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China's Conversion of Cropland to Forests Program: development
framework, economic impacts and future challenges
-Based on 10 years' monitoring results of 100 sample counties
around China

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Abstract: This paper uses a 10 years monitoring data set of 100 counties to examine the process, implementation and impacts of China's Conversion of Cropland to Forests Program (CCFP). A theoretical framework was constructed to explain the development of CCFG. We find that CCFG was originate from economic growth and will fulfill its goal by economic growth as it closely linked with rural poverty; Constrains such as income decline will finally be solved along with policy adjustment and economic growth; Huge amount of subsidies had been successfully delivered to farmers under strong administration and innovative policy; due to incentive incompatibility between farmers' private interests and public benefit, we assume that CCFG only achieved second best ecological goals, but a better sustainability. The policy still faces many uncertainties due to climate change, rural development progress, et al.

Introduction

In 2009, the Conversion Cropland to Forests Program (CCFP, known as 'Grain for Green Policy') had been implemented 10 years. Chinese government pre-launched the CCFP policy² with the aims of effectively halting ecological degradation caused by years' resources exploration in 1999. In 2002, when the Program initiated and reached its full range, it covered some 32 million rural households with 124 million populations in more than 2500 counties of 25 provinces around China. Until 2009, 9.05 million ha of steep slop and highly depredated sandy cropland had been converted to forests and grass with 14.14 million ha afforestation on barren land and 1.93 million ha of maintain closure, representing a 10% to 20% increase in current

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²The CCFP policy was divided into two phases. The first phase was implemented from 1999 to 2007. Main contents of the policy in the phase include 'Convert cropland to forests and grass, mountain closure for conservation, provide subsidy and individual contracts'. CCFP subsidy consists of three parts, grain, cash and seedling. Grain subsidy standard was 150 kg/mu/ year in the Yangtze River drainage basin and 100kg/mu/year in the Yellow River drainage basin. Since 2005, the grain subsidy was changed to equivalent cash. The cash subsidy standard was 20 CNY /mu /year. Seedling subsidy was 50 CNY/mu /year. For the time frame of subsidy, 8 years to ecological afforestation, 5 years to economic trees and 2 years for grass. Farmers got seedling from local forestry department in stead of seedling subsidy. The second phase of policy started in 2007 when first 8 years compensation ended. The core of the policy is to maintain exiting CCFP forests and further converting cropland to forestry was ended but adding afforestation on barren and mountain area instead. The policy consists of two parts. One is continue provide subsidy to farmers but reduced half for both grain and cash subsidy, and the time frame is the same with the First Phase. The standard of grain subsidy is 105 CNY for the Yangtze River drainage area and 70 CNY for the Yellow river drainage area. Cash subsidy remained unchanged but must subject to CCFP forests management. The other part of policy is to in titled 'strengthen CCFP outcome scheme'. The objective of the scheme is to providing better living condition to CCFP farmers, enhance their long term development capacity and well maintain CCFP outcome accordingly. The scheme covered basic grain filed construction, rural energy, ecological migration and amend afforestation, etc.

national forest area, and roughly a 10% decrease in China's cultivated area. Total central government investment had reached to 196.1 billion CNY and by the end of second phase of the program, total government investment will increase to some 500 billion CNY in 2016.

Why China employed CCFP? As the world largest ecological restoration and compensation program, after ten years implementation, does it achieved initial goals? Does the huge subsidy fully delivered to CCFP households? Under the condition of CCFP subsidy reduced half in its second phase while grain production subsidy is increasing year after year, how to maintain CCFP forests and sustain the program is of immense challenge for decision maker especially when considering grain production uncertainty shadowed by climate change. Those issues were raised and always argued by decision makers and policy researchers during the program implementation.

After literature review and find out main argument about CCFP since the policy initiating, we constructed a CCFP development theoretical framework in the context of economic growth, indicating that most of argument would no longer exist when taking economic growth into account. The paper will then test those issues and arguments based on a ten years continue monitoring results of 1165 CCFP households in 100 counties of 21 provinces around China.

The paper is structured as follows: next section is literature review and main argument of CCFP, the second part is theoretical framework of CCFP development in China, the third section tests the argument and theory framework by CCFP monitoring results, and the final part is conclusion and next step for policy and academic research of CCFP.

1. Literature review and main argument of CCFP

1.1 Literature review

Owning to its large scope and immense influence, CCFP tops environmental and resources economic related research in China in recent years and raise wide concern internationally. A number of academic papers and policy research reports appeared since the Policy implemented in 1999. Ten years CCFP research could be divided into 4 phases.

The first phase was from 1999 to 2001. Since in its trial stage, the focus of CCFPP was policy and management design. Research highlight in this stage include impact of CCFP on rural livelihood survey, stakeholders and their role in the Program, deliver of CCFP subsidies and design of the Program management (Feng, 2001, Zhu, et al, 2003, Du, et al, 2001). The outstanding research results in this phase were livelihood analysis of CCFP and landscape level management system design lead by Feng GI with the support of WWF (Zhu, 2003).

The Second phase was from 2002 to 2004. During this period, CCFP was implemented in its full scale and poverty alleviation goal was applied to CCFP in

addition to environmental improvement. The highlight of CCFP research turned to profound survey and impact analysis. Supported by China Committee International Cooperation on Environment and Development (CCICED), Xu J.T. lead a comprehensive CCFP research project that conducted profound survey on four pioneer CCFP provinces in West China, representing this period of CCFP work(CCICED Taskforce on Forests and Grasslands, 2002). Some innovative research methods such as program monitoring and assessment approaches developed by the World Bank and other international organizations (Xie, et al, 2002), the input-output technology (Zhang, 2002) as well as Participatory approach had been applied to CCFP.

The Third phase starting from 2004 to 2006, mark the peak of CCFP research. Topics ranging from cost-effectiveness and sustainability (Xu, et. al. 2004, Tao, et. al, 2004, Yi, et al 2004), grain security (Tao, et al, 2004, Xie, 2005), cost-benefit analysis of CCFP livelihood (Xie, et al, 2006) to non-market environment benefit estimation (Wang, et al, 2007). More innovative approaches such as the game theory, information economics as well as choice modeling approach had been applied in this phase. From policy implication point of view, Wang, X.L.'s work entitled 'The Cropland Conversion, Contracting Out and Public Regulation' was the most outstanding one³. Cost-effectiveness, sustainability and structure effects series research lead by Xu, J.T also arose broad concern. In 2003-2006, lead by Bennett, a ANU and FEDRC co-conducted research project⁴ had firstly applied choice modeling approach to estimate non-market environmental benefits in CCFP(Bennett, J; Wang, X; Zhang, L.(edit), 2008). The socio-economic monitoring and assessment (SEMA)of CCFP had began to systematically analyze CCFP policy and its impacts, assisting policy implementation and modification since then (SFA, 2003).

The Fourth phase (2006- present). Since the second phase of CCFP policy appeared publicly and no large policy modification in near term, CCFP research calm down. Realizing its previous limits, Yang and Xu further analyzed CCFP impacts on farmers' income (Yang, Xu, et al, 2009). Xie and Peng, et al systematically reviewed and assessed CCFP in 2010 by conducting a nation wide CCFPG household survey which covered some 3000 CCFP households in 24 provinces around China⁵, forming a land

³The article described various scenario of conflicts between CCFP farmers' private benefits and government's ecological goals by production possibility frontier and incentive compatible mechanism and how it would affect the realization of ecological goals. Though, without large amount of data to support his view, what he predicted from his theory had all come true and all suggests he raised in the article had become the second phase of CCFP Policy.

⁴The 'Sustainable land use in north west China' project was fund by ACIAR and co-conducted by Australian National University and China National Forestry Economics and Development Research Center (FEDRC), State Forestry Administration. In the project, cost-benefit analysis of CCFP households, choice modeling, water resource modeling as well as benefit transfer approaches were applied to construct estimate the costs and benefits of CCFP in Northern China. During the project implementation, 400 rural households, 600 city residents were interviewed. The research results was published by Edward Elgar in 2008

⁵ The survey was co-conducted by FEDRC CCFP monitoring group and Beijing Forestry University. 125 university students whose family or nearby villagers is implementing CCFP were recruit during their Spring Festival Holiday. The survey sample covered 3119 farmer households in 233 villages of 125 counties in 24 provinces. Household basic information, participating CCFP status, policy implementation, policy assessment, farmers' expectation to the policy were addressed by the survey

mark of CCFP policy research (Xie, et al, 2011). Based on previous research results, Bennett lead the Sino-Australian team further exploring land use policy efficiency by applying conservation auction into reallocation government ecological fund in the Yangtze river basin sine 2008. The research results will provide valuable policy advice to CCFP policy makers who used to deliver public money by administration channel.

1.2 Issues and arguments around CCFP

It is found that most of CCFP issues and arguments focus on income and poverty alleviation, cost-effectiveness, sustainability, structure effects as well as grain security when review previous research. Clarify and discuss those issues would help to see the development of CCFP research and policy progress itself as well. In the following section, those issues will be addressed one by one.

Sustainability. Sustainability of CCFP referred to the issue that whether or not farmers could maintain CCFP forests on the converted cropland through labor migration; intensify agricultural production and other sources of income when CCFP subsidy ended (Xu, et al, 2004). It is an issue raised at the very beginning of the policy implementation as in the middle of 1980s, several cropland converting to forests projects in Ningxia and Sichuan province funded by UN Food Planning Department failed after grain aid ended. Worried about Chinese government may not continue provide subsidy after 8 years program period, the early research believe that some farmers may reconvert the land back to cultivation after program ends (Uchida, Xu, Rozelle, 2005). Even after the second phase of CCFP policy was implemented, the worry still existed as some farmers can not find alternative income source after the Policy ended again. Is there any solution? Xie, et al found that all CCFP farmers when ever rich and poor are better off and possibility reconvert land to cultivation drive by poverty might substantially reduced thanks to recent years' rural preference policy and rapid urbanization. Hence, they believed that economic growth would eventually solve the sustainability issue of CCFP though it takes long time to achieve (Xie, et al, 2010).

Poverty alleviation and increase income to CCFP farmers. Xu and Liu insisted that CCFP had no effective impacts in increasing farmers income and in poverty alleviation especially to low and poor households (Xu, et. al, 2002; Xu, et. al; 2004, Yang, et. al, 2009; Liu, et. al, 2009). However, Xie found in 2003 that the subsidy would made poor farmers much better as it account for larger proportion of their income via their monitoring data (Xie, et.al, 2003). Using 10 years monitoring results, Xie further approved the finding by comparing sample farmers' deflated net average income before and after CCFP and by the University student survey, et al (Xie, et al, 2010).

Cost-effectiveness. Uchida, et al first rise the issue of cost-effectiveness of CCFP and found that the government may be able to generate fiscal savings if the payments

more accurately reflect the differences in the opportunity costs of each plots (Uchida, Xu, Rozelle, 2005). Tao and Xu point out that CCFP standard is 2.5-3.6 times of higher than CCFP. However, considering transaction costs of calculating opportunity costs of each plots and design and deliver different the payments in current Chinese farmers status, it might difficult to get this conclusions. Primary research results of the Sino-Australian project show that Chinese farmer has used to unified subsidy from government and it is difficulty to for them to accept different payment scheme based on conservation auction.

Incentive compatibility. Wang's Three hypothesis of CCFP farmers' behavior, i.e. Planting more economic trees, less investment⁶ and reconvert CCFP land to crop production, which would deviate government optimal ecological goal of had all been validated (Taskforce on Forests and Grassland, 2001, Xie, et al, 2010). However, having observing the gradually relaxed CCFP ecological requirement (allowing intercropping and dividing some economic trees into ecological tree category) and rapid increase of farmers' welfare, Xie points out that the conflicts between farmers' private benefits and CCFP' goal would gradually melt down.

Grain Security. Liu, et al points out that CCFP had caused some grain decrease at household level even though it differed by different regions in China (Liu, et al, 2009). Based on both farmer level and county level monitoring results, looking at national grain output volume in 10 years time span, Xie argued that the reducing grain output effects was only limited at household level. In a long run, CCFP have no negative impacts on China's grain security (Xie, et al, 2010) .

Looking back to above issues/arguments, except cost-effectiveness, the rest of them all have regional or time limitation. We argue that time would eventually solve those constraints/difficulties. Three factors support our view. *Firstly*, sustainability of CCFP would be gradually strengthen with rapid economic growth has increasingly improving overall welfare of Chinese farmers and enhancing their development capacity by better infrastructure and rural social insurance system. At the same time, more and more farmers would leave rural area driving by fasting urbanization pace. Rural land pressures will be reduced. As a result, farmers would rely less on CCFP subsidy to maintain converted forests. *Secondly*, the readjusted CCFP ecological targets also increasing incentive compatibility. After several years of implementation, having realized the importance of economic return for farmers to maintain CCFP forests, the decision makers relax ecological requirements (allowing intercropping and dividing some economic trees into ecological categories). The adjustment had better combine farmer's short economic benefit with government ecological objectives, hence increased incentive for CCFP farmers. *Thirdly*, the policy itself is also developing. Having recognized that poverty is the origin of ecological degradation

⁶Three step was carried out by farmers in Dingxi county, Gansu province when participating in the CCFP, i.e. first plant more grass, if government didn't against, plant grass in all converted land; next, if must plant tree, they would plant more fruit trees; the last, input as less as possible to the trees and grass (Taskforce on Forests and Grassland, 2001)

and biggest threaten to CCFP, in its second phase policy, CCFP had expanding its program contents to rural energy, basic cropland construction, ecological migration and fostering CCFP related industries with the aims of providing basic living conditions to farmers and helping maintain CCFP forests.

Ecological improvement is a long process. Taking CCFP into Chinese rapid economic growth and world forestry development, the results would be different to address above issues/agreements. This is also the limitation of all CCFP research until then. Hence, in the next section, we developed a theoretical framework of CCFP in the context of economic growth.

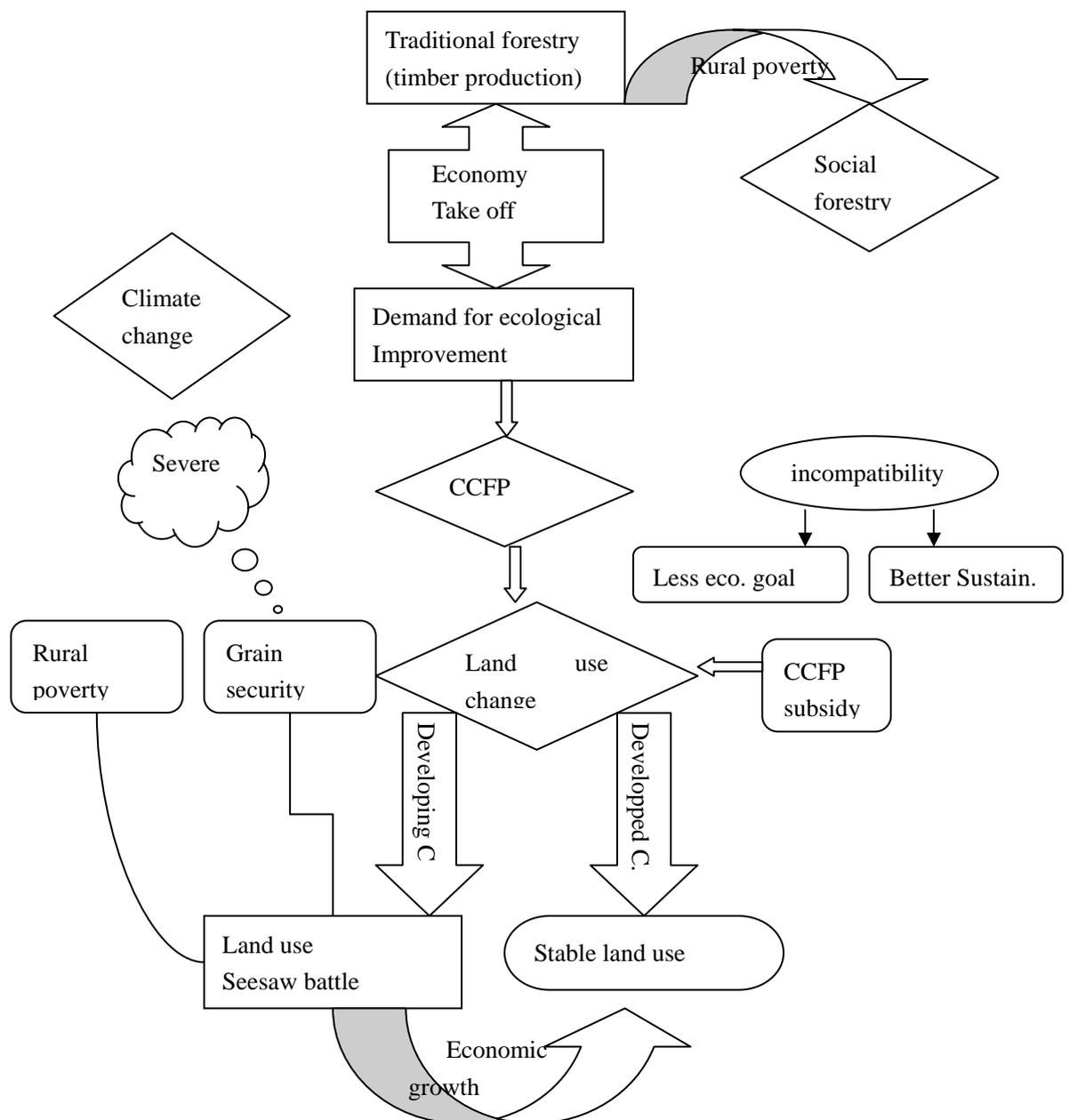
2. Economic growth, forestry change and CCFP development-a theoretical framework

Generated from economic growth, CCFP would ultimately achieve its goals by economic growth. Why China initiated CCFP in 1998 when its economy had just taken off? Popular reasons include the Yellow River break off stream in 1997, the Yangtze Rive flood in 1998, the intend to reducing national grain storage, so did the loss of state own grain enterprises (Tao, et al, 2004), and to boost domestic demand through rural market development (Zhang, 2002). We argue that those were all true factors to stimulate CCFP, but determined driving force behind them is economic growth which generated increasing demand to environmental improvement and ecological restoration in China. The fundamental conflict of Chinese forestry development of that time was the increasing demand to better environmental condition and severe ecological degradation trends after years' resources over exploration. The efforts to solve the problem brought CCFP to China and changed Chinese forestry ever since. Our thinking was demonstrated in Figure 1.

It can be seen that before the economic take off, timber production dominated traditional forestry. In developing country, forestry is related with rural poverty, which adding social forestry into traditional forestry; After a nation's economy take off, increasing demand for environment improvement and ecological restoration created CCFP which expanding traditional forestry boundary into cropland and agriculture, marking a historical shift from logging forests in expanding arable land to converting arable land to forests. Land use change is the core of CCFP, Since related to arable land, CCFP in developing country has a close link with grain security and agricultural production, which will eventually result in structure change of both rural livelihood and rural economy; CCFP subsidy is an economic instruments to realize the land use change, and as a public policy, it build up a contract relationship between individual farmers and government through land tenure rearrangement (Wang, 2004); In developing countries, CCFP is related to rural poverty and grain security is adding uncertainty to CCFP especially under the condition of climate change, hence, there will be a long term land use seesaw battle between forestry, crop production and animal husbandry. In contrast, in the developed countries, land use conflicts has

generally relaxed as economic growth has solved rural poverty problem and market based instrument build more smooth relationship between land users and government. It is the economic growth which made the difference as ecological degradation is rooted in rural poverty and economic growth is fundamental to poverty alleviation as well as ecological degradation related to it. Therefore, looking at the origin of CCFP and comparing different status of CCFP between developing and developed countries, we assume that the ecological restoration demand which originated from economic growth could only be meet by economic growth.

Figure1. Economic growth, change of forestry and development of CCFP



In summery, CCFP is a land use pattern which is originated from economic growth and realized through ecological compensation. Since related to rural poverty and crop production, conflicts between forests and grain production would remind in long period of time in developing countries like China. Only when rural poverty was eventually removed like developed countries driven by economic growth, can CCFP reach it full ecological goals? That's the developing law of CCFP which would be tested by our 10 years monitoring results.

3. CCFP: Effectiveness and Impacts-10 years demonstration

3.1 Data collection

Data source of this article is the Project of Monitoring and Assessment of Socio-economic Impacts of China's Key Forestry Programs⁷ (hereafter refers to 'Forestry Program M&A) which include CCFP. The CCFP monitoring data consist of two parts: one is the annual based CCFP socio-economic monitoring and assessment (hereafter refers to 'annual monitoring') and the other is the CCFP farmer households survey conducted by university students in 2010 (hereafter refers to 'student survey').

The annual monitoring continually collects data from fixed CCFP monitoring samples. There are three group of CCFP monitoring samples, namely county, administration village and farmer household. Until 2010, total annual sample include 100 counties, 118 villages and 1165 farmer households; The sample distributed in 21 provinces⁸ around China, in which, 52 counties, 61 administration villages and 609 farmer households located in the Yangtze river drainage basin, while 48 counties, 57 administration villages and 556 farmer households situated in the Yellow river drainage basin. All samples are fixed and subject to no change⁹; The three level samples were chosen by stratification sampling methods¹⁰ and total CCFP area of the sample counties account for 11.63% of the nation's CCFP area; Main monitoring contents include basic socio-economic situation, forest resources and forestry production, policy progress and implementation, et al. 431 indicators depict those monitoring contents in 2009¹¹., with 141 county indicators, 113 village indicators, 177 households indicators and 26 qualitative questions; To collecting data, monitoring

⁷ Initiated in 2002, funded by Ministry of Finance, the project was co-conducted by China National Forestry Economics and Development Research Center (FEDRC) and Department of Forestry Planning and Investment Management, State Forestry Administration. It has been implemented almost 10 years.

⁸ The 21 provinces are Hebei, Shanxi, Inner Mengolia, Liaoning, Jilin, Heilongjiang, Anhui, Jiangxi, Henan, Hubei, Hunan, Guangxi, Chongqing, Sichuan, Guizhou, Yunnan, Shannxi, Gansu, Ningxia, Qinghai and Xinjiang.

⁹ Since 2003, there is no change of county and village samples, few households sample changed due to various reason such as move to city, land was used for reservoir and pass away of household head, et. al. The change had informed to FEDRC according to the FEDRC' Key National Forestry monitoring regulation.

¹⁰ County samples were firstly chosen from 250 key CCFP counties randomly through a constructed framing which link the 250 counties by a CCFP areas. In each sample counties, one or two CCFP village were chosen mainly considering CCFP areas. For the counties who have two sample villages, one village is richer and the other is poorer in economic condition. In each sample villages, CCFP farmers were divided into three groups, rich, middle and poor, and then sample households were chosen from each three group roughly by their proportion, forming 10 households sample size.

¹¹ There are some minor changes of indicators according to program progress, hence, each year the number of indicators was different.

working groups was set up at SFA, province and county level with total staff of some 130 persons¹²; Each year, an annual Key National Forestry Monitoring data collection form which include CCFP will be formulated in SFA and then delivered to the monitoring provinces who then distributed the form to each sample counties; The data collection form consist of three type of data collection tables, county, administration village as well as farmer households. County data comes from related government department such as the Statistics Department, Agriculture Department, while village and households data will be collected by the monitoring staff by visit and interviewed with sample households each year; Data collection frequency is annually which usually start from the November last year when the data collection form was delivered to provinces and ended by next August when annual monitoring report was finalized and submitted to SFA.

The university student survey is an complementary of the annual monitoring. In order to sum-up its experience, in the 10 years anniversary of CCFP, the CCFP monitoring group initiated this survey in 2010. The survey was co-conducted by FEDRC CCFP monitoring group and Beijing Forestry University. 125 university students whose family or nearby villagers is implementing CCFP were recruit during their Spring Festival Holiday. The survey sample covered 3119 farmer households in 233 villages of 125 counties in 24 provinces. Household basic information, participating CCFP statue, policy implementation, policy assessment, farmers' expectation to the policy were addressed by the survey. Since most recruited students come from CCFP farmer households, it is much easier to get true information. With its wide distributed survey sample, the survey had become solid complementarities of the annual monitoring.

3.2 Effectiveness and Impacts of CCFP

After 10 years implementation, has CCFP achieved it goal of reducing water and soil erosion and increasing vegetation cover? Do farmers better off? Using CCFP monitoring data as well as university student survey, We try to testify the critical issues.

3.2.1 Achieving environmental improve goal?

County level monitoring results show that CCFP successfully achieved it goal of increasing vegetation cover. The 100 sample county monitoring results indicate that there is a notable forest resources growth since CCFP initiating in 1999. In 2009, forest area of the sample counties reached 10.79 million ha, increasing 25.30% comparing with 1998, forest coverage grow to 32.93%, 7.75 percentage higher than that of 1998, and CCFP contributed 26% of the forest resource grow. At the same period of time, forest area in China increased from 175 million ha to 195 million ha,

¹² This number didn't include forestry, township and village officials who help to facilitate data collection. If considering those people, the total CCFP monitoring team would at least expanding to some 300 people (each county 3 persons)

rising 11.43%, and forest coverage increased from 18.21% to 20.36%, 2.15 percentage higher. Comparing CCFP sample counties with overall China, the increase of forest coverage in CCFP counties is 5 percentages higher than the nation (Figure 2.).

Our field survey and university student survey also proved above monitoring results of sample counties. During our field survey in Gansu, Ningxia and Hunan, farmers told us the most obvious change since CCFP is that mountain is more green, river water is more clear, floods often attacking villages almost disappeared and wild animal had been frequently seen even in very dry area. The university student survey found that 63.28% of survey households believe mountain is more green, 40.73% recognize reducing sand and wind attack, 32.72% see more wild animals, 26.63% consider more rainfall and 23.72% think river water more clear (Figure 3.)

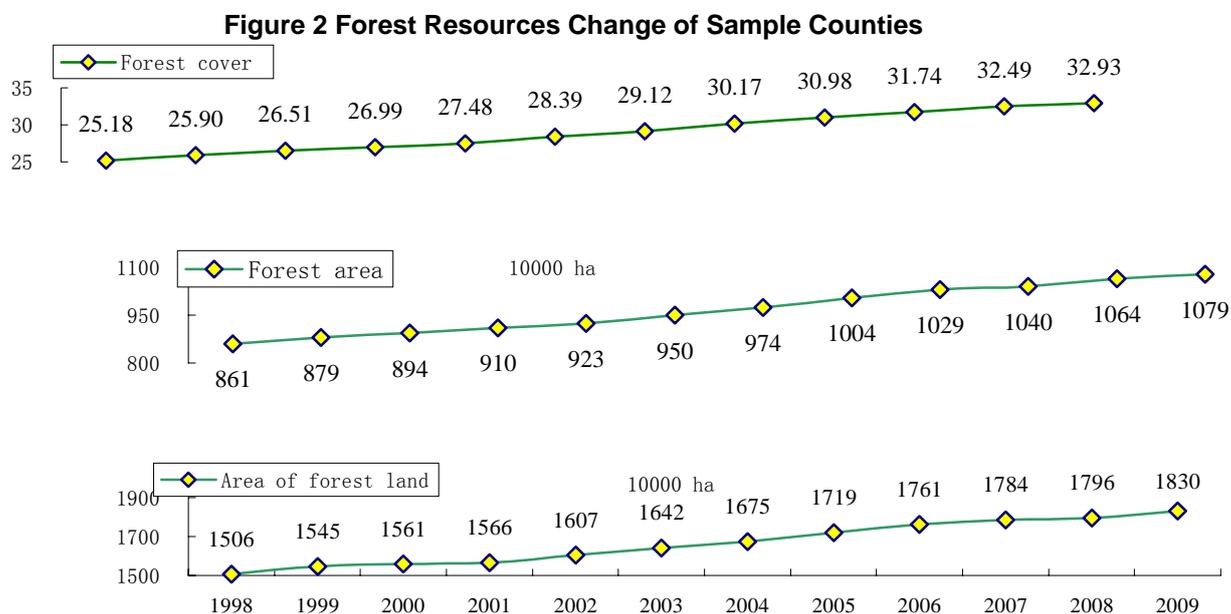
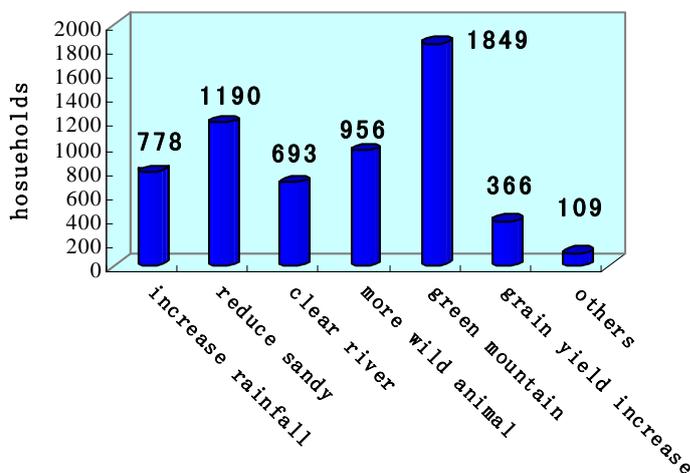


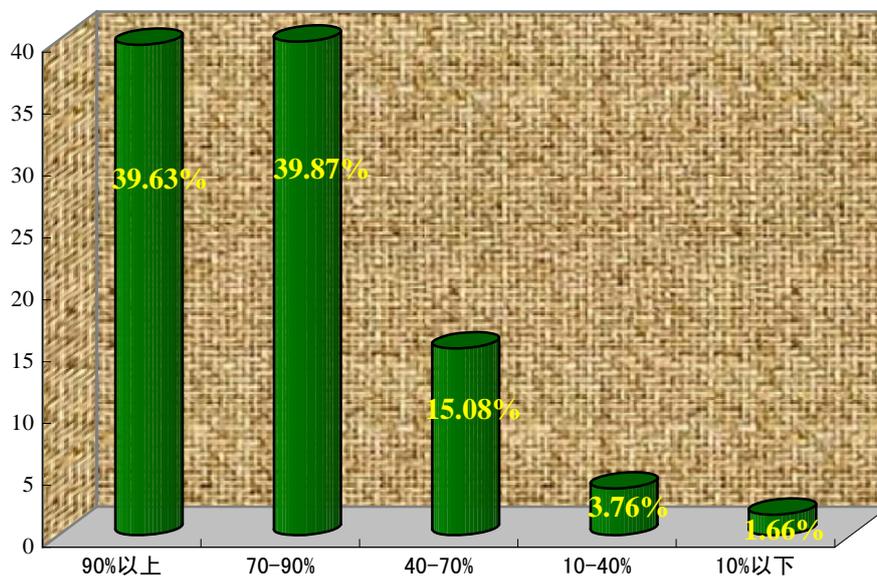
Figure3. Ecological change from survey farmers 'view



3.2.2 Does CCFP forests still there?

It was found that under strict government inspection and policy stimulation, CCFP forests grow well and average maintain rate is above 85%. After 10 years huge investment, how many trees still maintained on the CCFP land? This is critical indicator of CCFP. Since CCFP involved million of farmer households who would facing many difficulties and uncertainties to their converted forests such as drought, market fluctuation and wrong policy implementation, et al, how to made farmers well manage CCFP forests is of enormous tasks for Chinese government. What are the results? The 25.3% of forest area increase in the sample counties since CCFP indicate that CCFP trees remained and become forests. University student survey results tests this from farmers' point of view. It shows that farmers whose CCFP tree survival rate¹³ is from 70%~90% account for 39.87% of total survey households, survival rate rang from 40-70% account for 15.08%, those with survival rate lower than 10% , account for 1.66% (Figure 4.). So, it could be say that CCFP forests survival rate should be 85% in average from farmers roughly estimates. Drought is the dominant factor to low survival rate and other factors include bad seedling, short of technique and less management according to the survey.

Figure4.Survival rate of CCFP forests of survey farmers



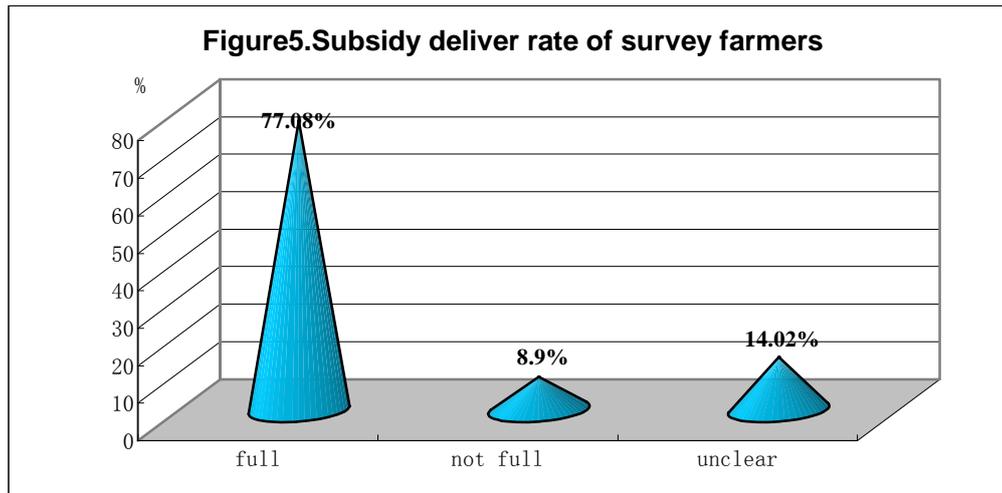
Strong program management and policy stimulation guarantee the results. In the program management perspective, many regulations and instruments were set up to implement CCFP, and at least three measures had made it possible. a. Province government take full responsibility of CCFP implementation and cities and county

¹³ In this survey, tree survival rate is different with standard technical term. It just let farmers to estimate what percentage trees still left on their converted land until 2010.

government take CCFP as their administrative targets, indicating all government resources has at and lower than province been mobilized to implement CCFP; b. At household level, the deliver of the 20 CNY/mu cash subsidy is related to CCFP forests management; c. In the second phase of CCFP, mend afforestation had been carried out in the failure or low survival CCFP plots. From policy stimulation, two factors encourage farmers concern and better manage their CCFP forests. a. Thanks to the ‘individual contract’ land tenure arrangement under CCFP, farmers own the outputs of CCFP plots and have initiative to manage the forests. b. For farmers who already obtain some outputs from the plots would have more incentive to better manage it. The sample households monitoring results show that 81.29% of them manage CCFP plots by themselves and 42.57% had invested into the management of the forests. University student survey got similar conclusion that 88.52% of survey households had managed their plots and 80.31% point out that their plots has been check by forestry persons.

3.2.3 Do the huge subsidy fully delivered to farmers?

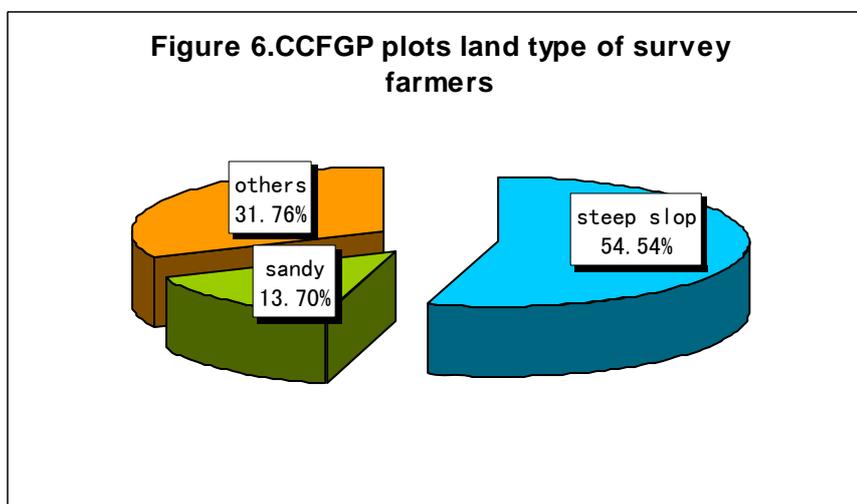
Our monitoring results demonstrate that innovative and continued improved policy mechanism had ensured huge CCFP subsidy delivered to farmers. Low efficiency of public investment is a common problem encountered by development countries. After design and applying series of innovative fund delivery approach, CCFP had effectively increased public investment efficiency. In its initial management mechanism design, grain, cash and seedling subsidy was required delivered directly to CCFP farmers, first of this kind in China. In addition, CCFP contracts, farmer households file, subsidy accept records as well as public postor of plots and subsidy delivered in administration village, et. al, further prevent leakage of the public investment. Annual monitoring results show that in average, rate of CCFP subsidy delivered to farmers was 95%. While, university student survey indicate that the rate should be above 90% if deducting some farmers don’t fully understand the policy (Figure 5.) . Moreover, when asked their preference, 87.20% of survey households point out that it is necessary to continue implement CCFP and only 1.64% of them want to stop it. If CCFP didn’t delivered to farmers, the supporting rate of CCFP should not be such high. Hence, it demonstrates that most of CCFP subsidy had been delivered to farmers from different angle.



Having successfully solve the difficult of deliver large amount of public funds to million of rural households, CCFP experience could be learn from other developing countries. Meanwhile, as million of rural households are beneficiaries of in a long period of time, CCFP has also become a profound rural development program in the world.

3.2.4 Targeting

It was saying that CCFP is an image program, CCFP plots mainly allocated along roadside, steep slop land was not included in CCFP, but high yield plots instead. Targeting of CCFP had always been blamed in the past. Is it true? University student survey denied it. Looking at reverted arable land type, 54.54% are steep stop plots, 13.70% are sandification land and 31.76% others. In converted land quality, 44.31% are low yield cropland, 48.08% are middle yield plots and high yield land only account for 7.61% (Figure 6.) Those figures point out that most of CCFP plots are marginal land which is the source of past ecological degradation, and targeting rate of CCFP was relatively high.



3.2.5 Increase income and poverty alleviation

As described before, CCFP's role in poverty alleviation and increase income had been argued most heavily. Our monitoring results show that CCFP had increased farmers income, played significant role in rural poverty alleviation and enhanced overall rural welfare. Four facts support our points. Firstly, in county level, the average net income growth rate of sample countries was higher than that of national average, indicating that CCFP has positive impacts on farmers' income (Figure 7.).

Secondly, comparing average revenue between 1998 and 2009 of the sample households deducting inflation, it is found that agricultural revenue, business revenue, migrant labor income as well as net per capita income increased in different extents. This result indicates that after CCFP, farmers' income increased and better off.

Figure 7. Net per capita income increase rate of sample counties and national average.

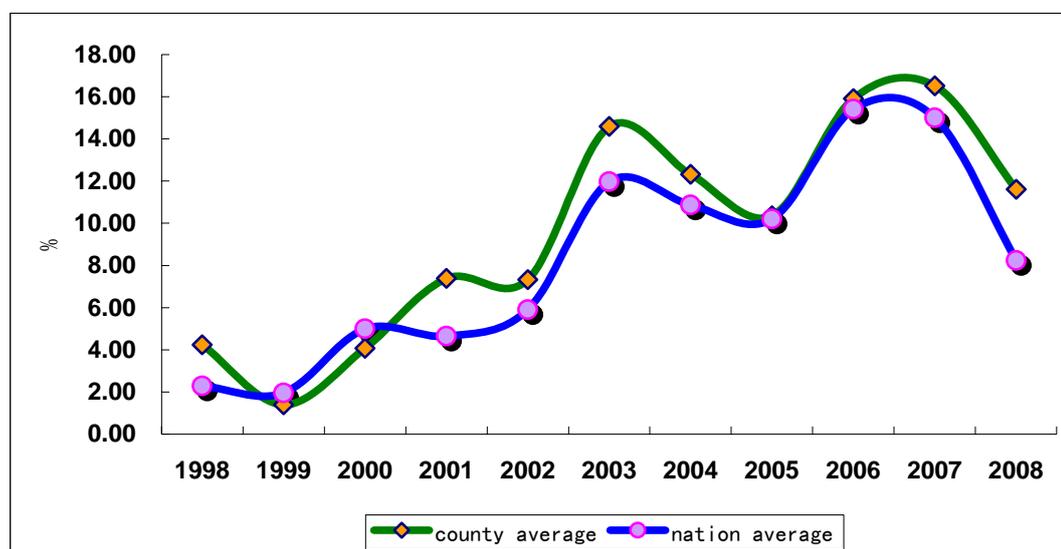


Table1. Revenue and income comparison of Sample households 1998-2009

Unit: CNY/households

	1998	2009*	Increased by % comparing 2009 to 1998
Crop revenue	5019	6035	20.25
in it: grain	2542	3450	35.72
cash crop	2477	2585	4.37
Animal husbandry revenue	1275	3664	187.37
Business and industry revenue	431	2715	529.87
Migrant labor income	956	5553	480.89
Per capita net income	1305	3940	201.93

Note: * deflated value

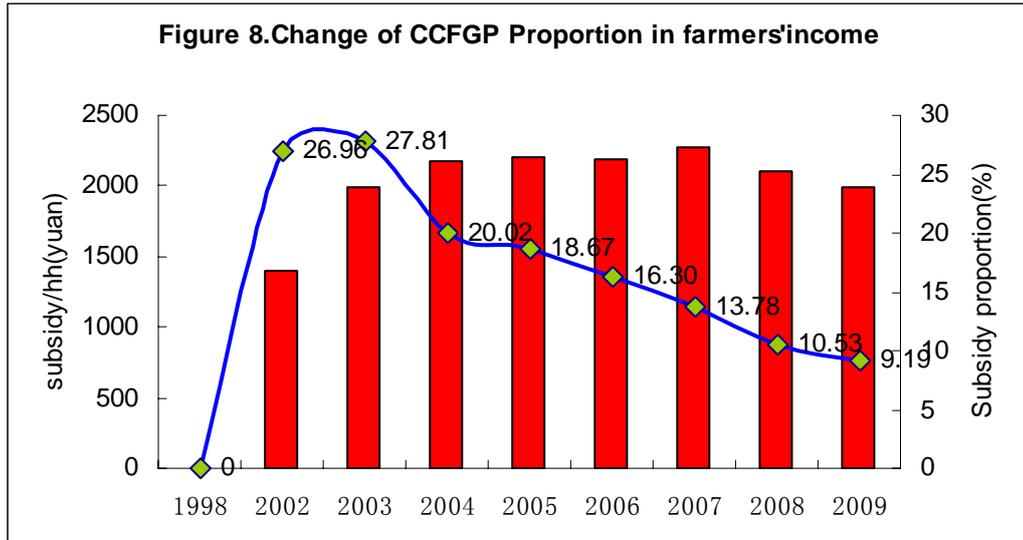
Thirdly, increase farmers' migrant labor income by releasing labor from crop production. Sample household monitoring results show that in 2009, farmers' migrant labor income has increased almost 5 times comparing that of 1998. Deducting wage factor, farmers' migrant labor income increased 182.55% from 1998-2009, that should be the net contribution of CCFP to sample households labor income when neglecting status quo of rural farmer's overall migrating trends in the context of rapid urbanization.

Fourthly, CCFP subsidy had become important part of farmers income and have significant impacts on poverty alleviation especially for the poor. In average, CCFP subsidy accounts for 15% of farmers' income. For lower income family or the ones who suffered natural disasters or only rely on arable land for living, the contribution rate could be 80% or 100% as observed by the university students. 'The subsidy might be little to farmers who have heavy burden to support college students or care patient, but for that poor grandmother, it is almost all income for her year round' (Lu Nini, student of Beijing Forestry University)

Finally, CCFP farmers' welfare will be effectively enhanced with the implementation of the Second Phase Policy as it will provide better rural infrastructure, higher agricultural productivity and living conditions to farmers.

Table 2. Proportion of CCFP subsidy in survey farmers' income

Region	Average proportion (%)
Northeast	16.82
Central	12.95
Northwest	19.11
Southwest	12.63
Minority	17.53
Key CCFP counties	16.36
average	15.58



3.2.6 Structure effects ?

There was a significant of structure change according to the monitoring results. At the basis of reverting steep slop and sandy arable land to forests, CCFP changed land use structure first, relocated labors and other production factors, gradually alter agriculture and rural economy structure, turn CCFP area from severe ecological fragile to sustainable development. Comparing to 1998, cropland area of sample households reduced 46.82%, while forestland expanding 5 times. At the same time, percentage of crop production revenue in farmer's total family production revenue drop from 71.28% to 39.45%, forestry revenue percentage raised from 4.46% to 18.86% and there were significant change for agribusiness and animal husbandry too (Figure 8. and Figure 9.) .

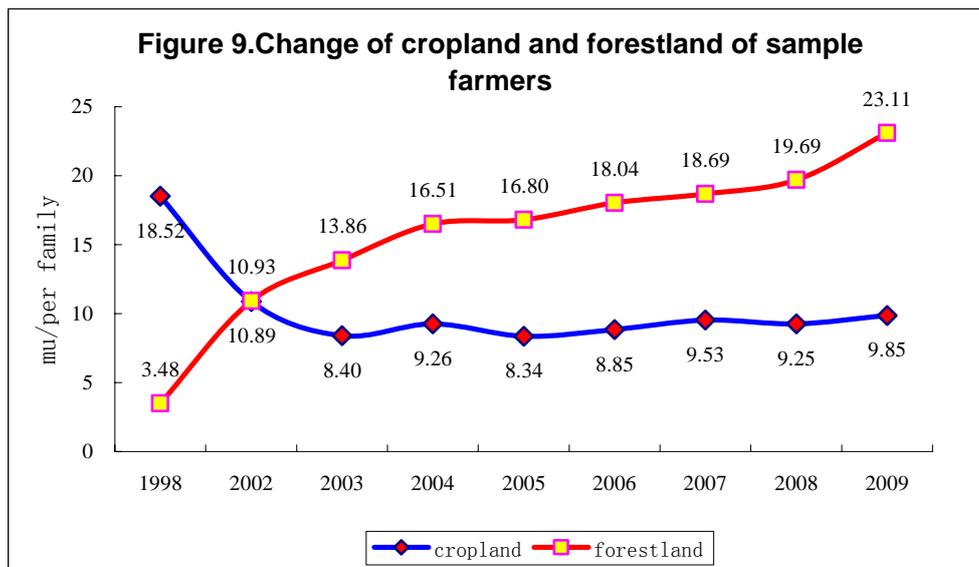
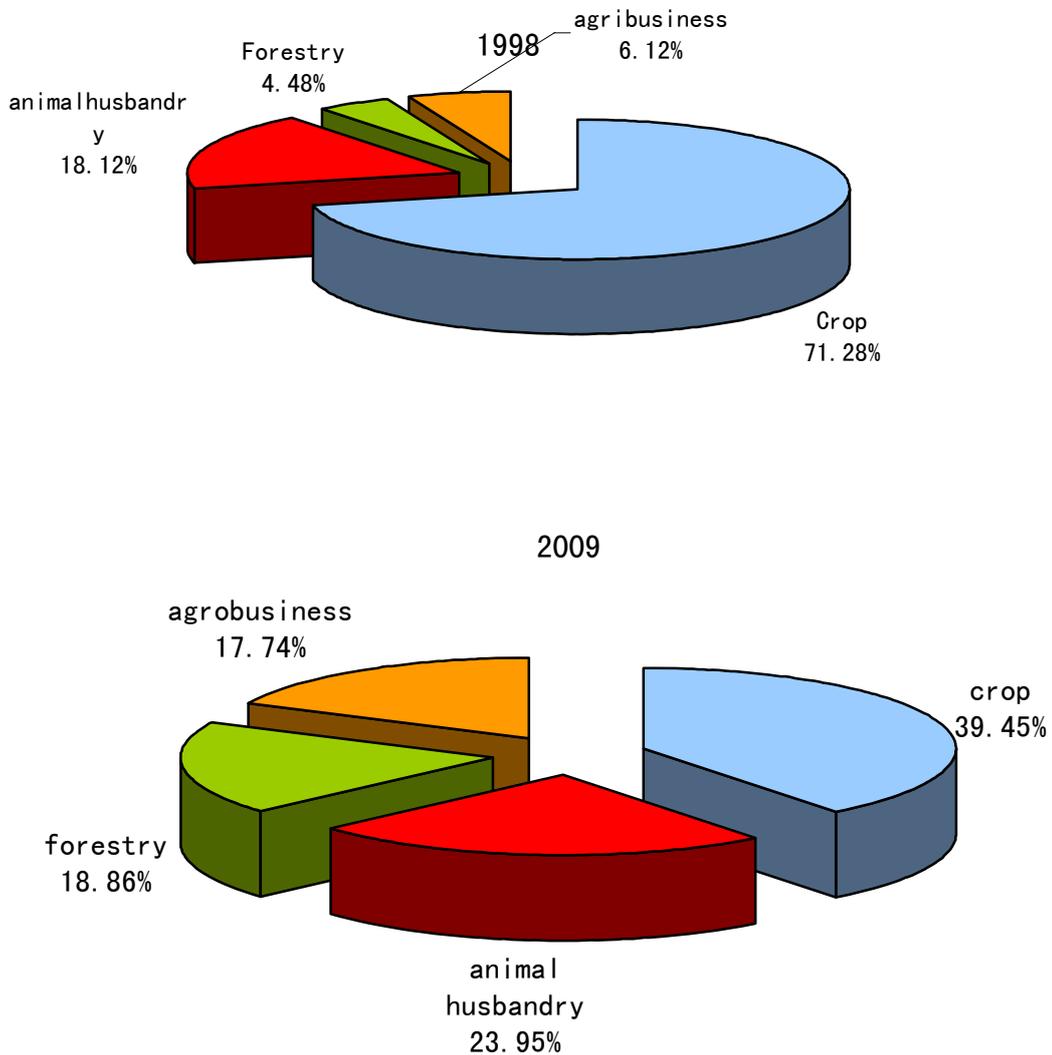


Figure 10. Structure Change of Family Production



3.2.7 Grain Security

CCFP had reduced large amount of cropland and will definitely reduce grain outputs. However, does it reduce China's grain security? According to the monitoring results, we found that CCFP had caused significant decrease of grain output value but not threaten China's grain security. Grain output volume change of sample households, counties as well as the nation were used to demonstrate the conclusion. In farmer household level, since CCFP reduced both of cropland area as well as grain sown area, in 2009, grain output volume reduced 31.49% comparing to 1998. At county level, from 1998 to 2003, grain output volume were decreasing, but in 2004, it stop decline and start surpass the 1998 grain output until then, and negative impacts of CCFP on

grain production was ended at county level. In 2009, grain output volume of sample counties increased 11.51% comparing to 1998. Similar trends occurred at national level, in 2004, it stop drop and start rising, and in 2008 it surpassed the 1998 output level. There is a 3.62% of increase of grain output volume at national level in 2009 comparing with 1998. Through the three level analysis, it can be seen that even though CCFP caused absolutely reduce of grain output at households level, it will not threaten to China's national grain security.

Table 3. Grain output of sample households, counties and China

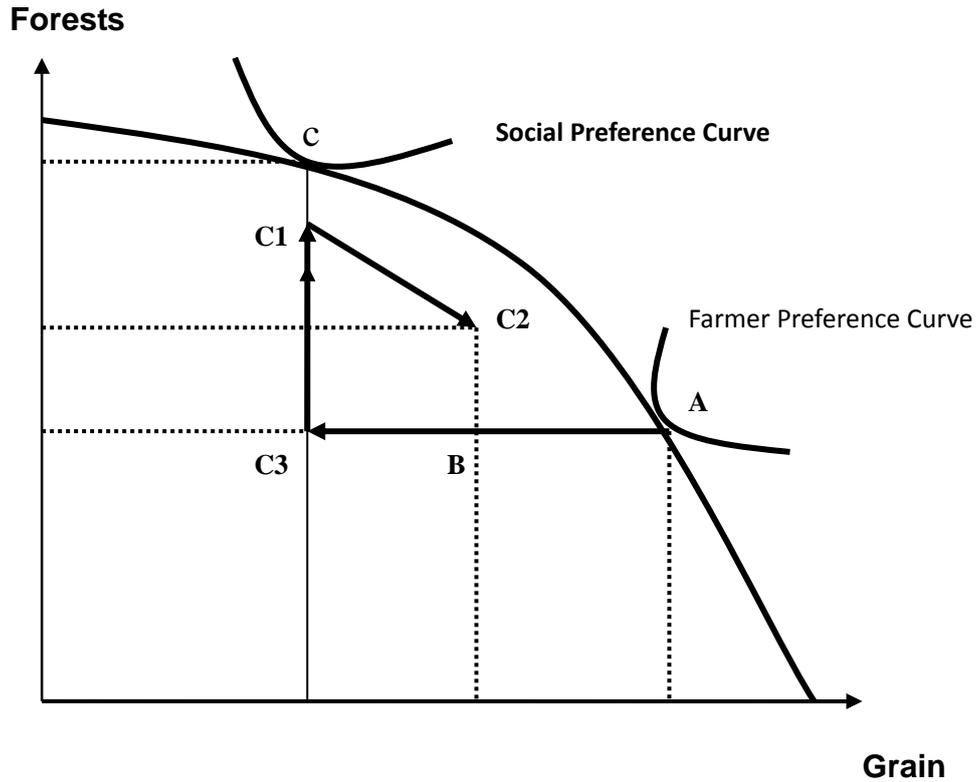
	Households (5000gk)	County (10000 tons)	Nation (10000 tons)*
1998	701.38	1912.32	51229.5
2002	489.73	1707.53	45705.8
2003	387.54	1659.28	43069.5
2004	423.20	1920.79	46946.9
2005	435.15	1942.73	48402.2
2006	463.10	1931.11	49804.2
2007	495.10	2061.73	50160.3
2008	483.55	2106.19	52870.9
2009	480.48	2132.37	53082
Increase of 2009 comparing to 1998 (%)	-31.49	11.51	3.62

Note: *data source: 2009 China Statistics Year Book. China Statistics Bureau.

3.2.8 Does CCFP optimize its ecological goals?

Due to incentive incompatibility between individual farmers private benefit and public goals, CCFP would not realize its optimal ecological objective but the second best. The theoretical assumption of Wang X.L was tested true by the monitoring results. Wang points out that at least three kind of farmers' behavior would driven CCFP away from its social optimization: i.e. planting more economic trees and intercropping (C_1), less investment (C_2) and reconvert to previous land use pattern (C_3). The results of university students survey show that economic tree rate was over 40%, intercropping rate was near 20%, percentage of reconvert CCFP plots to crop production was approaching 10%, and farmers who invest to CCFP plots account for 42.57% of total surveyed households. All those facts (C_1, C_2, C_3) had driven CCFP from away from its optimal ecological goal at point C (Figure 11.).

Figure 11. Production Possibility Frontier of CCFP



Econometric analysis of the relationship between arable land area (independent variable) and forestry revenue, grain subsidy, CCFP subsidy as well as migrant labor income (dependent variables) of sample household from 1998-2009 also proved above points (Table 4). Forestry revenue is notable negative to arable land area, indicating the conflicts between forestry and crop production. Since most of forestry revenue was generated form CCFP, this relationship also imply that farmers who have more CCFP outputs would more likely maintain the plots and less possible return to crop production. The grain subsidy was positively related to arable land area, implying that the subsidy has the effects to increase cropland area which may cause threaten to CCFP. CCFP subsidy is significantly negative to arable land area, demonstrating again that CCFP is the main source of arable land decrease of sampled farmers. The significant relationship between migrant labor income to arable land area once again indicating the effects of CCFP’s releasing rural labor from crop production and increasing rural larbor migration.

Table 4. Test of incompatibility of sample farmers

Dependent Variable: ARLAND

Method: Panel EGLS (Cross-section weights)

Date: 02/04/11 Time: 15:32

Sample: 2001 2009

Cross-sections included: 1165

Total panel (balanced) observations: 10485

Linear estimation after one-step weighting matrix

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	12.02298	0.045440	264.5903	0.0000
FINCOME	-6.22E-05	7.49E-06	-8.312001	0.0000
GSBSY	0.000216	3.90E-05	5.538294	0.0000
TSBSY	-0.000702	2.37E-05	-29.63837	0.0000
MLINCOME	-3.52E-05	2.28E-06	-15.48398	0.0000

Effects Specification			
Cross-section fixed (dummy variables)			
Weighted Statistics			
R-squared	0.990565	Mean dependent var	31.67682
Adjusted R-squared	0.989382	S.D. dependent var	79.25717
S.E. of regression	8.166852	Sum squared resid	621353.6
F-statistic	837.4039	Durbin-Watson stat	1.206615
Prob(F-statistic)	0.000000		
Unweighted Statistics			
R-squared	0.638323	Mean dependent var	10.45664
Sum squared resid	684662.2	Durbin-Watson stat	1.124347

It should be noted that relax ecological requirement might obtained second best of ecological outcome for CCFP, but since it considered farmers' private benefit, CCFP may gain more sustainability as the policy amending lead to a new round of incentive compatibility between farmers and government.

3.2.9 Sustainability

Even though Chinese government has successfully launched and implemented CCFP, maintaining its outcome still face uncertainty, so does its sustainability. *Firstly*, the conflicts between land use conflicts between forestry and crop production will exist for long period of time as result of tension among grain security, poverty alleviation

and ecological restoration. How long the seesaw battle would last and the result of it is unknown. The monitoring data show that comparative advantage of CCFP subsidy had gradually declined with the increasing agriculture incentive policy. From 2006 to 2009, proportion of grain subsidy in sample farmers' income had increased from 0.48% to 1.97%, meanwhile, proportion of CCFP subsidy in farmers' income had dropped from 16.30% to 9.14%. At the same time, arable land area of per sample households increased 11.26%; *Secondly*, even though the proportion of CCFP subsidy in farmer's income is declining, it is also part of farmers' income. Poor farmer rely more on it. Hence, how many farmers would find out alternative income source and will then not reconvert the CCFP plots is unknown. *Thirdly*, although output of CCFP plots has been increasing, but it only account for 15 % of farmers' revenue. Farmers who planting ecological trees have no output until then. Then facilitate by the second phase policy, to what extend the output of CCFP would be alternative income for farmers is unknown. *Fourthly*, what's the result of the second phase policy would be? To what extend it will help farmers solve food and rural energy problem and strengthen their development capacity, is uncertain. *Finally*, poverty is the root of ecological destruction. The only way to stop farmers return to previous land use is to solve their poverty problem. It is unknown that how long it will take for China's economic growth to solve poverty in the CCFP region.

4. Conclusion and next step

4.1 Conclusion

1. As the world largest ecological compensation program, CCFP has primarily achieved its goal of environment improvement and poverty alleviation. Monitoring results indicate that there is a significant increase of vegetation cover and number of wild animal along with better environmental conditions. Huge amount of subsidies had been successfully delivered to millions of farmers under the strong administration management and innovative policy mechanism, and contribute to significant poverty alleviation;
2. At the basis of reverting steep slop and sandy arable land to forests, CCFP changed land use structure first, relocated labors and other production factors, gradually alter agriculture and rural economic structure, turn CCFP area from severe ecological fragile to sustainable development.
3. Due to the exists of incentive incompatibility between farmers' private interests and public target of the policy, Grain for Green only achieved second best ecological goals, however, leading to better sustainability as the relaxed policy had better combined farmers short economic return and long term ecological restoration objectives.
4. Several factors such as land use conflicts, farmers' dependence on the subsidy, effectiveness of the second phase policy, and time frame of poverty alleviation, had

made maintain of CCFP face much uncertainty.

4.2 Next step

1. Analysis the impact of China's long term economic grow on CCFP and predicting CCFP trends by generating household, site, county and national simulation models;
2. Design new assessment system to analyze the effectiveness and impacts of the second phase policy and its role to maintain CCFP outcomes;
3. Explore the possibility of applying market based instrument to set subsidy standards;
4. Evaluating economic feasibility and cost efficiency at national level of CCFP comparing to other economic sectors;
5. Establish household and landscape model to analysis policy response and ecological benefits of CCFP;
6. Conducting comparison study and exchange experience and lessons with other countries regarding land use change and eco-compensation.

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