ECOSYSTEM-BASED ADAPTATION THROUGH SOUTH-SOUTH COOPERATION

GOOD PRACTICE CASE STUDY

Tackling Climate Change in Irrigated Agriculture in the 3H (Huang-Huai-Hai) Basin of China

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Globally, 70% of freshwater is used for agriculture[1]. According to the World Bank, in order to feed 9 billion people by 2050, agricultural production and water withdrawals will be increased by 60% and 15%, respectively. In many poor countries, agriculture is the most important economic sector. Unfortunately, it is also among the sectors most sensitive to climate change due to its high dependence, both directly and indirectly, on climate-induced conditions, such as droughts, floods, pests and epidemics. This case study presents an innovative way of tackling both agricultural production and climate change adaptation challenges through the two complementary projects at the time when China was just starting to prioritise climate change adaptation in the national policy agenda. One project sought to sustainably increase agricultural productivity, while the other one had the goal of enhancing adaptation to climate change in agricultural and irrigation management. The two projects were blended to be a combined operation. Both of them were implemented in China's most important breadbasket, where climate change is expected to bring about rise in temperatures and changes in precipitation patterns, among others, that will harshly hit an already water-scarce area. A range of interventions was introduced, such as productivity-enhancing and water-saving agricultural practices; better management of irrigation water through locally-based organisations; and promotion of high-value crops to boost rural incomes. Ecosystem-based adaptation (EbA) measures, for instance creating shelterbelts around the farmland to improve water retention, reduce soil erosion while also attract bird species, were a substantial part of the 'adaptation menu' developed for the field implementation. These adaptation measures have helped increase yields as well as provide greater protection from droughts and other events. Therefore, the farmers were enthusiastic to adopt those practices. Although this was the first comprehensive effort on agricultural climate change adaptation in China, it ultimately resulted in the successful mainstreaming of climate change adaptation in agriculture in China's 12th Five-Year Plan for Economic and Social Development (2011-2015).

The projects have provided extensive learning experiences for replication in other water and agricultural projects in China. This case study, therefore, could potentially inspire future development of climate change adaptation in agricultural sector in similar contexts worldwide.

[1] https://www.worldbank.org/en/topic/water/overview

Key lessons

- This case study has demonstrated that it is possible to retrofit an already on-going, large-scale agricultural irrigation project to integrate climate change adaptation focus. The positive results brought about from the combined projects have been realised by the key stakeholders, particularly the farmers and policy makers, on the improvements of agricultural productivity while saving water and the environment as well as responding to the climate change impacts. This is in fact a more cost-effective way to have a climate change adaptation project as an integral part of another project focusing on increasing agricultural water use efficiency, rather than implementing it as a stand-alone adaptation project.

- The objectives of both projects reflected that improved agricultural productivity was essential for better use of the country's water. In addition, they recognised that in order to be sustainable, land and water management was necessary to help protect the environment. In this regard, there were substantial investments in EbA measures to improve the agroecosystem. These measures typically benefitted both the productivity and ecological balance; shelterbelts could reduce soil erosion, integrated pest management decreased the use of pesticides, crop residue mulching conserved soil moisture, and application of organic fertiliser reduced the need of chemical fertiliser, among others.

- Since climate change adaptation was relatively new in China at that time, the adaptation interventions introduced to the farmers were easily assimilated as they brought benefits already under the current climate conditions, and would be resilient to further changes. Many of those 'no-regrets' adaptation measures, including EbA, were familiar to agriculture and irrigation extension staff. Some, such as the tree shelterbelts, were even already being practiced in the project areas, and were expanded during the implementation. Those measures evidently increased the farm yields as well as reduced the climate risks. Therefore, once the farmers understood the climate change concept and after they witnessed the demonstrations, they enthusiastically adopted those practices.

- The activities on knowledge generation, scientific assessment and capacity building on climate change adaptation were crucial to the success. The projects received technical support from experts both from domestic institutions (including the Chinese Academy of Agricultural Sciences and Chinese Academy of Sciences) and abroad throughout the whole process; from assessment of climate change impacts, design of the adaptation measures tailored to specific agro-ecological and climatic zones, to demonstration of those interventions that bring benefits for wider adoption. All were instrumental to achieving the adaptation objectives.

- Stakeholder engagement is of great importance. The projects highlighted the participatory implementation by working with the farmers and their associations, scientific community, provincial and county level command agriculture development programme offices, and the water and forestry bureaus to develop a commonly agreed list of climate change adaptation interventions. Substantial effort was put into dissemination of information to civil society, farmers, extension staff, government officials and political leaders on the concept of climate change and the adaptation required to respond to such changes. Altogether, these contributed towards obtaining immense support to implement such pioneering initiatives and eventually achieving the mainstreaming goal into one of the country's most significant development policies.

GOOD PRACTICE DESCRIPTION

LOCATION: Primarily in Hebei, Jiangsu, Anhui, Shandong and Henan with certain activities extended to Inner Mongolia, Jilin, Chongqing, Yunnan and Ningxia

IMPLEMENTATION PERIOD: Irrigated Agriculture Intensification III Project (IAIL3) in 2005-2010; Mainstreaming Climate Change Adaptation in Irrigated Agriculture Project (MCCA) in 2008-2012

OPERATIONAL BUDGET: Out of the IAIL3's total project cost of US$463 million, US$200 million loan was supported by the World Bank. The MCCA was financed by the Global Environment Facility (GEF) Special Climate Change Fund (SCCF) grant of US$5 million plus US$50.5 million as co-finance from the companion IAIL3 project.

KEY STAKEHOLDERS: Both projects were implemented by the State Office of Comprehensive Agricultural Development (SOCAD) under the Ministry of Finance. The Project Management Offices (PMOs) were also located in the Provincial Office of Comprehensive Agricultural Development (POCAD) and County Office of Comprehensive Agriculture Development (COCAD) in the project areas. The key stakeholders included national government agencies (e.g. Ministry of Finance, National Development and Reform Commission, Ministry of Water Resources, Ministry of Agriculture), local government agencies (e.g. Finance Bureaus, Planning Commissions, Water Resource Bureaus, Irrigation Districts, Agriculture Bureaus), national and sub-national research/academic institutions. The direct intended beneficiaries were farmers and local communities in the project sites.

Background information and climate change vulnerabilities

On a global scale, climate change and agriculture are intrinsically intertwined. According to the World Bank (2015), climate change impacts will affect agriculture the most. It is the key economic sector in the poorest countries and major source of income, food security, nutrition, jobs, livelihoods and export earnings. Even with adaptation actions such as adjusted agricultural practices and crops, studies show that by 2030 and 2080 climate change could still result in global crop yield losses as large as 5% and 30%, respectively. This could acutely lead to crucial increase of burden on the poor households, who spend approximately 60% of their income on food. The knock-on effects would include malnutrition, other social problems and countless challenges that altogether will threaten achievement of multiple Sustainable Development Goals. Certainly, climate change is only part of the equation besetting the world agricultural system; there are many other contributing factors that put the agricultural sector even more at risk. These factors are particularly related to market and regulations, including international trade policy.

China's accession to the World Trade Organisation (WTO) in 2001 had enhanced the country's economic position. At the same time, this also opened China to foreign competition. Within the WTO framework, China needed to participate and perform in internationally competitive agriculture, while food security was high on the country's development agenda. Although WTO membership provided opportunities for increasing farm incomes, it required the agricultural sector to undergo extensive structural change and modernisation by, *inter alia*, improving agricultural practices to produce safe, high quality and high value products; using water resources more efficiently; and cutting agricultural pollution. The Chinese government was well-aware of those issues and included them as central themes of the country's Five-Year Plans for National Economic and Social Development for 2001-2005 and for 2006-2010.

The 3H Basin, or the basin of the Huang-Huai-Hai rivers or the North China Plain, is China's most important agricultural area, producing 50% of the country's grain output and supported 425 million people. Water shortage was a critical issue in the 3H Basin, where the water demand was high and growing. Available water resources were already overexploited and groundwater levels were

reducing up to 1 meter per year in some areas. Improving performance of the agricultural sector in the 3H Basin was essential to take advantages of the WTO membership opportunities. However, there were a number of significant challenges, including low quality and efficiency of agricultural production; low efficiency of irrigation facilities; and low market value of the agricultural products.

Moreover, reduction in water stream flows and groundwater recharge in the 3H Basin due to climate change is projected, in addition to increase of irrigation water demand and withdrawals caused by higher temperatures and higher evapotranspiration (ET). Several studies[2] conducted in the 3H Basin consistently indicate water stress as a major climate change impact in the area. This will post crucial challenges for water resources management and likely lead to intensifying agriculture, industry, urban settlements and ecosystem related problems. Furthermore, groundwater depletion has long been the top issue facing agriculture in the basin as agricultural production strongly relies on groundwater irrigation due to restriction of surface water for urban water supply (Hu et al., 2010). Along with abstractions through human activities, climate change also has strong implications on groundwater level in the region (Zhang et al., 2014). As the country's most important agricultural area, water management and groundwater irrigation problems in the 3H Basin, therefore, crucially threaten food security in China (Li et al., 2011; Yuan & Shen, 2013).

Intervention technologies

The IAIL3 project was designed to respond to the critical challenges of China's rural and water sectors on enhancing agricultural productivity while also conserving irrigation water and the environment. Climate change was not part of the project's original objective since it was not a priority of the government at the time. However, the interest in climate change adaptation escalated due to a series of poor harvests and the necessity to address the impacts of climate extremes: floods, droughts and high temperatures, and finally the government issued a National Plan for Coping with Climate Change in 2007. Therefore, during the IAIL3 project's mid-term review in 2008, it was decided to adjust the project by including a targeted climate change adaptation agenda through the addition of the MCCA project. A GEF SCCF grant was, thus, sought to complement the IAIL3 project as well as to assist the government in mainstreaming climate change adaptation into the National Comprehensive Agriculture Development Programme (CAD), which is China's largest national investment programme in irrigated agriculture. Adaptation measures would be carried out under the on-going companion IAIL3 project, and would be expanded to cover as much of the project area as possible.

The ***IAIL3 project*** had an overall objective below:

To increase water and agricultural productivity in low and medium yield farm land areas; raise farmers' income and strengthen their competitive capacity under post-WTO conditions; and demonstrate and promote sustainable participatory rural water resources management and agro-ecological environmental management in the 3H Basin.

It consisted of 4 components and the major activities are summarised as follows:

(1) Water-saving irrigation and drainage: (a) building and improvement of local irrigation and drainage systems in 500,000 ha of low and medium yield land; (b) application of engineering water-saving measures e.g. sprinkler irrigation and micro-irrigation, canal system, combined use of canals-wells-surface and groundwater to increase the irrigation efficiency; (c) application of agronomic water-saving measures e.g. land levelling, modification of agro-production structure according to local natural resources and economic conditions, soil moisture conservation by using crop residues, water-saving planting methods coupled with irrigation scheduling to reduce ET of crops and increase yield; (d) application of water-saving management measures, such as river basin-based unified surface and underground water

[2] for instance: Fu et al. (2009), Liu et al. (2013), Mo et al. (2013), Zhang et al. (2014)

management, promotion of self-managed irrigation areas, establishment of Water User Associations (WUAs: to improve participatory local water management and maintenance of irrigation facilities) in the five project provinces and other selected provinces; and (e) preparation and application of groundwater management plans.

(2) Agricultural modernisation and organisational development: (a) strengthening and modernisation of agricultural services; (b) high quality crop production, extension and demonstration; (c) strengthening farmers' organisations; and (d) enhancement of individual and institutional capacity of farmers, agricultural technicians and farmers' professional organisations.

(3) Agro-ecological environmental protection and management: (a) formation of shelterbelt forest networks around farmlands; (b) application of Integrated Pest Management measures; (c) environmental management and monitoring; (d) capacity building on soil, water and environmental conservation; and (e) demonstration and extension services on ecology and environment.

(4) Institutional strengthening and project management support: mainly for the CAD offices at state, provincial and county levels on (a) domestic and international training and study visits; (b) technical assistance from domestic and international expert teams; (c) scientific research and demonstrations; (d) support for an upgraded computerised project Management Information System (MIS); and (e) survey, design and supervision work for project implementation, including monitoring and evaluation (M&E).

The ***MCCA project*** had the overall objective below:

To enhance adaptation to climate change in agriculture and irrigation water management practices through awareness raising, institutional and capacity strengthening and demonstration activities in the 3H Basin. This would assist in mainstreaming climate change adaptation measures, techniques and activities into the CAD Programme.

It consisted of 3 components and the major activities are summarised as follows:

(1) Identification and prioritisation of adaptation options: (a) conducting climate change impact assessment in the 3H Basin and project area; (b) conducting gap analysis and identifying the adaptation measures to be integrated into the IAIL3 project and the CAD programme; and (c) prioritising and selecting the adaptation measures and demonstration sites, including consultations with farmers as well as provincial and county experts to help incorporate first-hand experiences into the implementation of those adaptation measures.

(2) Demonstration and implementation of adaptation measures: (a) implementation of the selected climate change adaptation measures, focusing mainly on agricultural production and irrigation water management, at the demonstration sites; and (b) integration of appropriate adaptation measures into the implementation of the IAIL3 project to help reduce vulnerability to climate change in the 3H Basin.

(3) Mainstreaming adaptation into national CAD programme and institutional strengthening: a series of technical assistance, knowledge sharing, capacity building, and public awareness raising activities on climate change adaptation, and preparation of a National Climate Change Adaptation Plan for CAD.

Description of the results

The IAIL3 project interventions covered improvements of both purely technical as well as management aspects. It was successful in improving the agricultural yield, water productivity, irrigation efficiency and crop value per kg. These resulted in a considerable increase of farmers' income with no significant increase in total water demand. The MCCA project smoothly integrated various climate change adaptation measures, including EbA, to enhance resilience to floods and droughts. According to the combined projects' terminal evaluation report, the overall outcome is rated 'Highly Satisfactory'. The projects' innovations ranged from water saving techniques to improved WUAs, to climate change adaptation. All of these are essential for long-term agricultural sustainability and for increasing production, enhancing food security, increasing rural incomes, saving water, and decreasing environmental impacts of agriculture.

The *MCCA project* covered 210,659 ha of demonstrated areas with 298,732 participatory stakeholders plus 172,868 ha of farmland under the *IAIL3 project*. The key results are summarised below.

Increased climate change adaptation awareness: Through a large number of capacity building and awareness raising activities, more than 56% of the stakeholders have become aware of the potential climate change impacts and the adaptation measures. Those activities were designed for each stakeholder groups. For the project implementation and management officials at all levels and research groups, 27 climate change adaptation related studies (e.g. on climate change impacts, specific adaptation options, implications for water management and farming interventions, contribution to CAD programme) were conducted by national and provincial experts (with technical assistance from international specialists) and with involvement of this group of project team members. By participating in such extensive studies, as a result their awareness and knowledge tremendously increased. For farmers, farmers' associations and WUA members, their direct participation in the adaptation interventions leads to a considerable increase of their awareness. For the broader group of stakeholders, the project totally disseminated 331 publications related to climate change adaptation knowledge and measures through newspapers, booklets, magazine, TV, radio, website and conferences. Importantly, thematic capacity building activities for various stakeholder groups (including farmers, technical staff, officials) were organised through workshops and study visits on scientific understanding of climate change and adaptation in water and agricultural sectors for totally 37,659 persons. A great number of additional consultation and coordination meetings were also organised with the government leaders and officials of relevant agencies to enhance their capacity and awareness of climate change adaptation and to promote climate adaptation measures for implementation at the demonstration sites. With all the aforementioned efforts, climate change adaptation concepts have become extensively welcomed by the government officials and farmers, as reflected in their strong support throughout the project implementation.

Climate change adaptation measures implemented in selected demonstration areas with stakeholder participation: Various types of agriculture and water adaptation measures were demonstrated under both projects. Those under the MCCA included promotion of 450,000 kg of seeds of adaptive crop varieties, introduction of 33 adaptation agricultural technologies, forestation of 710 ha, establishment of 314 sets of stormwater collection and storage facilities, and installation of groundwater monitoring (in Hebei) to enhance water resources management and adaptation capacity. Moreover, certain adaptation measures related to water-saving initiatives were scaled up in the IAIL3 project areas that resulted in an increase of water and agricultural productivity from 1.1 to 1.39 kg/m^3 and the improvement of the production per unit of ET from 55,000 to 114,000 kg. Those adaptation measures included introduction of 1.55 million kg of seeds of pest tolerant varieties, 19,000 ha of mulching, 691 sets of small water storage facilities, 1.8 million m^2 of anti-seepage channels, 13 million m^3 of channel excavation and dredging, 39,000 ha of land levelling, greenhouse facilities of 1.2 million m^2, and 1,825 ha of replication of pest control and prevention. As a result, per capita income of typical farm households from the adaptation measures applied was increased from 1,100 to 1,570 RMB.

Climate change adaptation policies and measures integrated into documents issued by state, provincial and county CADs: Totally, 173 governmental official documents (government reports, policy briefs, implementation/replication plans) on climate change impacts, adaptation policies and technical standards were issued. Based on the review of climate change impacts, available adaptation options and provincial contexts, POCADs actively introduced numerous policies, which significantly provided policy support to the implementation of the climate change interventions and capacity enhancement on adaptation in the provinces, especially the agricultural sector. In addition, "Circulations to Strengthen Climate Change Adaptation in CAD" were issued by SOCAD and all POCADs to guide all CAD counties on national and provincial CAD investment programme. Eventually, the policy recommendations to integrate climate change adaptation into CAD programme were formulated to mainstream climate change adaptation into the national and provincial CAD programme in China's 12th Five-Year Plan for Economic and Social Development (2011-2015).

For the *IAIL3 project,* the key results could to some extent already contribute to climate resilience enhancement, even though climate change was not directly considered during the project formulation. First of all, average per capita net income (including non-agricultural income) of farmers in the project areas almost tripled, i.e. from 1,099 to 3,290 RMB, through increased high quality/value crop production. Additionally, unexpected sources of income, which was not quantified but estimated to be substantial, occurred from off-farm employment opportunities (e.g. fishery, animal husbandry, agro-product processing and transportation businesses) thanks to the reduced time and labour in agricultural operations from the mechanisation and effective irrigation initiatives introduced by the project. Secondly, the high-quality crop production (including high value, green, non-polluting and organic crops) was notably increased in order to strengthen farmer's competitive capacity under post-WTO entry conditions. The grain production in the project areas increased from 3.2 to 4.2 million tons. 100,000 hectares (from zero as the baseline) were allocated to non-polluting, green and organic crops. This not only increased the farmers' income but also improved food safety and agro-environmental management in the project areas. Thirdly, water productivity increased from 1.06 to 1.55 kg/m^3, and water usage dropped from 6,892 to 3,809 m^3/ha. The improvement could be essentially ascribed to the comprehensive water-saving actions to reduce the on-farm water consumption, improve irrigation efficiency, increase overall water availability, and improve participatory resource management through WUAs. Lastly, to promote sustainable participatory water resources management and enhance farmer participation, 1,022 WUAs (with membership of 490,000 and covering about 225,000 ha), 207 Farmers' Associations (FAs, with 153,941 household members), and 20 pilot Farmers' Cooperatives (FCs, with 5,783 household members) were established and operated. Establishment of these institutions significantly contributed to increase of crop yields and farmers' income in the areas compared to farmers in the control group. FAs and FCs are specialised farmer organisations that support the members in providing information, techniques, marketing services, and importantly, acting as the "bridge" linking up farmers with markets. Their roles are crucial in agro-production process, upgrading farmers' scientific knowledge, and assisting farmers to increase their incomes, e.g. from 2,321 to 4,031 RMB and from 2,637 to 4,160 RMB for the per capita income of households involved in the FAs and FCs, respectively.

GOOD PRACTICE ANALYSIS[‡]

Knowledge building

How has the project built upon or applied the findings of specific research projects? How has the project actively contributed to international understanding on Ecosystem-based Adaptation?

As the first comprehensive effort on agricultural climate change adaptation in China, a high level of expertise was required since the formulation. International and national experts, e.g. from the Chinese Academy of Agricultural Sciences, Chinese Academy of Sciences and provincial institutions, were brought in to support on climate change aspects throughout the planning and operations. The substantial integration of academics and expert consultants in the technical work was a notable feature that greatly contributed to the projects' performance. Tremendous efforts were particularly dedicated to building knowledge of the stakeholders, e.g. project teams at the provincial and county levels, farmer beneficiaries, government decision makers, senior and middle-level extension staff from various agencies, to understand and embrace the climate change agenda. Those activities included 37,000 person months of training for extension staff, 74,000 person months for farmers, 145 international and 3,600 domestic study tours, and 330 public outreach activities through media and other means. A variety of scientific analyses under the projects to support adaptation planning were significant in building capacity of Chinese scientists to rigorously address climate change issues and, therefore, laying a strong foundation for future work. In total, 27 studies were undertaken by applying integrated climate, hydrology, water allocation, and economic models. Numerous project-sponsored papers were published both in international and Chinese journals. Visits of technicians from neighbouring counties, presentations at conferences and other forms of international exchanges were also facilitated to disseminate the results and experiences at international level.

Political ownership, collaboration and approval

How has the project secured support from political-level stakeholders and aligned its activities with wider development agendas to trigger further collaboration opportunities?

Several factors were behind the success in political support of the projects. Government ownership and commitment were strong since the beginning; the key persons in SOCAD and other agencies were appointed and major implementing arrangements established in due time for the projects' fast start. Throughout the implementation, the government performed nearly ideal on its overall support. According to the Project Performance Assessment Report, the government's performance was ranked 'Highly Satisfactory' due to its full package to facilitate institutional arrangements, ready intervention to address inter-agency concerns, and demonstrate willingness to experiment. Particularly, the Project Management Offices (SOCAD, POCADs and COCADs)' performance was "outstanding" to cover such extensive project areas of 107 counties plus 16 countries of extended WUA programme. The provincial and county agencies under the Ministries of Water Resources, Agriculture, Environment and Forestry, among others, were also key implementers; while the academics and technical specialists played significant roles as well. Despite its seemingly cumbersome involvement of a large number of agencies, this extensive administrative structure turned out to be extremely effective, especially in facilitating the scale-up of climate change adaptation to a national programme via

[‡] This analysis is based on the "principles of good practice" developed by the EU/FP 7-funded project AfriCAN Climate (2011-2014). These principles represent critical cross cutting issues shared by the majority of climate change projects, regardless of focus, scope and scale. They are intended to encourage critical reflection and help project developers and decision-makers draw out relevant lessons. Source: http://africanclimate.net/en/good-practice/8-principles-good-practice

the existing government structure and agencies. In addition, the national decision makers, after witnessing the benefits of the adaptation measures, strongly supported further expansion of the initiatives. This could also be attributed to considerable information dissemination efforts plus the over 30 consultation meetings for the government officials and political leaders to obtain their support to implement such initiatives as well as to facilitate mainstreaming activity for the climate change adaptation agenda. Eventually, the inclusive value of IAIL3/MCCA is remarkable in terms of the impact on China's agricultural development at large. The IAIL3/MCCA had been taken as a model by the central government; the approach was integrated into the irrigated agricultural part of the National Comprehensive Agricultural Development Programme, which covers every province of China and in 2014 received a budget of 36 billion RMB (about USD 6 billion).

Building local capacities

How has the project ensured that local capacity was built during implementation phase? Explain how training programmes were integrated into core project activities and the measures taken to assure that built human capacity is maintained beyond the project's lifetime.

The project implementation mechanism was highly decentralised. In the project areas, the POCADs and COCADs coordinated the activities with the concerned provincial and county governmental bureaus, respectively, as well as other key implementers. Climate change adaptation awareness raising and capacity building activities were also the projects' fundamental elements, primarily conducted through training and demonstration for farmers as well as learning by doing for project field staff. Besides, the PMOs at different levels encouraged active participation from the farmer beneficiaries in the whole process of project preparation, implementation and maintenance, enabling them to become the owners of the project development. All those efforts greatly fostered the local level capacity in the projects. Nevertheless, a key highlight would be on the establishment and strengthening of the new grassroots organisations, who also implemented climate change adaptation measures under the projects and the members are mainly local farmers. These are the WUAs, FAs and FCs, which were created to derive the benefits for the farmer beneficiaries themselves, e.g. to better manage water, boost profitability, improve farming practice and commercialise agricultural products. Throughout the implementation, intensive technical assistance from the academics and specialists were provided to these farmer-led groups, such as on water-saving techniques, high-value crops, marketing, gender, climate change adaptation measures, together with such participatory principles as 'self-decision making' and 'self-management' approach, which underpin the successful operation of these farmer organisations.

Community participation and inclusiveness

Has the project consulted with local communities in the formulation, implementation and decision making process? How were gender issues incorporated? Explain how the project mobilized local interest and ownership in order to ensure its activities responded to the needs of local beneficiaries.

Due to the decentralised nature of the projects, local level stakeholder consultation was carried out even beyond a standard participatory practice, especially for those activities directly related to the farmer beneficiaries such as the preferences on proposed adaptation activities, suggestions on the measures' feasibility and practicability at the local level as well as the establishment and operation of the WUAs, FAs and FCs. Notably, engagement of the marginalised groups was well-considered. FAs and FCs have regulations to stimulate participation of poor households, who lived in about a third of the project counties. In the areas where ethnic minority groups were present, e.g. Mongol, Miao, Yao and Hui in Yunnan Province, Ningxia Hui Autonomous Region and Inner Mongolia Autonomous Region, Ethnic Minorities

Development Plans were prepared for the relevant project activities e.g. in the WUA development process. Participation of ethnic women was also a focus of the WUA formation. As a result, the ethnic minorities and women were adequately represented on the WUA executive committees. Moreover, specific training events were provided to women both in WUAs and provincial project staff, as part of the newly-integrated dimension to the SOCAD policies to promote participation of women in WUAs. This enhanced the perception of women, who play an important farming role i.e. 70-80% of agricultural labour force in some areas, in participation and democracy, and eventually led to upgrading women's status in the rural communities. Importantly, the introduced climate change adaptation measures had both provided greater protection from droughts and other climate events and helped increase yields. Thus, the farmers were enthusiastic to adopt the adaptation measures. Along with the substantial outreach to farmers and policymakers, farmers and government alike were committed to adapting agriculture to climate change and to take the programme forward. Through the institutional development of WUAs, FAs and FCs as well as continuous direct participation throughout the projects, the farmers were empowered and, therefore, ownership of the projects among farmers, WUAs, FAs and FCs became strong. According to the projects' assessment report, after the projects had ended several key activities, including the WUAs and FAs, become self-managed and self-financed and would expect to be sustained.

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Information from this case study is mainly taken from related project documents, available at http://projects.worldbank.org/P105229/mainstreaming-climate-change-adaptation-irrigated-agriculture-project?lang=en

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