

Partnership for Clean Indoor Air

**Household Energy Intervention
for Reducing IAP Exposure in Rural Areas
in China**

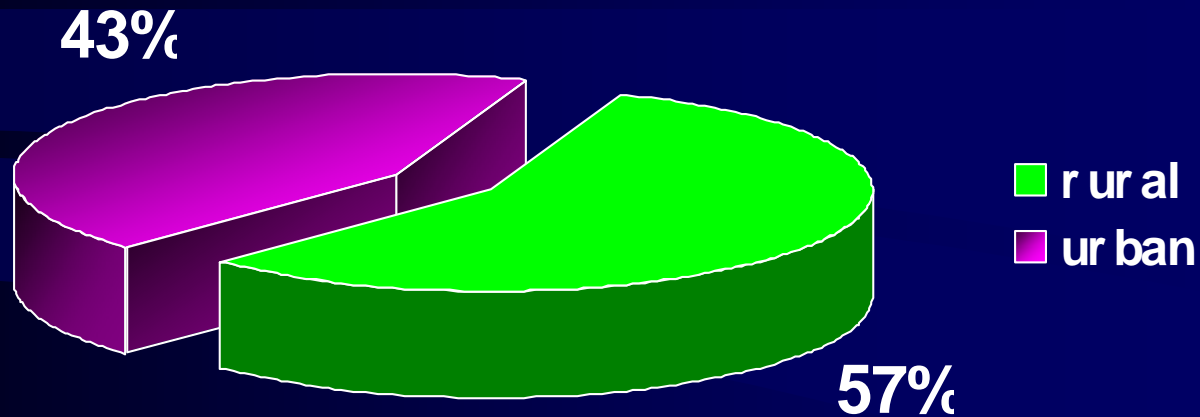
China Project Introduction

Project working team

Institute for Environmental Health & Related Product Safety, China CDC

I. BACKGROUND

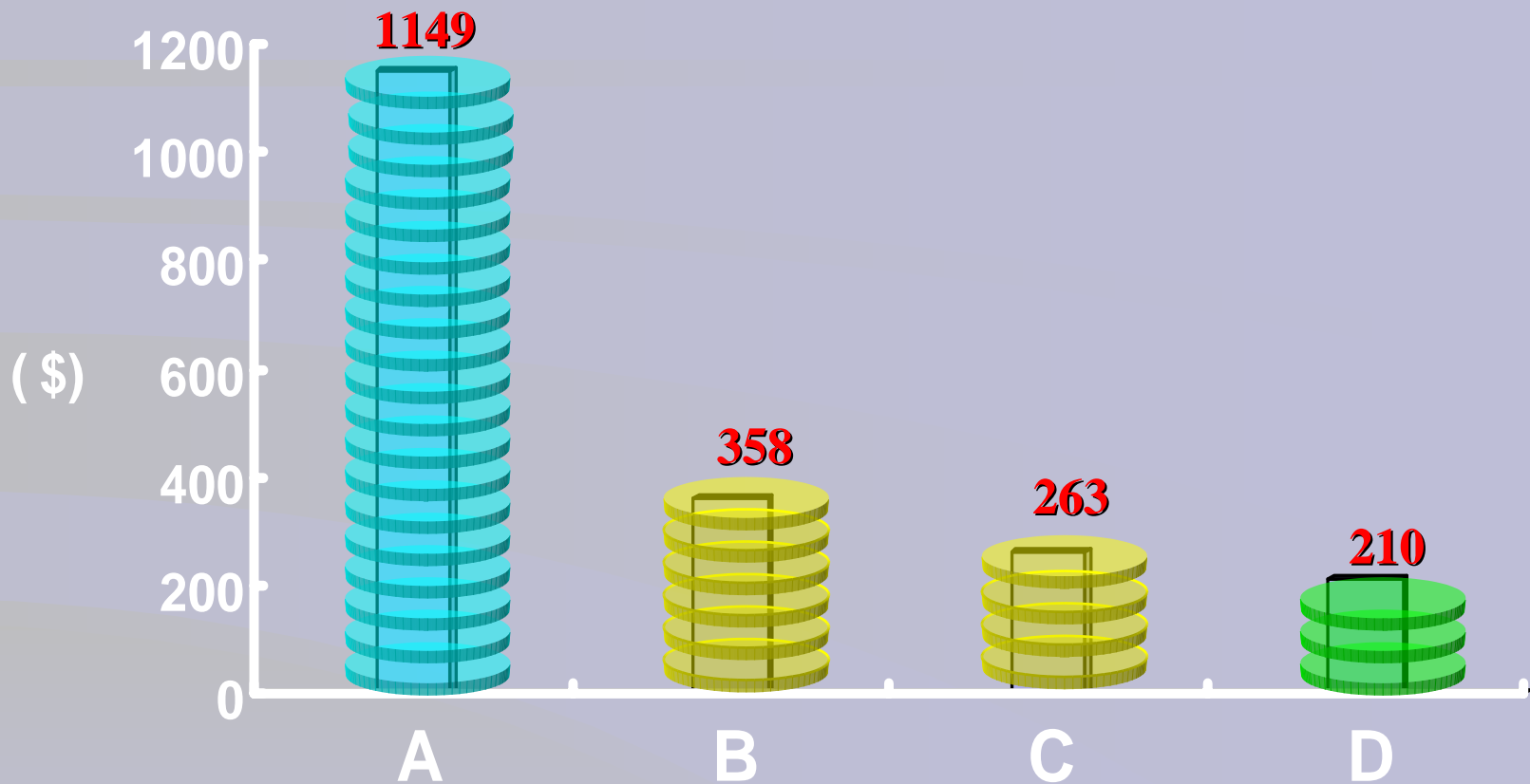
Population in rural and urban areas in China



Data source: National Bureau of Statistic of China

- More than 700 million, 57% of population live in rural areas.
- 250 million rural population live in 12 poor western provinces.

Per capita income in different areas in China (2004)



A: Urban areas of China

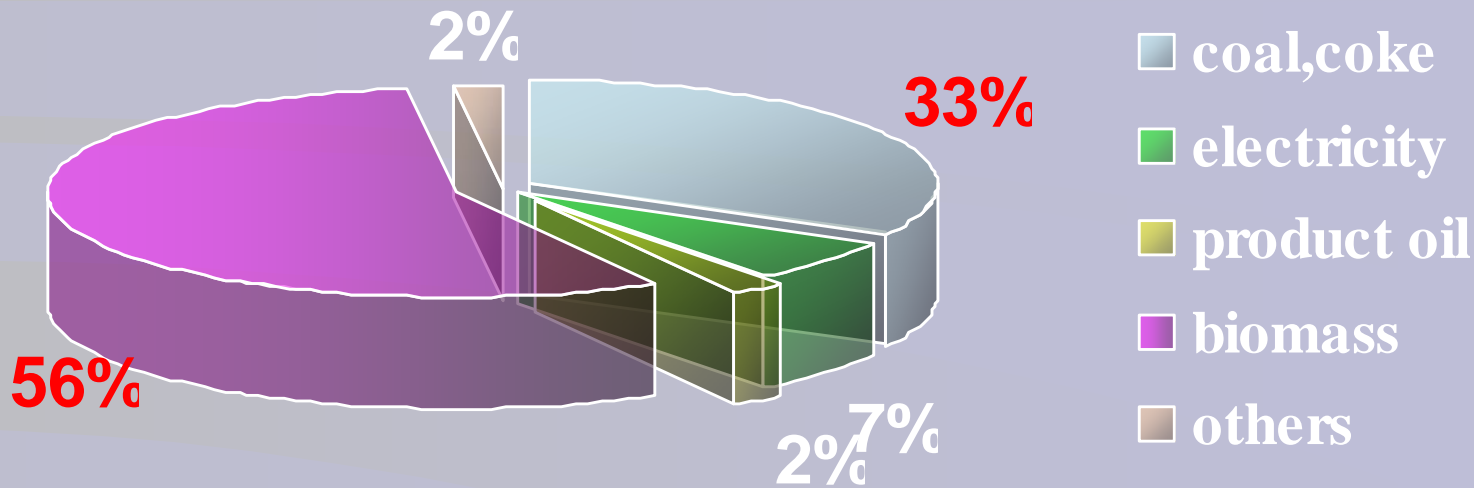
B: Rural areas of China

C: Rural areas of western China (12 provinces)

D: Rural areas of Guizhou, China

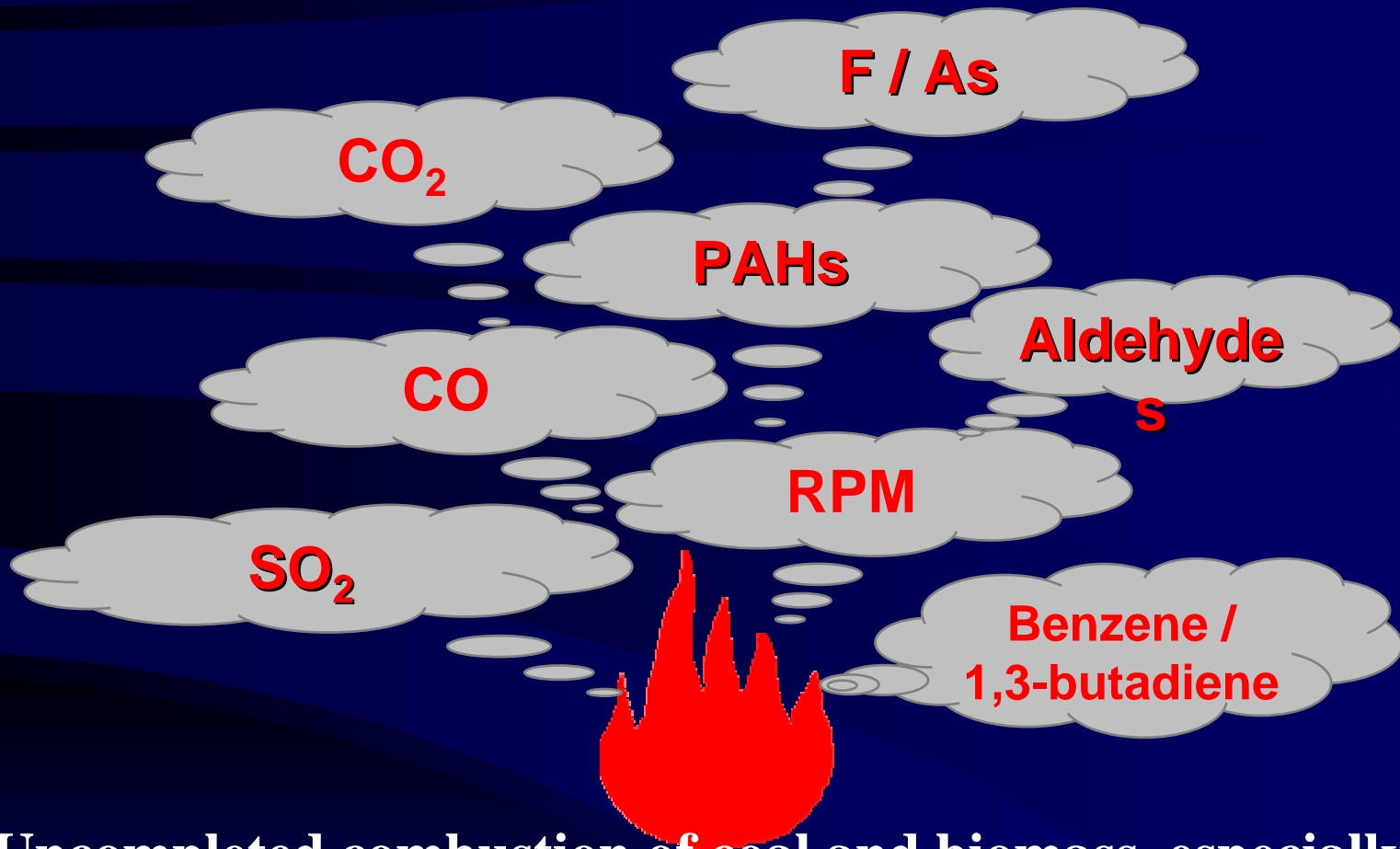
*Data source: National Bureau
of Statistic of China*

Structure of household energy consumption in rural area of China in 2003



- Coal and biomass are the most important fuels in rural areas in China.
- The rural household energy consumption (million tons of standard coal):
Coal = 153 (33%) Biomass = 259 (56%) Total = 461

Pollutants from combustion of solid fuels



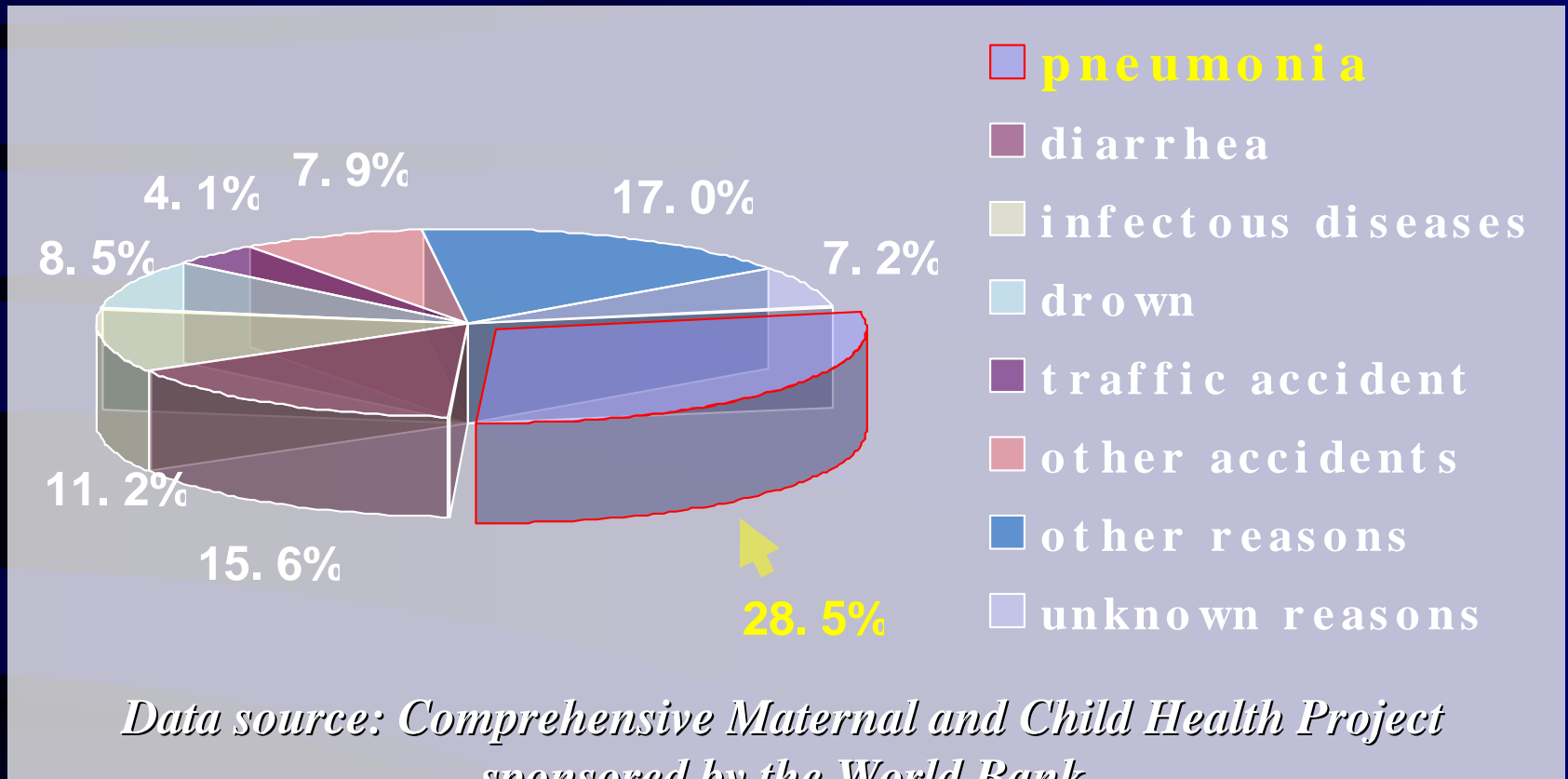
Uncompleted combustion of coal and biomass, especially in open or poorly ventilated combustion situation, hundreds of pollutants emit at levels of several folds higher than general health guidelines.

Severe health impacts linked with household energy using

Health impacts	Occurrence in Guizhou
Dental Fluorosis	66.6% (n=1283)
Resp Sym in W/1yr	37.2% (n=1660)
ARI Sym in C/4ms	31.2% (n=2247)

from Baseline data of WB project

Death reasons of children younger than five



Pneumonia occupies the first position of 28.5% among the death reasons of children younger than 5 in China.



Dental fluorosis



Skeletal Fluorosis

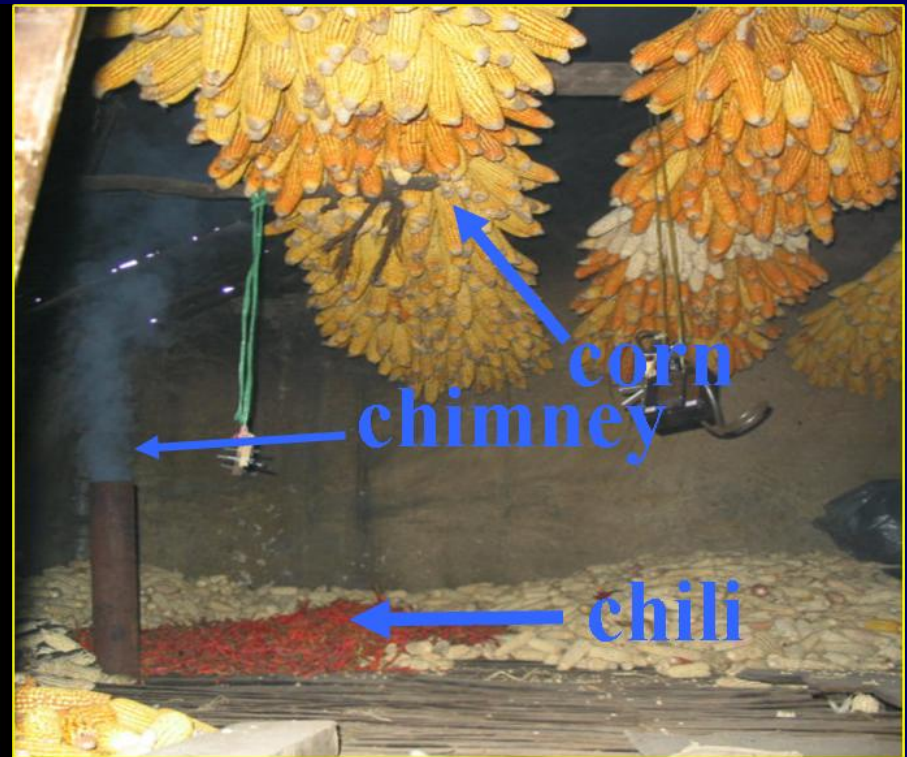
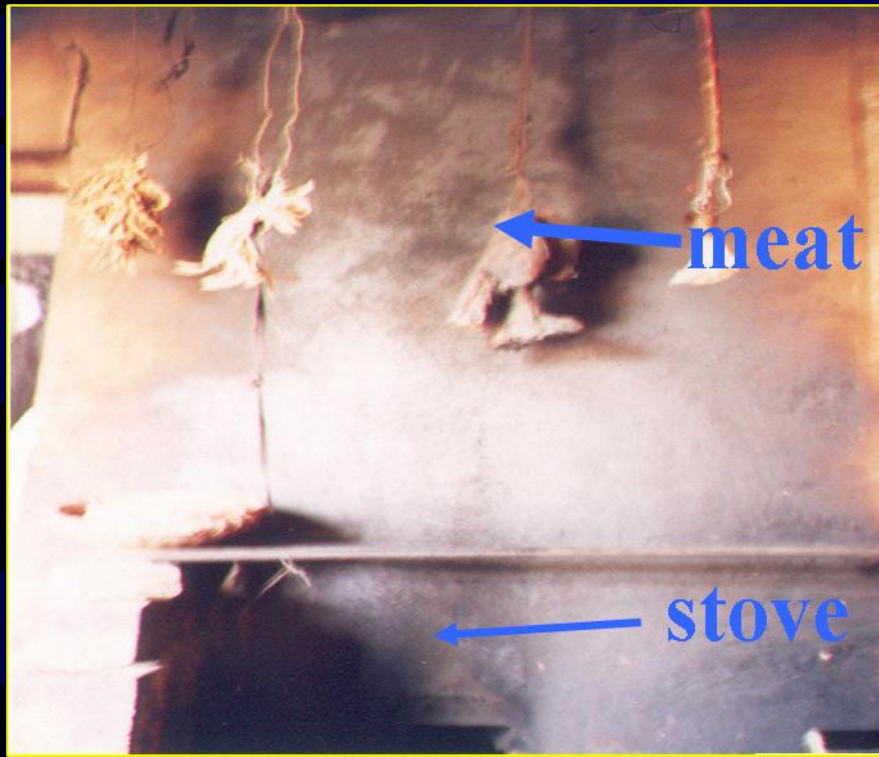
The coal smoke source endemic fluorosis areas in the whole province cover population of 16 million, about 50% whole province population. There were 10 million dental fluorosis patients and 640,000 skeletal fluorosis patients in Guizhou.



Arsenism

Coal smoke source endemic arseniasis areas cover 45,000 exposed population and 3,000 diagnosed arsenism patients.

Living habits make more F/As intake



Corn, chili and meat usually were dried by coal-burning smoke in some rural areas. The concentrations of fluoride & arsenic in rice, corn and chili dried by smoke may reach thousand times higher than criterion.

Previous efforts in stove improvement in China

- **“Sustainable and efficient energy use to alleviate indoor air pollution in poor rural areas in China” sponsored by the World Bank**
 - covered four northwestern provinces
 - This PCIA project was based on it
- **Xuanwei lung cancer etiology study**
 - 1979-1991, proved the relationship of coal smoke and lung cancer, successfully reduced its occurrence through stove-improvement, co-operated with USEPA
- **Three Gauges areas, coal-using fluorosis control**
 - stove improvement for 150,000 households
 - fluorides, SO₂, CO and inhalable particles were reduced 90% through stove-improvement in 1986-90

- **189 million stoves improved / MOA / 1990s**

- **Aimed to the effective using of fuel, China has succeeded in improving cooking stoves in 189 million rural households in the last two decades under the leadership of the Ministry of Agriculture.**
- **Only focused on biomass stoves for cooking, coal stoves for heating and cooking were not included.**
- **Contrary to improved biomass stoves, coal stoves used in rural households are usually inefficient and polluting.**
- **Health impacts due to fuel combustion were not considered in that project.**

II. What We Have Done

2.1 Project field location



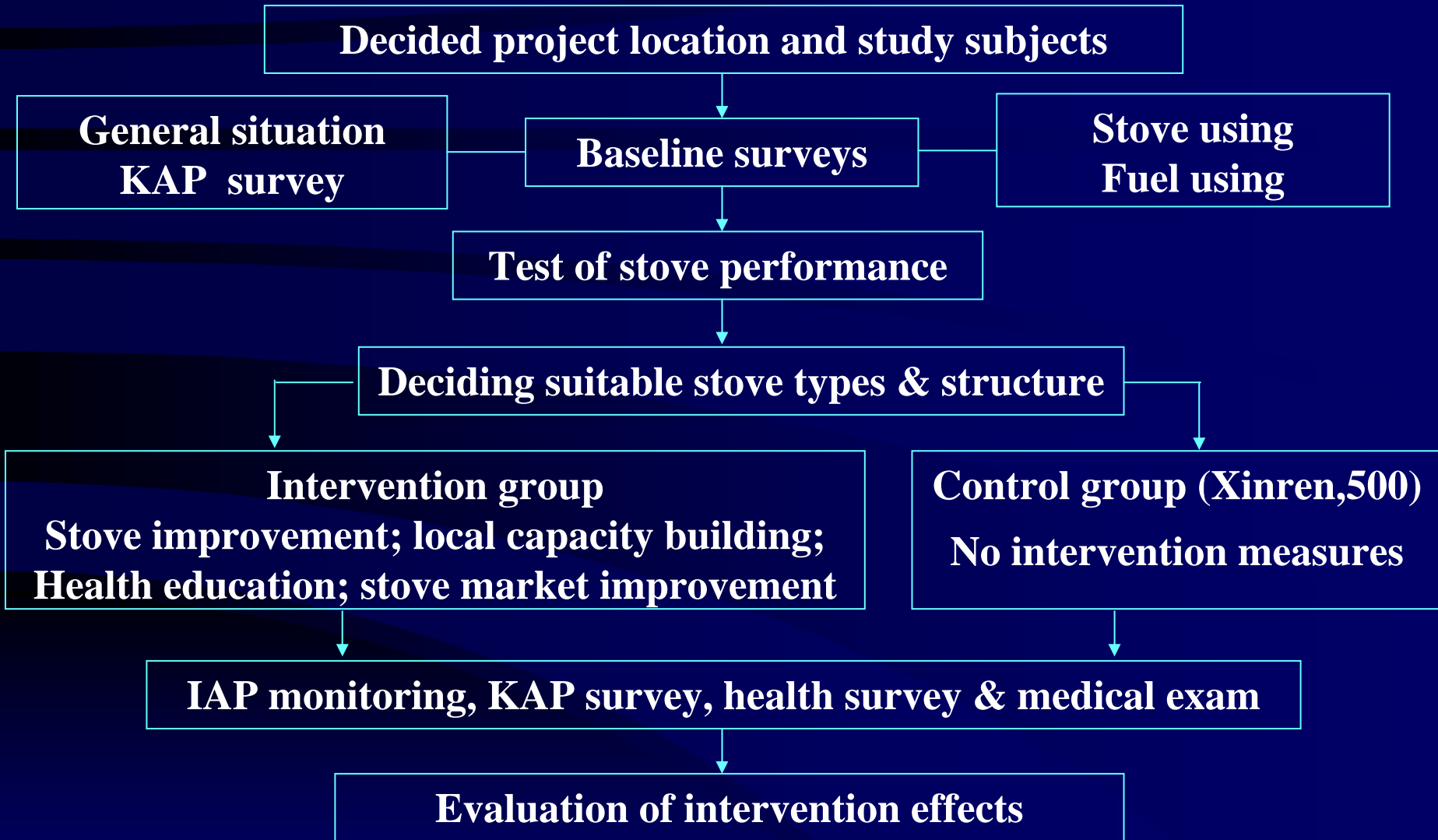
Guizhou province was selected as the project province, it located in southwest mountainous region of China.

Seven counties were selected as project counties. Where the coal combusting sourced fluorosis and arseniasis were dominated.

2.2 Main project objectives

- **To test a sustainable comprehensive resolution to reduce IAP and improve health situation through demonstration of affordable, reliable, clean, safe and efficient household energy use**
 - **Coal stove, for cooking, for heating and cooking**
 - **Biomass stove**
- **To explore the control resolution of arsenic poisoning due to coal combustion**
 - **To explore the more sensitive biomarkers for monitoring arsenic exposure**
- **To practice and retest the “soft subsidy strategy” introduced from the WB project for IAP control in rural areas**

2.3 Technical route



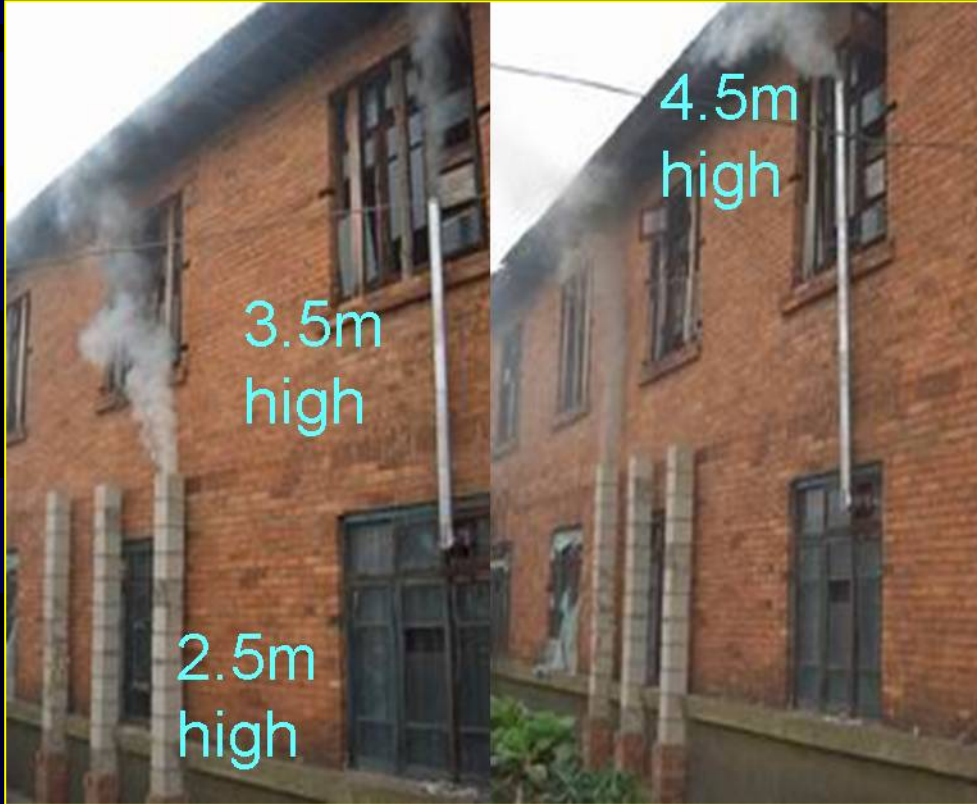
2.4 Stove intervention

- **Target population**
 - 50,000 households in 7 counties
- **Activities**
 - Investigation of stove types, fuel and stove market
 - Monitoring pollutant of PM_{10} , PM_4 , CO from stoves used
 - Tests of improved stoves
 - Deciding intervention stove types and parameters
 - Selection of improved stove manufacturers
 - Training of technicians for improved coal range construction
 - Preparing standard blueprint of improved stoves
 - Larger scale of improved stove dissemination, construction, or chimney extension outdoor

IAP emission monitoring and pyrology test



Simulated laboratory testing



Testing of chimney Height

Old stoves



Old iron stove



Old coal range



**Outlet of chimney
in the room**

Types of improved stove (1)



Air circular stove



**Movable coal stove
made of brick and
iron fittings**



Electricity stove

Types of improved stove (2)



Coal / biomass range



**Outlet of chimney
out of the room**

Training of technicians for improved coal range construction



Larger scale of stove improvement



Stove dissemination



chimney dissemination

Amount of improved stove

Project county	Air circular stove	Improved coal range	Chimney outdoor only
Longli	1253	1798	7670
Bijie	9014	0	1143
Liuzhi	35	10079	0
Puding	3100	6934	0
Anlong	4000	0	0
Xingren	3315	1685	0
Xingyi	109	897	0
Total (51,032)	20,826	21,393	8,813

2.5 KAP intervention

- **Target population**

- 50,000 families in 7 counties and students in primary and middle schools

- **Activities**

- Social mobilization
- Setting up health education leading group
- Training of trainers
- Health education in community
- Health education in schools
- Supervision of health education activities

Key information for health education

- **Sources of IAP**

- Improper stove devices, improper or no chimney, higher F / As contaminated coal, uncompleted combustion, unhealthy living habits

- **Health impact of IAP**

- Respiratory diseases and symptoms, fluorosis / arseniasis, neurological symptoms, eyes symptoms, CO poisoning

- **Prevention of endemic fluorosis and arseniasis**

- Correct purchase, use and maintenance of improved stoves
- Keeping healthy living habits

Health education in community

- **The health education network was set up at township and village level.**
- **The ways of health education included slogans, VCD, leaflets, community meeting, folk song, *etc.***

Health education in schools

- **The ways of health education in schools included health education lessons, composition, slogans, social practice, artistic performance, *etc.***

Health education activities in community



Poster



Blackboard



Slogan



Picture on wall

Health education activities in community

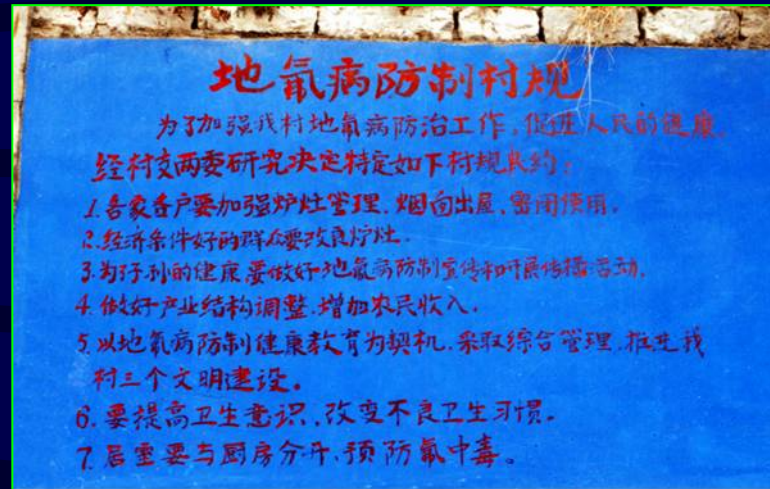


Household visiting



Film

Health education activities in community



Villagers' rule and pact



VCD propaganda



Community meeting

Health education activities in community

Field consultation



Health education activities in community

Artistic performance



Health education activities in community

Leading behavior change



- **Drying food with tobacco parching room**



- **Washing food before cooking and eating**



Behavior changes

Health education activities in school

Small hands linking big hands



Children are easy to accept new knowledge.

Children are paid more attention to in family.

Through the behavior changes in the next generation of children, to block the improper living habits related to fluorosis/arsenism was expected.

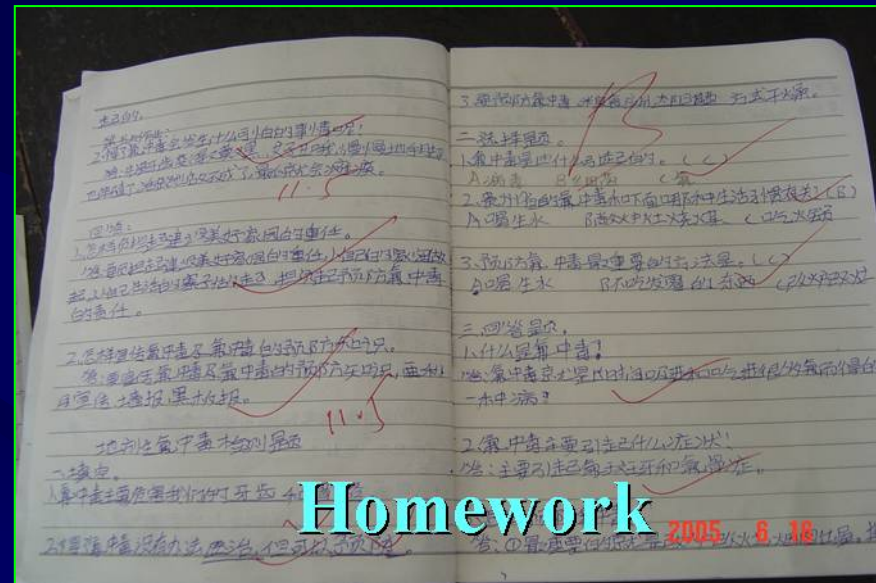
Health education activities in school



Health education lessons



Teaching materials



Homework

Health education activities in school



A poem for fluorosis prevention



On curriculum schedule

Health education activities in school



An oratorical contest



Knowledge quiz

Population coverage of health education

Counties	Township	Administrative Villages	Households	Population
Xingren	3	12	5000	19148
Xingyi	3	6	2368	9575
Anlong	3	13	4186	18400
Bijie	2	21	12468	49651
Liuzhi	2	24	13122	59357
Puding	5	37	11547	51452
Longli	6	53	12810	53946
Total	24	166	61,501	261,529

2.6 Comprehensive model of intervention

1) Multi-sector involvement

– Health, education, mass media, Women's Fed, energy, agriculture, poverty assistance, industry and business, development and reform committee, finance sectors

– Effects:

- ✧ Direct involved in project implement**
- ✧ IAP awareness building in themselves**
- ✧ Indirect: discussing IAP issues, project scheme, providing recommendations, exchanging data and experiences**

2) Project management

- **Setting up leading groups in central, province and county level**
- **Setting up project offices in each county for coordination**
- **Responsibility agreement signing was requested each level**
- **Setting up demo households and organizing visiting and exchanging experiences**
- **Period report was required to provincial and county offices**
- **Periodical supervisions were carried**
- **Archives and records system were set**

3) Combined the IAP control work with other rural works to “build a new countryside”

- **“build a new countryside” program are going on rural areas launched by central government**
- **in order to promote ecology situation and social-economic in project areas**
- **Endemic diseases prevention and control, drinking water hygiene, toilet sanitation, environment protection (forest reservation), poverty assistance and economic development are been combined with this project**
- **Combined with the central government financial transfer fund for fluorosis/arsenism control project in Guizhou**

4) Soft subsidy strategy conception

- **Capacity building in society, community, policy, research**
- **Enhanced health education**
- **Market development**
 - ✧ **on stove design, technician training, distribution net setting, community demand, market policy**
- **Shared payment in purchasing improved stoves**
 - ✧ **To lower the expectation of full-payment from project**
 - ✧ **To promote better use and maintenance**
 - ✧ **To push people to act by themselves**
 - ✧ **30% co-pay by villagers was reachable, 50% co-pay could be triable**

5) Promotion of improved stove market

- **Market chain:**
 - **Producer** (purchase supported qualified producers)
 - **Technician** (training)
 - **Sale/distribution** (setting up distribution agents)
 - **Consumers** (promoting consumers' willingness of buying new stove)
- **Product quality**
 - **Criteria regulation for IAP control**
- **Policy support**
 - **Tax**
 - **Villagers' rule and pact**

III. Evaluation

3.1 Evaluation Activities

- **Baseline survey**
 - Survey on family general situation, stove using and fuel using
 - KAP survey in community
 - KAP survey in students
- **Post evaluation survey**
 - Stove performance test
 - IAP monitoring in households
 - Personal IAP exposure monitoring
 - KAP survey in community and in pupils
 - Health survey and medical examination
 - ARI surveillance
 - Related sample collections (urine, food, water, soil, coal)

IAP monitoring



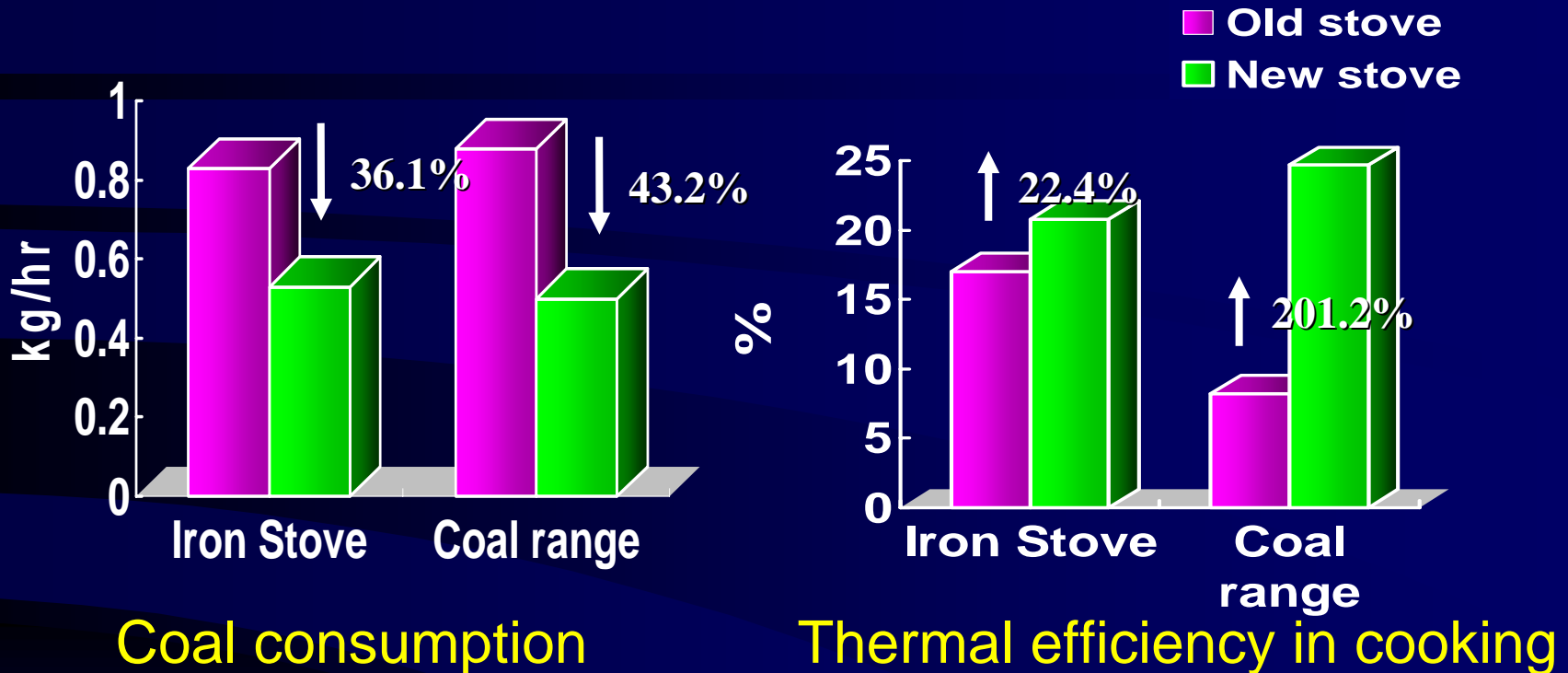
Health exam



Questionnaire survey

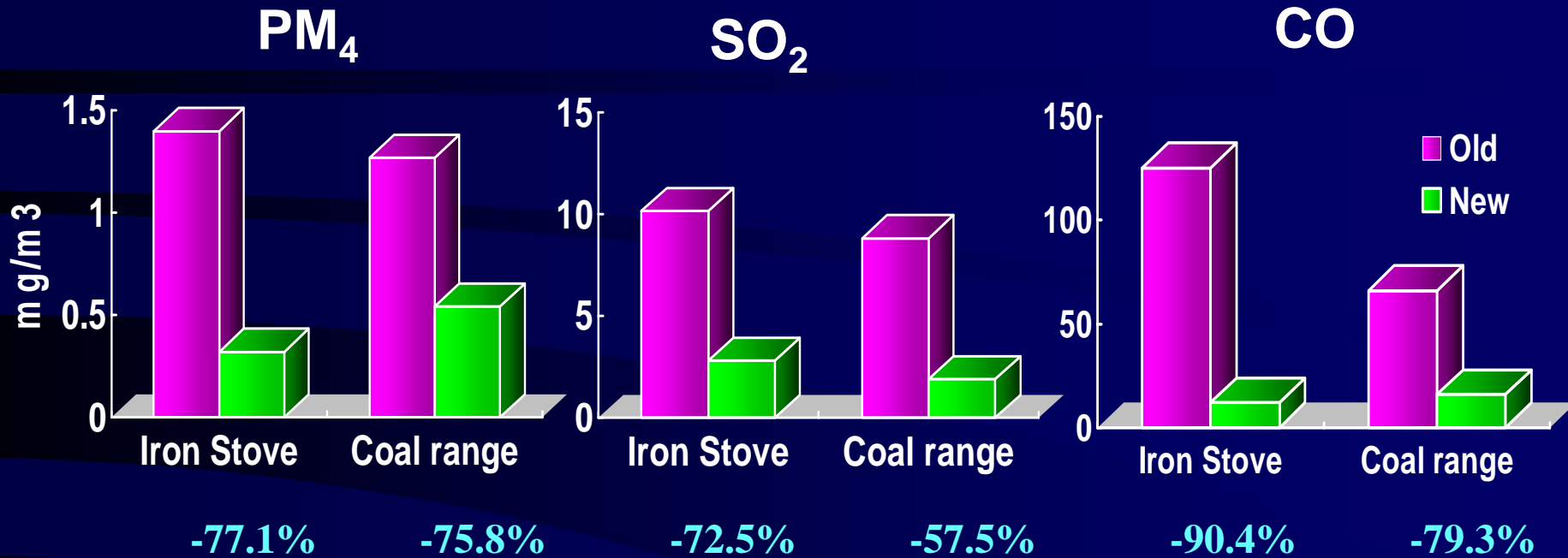
3.2 Some Results

Stove performance



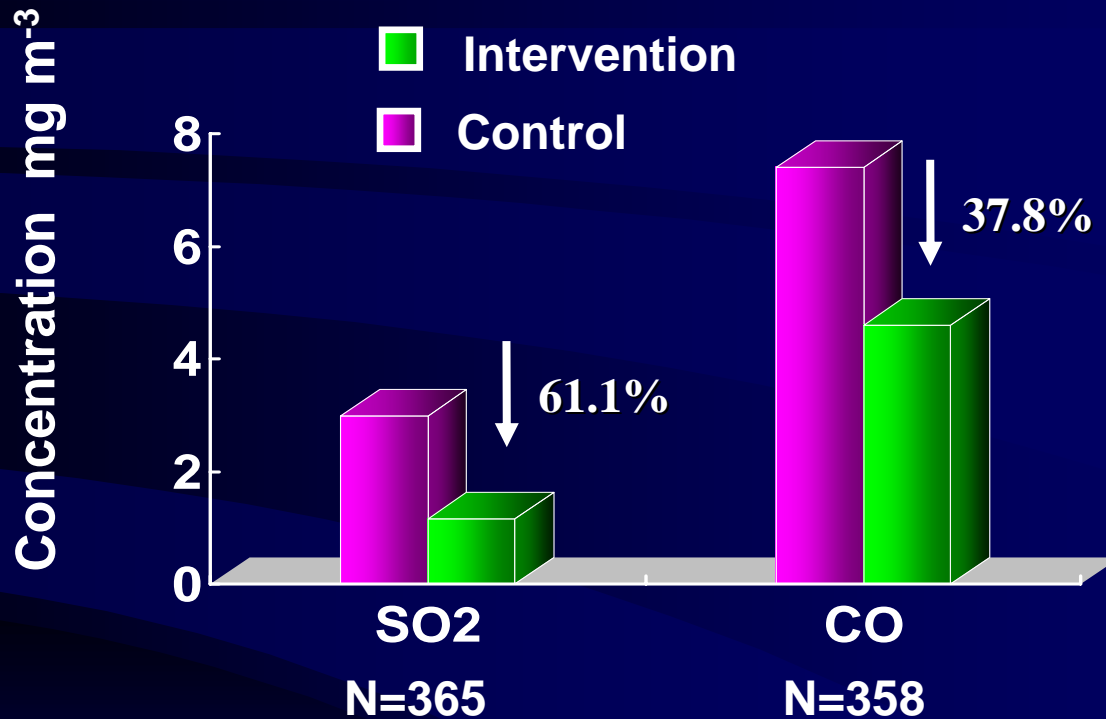
Compared with old stove, the coal consumption and thermal efficiency of new stove decreased and increased respectively.

IAP emission comparison between new and old stoves



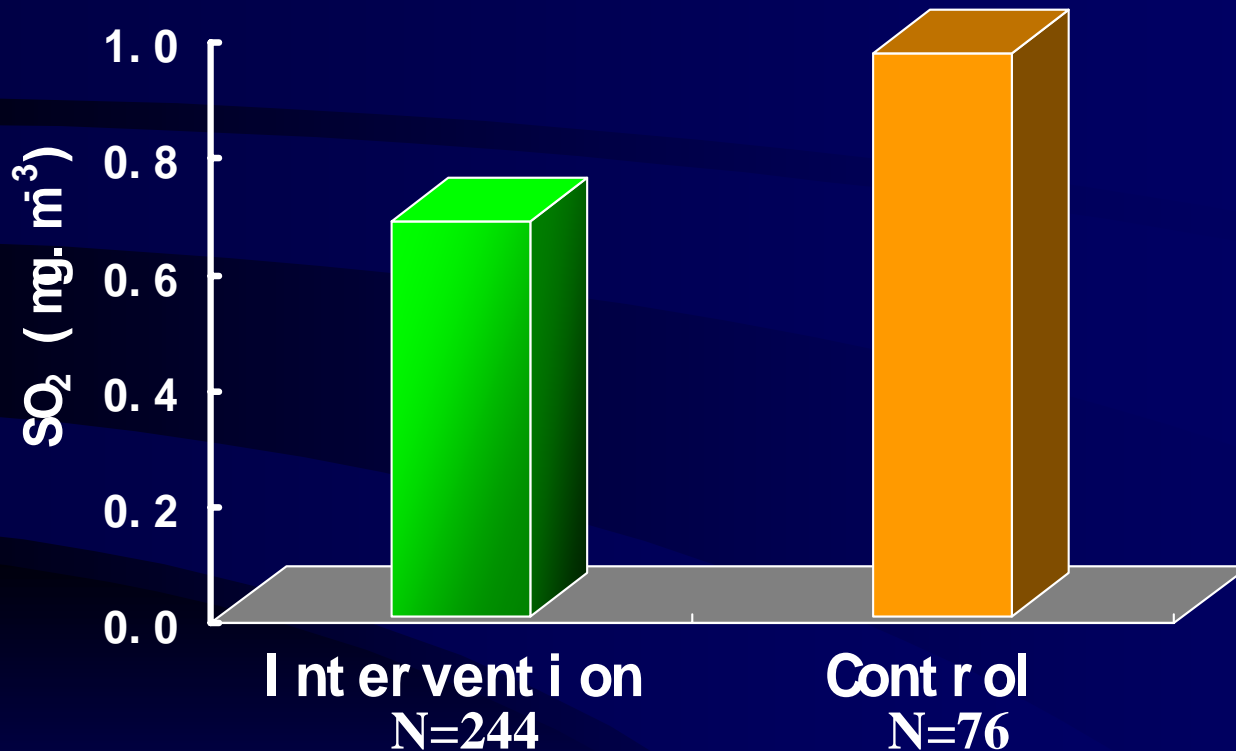
Compared with old stove, the concentration of PM₄, SO₂, CO from Air Circular Stove decreased by 77.1%, 72.5%, and 90.4%, and from New Range decreased by 75.8%, 57.5% and 79.3% respectively.

Comparison of indoor air pollutant concentration in intervention group and control group (December, 2005)



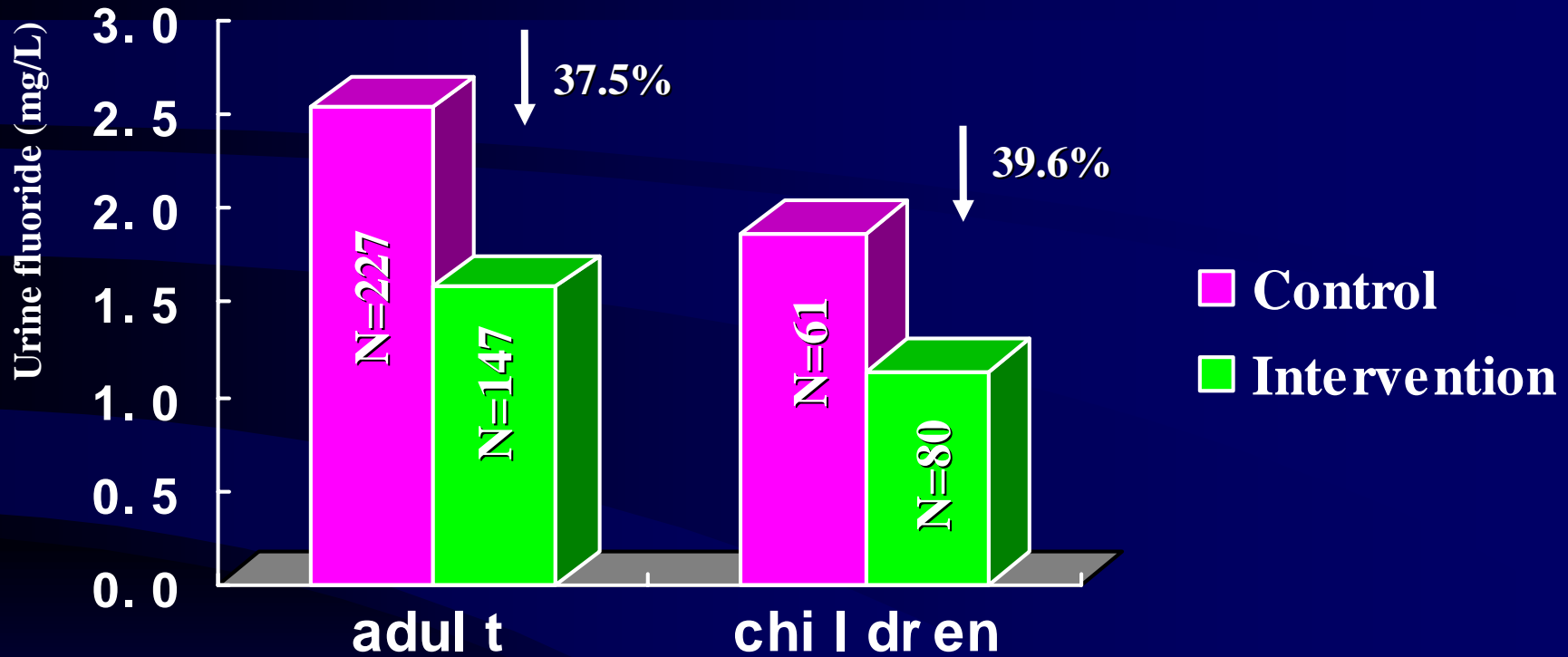
After stove intervention, SO₂ and CO in indoor air decreased by 61.1% and 37.8% respectively.

Average SO₂ concentration of personal exposure (December, 2005)



The SO₂ of personal exposure concentration in intervention group lower than in control group.

Comparison of urine fluoride between intervention and control group



Urine fluoride of adult and children in intervention group is lower than control group by 37.5% and 39.6% respectively.

IV. Conclusions

- **Improved stoves worked better than old ones in coal consuming, thermal efficiency and pollutants emission.**
- **After intervention, personal exposure to IAP and urine fluoride in intervention group were lower than control group.**

- **Stove / ventilation improvement is necessary in this period, which may effectively reduce IAP due to coal combustion**
- **Health education should be one of important component for activating community involvement in project as well as in stove improvement / correct use, and keep good habit**
- **IAP intervention could be combined with other work of local government**

V. Challenges

- Continuous health education activities should be necessary for sustainability (to keep good habits, correct use & maintenance).**
- Solid fuel use should be instead by clean fuel, because stove improvement can not finally solve problem.**
- Clean fuel use may be involved in stove improvement project for choice and introduction because the demand and financial status of villagers are varied.**
- More and better techniques for choice should be developed and popularized**

*For life,
environment,
and the earth!*

**Thank
you !**

