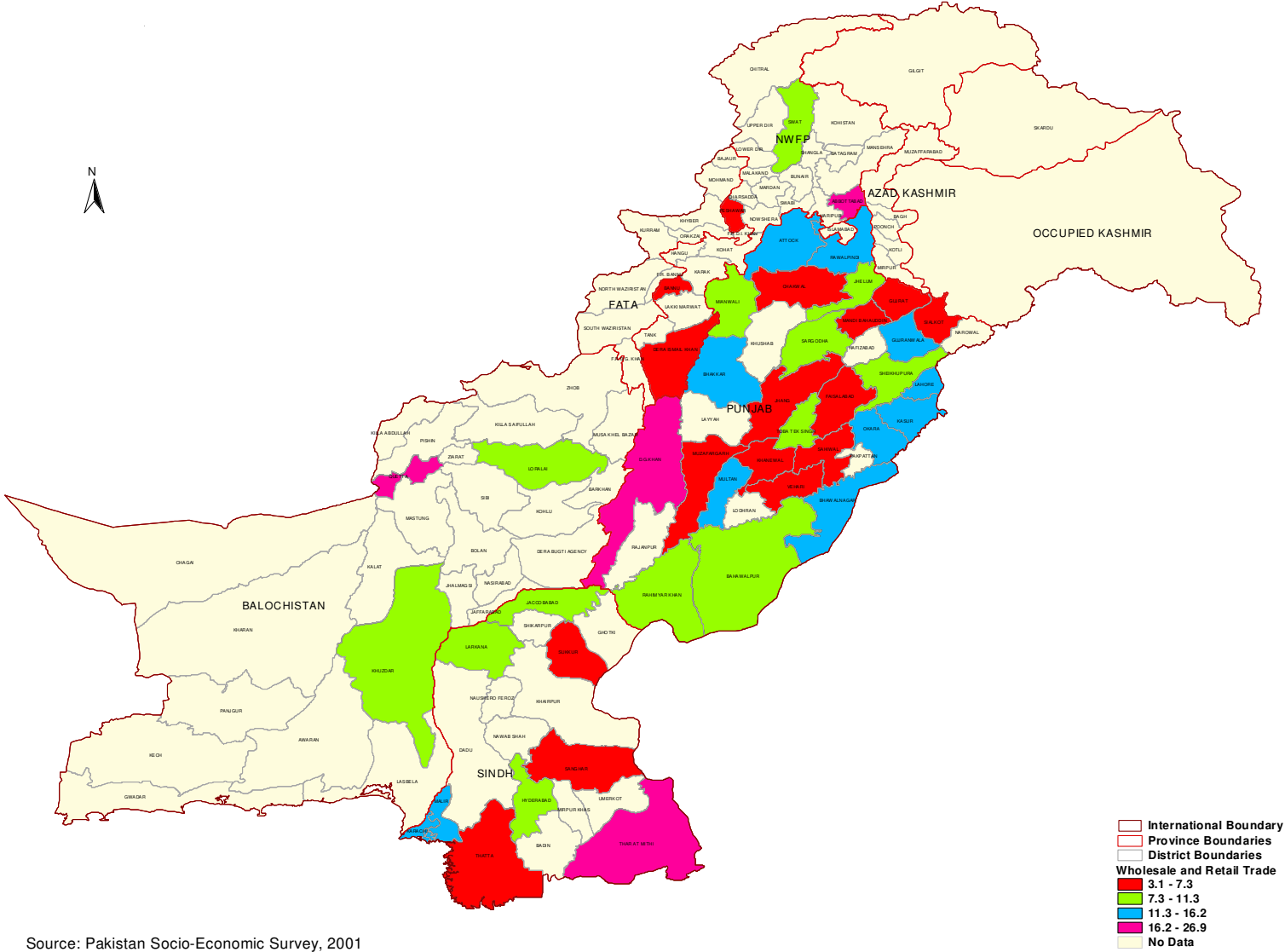
Source: Pakistan Socio-Economic Survey, 2001

MAP S13: Percentage of Household Heads Working in Construction Sector By Districts



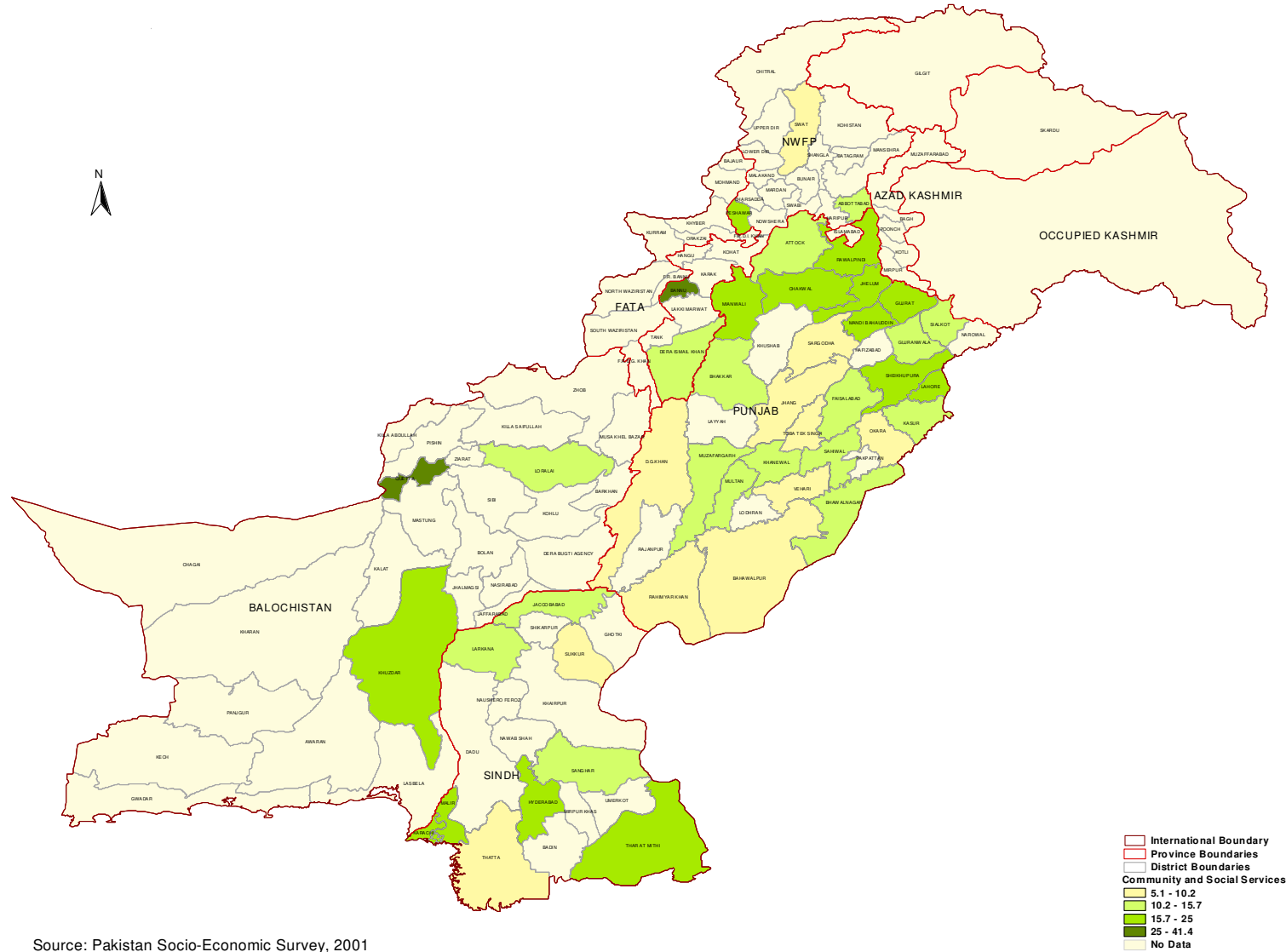
Source: Pakistan Socio-Economic Survey, 2001

MAP S14: Percentage of Household Heads Working in Wholesale & Retail Trade Sector By Districts



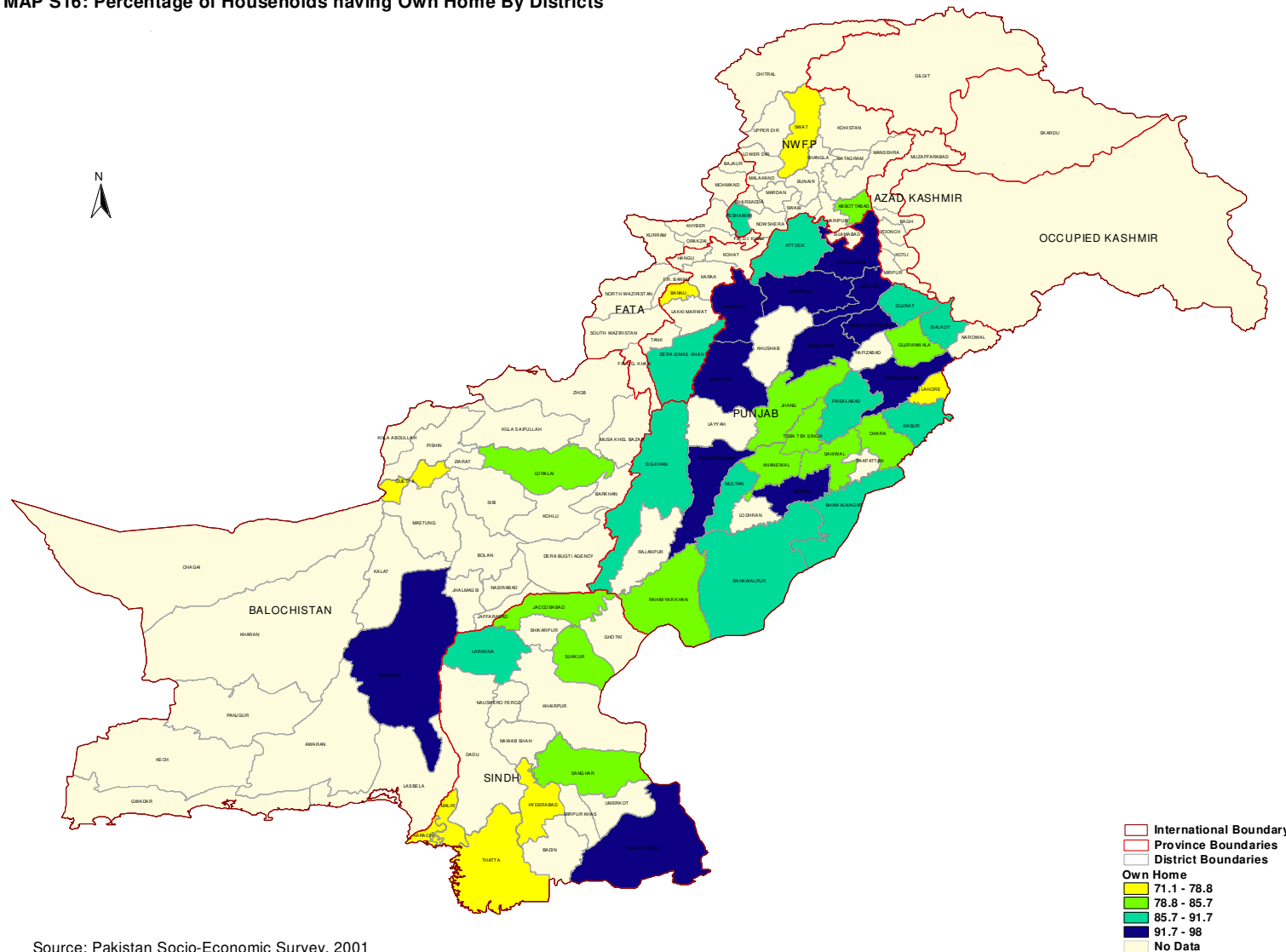
Source: Pakistan Socio-Economic Survey, 2001

MAP S15: Percentage of Household Heads Working in Community and Social Services Sector By Districts



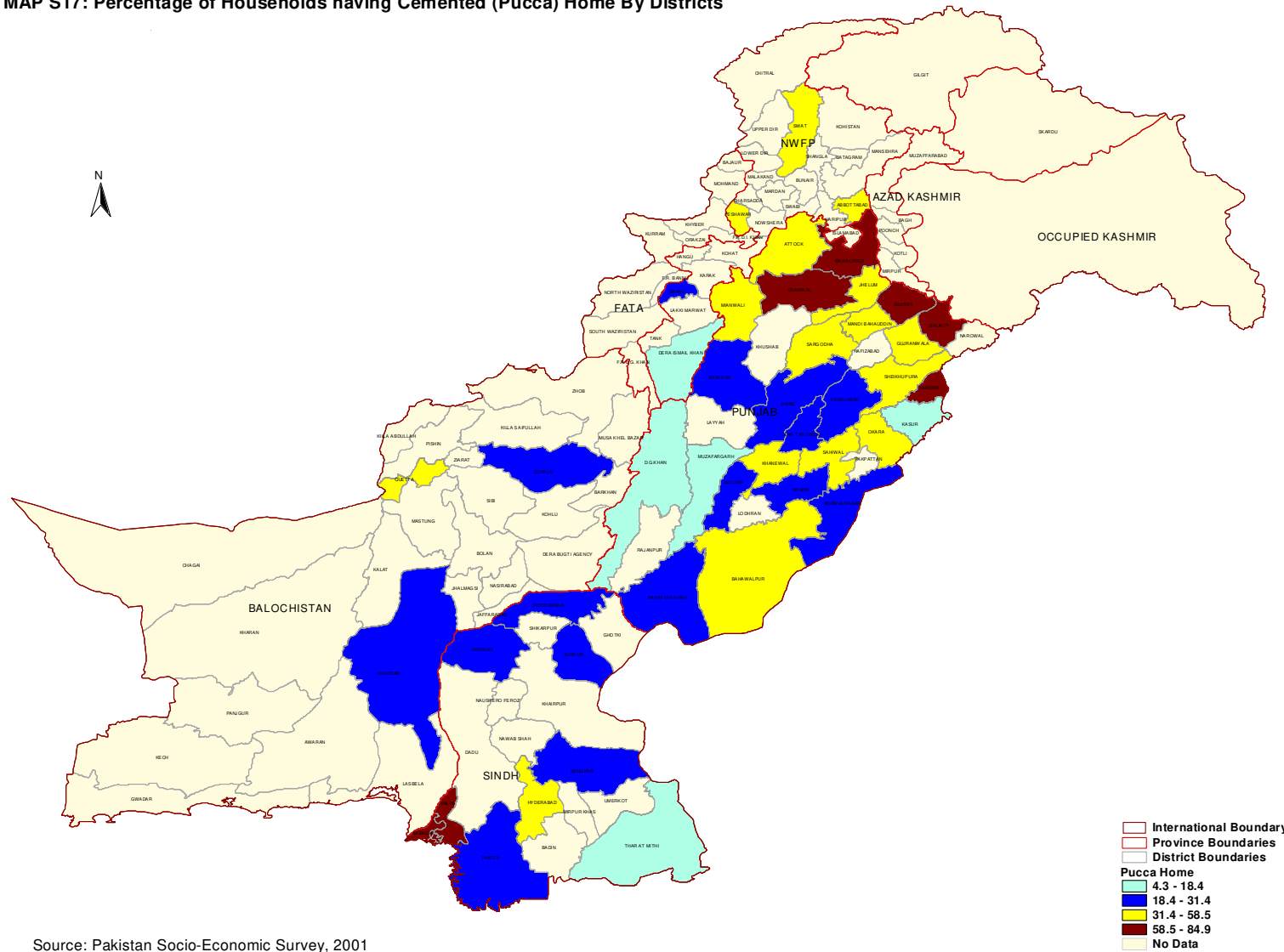
Source: Pakistan Socio-Economic Survey, 2001

MAP S16: Percentage of Households having Own Home By Districts



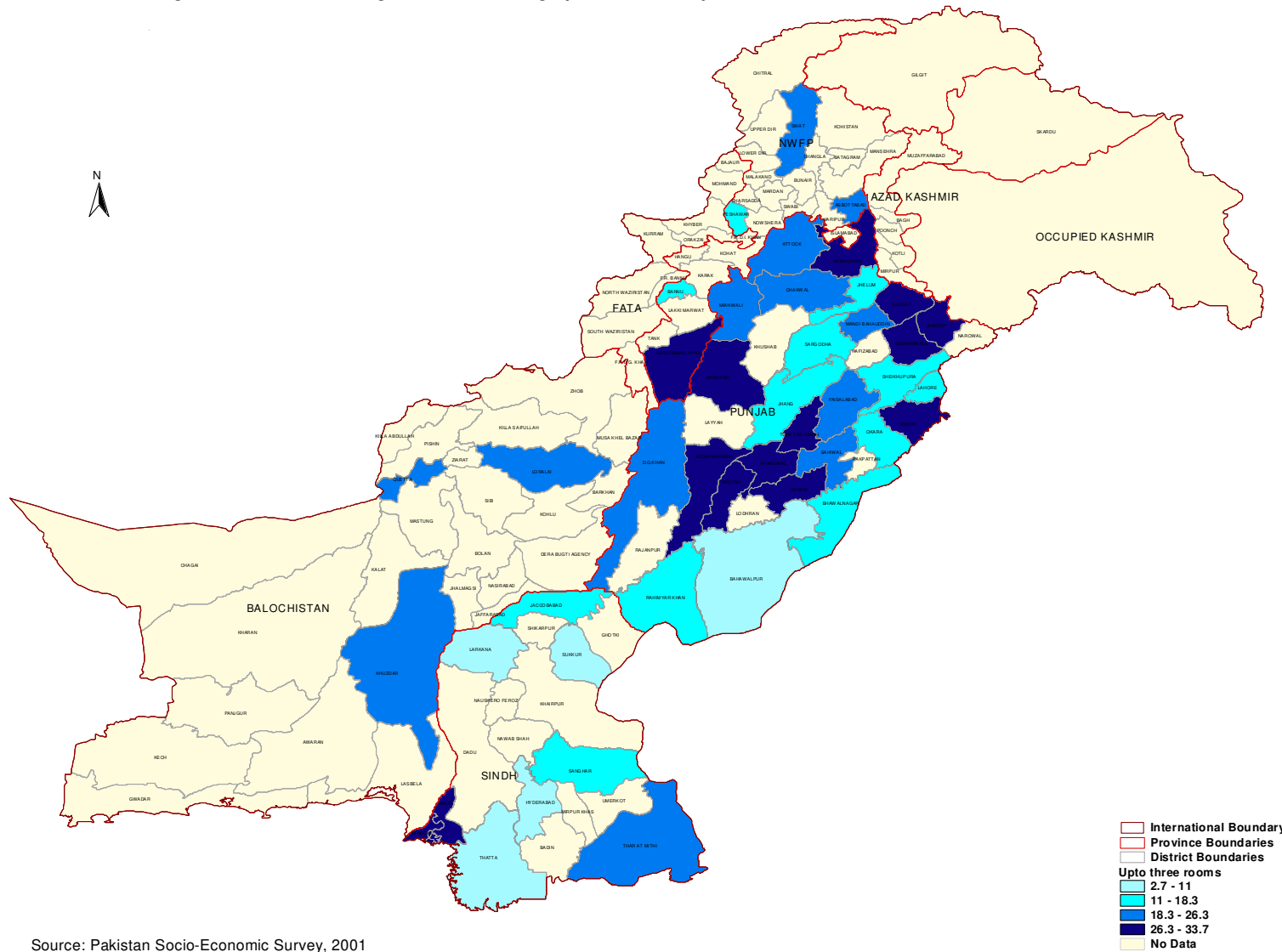
Source: Pakistan Socio-Economic Survey, 2001

MAP S17: Percentage of Households having Cemented (Pucca) Home By Districts



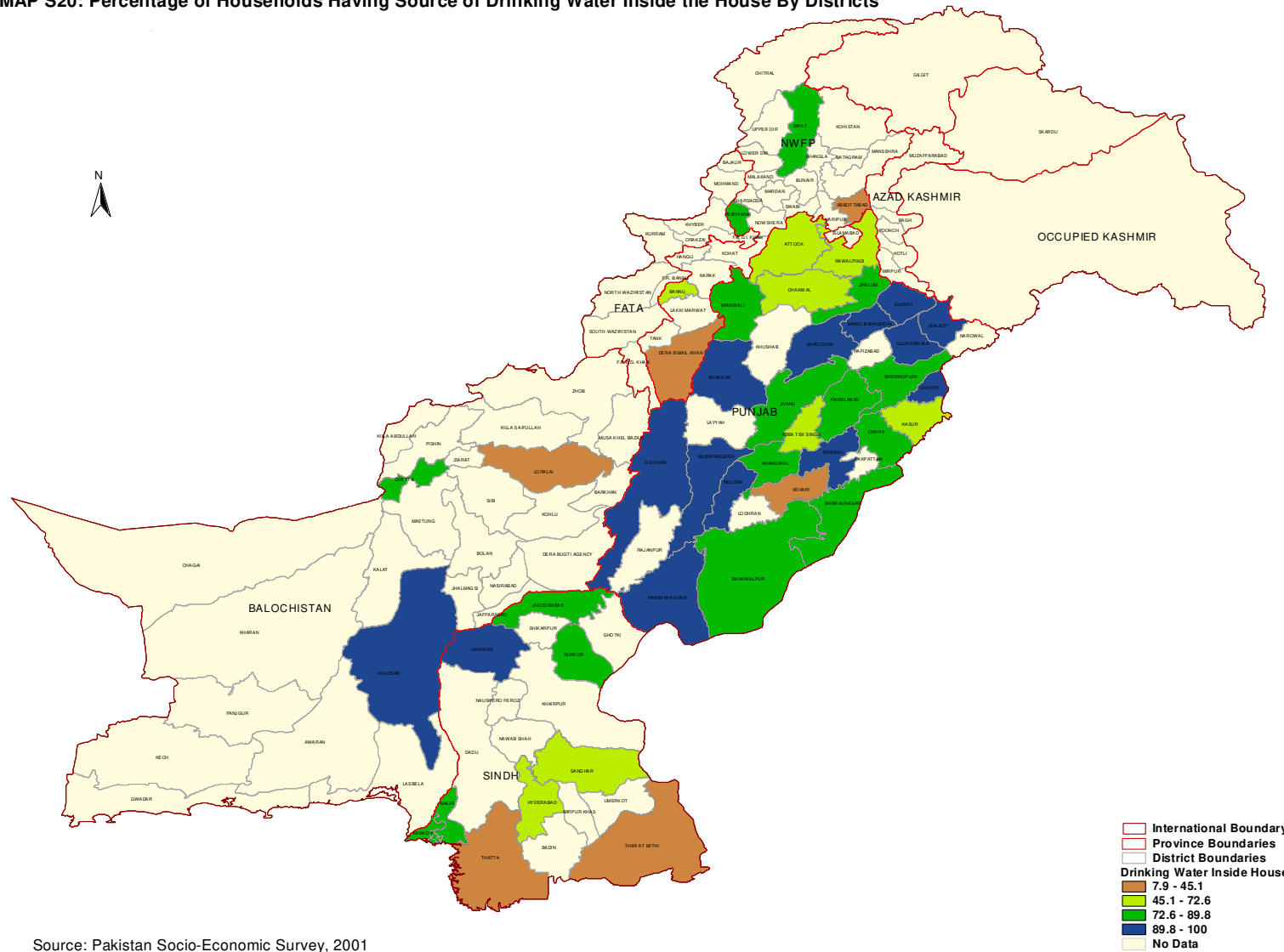
Source: Pakistan Socio-Economic Survey, 2001

MAP S18: Percentage of Households Living in Houses Having upto 3 Rooms By Districts



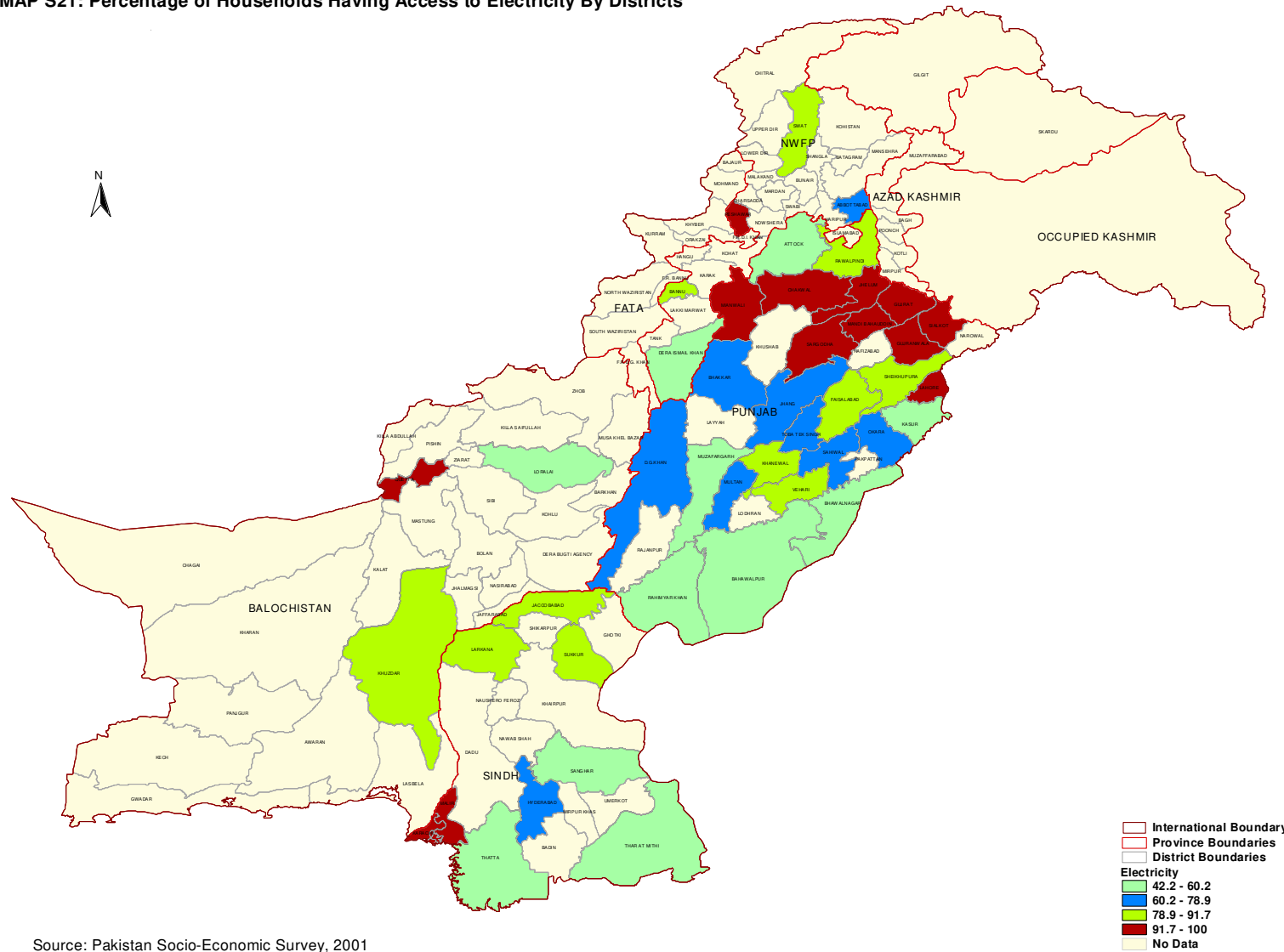
Source: Pakistan Socio-Economic Survey, 2001

MAP S20: Percentage of Households Having Source of Drinking Water Inside the House By Districts



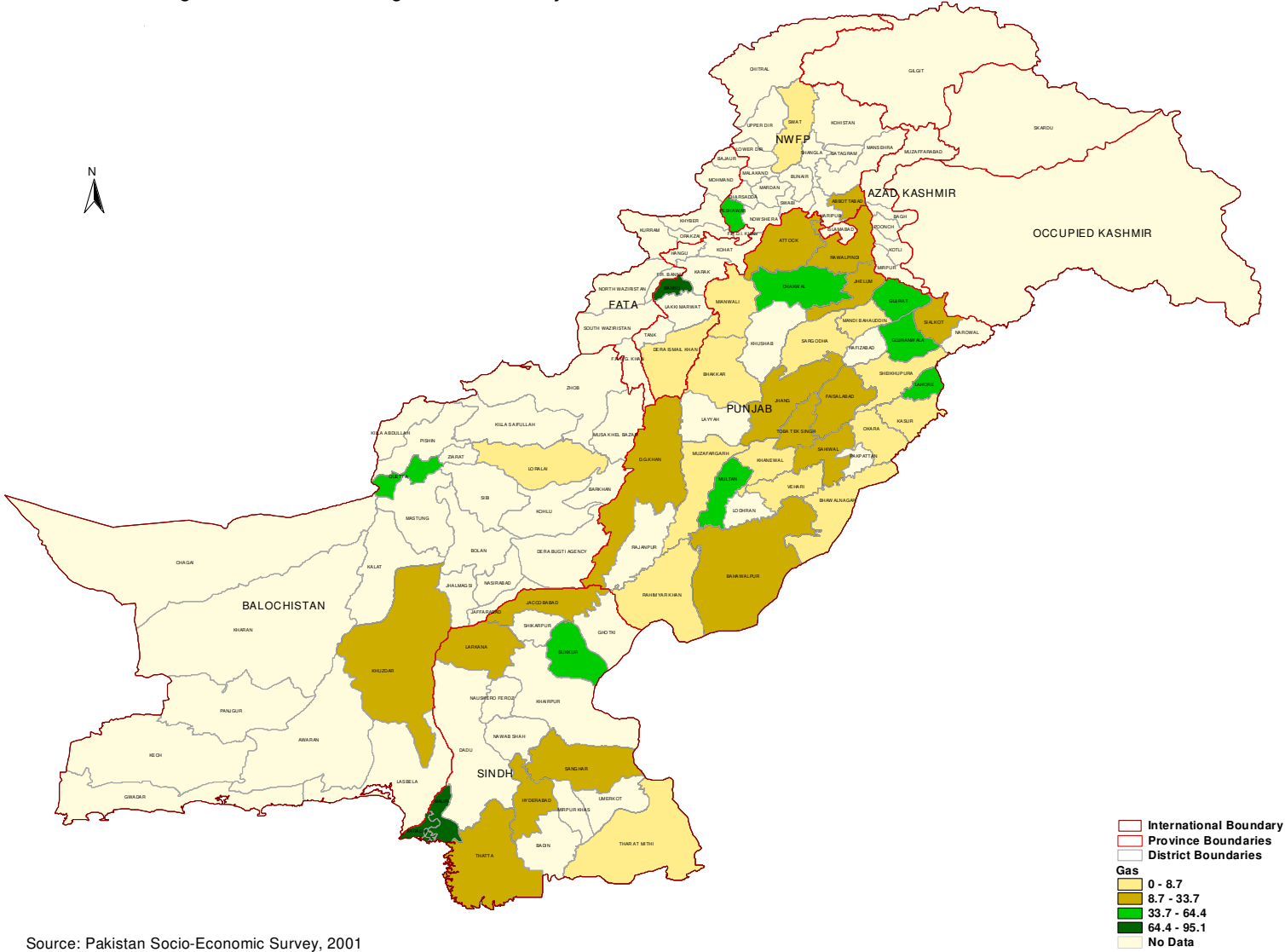
Source: Pakistan Socio-Economic Survey, 2001

MAP S21: Percentage of Households Having Access to Electricity By Districts



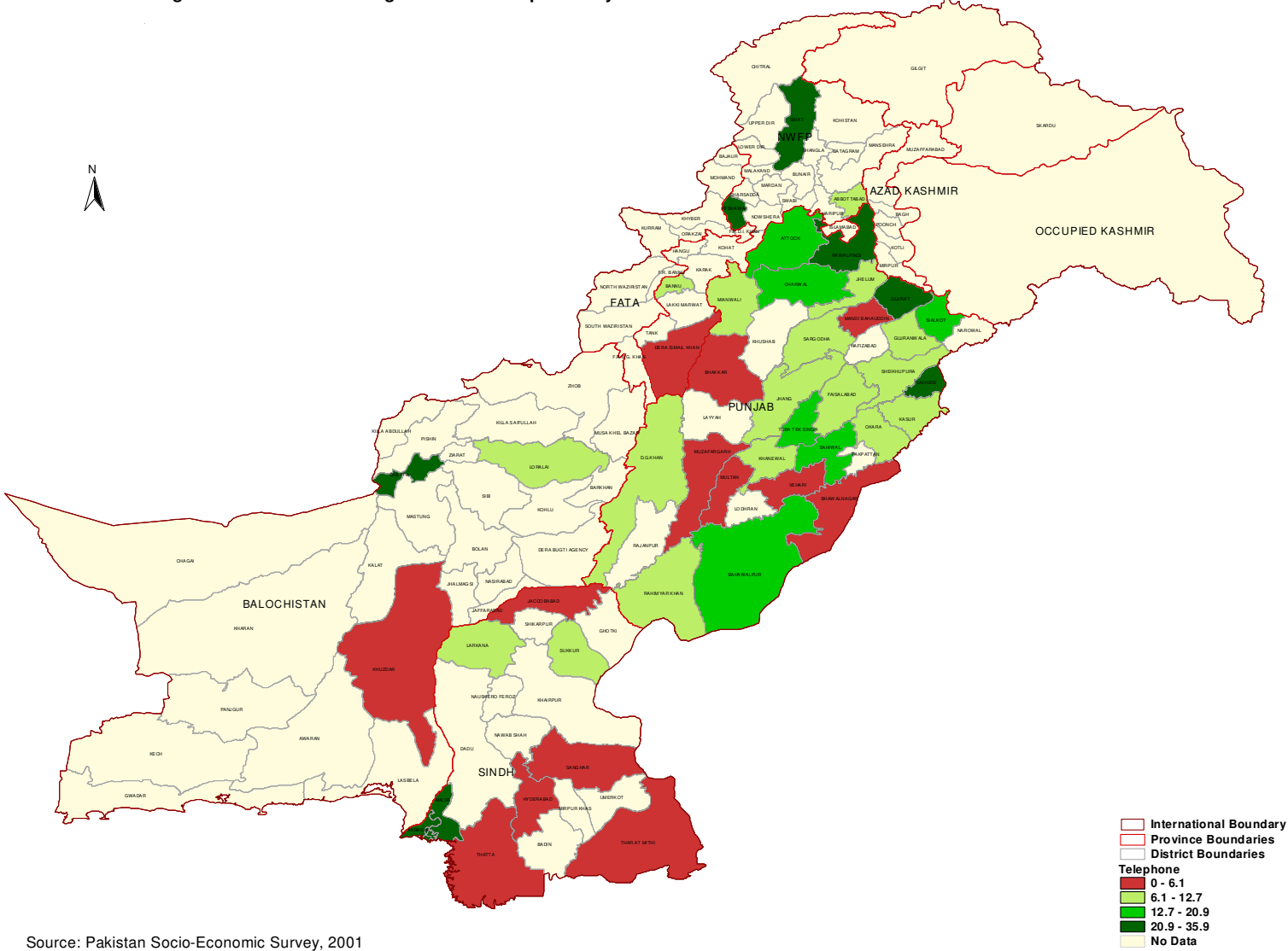
Source: Pakistan Socio-Economic Survey, 2001

MAP S22: Percentage of Households Having Access to Gas By Districts



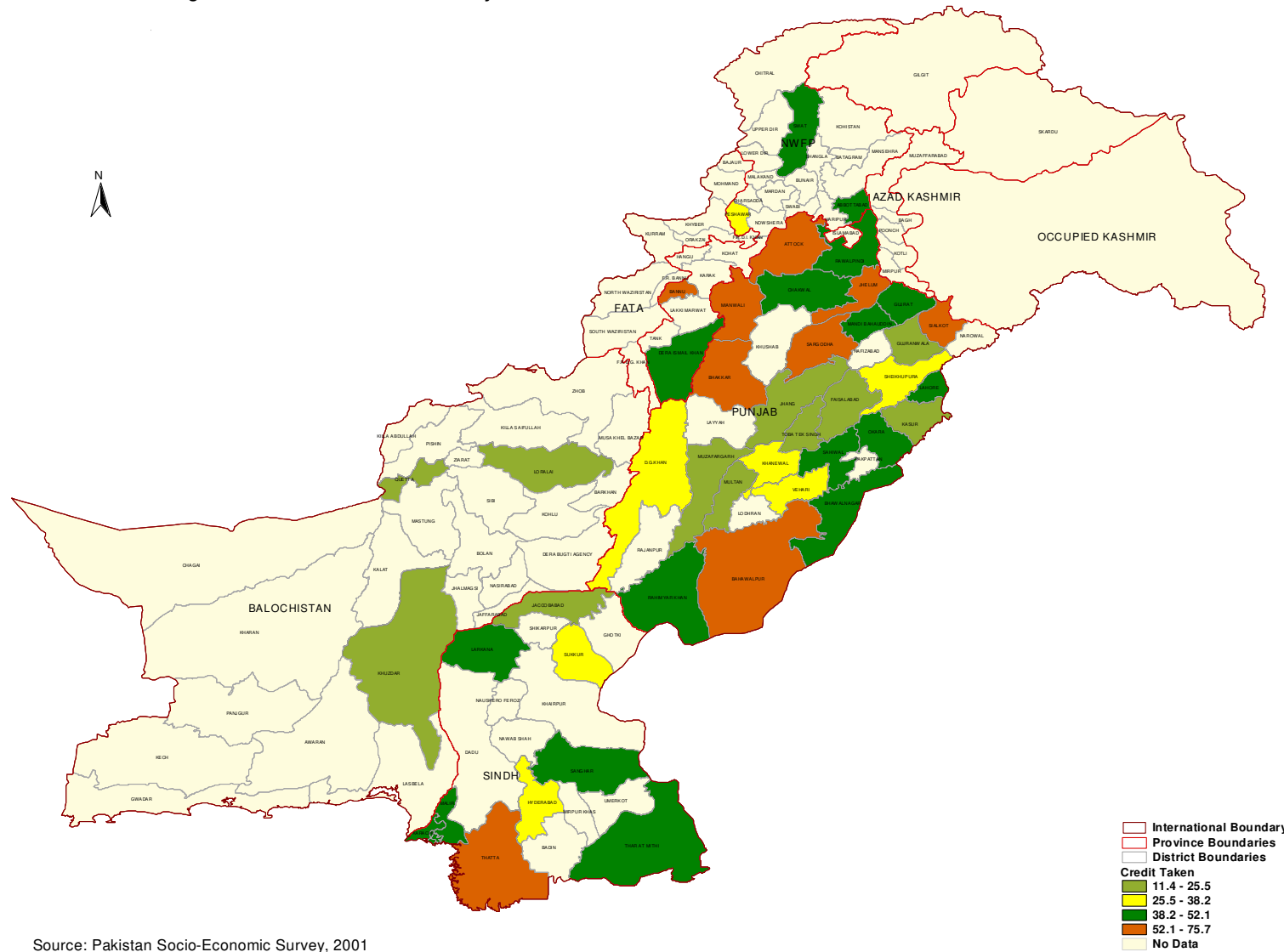
Source: Pakistan Socio-Economic Survey, 2001

MAP S23: Percentage of Households Having Access to Telephone By Districts



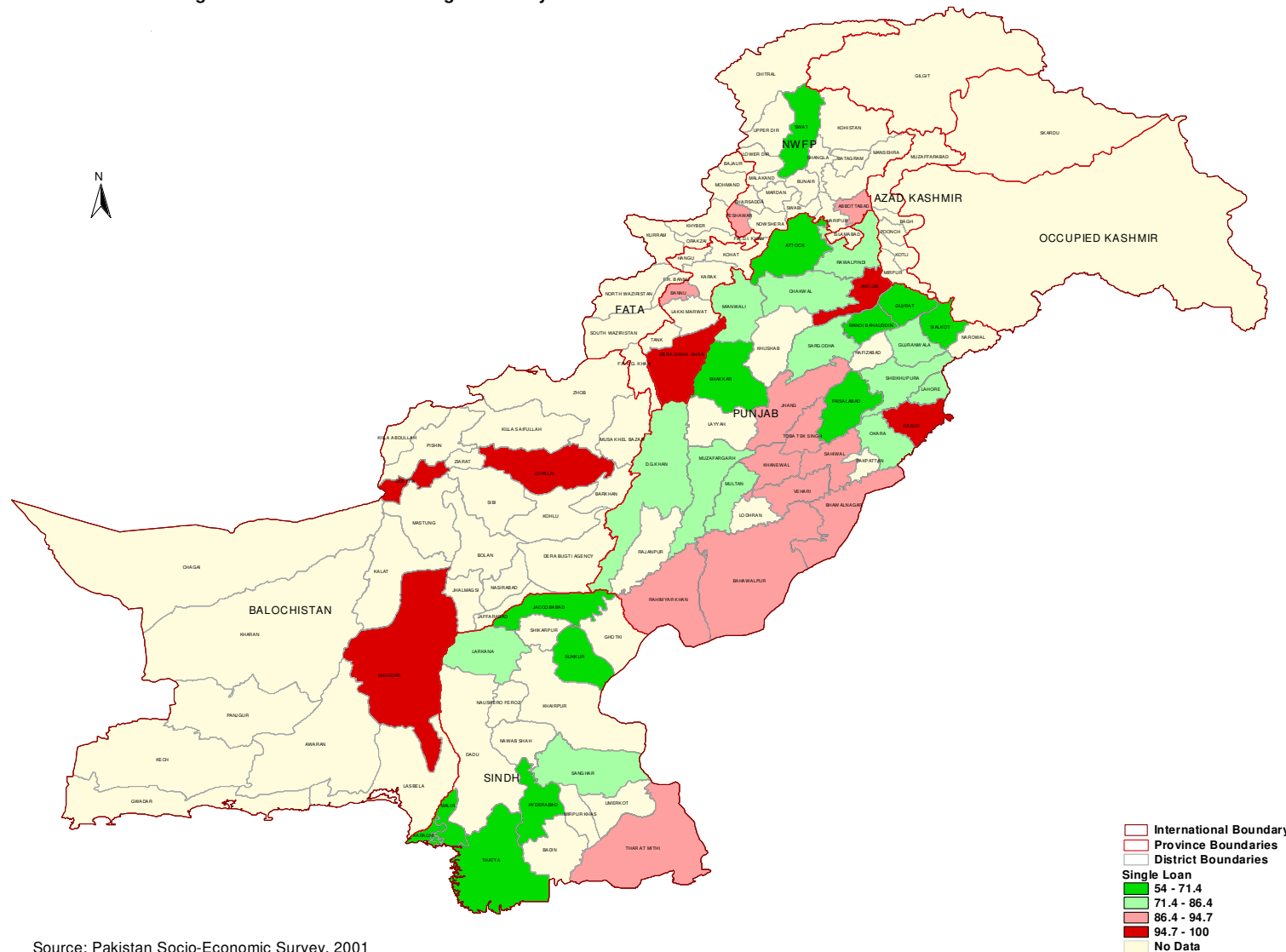
Source: Pakistan Socio-Economic Survey, 2001

MAP S24: Percentage of Households Taken Credit By Districts



Source: Pakistan Socio-Economic Survey, 2001

MAP S25: Percentage of Households Taken Single Loan By Districts



Source: Pakistan Socio-Economic Survey, 2001

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