

Effective implementation of crop diversification strategies for Cambodia, Lao PDR and Vietnam: Insights from past experiences and ideas for new research

Edited by
Ronnie Vernooy



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Bioversity International is a global research-for-development organization. We have a vision – that agricultural biodiversity nourishes people and sustains the planet.

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The editor

Acronyms

ACIAR	Australian Centre for International Agricultural Research
ACDI/VOCA	Agricultural Cooperative Development International/Volunteers in Overseas Cooperative Assistance
ADAM	Agro-Ecology in the Northern Mountainous Regions (Vietnam)
ADB	Asian Development Bank
ADDA	Agricultural Development Denmark Asia
ADRA	Adventist Development and Relief Agency
AFACI	Asian Food and Agriculture Cooperation Initiative
ARC	Agriculture Research Center (Lao PDR)
ASDP	Agriculture Sector Development Program Loan
ASEAN	Association of Southeast Asian Nations
AusAID	Australian Government Department of Foreign Affairs and Trade
AVRDC	The World Vegetable Center (previously Asian Vegetable Research Center)
BUCAP	Biodiversity Use and Conservation in Asia Program
Bioversity	Bioversity International (formerly IBPGR and IPGRI)
CARDI	Cambodian Agricultural Research and Development Institute
CBDC	Community Biodiversity Development and Conservation
CBO	community-based organization
CCAFS	Climate Change, Agriculture and Food Security
CCBAP	Cambodia Community Based Adaptation Programme
CCCA	Cambodia Climate Change Alliance
CCTAM	Climate Change Training and Adaptation Module
CDD	National Committee for National Democratic Development
CEDAC	Cambodia Center for Study and Development in Agriculture
CLRRI	Cuu Long Delta Rice Research Institute
CLUES	Climate Change Affecting Land Use in the Mekong Delta: Adaptation of Rice-Based Cropping Systems
COP 7	Marrakesh Conference of the Parties to the UNFCCC (2001)
DAFO	district agriculture and forestry office (Lao PDR)
DAHPP	Department of Animal Health & Production
DANIDA	Danish International Development Agency
DARE	Democratizing Agricultural Research and Extension
DED	German Development Service (now <i>Deutsche Gesellschaft für Internationale Zusammenarbeit</i>)

ECOSORN	Economic and Social Relaunch of North-West Provinces
ENHANCED	Enabling Households to Apply Necessary Cultivation for Economic Development
EU	European Union
FAO	Food and Agriculture Organization of the United Nations
FFS	farmers' field school
FSIF-CIDA	Food Security Initiative Fund of Canada International Development Assistance
GDA	General Directorate of Agriculture (Cambodia)
GDP	gross domestic product
GEF	Global Environment Facility
GIS	geographic information system
GMS	Mekong Sub-region countries
GRFA	genetic resources for food and agriculture
HARVEST	Helping Address Rural Vulnerabilities and Ecosystem Stability
HEKS	Swiss Interchurch Aid
HIV-AIDS	human immunodeficiency virus-acquired immune deficiency syndrome
HRC	Horticulture Research Center (Lao PDR)
IFAD	International Fund for Agricultural Development
IFC	International Financial Corporation, the World Bank Group
IPCC	Intergovernmental Panel on Climate Change
IRAS	Improving the Resilience of the Agriculture Sector to Climate Change Impacts
IRRI	International Rice Research Institute
IWEP	Integrated Women's Empowerment Programme
JICA	Japan International Cooperation Agency
Lao PDR	Lao People's Democratic Republic
LAREC	local agricultural research and extension center
LDC	least-developed country
LDCF	Least Developed Countries Fund
MAFF	Ministry of Agriculture, Forestry and Fisheries (Cambodia)
MALIS	Improving Food Security and Market Linkages for Smallholders
MARD	Ministry of Agriculture and Rural Development (Vietnam)
MJP	Maddox Jolie-Pitt Foundation
NAFRI	National Agriculture and Forestry Research Institute (Lao PDR)
NAMA	nationally appropriate mitigation action
NAPA	national adaptation programme of action for climate change

NCCC	National Climate Change Committee (Cambodia)
NGO	nongovernmental organization
NPA	National Committee for National Democratic Development (Cambodia)
NPA	Norwegian People's Aid
NSW-DPI	New South Wales Department of Primary Industries
NTFP	non-timber forest product
NURIFAR	Northern Uplands Rice Farming Systems Research Project
NZAID	New Zealand Agency for International Development
OPV	open-pollinated crop variety
PAFO	Provincial Agriculture and Forestry Office (Lao PDR)
PDA	Provincial Department of Agriculture (Cambodia)
PGRFA	plant genetic resources for food and agriculture
RIDP	Rural Income Diversification Project (Vietnam)
RPIP	Rice Productivity Improvement Project
RUA	Royal University of Agriculture (Cambodia)
RULIP	Rural Livelihoods Improvement Project in Kratie, Preah Vihear and Ratanakiri
SHG	self-help group
SMTA	standard material transfer agreement
SOFDEC	Society for Community Development in Cambodia
SRI	system of rice intensification
the Treaty	International Treaty on Plant Genetic Resources for Food and Agriculture
TSTD	Tonle Sap Technology Demonstrations for Productivity Enhancement
UBB	University of Battambang
UNDP	United Nations Development Programme
UNE	University of New England
UNFCCC	United Nations Framework Convention on Climate Change
USAID	United States Agency for International Development
VBARD	Vietnam Bank for Agriculture and Rural Development
VMM	vegetable-management modules

Chapter 1. Introduction: Identifying effective policy measures for crop diversification

Ronnie Vernooy and Vongvilay Vongkhamsao

1. Background

The governments of Cambodia and Lao PDR have made strong commitments through the Climate Change Initiative of the Association of Southeast Asian Nations (ASEAN) to integrate mitigation of and adaptation to climate change into their national and sectoral development policies and action plans. Vietnam has also started to address climate-change adaptation at the national and sub-national levels. Governments in the three countries have identified a series of agriculture-based interventions as priorities to strengthen the resilience of smallholder farmers, most notable of which is crop diversification. However, how to practically implement effective policy measures that are of particular benefit to smallholder farmers remains a challenge. Research could contribute to developing a number of pilot initiatives at a sub-national scale to test and assess promising measures. If proven effective, these could then be scaled up under national agricultural policies and the national adaptation programmes of action for climate change (NAPAs).

Vietnam does not have a NAPA, but chapter 2 offers a brief analysis of the NAPAs of Cambodia and Lao PDR in terms of the attention paid to crop diversification. It is based on a larger study about NAPAs and aims to explore the extent to which the NAPAs developed by Cambodia and Lao PDR include activities that, directly or indirectly, propose to utilize higher levels of biological diversity in production systems, agricultural research and development. The original study is entitled “Increased biodiversity in agricultural systems and the status of genetic resources for food and agriculture in the ‘National Adaptation Programmes of Action’ (NAPAs).” It will be published in 2015 by Bioversity International.

Bioversity International is working with national partners in the three countries to identify key elements needed to effectively implement policy measures for crop diversification targeted at farmers (both women and men) and ethnic minorities in low and upland regions. In 2014, this resulted in the elaboration of three country desk reviews of past and ongoing crop diversification projects and an international workshop on crop diversification in Cambodia, Lao PDR and Vietnam. This book presents the results of both the desk reviews and the workshop.

2. Country desk reviews

With the financial support of the Southeast Asia programme of the CGIAR’s Climate Change, Agriculture and Food Security (CCAFS) research programme, three country desk reviews on past and ongoing crop diversification projects were prepared, and a workshop was organized to discuss the results of the desk reviews and other experiences. The desk reviews were based on the following terms of reference:

1. Compile a list of past and ongoing programmes and projects with a focus on crop diversification or with one or more crop-diversification components supported by the national government, multilateral and bilateral agencies, international or national nongovernmental agencies (NGOs). Time frame to be covered: from 2000 until 2014.

2. List the full name of the programme or project, period of execution, implementing agency (name, address, website if available), funding agency (name, address, website if available); provide a brief description of the programme or project or specific crop-diversification component; include hyperlinks to the relevant outputs that are available on-line.
3. Describe in synthesis form the major characteristics of these initiatives in terms of design (the kind of measure, scope, intended beneficiaries, financial conditions, technical aspects, intended implementation process and timeline, and the monitoring and evaluation envisioned) and in terms of actual implementation outcomes (what were the benefits, who benefitted, were there any unforeseen outcomes).
4. Based on (1) and (2), present an analysis of the strengths and weaknesses of each of the measures described, in terms of both design and implementation.
5. Conclude by summarizing the main insights obtained from the desk review.

The final versions of the desk reviews are presented in chapters 3, 4 and 5.

3. Workshop

The workshop took place on 2 to 3 October 2014 in Vientiane, Lao PDR, hosted by the National Agriculture and Forestry Research Institute (NAFRI).

(www.bioversityinternational.org/news/detail/crop-diversification-strategies-for-cambodia-lao-and-vietnam). Participants included staff from national agricultural research organizations in Cambodia (five people), Lao PDR (11), Vietnam (five) and CGIAR centres (five). During the workshop, participants shared insights gained from past and current experiences with programmes and projects on strategies and policy measures related to crop diversification in the Southeast Asia region and beyond (based on presentations of the three country desk reviews and CGIAR research efforts). Based on these insights, the participants identified key elements for the design and implementation of effective measures to adapt to climate change through crop diversification. And last, they identified some initial ideas for new research on the effective implementation of strategies and policy measures for crop diversification in Cambodia, Lao PDR and Vietnam.

An important conclusion of the workshop was that, although there have been benefits from past programmes and projects, what is not well known is how to evaluate trade-offs between strategies with different degrees of diversification at various levels, from crop to farm to landscape. Participants also noted that little is yet known about how the influence of consumer demand and changing eating habits in the three countries affect crop diversification, either positively or negatively. In addition, more research is warranted about the ways in which markets and the development of value chains can support crop diversification.

The main insights from the workshop and the desk reviews are summarized below.

Major outcomes achieved through effective crop diversification interventions in Cambodia, Lao PDR and Vietnam

- Knowledge generation
- Improved farming systems
- Improved dietary variation
- Use of new technologies and practices (e.g. soil and water conservation, pest and disease control)

- New sources of energy (fuel)
- New plant varieties developed and released
- New plants (for food, fuel, fodder and forage) and animal breeds introduced
- Income generation
- Increased labour productivity
- Farmer groups formed: farmer empowerment
- Women's empowerment and gender equity
- Demonstration farms
- Conservation of plant genetic resources improved (including collection and protection)
- Exchange of plant genetic resources enhanced
- New linkages established among actors in the value chain
- New niche market opportunities developed
- Increased investment of the private sector in value added to crops and development of the value chain
- Increased public awareness of the importance of biodiversity and the benefits of diversification
- New policies formulated to support crop diversification
- Better coordination and cooperation among countries in the region

Cambodia

Farmers in target areas have gained knowledge and skills about crop-production techniques, integrated farming systems (including crop rotation and intercropping), and climate-resilient production techniques. Project interventions have improved agricultural production, especially of vegetables, and have improved the nutrition of rural families, leading to enhanced food security. The local environment has been enhanced through the introduction of good agricultural practices, organic crop production and/or integrated pest management. Farmers and their families have gained increased income from selling agricultural products (including household surpluses), partly through value-chain interventions.

Lao PDR

The goals of several projects included enhancing crop productivity, improving food security, increasing incomes and improving livelihoods. The people in rural areas, including ethnic minorities, have been the beneficiaries of projects that overall have improved livelihoods. The majority of the projects have been designed around home gardens for food security, commercial production for increasing income, and improvement of livelihoods, using integrated farming systems for protection against diseases and insect pests. The focus in several projects was on the main cereal crops like rice and corn. Other crops, like vegetables, edible legumes, tree fruit and other indigenous crops were neglected.

Vietnam

From an economic perspective, the projects analysed have contributed significantly to the reduction of poverty in Vietnam over the last 15 years, especially in the mountainous regions in the north. They have also contributed to social stability by creating and allocating secure long-term and stable land-use rights and encouraging investments to increase production and ensure food security. Environmental contributions have become apparent as diversified agroforestry systems take effect to

improve local climate conditions, mitigate the adverse effects of climate change and contribute to the reduction of greenhouse-gas emissions.

Lessons learned concerning project design and implementation

At the country level, the following lessons were identified in the desk reviews.

Cambodia

- Most projects were aligned with relevant government policies on agricultural development. There was good collaboration and participation of stakeholders: relevant government agencies, NGOs and farmers' associations.
- The use of technology packages has led to good results, such as improved crop varieties (including climate-resilient cultivars), soil-improvement techniques, integrated pest management and water management, and open-pollinated crop varieties.
- Projects that took into account agroecology and the development of the value chain in order to improve productivity and income were most successful. Farmers' associations have been established and strengthened to improve market position. The introduction of micro-credit or self-help groups (saving groups) was effective.
- Despite promising research results that were produced by various institutions, only a limited number of technologies have been disseminated to beneficiaries. The small number of farmer households involved in many projects (100-200) likely limited outreach.
- A large number of interventions did not include a water-supply system, so farmers are often faced with water shortages, resulting in reduced yields. With a limited water supply, crop diversification in the dry season has not been broadly adopted.
- Even where value-chain development was introduced, farmers and farmers' associations are still faced with low prices or no market. Often, the development of farmer entrepreneurship did not receive the required attention.

Lao PDR

- Several projects focused on farmers through the district and provincial agriculture forestry offices to develop and improve knowledge and experience through training. Farming techniques were demonstrated and knowledge was exchanged with neighbourhoods in several projects. Several farmers' groups for production, postharvest management and marketing of different types of crops have been established in villages, districts and provinces. These groups help farmers to access finance, information and markets, as well as serving as models for other groups or farmers, where they could learn, transfer knowledge and share experiences.
- Several projects were conducted without recognizing the needs and expectations of the local people and community.
- Results were not broadly applied: several projects were successful only in specific places and project budgets were not consistently supported.
- There was a poor relationship among research, development and extension in the design and implementation of several projects.
- Policies to support project results were limited at government levels. Credit or finance from local and central government was limited. In addition, financial support for projects was often limited.
- The information about marketing, potential crops and postharvest management was found to be poor in several project activities.
- There was poor monitoring from experts and staff in relation to farmers or groups.

- Many projects lacked cooperation/coordination with other ongoing or past projects.

Vietnam

- Projects that understand and address local conditions at the beginning are more likely to make a successful intervention. Building on indigenous knowledge about crop cultivation and dealing with natural disasters is a key success factor.
- The projects that target multiple interventions and use a decentralized approach appear very successful, for example through combining activities such as diversifying cultivation systems and livestock production, forest land use, savings and credit groups, intra-village infrastructure, education and rural youth training.
- Many projects have been successful in selecting drought- and salinity-tolerant crops and varieties that can adapt to increasingly severe climate conditions. There are also agroforestry systems that require less irrigation.
- Supporting decentralized participatory research and the dissemination of knowledge about the best sustainable agricultural practices by relying on existing farmers' organizations and networks (including women's organizations and networks) is an interesting approach.
- Many projects are poorly coordinated with other, ongoing projects, or they inherit the results of previous projects implemented in the same locality.
- The involvement of the private sector and trials with mechanisms for cooperation (i.e. public-private partnerships) with farmers for the adoption of advanced technologies, extension services, etc., is a weak point in both past and ongoing projects.
- Many technical and research projects are implemented by foreign institutions and are more research oriented, without being balanced by a strategy for scaling up and out.
- Many projects stop at food security and offer no further solutions to marketing or improving the well-being of the farmers as one of the strategies to move out of poverty.
- By supporting decentralization and poverty reduction, many projects have secured the government's political and financial support, which sets a sound basis for achieving project objectives. Many project modalities are aligned with and support the efficient functioning of government programmes. However, in the future, projects need to ensure that participatory planning forms an integral part of the local socioeconomic development plan, and to re-examine some of their procurement and disbursement practices to make them more consistent with those of the government.

Guidelines for effective policy implementation

In synthesis form, these lessons can be translated into guidelines for effective policy measures structured according to three major components:

1. A clear and coherent purpose concerning the outcomes of crop diversification, complemented by specific clear and coherent objectives concerning the level of intervention, envisioned trade-offs, enhancement of national capacities related to crop diversification, and harmonization with other policies at the national level and agreements and treaties at the international level
 - When the rationale for crop diversification is well explained, it can raise awareness about the potential benefits of crop diversification.
 - The links between crop diversification and climate-change adaptation should be spelled out clearly.

- Pilot projects can facilitate the introduction of novel technologies and techniques (e.g. participatory variety selection) and technology packages, but usually do not automatically lead to scaling out.
 - Strategies that promote multiple interventions at multiple levels can be successful if sufficient human and financial resources are made available.
 - Value-chain development (including the identification of new crops for cultivation and new ways of adding value to existing crops) merits careful attention as it could offer short-term incentives for farmers and other actors in the value chain. However, knowledge about this topic is still scant. More research into consumer behaviour and demand and how this influences value-chain developments is needed.
 - Strong capacity-building elements can contribute to a wide range of strengthened capacities for farmers (both women and men) and other stakeholders such as extension agents.
 - Alignment with existing government policies will guarantee political support and offer the potential to mobilize additional resources.
 - Coordination of programme and project interventions can reduce repetitions and avoid making the same mistakes again.
2. Identification of the institutional capacities and human behaviour that are prerequisites for achieving the purpose and specific objectives
- Agencies responsible for the design and implementation of policy interventions require knowhow and skills to understand and address local conditions and needs at the start of the policy-planning process. Building on indigenous knowledge about crop cultivation and existing capacities to deal with natural disasters is a key element of such knowhow.
 - Sufficient attention should be given to the need for policy analysis and policy dialogue as an input for creating an enabling environment.
 - Participatory approaches allow for active involvement of both women and men farmers and other stakeholders and can stimulate the formation of various kinds of community interest groups. These groups can help farmers to access finance, information and markets, as well as serving as models for other groups or farmers, where they could learn, transfer knowledge and share experiences.
 - Good collaboration among relevant government agencies, NGOs, the private sector and farmers' associations can create synergy.
3. Prioritization of policy interventions required to achieve purpose and specific objectives, such as promotional, administrative and restrictive measures, and an effective monitoring and evaluation system in place
- Special attention to seed diversity and the role of farmers' varieties can lead to more awareness about the importance of biodiversity and the need to conserve it.
 - Interventions should critically assess the availability of all the natural resources required for success. For example, farmers are often faced with water shortages, resulting in reduced yields. With a limited water supply, crop diversification, particularly in the dry season, could be hard to achieve.
 - Strong research-extension linkages can facilitate the uptake of results.
 - The elaboration of clear monitoring and evaluation activities can support effective and efficient implementation. It will also facilitate more precise assessment of outcomes.

- Public-private-sector collaboration can open new windows for interventions at wider scales.

Bioversity International and partner agencies will be exploring opportunities to use this guideline, assess its utility and further improve it. We invite others interested in the topic to join us.

Chapter 2. Diversification in the National Adaptation Programmes of Action of Cambodia and Lao PDR

Ana Bedmar Villanueva, Michael Halewood, Isabel López-Noriega

As of June 2014, 50 countries, including Cambodia and Lao PDR, had developed a NAPA. Least-developed countries (LDCs) have been identified by the United Nations Framework Convention on Climate Change (UNFCCC) to be among some of the countries that are most vulnerable to the adverse effects of climate change, with the least capacity to cope with and to adapt to these effects. Responding to this issue, the Marrakesh Conference of the Parties to the UNFCCC in 2001 (COP 7) decided that NAPAs should be developed by LDCs to identify their most immediate needs in key sectors such as agriculture, water resources, coastal zones and human health as a step towards accessing financial support from the Least Developed Countries Fund (LDCF) (Biagini and Dobardzic 2011, p 40). NAPAs are meant to be action-oriented, country-driven, flexible, and based on national circumstances, so their preparation should follow a complementary approach, starting from the revision of existing plans and programmes, such as national action plans under the United Nations Convention to Combat Desertification, national biodiversity strategies and action plans under the Convention on Biological Diversity, and national sectoral policies (LEG 2002).

Bioversity International started a global study in June 2014 to identify the extent to which increasing the use and conservation of biodiversity and genetic resources for food and agriculture (GRFA) in agricultural systems have been included in plans for adapting to climate change in the NAPAs developed by LDCs. This brief chapter is based on this larger study and aims to explore the extent to which NAPAs developed by Cambodia and Lao PDR include activities that—directly or indirectly—propose to utilize higher levels of biological diversity in production systems, agricultural research and development. The original study is entitled “Agricultural biodiversity in climate change adaptation planning: A comprehensive analysis of the ‘National Adaptation Programmes of Action’ (NAPAs)” (Bedmar et al. *in preparation*) and will be published in 2015.

The structure of this chapter is as follows: first, key concepts for the analysis of NAPAs derived from the literature on adaptation to climate change are presented. This is followed by a short description of the methodology used to conduct the larger study. The main characteristics found in the NAPAs of Cambodia and Lao PDR that are relevant for the purpose of this book are then summarized.

1. Key concepts

Our study is based on the assumption that the diversification of agricultural production systems can increase the resilience of those systems so that they are better able to adapt to climatic variability, thereby reducing farmers’ vulnerability to climate-related risks. In the light of climate change, resilience, vulnerability, adaptation and adaptive capacity have become key concepts in the most recent literature, research programmes and policies on climate change (McCarthy et al. 2001).

Resilience, as defined by Holling (1973), is the “magnitude of disturbance that can be experienced before a system moves into a different state and different sets of controls”. More recently, Walker et al. (2006) described it as the “capacity of a system to experience shocks while retaining essentially the same function, structure, feedbacks, and therefore identity”. The resilience of a system is also related to the magnitude of shock that the system can absorb and remain within a given state, the degree to which the system is capable of self-organization, and the degree to which the system can build capacity for learning and adaptation (Folke et al. 2002). Building on these definitions, the concept of socio-ecological systems, has been widely explored (e.g. Folke et al. 2002; Gallopin 2006; Walker et al. 2006).

Vulnerability to climate change refers to the propensity of human and ecological systems to suffer harm and their ability to respond to stresses imposed as a result of the effects of climate change (Brooks and Adger 2005). It has been defined as “the degree to which geophysical, biological and socioeconomic systems are susceptible to, and unable to cope with, adverse impacts of climate change” (Schneider et al. 2007) and described as a function of sensitivity to climatic changes, adaptive capacity and exposure to climate hazards (Smit et al., 2000). According to the Intergovernmental Panel on Climate Change (IPCC) (McCarthy et al. 2001), the extent to which systems are vulnerable to climate change depends on the actual exposure to climate change, their sensitivity and their adaptive capacity.

Adaptation is increasingly regarded as a key component of the response to climate change, and occurs through adjustments to reduce vulnerability or enhance resilience in response to observed or expected changes in climate and associated extreme weather effects (Brooks and Adger 2005). During the last several years, there have been a number of definitions for adaptation to climate change. Smithers and Smit (1997) defined adaptation as “changes in a system in response to some force or perturbation, in our case related to climate”. Likewise, Burton et al. (1998) described it as “all those responses to climate change that may be used to reduce vulnerability” and Füssel and Klein (2005) described it as “all changes in a system, compared to a reference case, that reduce the adverse effects of climate change”. According to the IPCC (McCarthy et al. 2001), “adaptation refers to adjustments in ecological, social, or economic systems in response to actual or expected climatic stimuli and their effects or impacts.... to changes in processes, practices and structures to moderate potential damages or to benefit from opportunities associated with climate change.”

Adaptive capacity has been described in some studies as a function of adaptation (e.g. Adger et al. 2004, p 128). According to the IPCC (McCarthy et al. 2001), adaptation greatly depends on the adaptive capacity or adaptability of an affected system, region or community to cope with the impacts and risks of climate change, and adaptive capacity is “the potential or ability of a system, region or community to adapt to the effects or impacts of climate change”. Similarly, it has been defined as “the ability of a system to adjust to climate change to moderate potential damages, to take advantage of opportunities, or to cope with the consequences” (Tompkins and Adger 2004). Along the same lines, Preston and Stafford-Smith (2009) established that adaptive capacity reflects the ability of the system to manage and thereby reduce “gross” vulnerability, and Adger (2003) defined it as “the potential or capability of a system to adjust to and therefore limit risk”. Adaptive capacity has also been defined as a component of resilience, reflecting the learning aspect of system behaviour in response to a given disturbance (Walker et al. 2002). In addition, it has been established that the inclusion of adaptive capacity is a necessary condition for the

design and implementation of effective strategies for climate-change adaptation (Brooks and Adger 2005).

According to the literature, **diversity in genes, species and ecosystems** all contribute to climate-change resilience (e.g. Altieri 2009; Altieri and Koohafkan 2008, p 72; Lin 2011; Ortiz 2011) and to the improvement of the adaptive capacity of the agricultural sector. Consequently, agrobiodiversity, defined by Wood and Lenné (1997) as “species and varieties of crops and livestock and their wild relatives, modified through the ongoing process of farmer-based domestication and adaptation”, constitutes an important instrument for the local adaptation and resilience of agroecosystems (Gregory 2008).

2. Adaptation in practice

In the past, smallholder farmers, drawing from their indigenous knowledge and experience, have responded to environmental changes with gradual changes in their agricultural practices, in the selection of adapted cultivars and by mixing crops with trees and livestock to reduce the risk of crop failure (e.g. Altieri 1999; Lasco et al. 2014; Ortiz 2011; Sthapit et al. 2010). Nowadays, the adoption of agroforestry practices, crop diversification, early planting, increased use of short-maturing and stress-tolerant crop varieties, wild plant gathering and mixed cropping production systems have been found to be among some of the most common adaptation measures adopted by farmers in response to climate change (chapter 1 of this book; see also Altieri 2009; Altieri and Koohafkan 2008; Kissinger et al. 2013, p. 40; Verchot et al. 2007).

Using diversity as an adaptation strategy may be a promising and viable option for farmers in LDCs as compared to producers in other countries with the capacity to adopt more resource-demanding measures. The diversity of traits and characteristics among existing varieties of agricultural biodiversity (both inter- and intra-specific) also have the potential to contribute to the adaptation of agricultural systems to climate change by providing traits for plant breeders and farmers to select resilient crop germplasm (Ortiz 2011). GRFA constitute raw material for the scientific breeding of new modern agricultural varieties (Lipper and Cooper 2009). This raw material is secured in genebanks, which are also responsible for conservation and distribution for science (Walters et al. 2008). Having a wide range of genetic resources available for the development of new and adapted varieties is considered essential for adapting to climate change, therefore genebanks and other organizational forms that safeguard genetic resources are acquiring an increasingly important role (Gitz and Meybeck 2012).

3. Our analysis

Based on these conceptual and practical insights, NAPA documents developed as of June 2014 were analyzed to identify activities that directly or indirectly promote higher levels of biological diversity in production systems, as well as increased use of biological diversity in agricultural research, plant breeding and complementary conservation efforts or agriculture research and development. Thirty-seven activities included among the priority activities within the NAPA’s final proposed projects were identified as relevant for this study. These activities were then clustered first by sector (crop/forage, livestock, fisheries, forestry, agroforestry, natural resources) and then according to the level of diversity prioritized: intra-specific, species or

ecosystem. The relevant agricultural biodiversity involved in the activities identified in the NAPAs was further assessed by using the following classification:

- activities suggesting probable use of agricultural biodiversity, not necessarily leading to more diversity in agriculture
- activities relying on the use of agricultural biodiversity but not necessarily translating into more diversity in agriculture
- activities found to rely on the use of agricultural biodiversity and leading to more diversity in agriculture

4. The NAPAs of Cambodia and Lao PDR

There is considerable variation in the formulation of policies, development of strategies and planning for adaptation within East, South and Southeast Asia. As of June 2014, eight Asian countries (Afghanistan, Bangladesh, Bhutan, Cambodia, Lao PDR, Myanmar, Nepal and Yemen) qualified as LDCs and had therefore developed a NAPA. Comparing the 50 NAPAs from a regional perspective revealed that the NAPAs developed by the countries belonging to this region prioritized activities in the crop and forage sectors: 55% of the priority activities were classified as such. The forestry sector also appeared important in the NAPA for Lao PDR.

Laos PDR had its NAPA endorsed in 2009 by the Ministry of Natural Resources and Environment. The development of this NAPA was based on national development policies cutting across multiple sectors: the National Environment Strategy/National Environmental Action Plan, the National Biodiversity Strategy to 2020 and Action Plan to 2010, National Growth Poverty Eradication Strategy, National Forestry Strategy and Integrated Agriculture Development Strategy, as well as the Sixth National Socio-Economic Development Plan from 2006-2010. The key vulnerabilities identified by Laos PDR's NAPA included agriculture/food security, forestry, health and water resources (Lao PDR 2009). As a result of the NAPA development process, 45 projects were prioritized and designed, nine of which contained activities potentially related to increasing the conservation and use of the biodiversity in the country's agricultural systems. This NAPA was among 16 out of the 50 that made explicit reference to the risks to and value of agrobiodiversity in the face of climate change, in the vulnerability analysis included in the introductory part of the documents.

An analysis of the distribution of the identified activities shows that they focus on the use and conservation of biodiversity mainly at the species and ecosystem level, with very little emphasis on activities at the intra-species level. When these activities were further analysed to assess the potential involvement of agricultural biodiversity that they implied, it was found that most of the identified activities relevant for the study rely on the use of agricultural biodiversity, but do not necessarily translate into more diversity in agriculture. Examples of projects under which these activities were found are "Promotion of short duration paddy and other cash crops in natural hazard prone areas" and "Improve and develop crop varieties and animal species that are better adapted to natural hazard prone areas".

The NAPA of Cambodia was endorsed in 2006 by the Ministry of Environment and was designed to be in line with the government's development objectives, as outlined in the "Rectangular Strategy for Growth, Employment, Equity and Efficiency" adopted in July 2004, the Cambodian Millennium Development Goals and the "National Strategic Development Plan 2006-2010" adopted in May 2006 (Ministry of

Environment 2006). Four objectives were identified during the NAPA preparation process: (1) to understand the main characteristics of climate hazards in Cambodia (flood, drought, windstorms, high tides, salt water intrusion and malaria), (2) to understand mechanisms for coping with climate hazards and climate change at the grassroots level, (3) to understand existing programmes and institutional arrangements for addressing climate hazards and climate change and (4) to identify and prioritize adaptation activities related to climate hazards and climate change (Ministry of Environment 2006). Agriculture, forestry, human health, and coastal zones were identified as the sectors most vulnerable to the impact of climate change.

The NAPA prioritized 39 adaptation projects, of which eight were found to contain activities potentially related to increasing the conservation and use of agrobiodiversity. Our analysis indicates that a fair number of proposed activities were based on the use of agricultural biodiversity, some of them with the potential to result in more diversity in agriculture, some of them without clear potential. These activities are, however, not evenly distributed across the three levels of biodiversity established in the study; most are focused at the ecosystem level. Examples of these activities are “Community mangrove restoration and sustainable use of natural resources”, “Promotion of agroforestry systems/species”, “Community based agricultural soil conservation” and “Promotion of household integrated farming, including multi-cropping, livestock rising and aquaculture”.

The conservation and use of biodiversity in agricultural production systems for adapting to climate change was found to appear in different degrees and with different approaches across the 50 NAPAs. The 37 identified activities were categorized according to the extent to which agricultural biodiversity was potentially involved in them. This allowed them to be ranked in terms of the estimated real content of activities that could potentially lead to an increase of the conservation and use of agrobiodiversity within the planning for adaptation (for more details, see Bedmar et al. *in preparation*). The scores obtained within this ranking went from 33 points (NAPAs whose content was found to be high on prioritized activities that were based on the conservation and use of agrobiodiversity) to zero (NAPAs where these kinds of practices were found to be absent). Within this ranking, the NAPA developed by Lao PDR, with 21 points, was ranked fourth. The NAPA developed by Cambodia, at 16 points, ranked 12th among the 50. However, when the distribution of the identified activities across the three levels of diversity (intra-species, inter-species and ecosystem) was also taken into account, the NAPA developed by Cambodia no longer stood out among the 50 documents due to the concentration of its prioritized activities mainly at the ecosystems level.

The NAPA-development process was followed by the elaboration and submission of project proposals to access funds from the LDCF (Biagini and Dobardzic 2011). As of June 2014, Laos PDR had submitted four project proposals and Cambodia five.

Overall, we observed that the implementation of the NAPAs has been limited in scope, mainly as a result of difficulties encountered in accessing resources from the LDCF (LEG 2012). However, the NAPA-development process has had an important role in raising the awareness of many stakeholders, in particular the most vulnerable communities in LDCs, about the importance of adapting to climate change (LEG 2012). Therefore, assessing the attention given to biodiversity within the NAPAs provides a useful reference for its consideration in ongoing and future planning for climate-change adaptation.

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Chapter 3. Cambodia¹

Khun Leang Hak

1. Introduction

1.1 Agriculture

According to the 2013 Census of Agriculture in Cambodia, 2.2 million households are engaged in agricultural activities. Of these households, 85% (1.87 million) were reported to be growing crops in agricultural holdings. The agriculture sector contributes 34% of national GDP and employs 63% of the entire labour force (8.2 million persons).

Total agricultural land (arable and permanent) is estimated at 4.5 million ha: 3.99 million of arable land and 0.51 million of permanent crops (MAFF 2013). The main crops being produced and changes in production between 2006/2007 and 2010/2013 are shown in Table 1 and Figure 1. The production areas of most crops (rice, vegetables, maize, black pepper) have increased continuously, with rubber and cassava tripling. The production areas of sugarcane, oil palm, rambutan, durian and maize have also markedly expanded, while some crops, such as sweet potato, mung bean, sesame, jute, coffee and guava have declined.

1.2 Cropping systems

The cropping systems in Cambodia have been recorded mainly for rice, which is planted in both wet and dry seasons. Wet-season rice (2,567,723 ha) is mainly rainfed lowland (80%), upland (2%) and deep-water/floating (2%). Dry-season rice (484,697 ha, 16%) is planted largely in low-lying areas where irrigation is available, particularly in the areas flooded by the Mekong River (including the Tonle Sab Lake Zone). Cambodian farmers also plant other crops in the rice-based cropping systems—vegetables, legumes, fruit trees and so on—as part of crop rotation, mixed cropping and individual. Rice-mung bean or mung bean-rice is the common rotation practiced by farmers in Kampong Speu, Takeo, Kandal and Kampong Chhnang.

In the plateau and mountainous areas, there are industrial crops and fruit trees such as rubber tree, oil palm, sugarcane, black pepper, cassava, mango, rambutan, longan. At the early stage of growing rubber trees, farmers intercrop some legumes, particularly soybean, mung bean and peanut, which are also planted largely in the plateau area.

1.3 Biodiversity

The most collected germplasm in Cambodia is rice: more than 3000 accessions have been collected and stored at the Cambodian Agricultural Research and Development Institute (CARDI) and the International Rice Research Institute (IRRI). This is followed by maize,

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banana and sugarcane. Some mung bean cultivars from Kbal Koh Research Station are stored at the World Vegetable Center (AVRDC), and the local agricultural research and extension centre has collected and evaluated local varieties of glutinous rice, floating rice, mung bean, pumpkin and cucumber.

Table 1: Main Crop Production in Cambodia

Crop	Production Area (ha)						
	2007	2008	2009	2010	2011	2012	2013
Rice	2,585,905	2,615,741	2,719,080	2,795,892	2,968,529	3,007,545	3,052,420
Maize	142,391	163,109	221,287	213,622	174,257	175,512	239,748
Cassava	108,122	179,945	160,326	206,226	391,714	361,854	421,375
Sweet potato	8,620	8,246	9,283	11,452	8,204	10,428	7,432
Vegetables	42,360	47,781	50,278	52,732	53,757	76,495	52,449
Mung bean	65,261	45,605	49,599	69,206	68111	66850	54312
Peanut	21,466	18,183	16,474	20,041	16,287	18,048	19,954
Soybean	76,981	74,413	96,388	103,198	70,584	71,337	80,688
Sesame	47,810	35,874	43,206	48,299	42,599	36,772	34,136
Sugarcane	10,458	13,297	13,533	17,207	22,614	48,586	23,810
Jute	461	397	347	594	342	288	243
Tobacco	7,277	9,447	9,269	10,062	8,308	5,947	6,881
Rubber	82,059	108,510	129,920	181,443	213,104	280,355	328,771
Banana	30,631		25664	35,071			
Cashew	60,453		66513	69,102			
Oil palm	4,000		7486	9,780			
Coconut	29,142		27288	27,114			
Longan	2,329		2376	2,962			
Mango	14,077		23734	23,980			
Milk fruit	1,299		1216	1,276			
Sapodilla	1,642		2052	1,886			
Durian	1,290		2200	2,400			
Jack fruit	4,276		4397	5,584			
Sweetsop (custard apple)	3,005		3218	3,163			
Orange	2,720		3553	3,169			
Coffee	400		231	231			
Rambutan	525		943	1,337			
Guava	2,170		1745	1,888			
Pineapple	656		1056	825			
Black pepper	515		861	861			
Palm (number of trees)	3,002,501		3272324	4,038,890			

Source: MAFF (2006-2013).

Note: Data from 2006 are highlighted in grey.

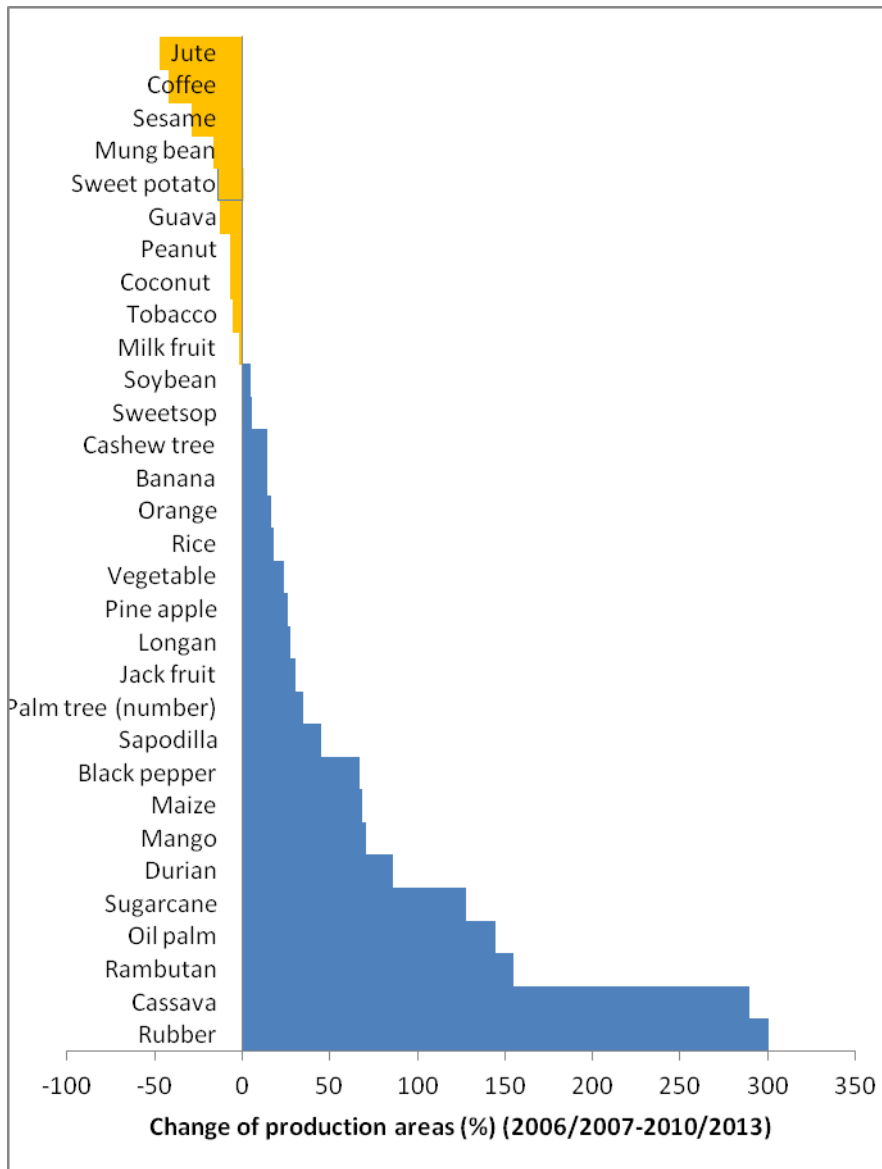


Figure 1: Change in production area

There is no clear information on trends in the use of crop varieties by Cambodian farmers; however, the use of new crop varieties (including hybrids) is increasing. Some new cultivars are developed in Cambodia while others are imported. Farmers have planted different varieties of wet-season rice: white rice, fragrant rice, glutinous rice, upland rice and floating rice. Large crops of white rice and fragrant rice are produced using improved varieties (from CARDI and imported). According to a recent survey by the International Financial Corporation (IFC), more than 50% of farmers growing wet-season rice planted improved varieties of fragrant rice (from CARDI), especially Phka Rumduol. Almost all varieties of upland, floating and glutinous rice are traditional. For other crops, such as watermelon, cucumber, maize, mung bean, etc., most farmers use improved cultivars, including hybrids. All hybrids are imported. Hybrid maize has been planted largely for livestock feed while glutinous maize is for human consumption. In

the case of cassava, although local varieties are available, imported cultivars are used in commercial production. Black pepper from Kampot Province is a well-known Cambodian crop. Farmers plant two varieties: Kamchay and Lampong, known locally as “big leaves” and “small leaves”. Replication is done by cuttings. Kampot pepper is the first Cambodian product to have the status of Protected Geographical Indication.

Mango is the most popular tree fruit, produced in home gardens and commercial plantations. In addition to imported varieties, a number of local varieties are produced, with Keo Lamiet being the most popular. Cambodia has a reputation in the production of durian (from Kampot province) as its eating quality is better than imported products. Another popular fruit tree is longan, planted in commercial plantations in plateau areas. There are two type of longan: local and improved (which are believed to have been import from neighbouring countries).

Table 2: Germplasm Collection and Conservation by CARDI

Crop	No. of Accessions	Crop	No. of Accessions
Banana	153	Rice (traditional variety)	3,336
Bitter melon	2	Sesame	10
Cassava	28	Sing qua	10
Chili	48	Soybean	12
Cucumber	9	Sugarcane	129
Eggplant	21	Sweet potato	13
Maize	52	Taro	7
Mango	2	Tomato	35
Mung bean	12	Watermelon	8
Ornamental plant	5	Wild rice	291
Other tree fruit	30	Wild vigna	64
Papaya	1	Winged bean	2
Peanut	12	Winter gourd	7
Pumpkin	15	Yam (Chheam Moan)	1
Rice (breeding line)	1,925	Yam (Dai-kla)	1

Source: CARDI Annual Report 2012.

1.4 Impact of climate change on agriculture

Cambodia suffers from frequent natural disasters, mainly floods, drought and severe storms, which claim lives and destroy infrastructure, houses and harvests (NAPA 2006). As shown in Table 3, from 2010 to 2013, as many as 452,211 ha (equivalent to 15% of the rice crop) was destroyed by drought, flood and insects (MAFF 2006-2013). In 2011, Cambodia experienced the worst floods of the last decade. It was reported by the Food and Agriculture Organization of the United Nations (FAO) that 60,000 households (roughly 25%) of flood affected families in 18 provinces were made food insecure, which was manifested in high levels of chronic and acute child malnutrition (FAO 2012). In 2009, typhoon Ketsana hit Cambodia between September 29 and October 5 (Royal

Government of Cambodia 2010). Fourteen out of 24 provinces were affected by the storm and subsequent flash floods. The typhoon left 43 people dead and 67 people severely injured. It destroyed the homes and livelihoods of some 49,000 families (about 180,000 people: 1.4% of Cambodia's total population). The value lost due to this typhoon was around US\$ 56.5 million.

A study on 'Drought Management Considerations for Climate Change Adaptation' (Kyoto University, no date) revealed that drought poses a particular challenge in the Svay Rieng Province (one of the drought-prone areas in Cambodia). Its impact is severe in every respect: economic, health, social and environmental. It was found that women suffer particularly badly. Even if the climate tends to be wetter in future, rainy seasons may be shorter and more intense, creating problems for agriculture. Furthermore, drought, as such, is only partly a result of low rainfall; it is also due to water management, storage and access. The study identified the root causes of vulnerability: it was apparent that communities saw poor or delayed rainfall as only one issue. They consistently identified such factors as poverty, the high cost of inputs, poor access to seeds or irrigation, and lack of alternative income-generating opportunities as key factors underlying their vulnerability.

Table 3: Rice Crop Damaged by Disasters, 2010-2013

Year	Drought	Insects	Flood	Total
2010	2,934	298	17,357	20,589
2011	53		267,184	267,237
2012	19420	95	16,510	36,025
2013	178	548	127,634	128,360
Total	22,585	941	428,685	452,211
Percentage	5.0	0.2	94.8	

Source: MAFF (2006-2013).

On the other hand, the coastal area of Cambodia, located in the western part of the country (Kampot, Kampong Som and Koh Kong provinces) is where rice and other crops are grown. Saline soil tends to predominate under coastal conditions, and rice plants experience osmotic stress resulting in the reduction of water uptake (similar to the effect of drought). Furthermore, the increase in sea level as a result of climate change means that more coastal rice fields will be exposed to sea water, which will also affect the production of other local crops.

2. Programmes and projects implemented since 2010

Table 4 presents a number of past and on-going projects and programmes in Cambodia since 2010.

Table 4: List of Past and Ongoing Projects Implemented by Various Agencies and NGOs in Cambodia

Project name (arranged alphabetically)	
Time period	Description
Agriculture Sector Development Program Loan (ASDP)	
2003-2009	<p>Implemented in four provinces—Takeo, Kampot, Kampong Cham and Kampong Speu—to promote sustainable growth of market-based agriculture and improve agricultural productivity.</p> <p>Specific objectives:</p> <ul style="list-style-type: none"> • improve ability of smallholders to raise productivity and diversify into high-value products • improve market environment for private agro-based enterprise growth • strengthen institutional capacity for competitive agricultural commercialization <p>Also promoted increased participation of the poor and women in agricultural production, marketing and post-production. Mainly implemented using loan from Asian Development Bank (ADB) and technical assistance from government of Japan.</p> <p>Effective in achieving objectives, especially with extension support under component 1. A total of 52,176 farm households have received one or more training sessions (as compared with 56,000 targeted at appraisal).</p> <p>Latest adoption surveys: most commonly used technologies concerned paddy (83%), chicken raising (76%) and vegetable production (65%).</p>
Cambodia Climate Change Alliance (CCCA)	
2010-2014	<p>A comprehensive and innovative approach to address climate change in Cambodia, including unified engagement point for development partners and multi-donor financing to provide resources for climate change capacity building and implementation at national and local level. Anchored in the National Climate Change Committee (NCCC)—the mandated government coordinating and policy support entity for all aspects of climate change.</p> <p>Aiming to strengthen NCCC capacity to address climate change and to enable line ministries, local government institutions and civil organizations to implement priority climate change actions.</p> <p>Sub-projects: grants to support development projects related to climate change adaptation, projects on improving small-scale agriculture production for food security and income generation:</p> <p>Building Capacity of Institutions to Help Farmers Better Adapt to Climate Change and Climate Variability in Cambodia (implemented by Royal University of Agriculture (RUA):</p> <ul style="list-style-type: none"> • assess performance of improved (generally drought-tolerant) Cambodia rice variety Rieng Chey • assess performance of improved (short-maturity, flood-tolerant) Cambodia rice variety Chul'Sa • evaluate performance of selected forage crops for income diversification; introduce forage crop variety for feed in drought- and flood-prone areas • monitor and analyse climate variability in the three target districts <p>Building Resilience Against Climate Change for Small-Scale Farmers and Local Authorities in Ratanakiri Province (implemented by Cambodia Center for Study and Development in Agriculture [CEDAC]): contribute to eradication of extreme poverty and hunger among small-scale farmer families, through enhancing resilience against climate change. Identified inadequate technical and local institutional capacity as one of the greatest obstacles to achieve project objectives, especially climate change knowledge related to agricultural practices.</p> <p>Adaptation to Climate Change through Alternative Livelihood in Community Forestry (implemented by Forestry Administration, MAFF): designed to build capacity within community forestry sector through effective participation of community forestry management committees and commune councils in newly established cantonment-level community forestry planning and co-ordination committees, and implementing related climate-change adaptation pilots: bio-digesters and home gardens.</p>

Cambodia Community Based Adaptation Programme (CCBAP)	
2010-2015	<p>Implemented in 20 provinces: Svay Rieng, Kandal, Prey Veng, Kampong Speu, Siem Reap, Kampong Thom, Battambang, Preah Sihanouk, Kampot, Ratanak Kiri, Mondul Kiri, Banteay Meanchey, Otdar Meanchey, Takeo, Kratie, Kampong Chhnang, Kampong Cham and Pursat, Steung Treng, Koh Kong:</p> <ul style="list-style-type: none"> to reduce vulnerability and increase adaptive capacity of targeted communities to manage the additional risks of climate change to reduce vulnerability of agricultural sector to climate-induced changes in availability of water to enhance capacity of vulnerable communities in building resilience, mainstreaming climate change in commune development planning and documenting good practices of adaptation to climate change <p>Three main activities:</p> <ul style="list-style-type: none"> improve necessary capacity within NGOs, community-based organizations and local communities to implement community adaptation measures mainstream adaptation to climate change at the commune level document good practices and share lessons learned to influence changes of policy and programme development <p>450 vulnerable communities in flood-/drought-prone areas targeted, in collaboration with government agencies (e.g. Ministry of Agriculture, Ministry of Water Resources, Forestry Administration, etc.)</p> <p>Three projects:</p> <ul style="list-style-type: none"> focus on resilient agricultural techniques, with training course on system of rice intensification (SRI), home gardening, animal and fish husbandry (benefit to 10,578 people, including 4,838 women) introducing rice varieties suitable to local growing conditions and other climate-resilient cultivars, diversifying crops and cultivars as well building capacity of project farmers for home gardens, supporting crop seeds/seedlings (Chinese cabbage, eggplant, cucumber, pumpkin, watermelon, papaya, mango, etc.) and other production inputs; seeds or seedlings provided based on farmer's request; successful for small-scale production (for household consumption) but challenges for commercial farmers with marketing and water shortages
Capacity Development of Rural Farmers for Food Security Project	
2001-2006	<p>Norwegian People's Aid (NPA): providing technical and financial support to Srer Khmer based in Malai District, Banteay Meanchey Province.</p> <p>Objectives:</p> <ul style="list-style-type: none"> support farmer field schools, farmer life schools and farmer action research organized by farmer trainers strengthen village-based associations and farmer trainer networks through training, experimentation, cross-/exchange visits and meetings <p>Main activities:</p> <ul style="list-style-type: none"> conduct farmer field schools establish farmer associations integrate homestead production support family ponds conduct field demonstrations/experiments
Diversification and Intensification of Rainfed Lowland Cropping Systems in Cambodia	
2007-2012	<p>Aimed at increasing range of crops grown under rainfed lowland conditions by promoting non-rice crop technologies with efficient water use and high financial return to growers, by adding a non-rice crop after main wet-season rice crop (i.e. rice/non-rice double cropping). Key research issue was water: selecting appropriate soil and water environment in wet season for following non-rice crop, particularly peanut, soybean, and mung bean, and ensuring adequate water.</p> <p>Target group: small-scale lowland rice farmers with favourable water availability on-farm in 5 provinces—Takeo, Kampot, Kampong Cham, Kampong Thom and Battambang. Limited underground water may be available or water from on-farm ponds, as supplementary irrigation to non-rice crops.</p> <p>Two key aspects: assessment of cropping risks and economic evaluation of new technologies.</p>

Economic and Social Relaunch of North-West Provinces (ECOSORN)	
2008-2010	<p>Overall objective: reduce poverty through increased household income, mainly generated from increased agricultural production.</p> <p>Purpose: economic and social development of rural population in 3 north-west provinces—Siem Reap, Battambang and Banteay Meanchay—with equitable benefit to both men and women; smallholder farmers and family members in project area.</p> <p>Three results to be achieved:</p> <ul style="list-style-type: none"> • <i>Result 1:</i> Intensified and diversified lowland rainfed farming systems • <i>Result 2:</i> Intensified and diversified lowland irrigated farming systems • <i>Result 3:</i> Intensified, diversified and expanded upland farming systems <p>Specifically supported rice, home gardens (vegetables such as eggplant, leek, lettuce, cauliflower, cabbage and fruit trees) and upland crops (mung bean, soybean, peanut, cucumber, watermelon, maize, sweet potato and cassava). Crop rotation also introduced.</p>
Enabling Households to Apply Necessary Cultivation for Economic Development (ENHANCED)	
2012-2015	<p>Implemented in Baray District, Kompong Thom Province, building on knowledge base in rice, vegetables and fruit, animal production, other rural livelihoods, giving opportunity to make sustainable improvements and changes for increased value of products and income. Particular emphasis on increasing positive contributions of women in family livelihood choices and production, benefiting 5,900 beneficiaries.</p> <p>www.adracambodia.org/projects/enhanced.html</p>
Enhancing Productivity of Major Upland Crops in Some Greater Mekong Sub-region (GMS) Countries: Vietnam, Lao PDR and Cambodia	
2005-2008	<p>Financed by Rockefeller Foundation, entitled Enhancing Productivity of Major Upland Crops in Cambodia, implemented in Ou Reang Ov and Tboung Khmum districts, Kampong Cham Province at CARDI station in target province and on farmers' fields.</p> <p>Objectives:</p> <ul style="list-style-type: none"> • develop and improve crop varieties suitable for different ecological environments • develop sustainable farming systems based on improved practices of crop production to supply sufficient food all year, increase farm family income and sustainable natural resource management <p>Focus on 2 major crops: maize (from Mexico and CARDI) and cassava (from Thailand, Malaysia and Cambodia), and 3 minor crops: mung bean (CARDI Chey), soybean (DT84) and sesame (local variety white sesame).</p>
Farming Systems Research for Crop Diversification in Cambodia and Australia (ASEM/2000/109)	
2004-2008	<p>Collaborative effort between CARDI and NSW DPI.</p> <p>Specific objectives:</p> <ul style="list-style-type: none"> • identify and overcome constraints to adoption of non-rice upland crops in Cambodia and non-cereal crops in north-eastern Australia by analysis of on-farm data and experimentation • develop simple diagnostic and analysis tools that farmers and advisers can use to monitor crop performance and how crops fit into farming system • produce appropriately packaged technical and financial information <p>Implemented in two Cambodian provinces—Battambang and Kampong Cham—by conducting 153 on-farm experiments and demonstrations: variety evaluation (43), insect pests and diseases (19), reduced tillage (22), agronomy and farming systems (69) in collaboration with various government departments, especially Department of Agriculture Extension and Provincial Department of Agriculture in target provinces.</p>

Food Security and Livelihoods Improvement	
2006-2008	<p>Funded by Food Security Initiative Fund of Canada International Development Assistance (FSIF-CIDA), 2-year project in Banan, Sangker and Thmor Korl districts, Battambang Province.</p> <p>Objective: improve livelihood situation of 14 poorer farmer groups in the communities by improving availability of nutrition for family members, especially children, with surplus sold for income.</p> <p>One component on integrated homestead production (crop and livestock) with vegetables among the integrated farming practices, supporting seeds of Chinese kale, bunching onion, long bean, petsai, water convolvulus, eggplant, papaya, etc., for home gardens.</p>
Helping Address Rural Vulnerabilities and Ecosystem Stability (Cambodia HARVEST)	
2011-2015	<p>In provinces around Tonle Sap Lake, with high percentage of poor and food-insecure families, currently working with over 55,000 clients in more than 300 villages throughout Battambang, Kampong Thom, Pursat, and Siem Reap provinces.</p> <p>Goals:</p> <ul style="list-style-type: none"> • improve food security • strengthen natural resource management and resilience to climate change • increase capacity of public and private sectors and civil society to support agricultural competitiveness <p>Main components:</p> <ul style="list-style-type: none"> • crop diversification • rice value chain • aquaculture • natural resource management • social inclusion and nutrition • policy <p>Specific objectives:</p> <ul style="list-style-type: none"> • increase incomes for 70,000 rural households • accrue economic benefits for 150,000 people • develop income-generating activities for 8,500 "extremely poor" households • diversify cropping systems for 31,500 households • generate \$25 million in incremental new agricultural sales <p>Crop diversification component has introduced horticulture, including home gardens for dry-season vegetable production on rice fields close to houses and commercial horticulture farms (> 1,000 m²) on rice fields with year-round irrigation (for cucumber, bitter gourd, cabbage, etc.).</p>
Improve the Food Security of Farming Families Affected by Volatile Food Prices	
2009-2011	<p>Implemented in 10 provinces in partnership with General Directorate of Agriculture and the Fisheries Administration of the Ministry of Agriculture, Forestry and Fisheries; Ministry of Water Resources and Meteorology and Ministry of Women's Affairs to develop sustainable increases in productivity, by enhancing access to agricultural inputs and services, diversifying and improving food preparation and nutrition, and strengthening management practices.</p> <p>Major components include: sustainable crop production and intensification of rice and vegetable production, strengthened postharvest management of rice; fisheries, water management and nutrition.</p> <p>Benefiting at least 80,000 food-insecure smallholder rural households with potential for rapidly expanding their food and agricultural production (i.e. having access to farm land of less than 1 hectare and with adequate labour).</p> <p>Specific results:</p> <ul style="list-style-type: none"> • 50,000 households benefiting from distribution of quality inputs for rice production (seed and fertilizer) • training on improved agricultural practices and farmer-to-farmer learning • around 9,000 households (of the 50,000) received equipment, storage facilities and training on improved postharvest management.

Improving Food Security and Market Linkages for Smallholders (MALIS)	
2011-2015	<p>Implemented in 5 districts in Otdar Meanchey Province—Anlong Veng, Trapaeng Prasat, Banteay Ampil, Chong Kal, Samrong—and 4 districts in Preah Vihear Province—Kuleaen, Chey Sen, Rovieng, Tbeng Meanchey. Funded under the Food Security Thematic Programme of the European Union for 3.5 years. Implemented by FAO in partnership with Ministry of Agriculture, Forestry and Fisheries and NGOs, with focus on community-based organizations (CBOs) such as agricultural cooperatives, farmers' associations, women's groups and rice banks, involving farmer field schools, farmer business schools, improved nutrition and disaster risk reduction, through capacity building and institutional strengthening with strong commercial orientation for sustainability.</p> <p>Objective: improve food security and nutrition for vulnerable smallholder farmers by improving farming systems, household income and family food preparation and nutrition.</p> <p>Expected achievements:</p> <ul style="list-style-type: none"> • increased capacity of smallholders to diversify production, increase productivity and build resilience; direct support in agricultural production to at least 7,500 vulnerable farmers in approximately 300 farmer groups; indirect benefit is learning from others' success • improved market linkages, value addition and profitability for targeted smallholders; basic business module for farmer field schools, extended business training in farmer business schools for selected groups, agricultural fairs and strengthening of CBOs to build market linkages • improved family food preparation and nutrition, targeted primarily at mothers and caregivers of children under two years old; food-based approach focusing on improved complementary feeding, diversified diets and small-scale food processing. 160 government and NGO staff from implementing partners and 300 community-level health workers trained to ensure competence in delivering quality training to smallholder beneficiaries • strengthened institutional capacity of local authorities, implementing partners, CBOs and agricultural cooperatives; training for farmers and farmer groups by multi-disciplinary training teams to provide foundation for sustainability; lessons learned shared locally and recommendations made to shape agricultural and nutrition-related practices and policies at the sub-national level
Improving Livelihood of Small Farmers in Tramkok (ILFARM-Tramkok)	
2002-2005	<p>Implemented in Tramkok District, Takeo Province, to improve livelihoods of 600 subsistence farmers by enhancing capacity for sustainable intensification and diversification of agricultural production.</p> <p>Four main outputs:</p> <ul style="list-style-type: none"> • farmers trained in ecological farming techniques and integrated farm management • farmers in key target villages and neighbouring villages exposed to innovations adapted or developed by cooperating project farmers • agricultural development led by farmer network established in project area • farmer resource centres established and accessible to farmers <p>Outcome:</p> <ul style="list-style-type: none"> • integrated farming systems with project farmers trained on system of rice intensification (SRI) and multi-purpose farming, including livestock (chicken and pig), fish culture and home gardens with fruit trees and vegetables (including long bean, bottle gourd, bitter melon, ivy gourd leaf, amaranth, chili, winged bean, water convolvulus and wax gourd) for household consumption and income generation
Integrated Farming and Marketing for Livelihood Improvement Project	
2007-2008	<p>Funding from New Zealand Agency for International Development (NZAID) small grants to establish self-help groups (SHGs) in 16 villages, providing technical skills training on agricultural activities (livestock, aquaculture, vegetable and rice production).</p> <p>Approximately 480 direct beneficiaries and 2,400 indirect beneficiaries, providing training on vegetable production and field demonstrations of early growth duration of rice, as well as providing vegetable and rice seeds to project farmers.</p>

Integrated Women's Empowerment Programme (IWEP)	
2005-2008 (I)	<p>Implemented in five districts of Siem Reap Province, financed by Danish International Development Agency (DANIDA) and Agricultural Development Denmark Asia (ADDA).</p> <p>Objectives:</p> <ul style="list-style-type: none"> • improve standard of living for poor farming families • train women in practical farming together with dissemination of knowledge on better production methods (e.g. of chickens and pigs as well as vegetable growing) • give women a chance to save up money and obtain cheap loans (micro-loans) • boost women's position in the family, the village and local society • raise awareness about human immunodeficiency virus-acquired immune deficiency syndrome (HIV-AIDS), domestic violence and human trafficking <p>Main activities:</p> <ul style="list-style-type: none"> • training of trainers on food security and gender • supporting scholarships • conducting farmer field schools (FFSs) • establishing village women self-help groups (SHGs) <p>Runs 2 FFSs in each target village for vegetable growing and livestock production: 14 weekly meetings for 25 to 30 farmers, with demonstrations to teach techniques such as compost making, pest and disease management, treatment and vaccination of livestock, as well as providing vegetable seeds (e.g. tomato, string bean, Chinese cabbage, eggplant).</p>
Local Agricultural Research and Extension Center (LAREC)	
2011-2015	<p>Established at Cheung Kreav commune, Kampong Chhnang Province; financial support from Swiss Interchurch Aid (HEKS).</p> <p>Goal: poverty reduction and food security of rural families through improved agricultural technologies, practices and input supply.</p> <p>Conducts research on local crop varieties, chicken breeding, sustainable land management and seed/breed production. Crop research related to crop diversification:</p> <ul style="list-style-type: none"> • improvement of Cambodian glutinous rice varieties • improvement of submergence-tolerant and floating rice varieties • identification of good-quality watermelon varieties for farmers • identification of high-quality Khmer pumpkin varieties • evaluation and selection of high-yielding mung bean varieties • breeding of early-growth duration rice (fragrant and non-fragrant) <p>Research conducted in the centre and on farmers' fields (mainly in Kampong Chhnang Province), working mainly on local crop varieties or combination of improved varieties/breeding lines and indigenous ones.</p>

Market-Focused Integrated Crop and Livestock Enterprises for North-Western Cambodia	
2012-2016	<p>Implemented in North-western Cambodia (Battambang and Pailin provinces), to identify and evaluate novel crop-cattle integration options to increase profitability, consistent with intensification, processing and marketing opportunities, and to shift focus from subsistence-based food security interventions to sustainable food security through diversification, generation of cash income and commercialization.</p> <p>Specific objectives:</p> <ul style="list-style-type: none"> • identify and explore potential for intensification, processing and marketing opportunities through an understanding of livelihood and operating environment of current and alternative whole-farm crop/cattle production systems • review current soil status with regard to degradation under existing farming systems and identify crop/cattle management options that meet economic, social and environmental goals • evaluate opportunities and technologies for crop/cattle production systems in context of declining soil fertility in partnership with 200 focus households • assess and develop options for adaptation to climate variability and climate change for crop/cattle farming systems in north-west Cambodia and north-west New South Wales, Australia <p>Engaging commercial and education sectors with research and extension providers to ensure development and delivery of alternative commercial crop and livestock enterprises.</p> <p>Research indicates that farmers burned crop residues, aggressively tilled soil, and lacked crop diversity and fertilizer, leading to declining soil fertility, soil erosion, high production risks and declining profitability. Cropping systems of target areas also revealed:</p> <ul style="list-style-type: none"> • early wet-season crop planted after isolated rain in February-March with high rate of failure • main wet-season crop planted in July-August and harvested in October-November at peak rainfall • soil full of water after main wet-season harvest but not utilized • crops such as sunflower can be successfully grown in dry season using residual soil water • crops can be grown for forage or silage in dry season with production coinciding with gap in cattle feed <p>Three possible cropping cycles per year:</p> <ul style="list-style-type: none"> • dry season (Nov-Feb): sunflower (dual-purpose: crop-forage) • early wet season (Mar-Jun): maize, mung bean, peanut • main wet season (Jul-Oct): maize, peanut, soybean
Promoting Climate-Resilient Water Management and Agricultural Practices in Rural Cambodia	
2009-2013	<p>Implemented in two provinces— Preah Vihear (Choam Khsan District) and Kratie (Chit Borei District).</p> <p>Objectives:</p> <ul style="list-style-type: none"> • make agricultural sector less vulnerable to changes in availability of water resulting from climate change • contribute to broader goal of enhancing adaptive capacity to prevent food insecurity induced by climate change • increase awareness of climate change, demonstrate climate-resilient practices in agriculture and water-resource management and integrate responses into provincial, district and commune development plans • respond to priorities identified in Cambodia's national adaptation programme for climate change (NAPA) by involving various dimensions to improve rural livelihoods of target beneficiaries, particularly by combining water sources and diversified farming systems that include crop diversification <p>Beneficiaries:</p> <ul style="list-style-type: none"> • more than 2,000 households get water for rice farming, home gardening and animal raising • 1,500 households benefit from pump wells, community ponds, rainwater harvesting containers and solar and wind-powered pumps • more than 3,600 families have adopted adaptive measures such as rice varieties, water harvesting, seed purification, dripping systems, integrated farming systems, SRI, and early warning information in their livelihood activities • 11,000 families learn about climate change and adaptation through on-going awareness-raising campaigns <p>Project conducted demo fields of improved rice varieties adapted to climate change (submergence and drought tolerance) and vegetable growing (e.g. mung bean and tomato).</p>

Rural Livelihoods Improvement Project in Kratie, Preah Vihear and Ratanakiri (RULIP)	
2007-2014	<p>Rural development that targets poor people in 84 poor communes in three provinces—Kratie, Preah Vihear and Ratanakiri—with the goal of improving livelihoods through positive and sustainable impact on agricultural development. Target group includes about 22,600 poor households (30% of population of designated area): poor people with little land or landless, indigenous and ethnic groups, and households headed by women, particularly with young children and/or many dependents.</p> <p>Objectives:</p> <ul style="list-style-type: none"> • capacity building • skills training • technology transfer • improvement of food security, agricultural productivity and natural resource management • income generation through on-farm and off-farm activities • development of market-oriented production <p>Participants also have role in monitoring project performance and assessing its impact on their communities.</p> <p>Grant from International Fund for Agriculture Development (IFAD) (administered by United Nations Office for Project Services [UNOPS]) for:</p> <ul style="list-style-type: none"> • access to more advanced agricultural technology to improve household food security and incomes and agricultural productivity • diversification of on-farm income opportunities • linkages with markets and development led by private sector • building capacity of commune councils and village-based organization to plan and monitor economic development activities <p>Also enhances MAFF capacity to formulate pro-poor policies and poverty-reduction programmes.</p>
Strengthening the Cambodian and Australian Vegetable Industries through Adoption of Improved Production and Postharvest Practices (HORT/2006/107)	
2010-2013	<p>Partnership between 2 Australian organizations: NSW Department of Primary Industries and Charles Sturt University; 3 Cambodian organizations: General Directorate of Agriculture (GDA), CARDI and RUA; and 1 international organization: AVRDC. Seeking to build on predecessor (HORT/2003/045) and implement seed-to-plate approach to vegetable research and development in Cambodia, and enhance vegetable farmers' ability to meet domestic demand for high-quality, nutritious tomatoes, chilies and leafy vegetables.</p> <p>Objectives:</p> <ul style="list-style-type: none"> • more fully map supply chains for tomato, chili and leafy vegetables • improve product quality and supply through delivery of technical packages on production, disease management and supply-chain management • build capacity of research and extension staff in vegetable production, postharvest research and plant pathology • better understand gaps in vegetable extension material and produce appropriate suite of materials suitable for use with farmers and supply-chain participants

Sustainable Rural Livelihood Improvement	
2011-2016	<p>Aimed at improving food security and incomes of around 5,000 farmer families in Kampong Chhnang and Kampong Speu provinces through Society for Community Development in Cambodia (SOFDEC).</p> <p>Objectives:</p> <ul style="list-style-type: none"> empowering village through organizing and strengthening community committees and developing village development plans improving farmers' rice and vegetable production enhancing farmers' livestock production developing integrated rice-based farming systems providing access to good-quality water for human consumption, animal use and crop production increasing income generation through access to markets for agricultural and handicraft products <p>Second and fourth objectives involve crop diversification in rice-based farming systems with new production techniques and quality seeds of rice and vegetables/cash crops (maize, mung bean, sesame, water melon, pumpkin, sweet potato, taro, etc.) through 2 approaches in crop diversification; strengthening existing cropping systems and introducing new crop production based on market and local context, as well as no-till practices (by using water hyacinth as cover crop), supporting production and postharvest facilities together with water wells, while improving access to cash credit.</p> <p>Common cropping system includes crop rotation of rice and non-rice (rice-mung bean, watermelon, sesame) and non-rice and non-rice (e.g. sweet melon-maize, mung bean-sesame).</p>
Tonle Sap Poverty Reduction and Smallholder Development Project	
2010-2017	<p>Implemented in 196 communes in Kampong Cham, Kampong Thom, Siem Reap and Banteay Mean Chey provinces, to benefit about 630,000 households (approximately 2.5 million people).</p> <p>Objective: increase agricultural productivity and improve access to markets in these 4 provinces through better agricultural support and improved access to rural financial services, increased diversification of household economic activities, creation of on- and off-farm livelihood opportunities and enhanced rural infrastructure.</p> <p>Overall goal: to improve livelihoods of resource-poor households in 4 target provinces in the Tonle Sap Basin by 2020 through:</p> <ul style="list-style-type: none"> improving rural infrastructure strengthening rural financial services improving agricultural productivity through crop diversification by establishing farmer extension, training, demonstrations and adaptive research, and marketing groups, including demonstration of improved rice varieties (Phka Rumduol, Phka Rumdeng, Sen Pidao, etc.) and vegetable production after wet-season rice (chili, eggplant, melon, bitter gourd, cucumber, etc., based on farmers' request and local growing conditions) creating enabling environment
Tonle Sap Technology Demonstrations for Productivity Enhancement (TSTD)	
2009-2012	<p>Technical assistance implemented in 4 Tonle Sap provinces—Banteay Meanchay, Kampong Cham, Kampong Thom and Siem Reap—for diversified and improved income of smallholders, marginal farmers and poor households in Tonle Sap Basin to increase access to good agricultural practices, technologies and information.</p> <p>Outputs:</p> <ul style="list-style-type: none"> demonstrated good agricultural practices, technologies and training, including piloting of selected food crops, livestock, fisheries, and water-management technologies rural communication facilities <p>Two components:</p> <ul style="list-style-type: none"> pilot demonstration of productive, profitable and bio-secure technologies through demonstration of diversification (vegetable production, livestock, aquaculture and mushroom) and introduction of important food crops: bitter gourd, yard-long bean, cucumber, tomato, sweet and hot pepper, eggplant, chaisim, bok choy, Chinese kale, cauliflower, sweet corn and water melon (vegetable seeds provided by seed company) promotion of development and application of rural communication facilities for technology adoption and improving market access, thereby influencing productivity, diversification and competitiveness

3. Analysis of programmes and projects

3.1 Project design

Beneficiaries: The majority of the projects focus on poor or vulnerable groups of farmers, including ethnic minorities. A number of students were also supported to pursue degrees at the agricultural university. In the value-chain improvement projects, beneficiaries also included better-off families (farmers and input suppliers).

Implementation arrangement/process: There are two types of implementation arrangements. The United Nations (UN) agencies (UNDP, FAO, IFAD, etc.), international universities, international NGOs and firms functioned as coordinator/donor, while relevant government agencies (GDA, national research institutes/stations, universities, etc.) and local NGOs implemented the projects. In general, the project time line ranged between two and five years with most lasting three years.

Scope and measures: The development projects carried out by the governments and NGOs have broad objectives that include rural community development, agricultural improvement/food security, gender mainstreaming, adaptation to climate change, value-chain and micro-credit or community saving. Projects implemented by government agencies cover most of the provinces in the country, while those of NGOs worked in specific target areas where there is a high incidence of high poverty. The measures used to implement the projects include the following:

- introducing new crops or improved varieties (e.g. 10 rice varieties issued by MAFF) and climate-resilient cultivars
- capacity building in agricultural production techniques, including crop diversification and climate-adaptation
- supporting production inputs
- improving postharvest management and processing
- improving access to water: developing infrastructures for irrigation: dams, canals, ponds, wells, etc.
- improving the value chain of a particular crop
- introducing micro-credit or self-help groups (saving groups)
- establishing farmers' associations
- improving integrated livestock enterprises

The common purpose of the projects in relation to crop diversification has been to improve the food security and nutrition of target beneficiaries. The projects have also worked to increase the incomes of rural households by promoting entrepreneurship.

Technical aspects: The most common tool used in capacity building is the farmers' field school (FFS). Technicians from the Provincial Department of Agriculture (PDA) and NGOs are involved with these training courses, which allow farmers to learn and practice the particular subject in a real situation, sharing information and reflecting on the results of the project at meetings and workshops... In addition, this method shows the real progress of a package of technology in a demonstration field, allowing farmers who have not been directly involved to benefit. As rice is the staple crop, it is included

in most projects and programmes, mainly through the introduction of the system of rice intensification (SRI). Home gardens (small-scale production of vegetables and fruit trees) are another popular intervention to improve the availability of food for consumption or for sale of the surplus to generate income. Some projects have been involved with commercial horticulture, where new crops, based on market demand, are introduced. Organic vegetables have also been introduced by some NGOs. Other projects work to improve the production techniques of existing crops where market niches have been established. Crop-rotation and intercropping techniques are usually included.

The results of the projects are usually shared through reports and workshop and through exposure visits to increase farmers' knowledge, experience and confidence.

Financial conditions: There are two funding types: grants and loans. A grant is a charitable donation from various donors, such as the European Union (EU), UN agencies, international NGOs, bi-lateral funds, the ADB and World Bank. All budgets for NGO projects are funded by grants, while funding for government-implemented projects are a combination of grants and loans (from the ADB, World Bank, bi-lateral funds, etc.).

Monitoring and Evaluation: Monitoring is normally done during the project. Donors monitor the projects implemented by partners (government agencies and NGOs). The implementers also set up or assign a monitoring team or individual to monitor project implementation. In addition, key farmers or farmer promoters are selected and their capacity is built; they play a role in promoting the agricultural techniques to other farmers within and outside the target areas through networking, field days, coaching and so on. Evaluation is generally done by the external consultants and takes place when a project has ended—to assess the impact and key lessons learned for further project design and implementation.

3.2 Implementation outcomes

Farmers in target areas have gained knowledge about crop-production techniques, integrated farming systems (including crop rotation and intercropping), and climate-resilient production techniques. And they have applied this knowledge in their fields.

The beneficiaries have also had access to quality seeds of improved varieties (rice, vegetables, cash crops, fruit trees, etc.) and agricultural tools. The quality seeds of some improved crop varieties are from CARDI, provincial seed-production centres, Kbal Koh Vegetable Research Station, local agricultural research and extension centres (LARECs) and private companies who sell seeds, including imported materials.

Some projects established community seed banks (with local seed producers) or supported government seed-production stations to increase the number of beneficiaries and to ensure the continuation of activities when the interventions ended.

Irrigation infrastructures, such as canals, dams, community ponds, wells, etc., have been developed or renovated. The participation of local people and the authority to manage the facilities in a sustainable way were organized through water-user groups and contributions from group members.

Such interventions have improved agricultural production, especially of vegetables, and have improved the nutrition of rural families, leading to enhanced food security. In addition, the local environment has been enhanced through the introduction of good agricultural practices, organic crop production and/or integrated pest management. More importantly, farmers and their families have gained an increased income from selling agricultural products (including household surpluses), partly through value-chain interventions.

Some projects have supported students in pursuing degrees at the agricultural university.

According to reports from the project Cambodia HARVEST, rainfed lowland rice yields of project farmers reached 4 tonnes/ha with a gross annual margin of \$450/ha; commercial horticulture (bitter melon) provided a gross margin of \$3,400/ha per crop.

The rice yield of farmers in the SOFDEC target areas reached 4.3 tonnes/ha (wet-season or rainfed lowland rice) and 6.8 tonnes/ha (dry-season rice)—yields that are higher than the national figure of 2.9 tonnes/ha for wet-season rice and 4.4 tonnes/ha for dry season). Furthermore, according to projects on promoting climate-resilient water management and agricultural practices, farmers can increase their income by two to three times through reduced seed use and improved yields. Target farmers in the project implemented by Sreer Khmer had improved food security, and according to FAO's MALIS project, the outcome was a substantial boost in vegetable production that allowed farmers to grow better and more nutritious food for their family, along with a surplus for sale. The result has been reduced expenditure on food items, income from the sale of their own produce and the ability to feed their children better meals. Based on the latest adoption surveys in the ASDP project, the most commonly used technologies were paddy (83%) and vegetable production (65%), leading to an average increase in farm family incomes from \$399 to \$562 per annum—an increase of \$163 per annum or 41% (from agricultural production). The production of upland crops (maize, soya bean, mung beans and groundnuts) under the ECOSORN project increased expected yields to 2.2 tonnes/ha.

During implementation of Cambodia HARVEST, the introduction of vegetable crops in some location changed to maize, which was not included in the work plan. The rice-maize cropping system that was established coped better with market and water-shortage issues because maize is more tolerant to drought and is easy to market.

3.3 Strengths and weaknesses across projects/programmes

3.1.1 Strengths

The following strengths of project design and implementation have been identified:

- Alignment with relevant government policies on agriculture development. In the National Strategic Development Plan (2009-2013) (Royal Government of Cambodia 2009), under the sub-sector of Improving Agricultural Productivity and Diversification, the government has formulated a number of actions to support this policy:
 - strengthen research on and development of seeds, crop-production technologies, machinery and postharvest technologies

- promote crop intensification and diversification; diversify lowland cropping with legumes after the harvest of wet-season rice
- strengthen and expand the structure and system of agricultural extension
- foster the strengthening and development of farmer organizations and agricultural communities
- promote effective enforcement of related legal and regulatory frameworks
- Focus on Institutional Capacity Building and Management Support Program for Agriculture and Water, Food Security Support Program, Agricultural and Agri-business (value chain) Support Program, Water Resources, Irrigation and Land Management Program, as well as Agricultural and Water Research, Education and Extension Program (in the Agriculture and Water Strategy 2006-2010 [Royal Government of Cambodia 2006]). In the Food Security Support Program, there was more emphasis on the following:
 - an increasingly productive and diversified agricultural system capable of assuring food security for the nation and delivering an acceptable quality of life for rural communities, especially the poor
 - intensified and diversified food production by smallholder farming households, particularly those that are food-insecure, based on their own crop and grazing lands, and access to common property resources of land, fisheries and forests
 - community groups, particularly for food-insecure households and women, who are empowered to gain the full benefit of government assistance programmes, provide their own “food-security safety nets” such as rice banks, and represent their own interests in political and administrative environments
 - policies and information on aspects of food security related to agriculture and water management that effectively guide public administration at all levels
- Applying packages of technology such as improved crop varieties, including climate-resilient cultivars, soil-improvement techniques, integrated pest management and water management; introducing open-pollinated crop varieties (OPVs) so that farmers can keep seed for the following planting seasons.²
- Taking into account the agroecology and development of the value chain in order to improve productivity and income, or having flexibility during implementation, such as allowing beneficiaries to select niche crops for the market. Farmer associations have been established and strengthened to improve market position.
- Conducting research to identify issues and opportunities before intervention, working to improve local crop varieties and cropping systems, e.g. crop rotation, intercropping, home garden, and so on.
- Collaboration and participation of stakeholders: relevant government agencies, NGOs and farmer associations.
- Helping farmers to adopt a positive and creative mental attitude, to learn to analyse their own situation and problems, learn to propose own solution, learn to set goals and action plans to solve own problems; regular reflection and evaluation of own actions.

² There are two types of seeds available from markets (hybrid and OPVs). All seeds from the national research institute and some seeds from the markets are OPVs. Hybrid seeds, such as maize, and some vegetables (cucumber, watermelon, etc.) are available in the market from private companies. All traditional seeds (local varieties) are OPVs. Farmers still use traditional varieties of rice, local vegetables, mung bean, waxy maize, etc.

- Promoting self-development and continuous learning culture among farmers and staff.
- Introducing micro-credit or self-help groups (saving groups).

3.3.2 Key challenges/weaknesses

- Despite the research results that have been produced by various institutions, only a limited number of technologies have been disseminated to beneficiaries. For example, cassava-based intercropping and maize-based intercropping have been developed and improved crop varieties including flood- /drought-tolerant cultivars (e.g. rice, mung bean, etc.) have been identified. However, these have not been widely used in the development projects, for several reasons: the research information is not widely shared, seeds of improved varieties are not available or difficult to obtain (lack of suppliers, high prices), agricultural extension services are insufficient and funds for implementation are limited. The small number of farmer households involved in many projects (100-200) also likely limits outreach
- Some projects have been implemented by a large number of sub-contractors, which leads to increased administrative and coordination costs while reducing benefits to the target households.
- Entrepreneurship is crucial in sustainable implementation of projects. The projects with small-scale farmers often have problems with sustainability or continuation of interventions when the project ends, because resources (budget, time, etc.) are not adequate to support the farmers in becoming entrepreneurs and generating enough income for their families.
- Some of the improved crop varieties for niche markets are not available from the research institutes, such as chili (bell and hot varieties), waxy maize, sesame, soybean, etc., so farmers use traditional and imported materials. Furthermore, the performance of some of the released varieties is not comparable to those of private companies in terms of growth duration, grain quality and yield, so such cultivars have not been used (e.g. maize, water melon, rice).
- A large number of interventions did not include a water-supply system, so farmers are often faced with water shortages, resulting in reduced yields. Even when a water-supply system is installed, the beneficiaries are still challenged with water shortages when there is a prolonged drought in the wet season. Furthermore, crops are sometimes devastated by floods, which quite often occur in lowland areas, especially provinces along the Mekong River; upland crops are sometimes damaged by flash floods. In addition, with a limited water supply, crop diversification in the dry season (e.g. peanut, mung bean and vegetables after rice) has not been broadly adopted.
- Ineffective pest-management programmes have led to an over-reliance on chemical control, exacerbated during the wet and dry seasons, which limits crop yields and increases input costs, leading to less profit. In order to have sufficient income for their families, some farmers have migrated to work in the cities or in other countries. Migration also occurs in smallholder families with insufficient labour, especially youths, which is another constraint in the agriculture sector. In this regard, the introduction of agricultural machinery, such as hand tractors, tractors, combine harvesters, and so on have become popular. But sometimes this brings up new issues. For example, because of a shortage of labour, farmers have tried to harvest mung bean with a combine harvester, but because of improper operation, the yield was low (from losses in the field) and beans were of poor quality (dark colour and cracked), which resulted in around 15% reduction

is sales revenues. In addition, hiring machinery is expensive and adds to production costs.

- Limitation of human resources in some local partner NGOs and government departments. Government officials receive wages when monitoring the projects, and government salaries are quite low.
- Some projects introduced new crops (for example, tomato) that were not suited for the location or for which there was no market.
- Marketing is the hot issue for farmers. Even where a value chain has been introduced farmers and farmer associations are still faced with low prices or no market. This is due to the following reasons: flow of information along value chains is fragmented, the market is under the control of companies or buyers or there is a lack of industry coordination, contract farming has not been widely used, competing products from neighbouring countries are freely imported, postharvest management is poor, there is a lack of facilities and insufficient interventions (to regulate prices). In addition, at peak periods farmers sell products at a low price to input suppliers from whom they buy agriculture inputs on credit.³

4. Conclusions

Crop diversification is chiefly designed and implemented as part of the projects and programmes for agricultural development, food security, development of rural communities and other cross-sectors: education, health, and climate change, and is a key factor for enhancing agricultural productivity in the National Strategic Plan of Cambodia 2009-2013. Projects and programmes have been implemented by various government agencies (especially MAFF), NGOs, universities, UN agencies, ADB and the World Bank Group. Most poor Cambodians, including ethnic minorities, are the beneficiaries, with the majority of projects designed for home gardens, commercial horticulture/cash crops and integrated farming systems in which crop rotation and intercropping are the main component (Table 5).

Table 5: Crop Diversification

<p>Crop diversification in rainfed lowlands</p> <ul style="list-style-type: none"> • Crop rotation: Rice-mung bean or mung bean-rice, rice-watermelon/pumpkin, rice-maize, and rice-vegetables • Individual crops: Peanut, sugarcane, sweet potato, cassava, etc.
<p>Crop diversification uplands (northern-western Cambodia)</p> <ul style="list-style-type: none"> • Early wet season (Mar-Jun): Maize, mung bean, peanut • main wet season (Jul-Oct): Maize, Peanut, Soybean • Dry season (Nov-Feb): Sunflower (dual-purpose: crop-forage)
<p>Crop diversification dry season (from January to July)</p> <ul style="list-style-type: none"> • Crop rotation: Rice-sesame/mung bean/maize, muskmelon/watermelon/vegetables-maize and mung bean-sesame • Intercropping: Eggplant with muskmelon/watermelon/pumpkin • Individual crops: Rice, chili, sugarcane, cow pea, etc.

³ Farmers are unable to access micro-credit in the community or from micro-finance institutions. For example, it was reported by SOFDEC that a number of mung bean producers had borrowed money from sellers (at provincial markets in Kampong Chhnang) in order to buy production inputs. Each family had to pay back the money at harvest with an interest rate of around 10% per month. Furthermore, farmers borrow mung bean seed (in reality, beans that can be used as seed because farmers cannot find quality seed) and then have to repay a double quantity at harvest (or an interest rate of 30% per month).

There are a number of measures applied to implement crop diversification, such as introducing new crops or improved varieties and climate-resilient cultivars, capacity building of agricultural production techniques, including crop diversification, climate adaptation and so on. The strength of project design and implementation depends on how the technology package is applied and to what extent the collaboration and participation of relevant stakeholders are included.

The implementation of crop diversification has enhanced crop productivity, improved food security, increased incomes and contributed to adapting to climate change, thereby improving livelihood of the beneficiaries.

Nevertheless, there are a number of challenges, ranging from a lack of technologies to the impact of the climate. Better results cannot be realized unless the weaknesses identified have been solved by all relevant stakeholders: improving the availability of relevant technologies developed by research institutions, increasing access to water resources, mainstreaming technologies for adapting to the climate, strengthening value chains and more successfully sharing project results and lessons learned.

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Photographs



Project farmers in Siem Reap Province gained new knowledge about agriculture and livestock production by participating in the farmer field school.

Photo by IWEP



Project farmers in Kampong Speu Province received production inputs in the SOFDEC vegetable improvement project.

Photo by SOFDEC



Members of a food security and nutrition group attend a training event on record keeping in Siem Reap Province.

Photo by Cambodia HARVEST



Spillway constructed to keep water in the canal and to bring more water to the lake reservoir in the target area of CCBAP.

Photo by CCBAP



Horticulture farmers like this one in Kampong Thom Province are alternating rice, vegetables and corn to take advantage of the benefits of crop diversification.

Photo by Cambodia HARVEST



Target farmers in Kampong Speu and Kampong Chhnang had access to quality rice and mung bean seeds through community seed banks.

Photo by SOFDEC (2012)



Project farmers apply new rice-production technique: system of rice intensification (SRI).
Photo by Cambodia HARVEST



Farmers in integrated rice-based farming system in Kampong Chhnang (2012) had access to well for household water, home garden and animal use.
Photo by SOFDEC



Project farmer in Kampong Chhnang applies new technique in planting watermelon using no-till practice before maize cultivation (2014).
Photo by SOFDEC



Mrs. Thieng Leub in front of her vegetable garden in Preah Vihear Province.
Photo by MALIS of FAO

Chapter 4. Lao PDR¹

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1. Introduction

1.1 Agriculture

Lao People's Democratic Republic (Lao PDR) is a landlocked country, with a total land area of 236,800 square km, 80% of which is mountainous. Located in Southeast Asia, it shares its borders with Vietnam, Cambodia, Thailand, Myanmar and China. The country's population was 6.77 million in 2013 (World Bank 2014), and around 73% of the population lives in rural areas, depending on natural resources and agriculture for their livelihood (Ministry of Planning and Investment, National Statistics 2012).

The agriculture, natural resource and environment sectors account for over 40% of the country's GDP and over 70% of the employed workforce. Agriculture alone contributed to 32% of GDP in 2008, but the country's development depends on its natural resources (Bouahom 2010).

Farming practices include three systems (lowland, upland and mountain), mainly planted to rice, maize, cassava, coffee, etc. (table 1). The total cultivated area was about 1.2 million ha in 2006 and increased to 1.6 million ha in 2010. Total area devoted to rice is almost 0.8 million ha, with total production around 3 million tonnes in 2010 and an average yield of 3.5 tonnes/ha (Rasabud 2011).

1.2 Characteristics of cropping systems

There are six agroecological zones in Lao PDR: Northern highland, Northern lowland, Vientiane plain, Mekong corridor, Center and Southern highland, and Bolaven plateau (World Bank 2006) and, in general, three cropping systems: mono-cropping, intercropping and rotation.

Mono-cropping: In the system of mono-cropping or single cropping, only one crop is grown on a piece of land season after season. This has several disadvantages: it is difficult to maintain cover on the soil; it encourages pests, diseases and weeds; and it can reduce soil fertility and damage soil structure. An advantage of this system is that it can save labour in such production activities as transplanting, weeding, fertilizing and watering because machines can do the work. However, it is much better to rotate crops, or to use intercropping or strip-cropping systems.

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Table 1: List of Major Crops Produced in Lao PDR

No.	Types of crop	Area of production (ha)	Production (tonnes)	Productivity (tonnes/ha)
1	Rice	825,500	2,925,000	3.54
2	Corn	229,200	1,107,700	4.83
3	Sweet potato	4,400	34,400	7.7
4	Cassava	18,300	315,200	17.1
5	Mung bean	2,900	3,800	1.3
6	Soybean	9,600	13,500	1.3
7	potatoes	3,085	54,245	17.58
8	Yam bean	765	6,975	9.12
9	Taro	5,625	51,720	9.19
10	Groundnut or peanut	19,300	32,600	1.6
11	Sesame	18,100	34,600	1.3
12	Tobacco	5,900	13,100	2.2
13	Cotton	1,700	1,100	0.6
14	Sugarcane	17,000	749,200	43.9
15	Coffee	57,800	31,100	0.5
16	Tea	1,900	2,500	1.3
17	Vegetables	85,710	744,450	8.69
	• Leaf vegetables	45,240	358,610	7.93
	• Root vegetables	7,955	42,750	5.37
	• Fruit vegetables	32,510	343,090	10.55
18	Tree fruit	6,320	108,080	17.10

Source: Annual report of Department of Agriculture, 2010-2011.

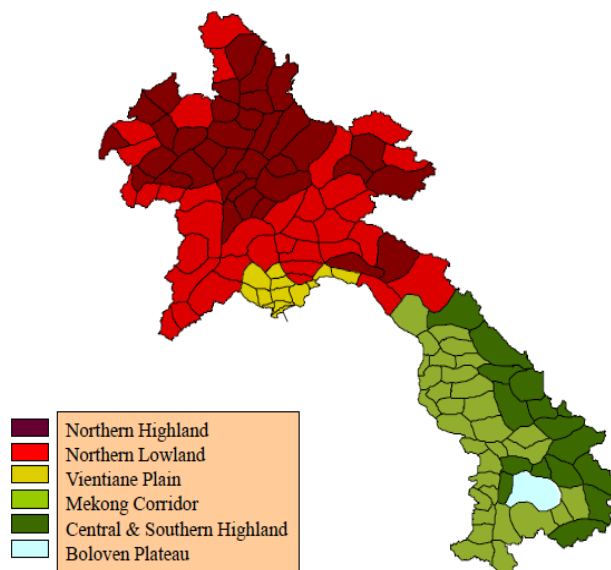
Intercropping: This system involves planting alternating rows of maize and beans, or growing a cover crop in between the cereal rows; in other words, growing a two or more crops in the same field at the same time.

Rotation: Rotating crops means changing the type of crop grown in the field each season or each year—rice-mustard-maize or rice-potato-sesame, for example—(or allowing the land to lie fallow). Crop rotation is a key principle of conservation agriculture because it improves the soil structure and fertility, and helps reduce weeds, pests and diseases.

1.3 Biodiversity

Lao PDR has been a contracting member of the International Treaty on Plant Genetic Resources for Food and Agriculture (hereinafter “the Treaty”) since 2006 (FAO 2007). Three months later, national representatives participated in the first meeting of its governing body, which took a number of important decisions for the Treaty’s implementation, including (1) the adoption of the standard material transfer agreement for exchanging materials under the multilateral system of access and benefit sharing for plant genetic resources for food and agriculture (PGRFA) and (2) the definition of

priorities under the Treaty's funding strategy. Since then PGRFA in Lao PDR have been conserved successfully for rice, some vegetables and some non-timber forest products (NTFPs).



Source: Rural and Agriculture Sector Issues Paper, World Bank, 2006

Figure 1: Agroecological zones in Lao PDR

Lao PDR is one of the richest countries in biodiversity, with 8,000-11,000 flowering plants, more than 700 species of NTFPs and 2,000 medical plants (Suvimon 2013). In situ conservation has involved continuous evaluation of the plant genetic materials available in the National Forestry Protection Area and National Park, for example. The Agriculture Research Center (ARC) and Horticulture Research Center (HRC), which belong to NAFRI, have been conducting research on the adaptation of PGR outside in situ conservation areas. Ex situ conservation involves ARC's rice accessions in the ARC genebank, and HRC's vegetable accessions in a separate, small genebank (with refrigerators and cold storage). Between 1996 and 2000, NAFRI and IRRI cooperated in surveying and collecting local varieties of Lao rice. More than 13,000 accessions (local varieties and wild rice) were investigated and conserved in ARC and IRRI genebanks. In addition, HRC, the German Development Service (DED) and the Asian Food and Agriculture Cooperation Initiative (AFACI) worked together to survey and collect PGR in several regions of the country. The results included more than 2,000 accessions of 16 types of vegetable (Figure 3), which were explored and conserved in the HRC genebank.

1.4 Influence of climate change on crop cultivation

The climate of Lao PDR is tropical monsoon, which comprises two distinct seasons—rainy (May to October) and dry (November to April)—with temperatures between 15°C and 35°C, high humidity and annual rainfall averaging between 1,000 and 1,500 mm in all areas of the country.



Figure 2: Diversity of rice, eggplant and pumpkin varieties in Lao farmers' fields and local markets

Photos by Suvimon, 2013, NAFRI workshop.

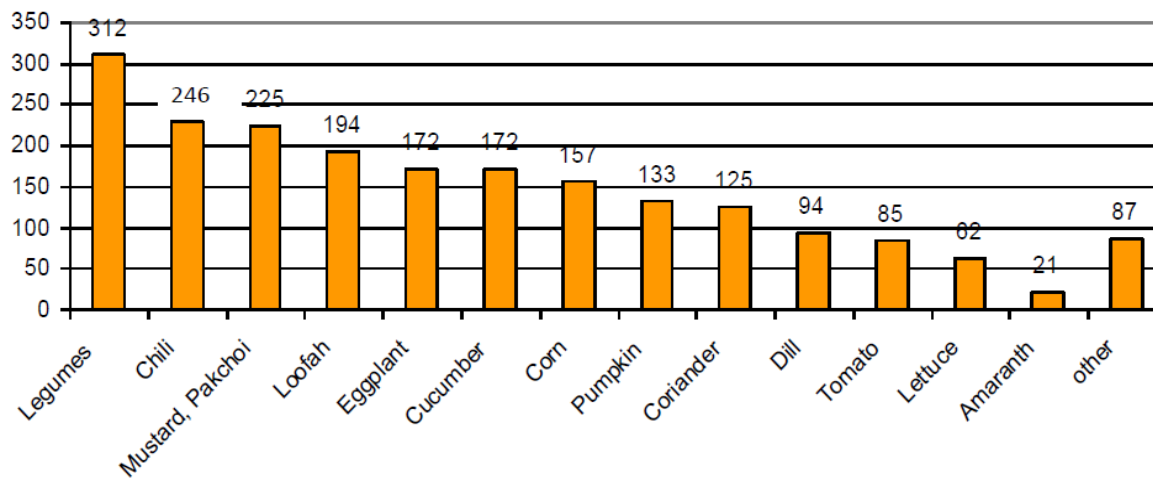


Figure 3: Vegetable conservation in Lao PDR: more than 2,000 accessions of 16 types of vegetables investigated and conserved in HRC genebank

Changes in the climate have led to an increase in irregular weather events such as extreme drought and severe floods, storms, cyclones and heat waves, which have had a significant impact on agricultural production, the environment, economic growth and society as a whole. Agriculture, in particular, is susceptible to droughts and floods, resulting in low productivity and poor quality, increased diseases and insect pests, soil erosion and nutrient loss due to heavy rains.

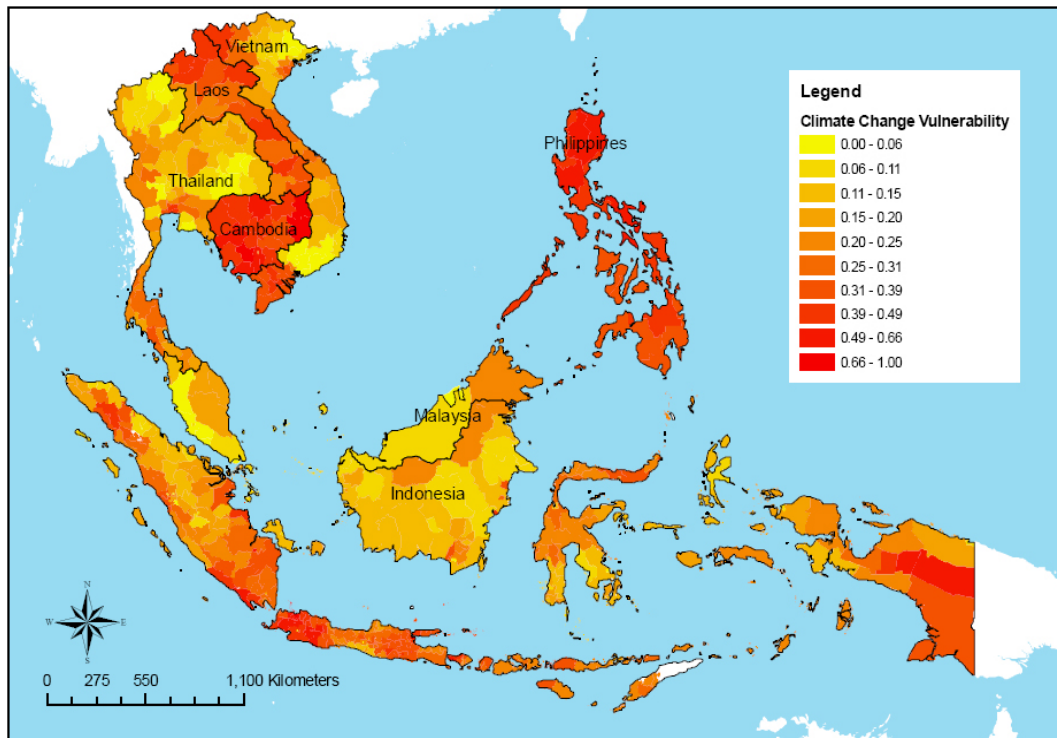
Climate change can affect agriculture in a variety of ways. Beyond a certain range of temperatures, warming tends to reduce yields because crops increase their growing rates, producing less grain in the process. Higher temperatures also interfere with the ability of plants to take up and use moisture. Evaporation from the soil accelerates when temperatures rise and plants increase transpiration and lose more moisture from their leaves, resulting in "evapotranspiration." Because global warming is likely to increase rainfall, the net impact of higher temperatures on water availability is a race between higher evapotranspiration and higher precipitation, which is won by higher

evapotranspiration. A key culprit in global warming is carbon emissions, but higher carbon levels can also help agriculture by enhancing photosynthesis in many important, so-called C3, crops (such as wheat, rice and soybeans). The science on the benefits of carbon fertilization is far from certain, but we do know that this phenomenon does not help C4 crops (such as sugarcane and maize), which account for about one-fourth of all crops by value (Cline 2008).

The severity and frequency of floods and droughts have increased in Lao PDR, with a significant impact on agriculture, and the report by Yusuf and Francisco (2009) showed that the country is classified as highly vulnerable to climate change (Figure 4). Damage from flood and drought to rain-fed rice fields, in particular, has increased from 12,660 ha in 2006 to 44,331 ha in 2010, and severe flooding damaged 75,000 ha of paddy in 2008. In 2009, tropical typhoon Ketsana hit the country heavily, especially the central and southern parts, which are food-producing regions, and caused severe damage to 21,671 ha of paddy fields. Extreme drought in the dry season and severe floods in the rainy season have become common, with negative effects on agricultural production and food sufficiency. Lao farmers who live in the rural areas are especially hard hit because they are poor and are losing their food security.

Agricultural production is closely linked climate, so changes in climate and irregular weather patterns can have a severe effect on agricultural production and the livelihoods of people in rural areas. In 2012, the village of Kachet, Nambak District, Luangprabang Province (in the northern part of the country) was studied by students of Nagoya University to see investigate the influence of changes in climate on the livelihood of local people (Sisaphaithong et al. 2012). They found that six activities were widely practiced by families in the village: shifting cultivation, lowland rice production, work outside the village, animal husbandry, fishing and collecting NTFPs. The average potential income² of a family was approximately US\$259.29 per year per person (Table 2). Shifting cultivation (which is the traditional means of crop production in the northern part of the country) was the main source of income (approximately 44% of total potential income), followed by collecting NTFPs (24%). Animal husbandry, which includes cattle, buffalo, pigs, ducks and chickens, was third. The smallest amount of potential income came from river fishing (2%). Crop yields were strongly dependant on the climate, and abnormal weather events, such as drought or early rains, could reduce yields and the resulting income of families. For example, early rains occurred in 1954, 1968, 1976 and 2011 in the village and caused serious problems because the land could not be cleared and the usual crops of upland rice, cucumber and several types of vegetables could not be cultivated.

² Potential income is calculated as the total amount that a person could earn from selling all his or her products and earning all the money possible from such sales.



Source: Yusuf and Francisco (2009).

Figure 4: Vulnerability to climate change in Southeast Asia

Table 2: Usual Sources of Potential Income of Families in Kachet, Nambak District, Luangprabang Province

No.	Income source	Potential yearly income (US \$)	% Potential Income
1	Shifting cultivation		
	• upland rice	352.60	23.33
	• cucumber in shifting cultivation	270.83	17.92
	• other products from shifting cultivation	32.50	2.15
2	Lowland rice	114.58	7.58
3	Work outside village	97.92	6.48
4	Animal husbandry	249.79	16.52
5	Fishing	30.50	2.02
6	Collecting non-timber forest products	362.96	24.01
	Total yearly family income	1,511.69	100.00
	Average number in family	5.83	
	Average income/person	259.29	

Source: Sisaphaithong et al. (2012).

2. Programmes and projects

Several sources of information and data, such as reports, digital newspapers and journals and other communications, were reviewed, and 12 projects related to crop diversification were studied to identify key elements for the design of effective strategies for implementing adaptations to climate change.

Table 3: Overview of Projects

Name of Project Period of activity	Objectives of project and brief description
1. Vegetable Management Modules for Extreme Drought and Flood Conditions in the study sites of the UNDP project: Improving the Resilience of the Agriculture Sector to Climate Change Impacts (IRAS)	
2014-2015	Venue: Phieng District, Xaiyabuli Province Objective: test vegetable-management modules (VMM) for adaptation under extreme conditions of drought and flood Crop-diversification component: using different types of vegetables, such as kangkong, coriander, chili, yardlong bean, amaranth, lettuce, dill, Chinese mustard
2. Improving the Resilience of the Agriculture Sector in Lao PDR to Climate Change Impacts—NAPA Follow up (IRAS/NAPAFU)	
2011-2016	Venue: 4 districts of 2 provinces (Outhumphone and Champhone districts of Savannakhet Province and Phieng and Paklai districts of Xayabouly Province) Objectives: minimize food insecurity resulting from climate change in Lao PDR and to reduce the vulnerability of farmers to extreme flooding and drought events Crop-diversification is a small component of the project
3. Climate Change Training and Adaptation Module (CCTAM) on Crop and Agro-Forestry	
2013-2014	Objective: establish a module on adaptation for training staff of district agriculture and forestry offices (DAFOs) and farmers Crop-diversification component: cereals, beans, vegetables, tree fruit, industrial crops.
4. Rice Productivity Improvement Project (RPIP)	
2009-2011	Objective: provide support to farmer seed groups, on-farm demonstrations, rice research and seed-multiplication centres Crop-diversification component: focused on rice
5. Northern Uplands Rice Farming Systems Research Project (NURIFAR)	
2008-2012	Venue: rice-based farming systems in the uplands Objective: improve production and increase self-sufficiency for relevant stakeholders Crop-diversification component: upland rice
6. Developing Improved Farming and Marketing Systems in Rain-Fed Regions of Southern Lao	
2009-2013	Objectives: <ul style="list-style-type: none"> • diagnose and integrate assessment of farming and marketing systems • optimize, test and adapt crop and livestock technologies and marketing/extension approaches • share knowledge; • pilot scaling up of varieties, crop and livestock technologies and marketing • alleviate constraints posed by drought and uncontrolled flooding Crop-diversification components: rice, corn, beans, testing of varieties in different locations (upland and lowland)

7. Developing Multi-Scale Climate Change Adaptation Strategies for Farming Communities in Cambodia, Lao PDR, Bangladesh and India	
2010-2014	<p>Objectives:</p> <ul style="list-style-type: none"> • adapt and apply available tools/methods to select and assess adaptation strategies for rice-based cropping systems • develop capacity in research and extension that support building adaptive capacity in rice-based cropping systems • select and evaluate a suite of crop- and water-management adaptation options suitable for provincial-level dissemination • derive and disseminate principles and policy recommendations to enable more effective design and implementation of adaptation programmes at multiple scales <p>Crop-diversification component: rice, with screening to find flood-tolerant varieties</p>
8. Seed for Need: Climate-Smart Agriculture for Poor Rural Communities in Laos	
2013-2017	<p>Objectives: identify, test and disseminate seed varieties best adapted to a broad range of environmental conditions, using geographic information system (GIS) technology, environmental data and information management</p> <p>Crop-diversification components: rice, corn, vegetables, beans</p>
9. Mechanization and Value Adding for Diversification of Lowland Cropping Systems in Lao PDR and Cambodia	
2014-2018	<p>Objectives:</p> <ul style="list-style-type: none"> • assess crop mechanization options for increased labour productivity • evaluate agronomic and postharvest innovations for adding value • evaluate intensified, diversified and market-oriented cropping systems to take advantage of mechanization and value-adding options <p>Crop-diversification components: rice, corn, beans, cropping systems</p>
10. Community Biodiversity Development and Conservation (CBDC) and Biodiversity Use and Conservation in Asia Program (BUCAP) (CBDC-BUCAP)	
2007-2010	<p>Objectives:</p> <ul style="list-style-type: none"> • conserve and develop PGR diversity • improve livelihoods through sustainable use of PGR diversity • strengthen farmers' management system of PGR at community, national and regional levels • strengthen and develop capacity of local institutions and other stakeholders to support farmers' management of PGR diversity • affect policy environment at local, national, regional and international levels with positive changes and actions towards the protection of farmers' rights over PGR <p>Crop-diversification component: rice diversity</p>
11. Democratizing Agricultural Research and Extension (DARE)	
2011-2014	<p>Objectives:</p> <ul style="list-style-type: none"> • build on farmers' experience in developing innovations vital to bringing about food security and improving livelihood systems • strengthen capacity of researchers, plant breeders and institutions in adapting participatory methodologies for technology development and community innovations through biodiversity-based agriculture systems • establish strong linkages and partnerships between farmers and relevant institutions responsible for agricultural food production programs as part of the support system during implementation and after the program ends • contribute to the development of agricultural policies that relate to all legal frameworks and regulations on biodiversity-based agricultural conservation and sustainable use <p>Crop-diversification components: rice, maize, garlic and peanut</p>

12. Agroforestry in Degraded Forestland after Shifting Cultivation in Northern Lao: Thongkhang, Nan, Luangprabang and Huayyang, Xai, Oudomxay	
2000-2005	<p>Objectives:</p> <ul style="list-style-type: none"> determine agroforestry techniques suitable for two geographical zones with specific local and socioeconomic conditions identify suitable species of commercial timber trees, fruit trees and crop species for agroforestry system <p>Crop-diversification components: <i>Aquilaria crassna</i>, <i>Tectona grandis</i>, longan, prunus, <i>Litchi chinensis</i>, upland rice, soybean, Job's tears, maize, sesame, groundnut, pineapple</p>

3. Analysis of programmes and projects

The 12 projects related to crop diversification were reviewed and analysed in regard to their strengths and weaknesses in terms of both design and implementation.

3.1 Strengths

- Several projects focused on farmers through the district and provincial agriculture forestry offices to develop and improve knowledge and experience through training.
- Projects improve livelihoods and income of villagers, especially in rural areas.
- Farming techniques were demonstrated and knowledge was exchanged with neighbourhoods in several projects.
- Several farmers' groups for production, postharvest management and marketing of different types of crops have been established in villages, districts and provinces. These groups help farmers to access finance, information and markets, as well as serving as models for other groups or farmers, where they could learn, transfer knowledge share experiences.
- The people in rural areas, including ethnic minorities, are the beneficiaries. The majority of the projects have been designed around home gardens for food security, commercial production for increasing income, and improvement of livelihoods, using integrated farming systems for protection against diseases and insect pests.
- The goals of several projects included enhancing crop productivity, improving food security, increasing incomes and improving livelihoods.

3.2 Weaknesses

- Several projects were conducted without including the requirement and expectation of local people and the community.
- Results were not broadly applied: several projects were successful only in specific places and project budgets were not consistently supported.
- There was a poor relationship among research, development and extension in the design and implementation of several projects. The mechanism to link each division and work together was weak. For example, extension service was weakly connected to the research areas or research centres. Several Centres or stations have researched and developed new techniques, new varieties, and information, but there were no effective links with extension. Improving the mechanism to link and work together toward a target might be a way to overcome this problem.
- Policies to support project results were still limited at government level (local, ministries and central government).

5. Credit or finance from local and central government was limited. In addition, financial support for the projects was limited.
6. The information about marketing, potential crops and postharvest management was found to be poor in several project activities.
7. There was poor planning and management.
8. In several projects, the concept of adapting to climate change was poorly explained and not well linked to the activities.
9. The focus in several projects was on the main cereal crops like rice and corn. Other crops, like vegetables, edible legumes, tree fruit and other indigenous crops were neglected.
10. There was poor monitoring from experts and staff in relation to farmers or groups.
11. Staff were found to lack knowledge about technologies and crop diversification. On the other hand, not much time was allotted for implementing projects.
12. Many projects lacked cooperation/coordination with other ongoing or past projects.
13. There was poor research and support from donors about crop diversification to increase the income of smallholder farmers.

4. Conclusions

Agriculture is a very important part Lao economics, with more than 70% of the workforce involved in agriculture. The major crops are rice, maize, cassava, coffee, sugarcane and vegetables. Climate change has led to an increase in severe, irregular weather events such as extreme drought and flooding, which have a negative impact on agriculture in the form of low productivity and poor quality, increased disease and insect pests, soil erosion and nutrient loss due to heavy rain. One way to adapt to climate change involves increasing sources of income and nutritious food for smallholder farmers. Crop diversification is an effective strategy for countering the uncertainties and risks associated with climate change while, at the same time, contributing to improved livelihoods for smallholder farmers. The NAFRI team conducted this review of past and ongoing crop diversification activities, focusing on 12 representative projects.

The projects have a common purpose in relation to crop diversification: to improve the food security and nutrition of target beneficiaries. Strengths included improved knowledge and experience through training, demonstration farms and farmer groups, which were the strong points of design and implementation. On the other hand, there were also weaknesses: limited broader application of results; poor relationships among research, development and extension; poor policy support for the results; poor monitoring of project experts; and inconsistent financing condition.

Several factors influence agriculture in Lao PDR and need further study, research on options and recommendations on policies to support development for smallholders and the landless poor:

- Production is limited, especially that of vegetables in the rainy season due to high humidity and high incidence of diseases and pests. During the dry season, over-harvesting can result in low prices—low incomes because farmers have poor access to information on marketing.

- There is a lack of effective management of water resource during the dry season and there are drainage problems and a lack of availability of land during the wet season.
- Producers, traders and researchers have insufficient knowledge about postharvest and processing technologies.
- Small-scale farmers often have high investments for production and postharvest losses because of the high cost of developing the proper infrastructure, such as cold rooms that require high capital input and need a constant supply of electricity.
- Severe weather events (extreme drought and flooding) are becoming more frequent and can affect production.
- The soil quality is poor in some areas, with a pH of 3.5-4 and low organic matter.
- The increasing price of labour affects the price of products and means high input costs for cultivation.
- Knowledge of farm management is poor, which has an effect on quality, safety and quantity of products.

The strategies in the agriculture and food-security sector have the following objectives to support adaptation:

- mainstreaming climate change into the agricultural sector's policies, strategies and action plans through the planning and design of future investment programmes
- enhancing productivity through promoting conservation agriculture
- improving and monitoring water resources and the water-supply system and rehabilitating the flood-control system
- strengthening financial instruments and capacity development for farmers: improving the development of small- and medium-sized farming in the rural areas and supporting community-based adaptation measures
- undertaking a country-specific, sector-based research on vulnerability, impact and adaptation options in the agriculture sector at the macro and village level
- enhancing information dissemination and extension support to technical staff and Lao farmers in regard to preparedness and responses to climate change
- improving mechanisms for cooperation among relevant sectors and strengthening regional and international cooperation

The severity and frequency of floods and drought from climate change are expected to increase, resulting in a negative impact on the agriculture sector. Adaptation is a way to mitigate this negative impact. Establishing farmer and community models is one option for testing the adaptation of production under extreme weather conditions, but these models should include training modules on marketing, water management, suitable crops and information on seeding, soil, transplanting, weeding, watering, fertilizing and pest management under irregular weather conditions. In addition, demonstration sites should be developed for learning and exchanging knowledge among farmers and communities.

Learning from the weak and strong points of past and ongoing projects can contribute to achieving excellent results and outcomes. Strengthening the exchange of information could link projects and provide access to useful and important information.

Projects should also focus on making the connection among researchers, extension staff, producers, traders and marketing more sustainable. Many projects reviewed were poorly linked and cooperation among these sectors was lacking.

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Chapter 5. Vietnam¹

Dinh Huu Hoang and Nguyen Quoc Tuan

1 Introduction

1.1 Agriculture

The Vietnamese agricultural sector is currently worth US\$ 40 billion, representing about 21% of the country's GDP, employing about 47.7% of the population, with the majority of agricultural production being highly labour-intensive, taking place on household farms of less than 0.5 hectares (Maerten and Le 2012) and much ploughing still done with water buffalo. The main exported commodities are rice, coffee, rubber, timber and aquaculture; however, agriculture's share of exports has declined considerably over the last decade, from 24% to 12% (valued at US\$ 25 billion in 2012) (GSO 2013).

Rice is the most important crop. It is grown principally in the Red and Mekong river deltas. Other major food crops are sugarcane, cassava (manioc), maize, sweet potatoes and nuts. While Vietnamese agriculture is also characterized by a wide variety of fruits and vegetables for both household consumption and marketing, there are many plantations of banana, coconut and citrus, most in the Mekong Delta and the southern terrace regions. Coffee and tea are grown in large amounts in the central highlands. The production of rubber is strong, expanding in recent years, mainly in the southern terrace regions. The total rubber-producing area is now around one million hectares, exceeding the government's development plan.

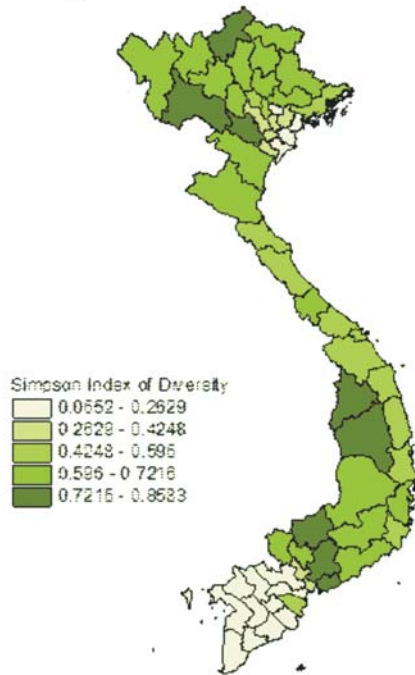
Since the 1990s, Vietnam has successfully focused on increasing production in both area and intensity. However, this has come at the expense of reduced quality, reduced biodiversity, polluted water supply and degraded soil and environment; Vietnam is now a middle-income country and is facing the middle-income trap.² The government is restructuring the agricultural sector with the objective of enhancing added value for agricultural commodities. Agricultural income can be increased by expanding the area cultivated, increasing the land-use index, increasing productivity and market prices and diversifying crops. Even if the area cultivated remains unchanged, farmers can still increase their income by changing cropping patterns from low- to higher-value crops, so crop diversification plays a vital role in the restructuring of Vietnamese agriculture.

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² The middle-income trap refers to an economic situation where a country attains a certain income level and gets stuck at that level: a country that loses its competitive edge in the exportation of manufactured goods because wages are rising.

1.2 Cropping systems

Vietnam has nine ecological zones made up of diverse climatic and topographical conditions, stretching from north to south over a distance of more than 1,600 km. Cropping systems are also very diverse, both within and between regions. The crop diversification index (Simpson index) in figure 1 shows that the greatest crop



Source: Nguyen Ngoc Que et al. (2004).

Figure 1: Crop diversification in Vietnam, 2001

diversification is in the northern upland and lowland, where each household grows more than eight crops, as compared to the national average of five to six crops. Characterized by fertile basaltic soils, the central highlands is also a region of highly diversified cropping systems with perennial crops, fruit and forest trees. The index for the south and Mekong River Delta is 2.6 crops/household (Minot et al. 2006). There are 15 strategic food crops in Vietnam (Table 1).

Northern mountainous regions: Rice, cassava, tea and peanut are the main crops. Paddy rice, peanut and soybean are grown in the flatter areas, while upland rice, cassava, tea and fruit trees are cultivated on sloping land. Cropping systems in the northern mountainous regions are mainly for self-subsistence.

Coastal and central provinces: Natural areas occupy 5.1 million ha, and 80% of the region is hills and high mountains. Agricultural land occupies about 14% of the area in both regions. Rice, corn, peanut, beans (of all kinds) and sugarcane are the major crops. However, water

shortages are a serious problem that prevents a second rotation, despite investments in irrigation systems; crops that require less water should be considered.

Table 1: Cultivated Area and Productivity of Major Crops in Vietnam

Crop	Area (1000 ha)	Productivity (100 kg/ha)	Crop	Area (1000 ha)	Productivity (100 kg/ha)
Rice	7899.4	55.8	Coconut	136.7	Na
Corn	1172.6	44.3	Sweet potato	135.9	100.4
Coffee	584.6	2.21	Soybean	117.8	14.3
Rubber	545.6	1.74	Tea	114.1	8.1
Cassava	544.3	179.0	Pepper	51.1	2.4
Sugarcane	309.3	647.3	Sesame	42.9	7.7
Cashew	301.3	0.76	Tobacco	26.3	19.3
Peanut	216.3	22.8			

Source: Government of Vietnam (2014).

Central highlands and southeast regions: Agricultural land occupies 24% of the central highlands and 40% of the southeast region. Perennial crops, fruit trees and forest trees are typical in these regions and make up about 79% of the total cultivated area (World Bank 2010). Cash crops, such as coffee, rubber, cashew and pepper have expanded rapidly over the last decades and have reached the highest levels in recent years. These crops can be intercropped with each other or with different fruit or forest species or annual crops.

Table 2: Coffee-Based Agroforestry System in the Central Highlands of Vietnam

Type of Agroforestry	Spacing	Average yield (tonnes/ha)	Location
Coffee – durian and other fruit crops (1995)	Coffee: 3 x 3 m Durian: 9 x 9 m	Coffee: 2.34 ± 0.35 Durian: 4.1 ± 0.48	Across provinces, household gardens or local farms
Coffee – cashew nut (1997)	Coffee: 3 x 3 m Cashew: 8 x 8 m	Coffee: 2.2 ± 0.40 Cashew: 1.2 ± 0.07	DakRlap, CuMga,
Coffee – cinamomo (<i>Melia azedarach</i> L.) (1994)	Coffee: 3 x 3 m Cinamomo: 3 x 12 m	Coffee: 3.54 ± 0.25 Cinamomo: 0.75 kg dry bark/yr	Buon Me Thuot
Coffee – rubber (1997)	Coffee: 1.2 x 1.5 m Rubber: 7 x 3 m	Coffee: 3.50 ± 0.20 Rubber: Immature	Buon Me Thuot, Dleiya
Coffee – leucaena (1992)	Coffee: 3 x 3 m Leucaena: 6 x 6 m	Coffee: 3.53 ± 0.2 Leucaena: 0.027 m ³ /yr	Krong Ana, Buon Ho, CuMga,
Coffee – paulownia (2000)	Coffee: 3 x 3 m Paulownia: 6 x 12 m	Coffee: 3.0 ± 0.25 Paulownia: 0.032 m ³ /yr	Phuoc An Coffee Enterprise, Dleiya
Coffee – teak (1987)	Coffee: 3 x 3 m Teak: 6 x 6 m	Coffee: 2.8 ± 0.3 Teak: 0.033 m ³ /yr	Buon Za Wam
Coffee – cassia (1995)	Coffee: 3 x 3 m Cassia: 12 x 12 m	Coffee: 2.29 Cassia: 0.027 m ³ /yr	Buon Me Thuot, Krong Pach, Krong Ana

Source: Central Highlands Institute of Agriculture and Forestry Science.

Red River and Mekong Delta: These are the two major rice-producing regions of the country. The Mekong Delta alone has 2.56 million ha of agricultural land: 50% of the country's total rice area, 71% of the area devoted to aquaculture (54% of the national aquaculture output) and 30% of the total area for agricultural production. Rice yields in the Mekong Delta are higher than in the Red River Delta, where rice production is shifting to higher-quality production. The farm size in this area is also much smaller than that in the Mekong Delta, so farmers focus more on crop diversification and intensification, compared to the Mekong region where cropping systems in association with paddy rice are very limited because farmers prefer to focus on rice production. However, rice-shrimp, rice-fish and rice-shrimp-mangrove forest are practiced there.

The Mekong River Delta is also a major fruit-producing region, with an area of 320,000 ha devoted to fruit, occupying 8.2% of the total natural area of the region.³ The Ministry of Agriculture and Rural Development (MARD) has identified five strategic fruit crops for export: dragon fruit, mangrove, rambutan, durian and longan. Many fruit crops and vegetables are intercropped in home gardens in this region.

³ Vietnam agricultural and rural development information project 11t KC-01/11-15, Ministry of Agricultural and Rural Development.

1.3 Biodiversity

Vietnam is a country with 4,000 years of civilization and agriculture practices that have existed for millennia. The diverse ecological systems are favourable to an enormous diversity of plant genetic resources. In addition, the fauna and flora of India-Myanmar, South China and Indo-Malaysia come together in Vietnam, making it one of the richest biodiversity hotspots in the world. It is home to 10% of the total number of species globally while making up only 1% of the world's landmass (MARD 2002). The results of numerous studies show the existence of more than 13,000 plant species, belonging to 3,500 genera and 500 families, 60% of which have their origin in Vietnam (Ha Dinh Tuan et al. 2001). It is also a centre of seed sources (802 popular crop plant species belonging to 79 branches) and of the domesticated animals of the world (Jucovski 1970, in MONRE 2008). Table 3 provides a list of the number of popular species, by purposes:

Table 3: Number of Popular Crop Plant Species in Vietnam

No.	Plant group	Number of species	No.	Plant group	Number of species
1	Main food crops	41	9	Oil plants	45
2	Minor food crops	95	10	Plants for fragrances	20
3	Tree fruit	105	11	Soil improvement	28
4	Vegetables	55	12	Medicinal plants	181
5	Spices	46	13	Ornamental plants	62
6	Juice	14	14	Shade trees	7
7	Fibre	16	15	Industrial crops	24
8	Foodstuffs	14	16	Timber	49
Total					802

Source: MARD (2005).

Biodiversity plays a very important role in the prosperity of the country and its people, as well as maintaining natural cycles and an ecological balance. The government has promulgated a biodiversity conservation strategy for the period of 2013-2020 and vision to 2030. Ex situ facilities, such as net houses, cold storage, botanic gardens are being developed, and in situ conservation practices are currently being applied. At present, approximately 18,300 germplasm accessions of 150 plant species (50% rice) are maintained in seed, in the field and in in vitro collections. According to the national genebank, there are 17,000 accessions that are categorized by 30-60 characteristics and more than 7,000 accessions that have been evaluated with respect to resistance to at least one pest or disease. The amount of plant germplasm being conserved includes 2,404 varieties of rice and 616 varieties of maize (in cold storage), 1,141 fruit varieties, 306 of coffee, 546 varieties of sugarcane, 230 types of flower, 179 tea varieties and 1,545 others (PRC no date).

Because of high population pressure, industrialization, urbanization and unequal food distribution, Vietnam's agricultural biodiversity is under threat and has deteriorated rapidly over the last several decades. Anthropogenic disturbances (such as high chemical use) and intensive destruction of natural resources as part of the development process have also contributed. Climate change is regarded as a threat to biodiversity because it eradicates the ecological niches of many species, disconnects the landscape and displaces the living environment, with a rise in sea level of great concern.

1.4 Impact of climate change on agriculture

Vietnam is one of the countries most afflicted by the adverse effects of climate change. This threat is more pronounced for the agriculture sector and rural society, where approximately 70% of the inhabitants rely on agricultural production that does not depend on modern technologies. In Vietnam, climate change has shown terrifying effects: annual average temperatures have increased by about 0.5°C to 0.7°C over the past 50 years (1958-2007). Between 1993 and 2008, the mean sea level rose at a rate of 3mm per year. Average precipitation has fallen by 2% during the last 50-year period (1958-2007), the number of cold fronts have decreased significantly over the last two decades and typhoons with higher-than-normal intensity have occurred more frequently (FAO 2011). Salinity is also a serious threat to the low wetland-rice cultivation areas. These problems, together with other extreme climate events, have caused serious losses of human life and damage to infrastructure in the country. In the 12-year period from 1996 to 2008, hurricanes, floods, landslides and droughts have resulted in 9,600 deaths and a 1.5% loss in GDP per annum (Dao Xuan Hoc 2009). Climate change has also had a serious impact on agricultural sectors, such as the loss of cultivated land area, geographic redistribution of crops, growth rates, changing demand for water and the spread of detrimental pests and diseases. A one-meter rise in sea level would mean that 10 provinces would be submerged, causing a loss of 24.7% to 50.1% of the land area and reducing grain output by up to 12% (5 million tonnes), with a resulting loss in total GDP of at least 10%.

To reduce vulnerability, strengthen resilience and provide more sources of income and nutritious food for smallholder farmers, the Vietnamese government has identified several agricultural interventions as part of its national priority strategies to adapt to climate change. These measures include inter- and intra-species crop diversification, integrated farming, multiple cropping, agroforestry and development of the agricultural value chain. Vietnam has drafted a national adaptation programme of action for climate change (NAPA); however, NAPAs do not set out practical measures for their implementation.

Biodiversity International and national institutions in Cambodia, Lao PDR and Vietnam are working together to identify the key elements needed to effectively implement policy measures for crop diversification targeted at farmers (including women) and ethnic minorities in the low and upland regions. Crop diversification is seen as an effective strategy to counter the uncertainties and risks associated with climate change while at the same time improving the livelihoods of smallholder farmers.

However, little is known about how best to design and implement effective measures for crop diversification.

2 Programmes and projects

Over the last two decades, many projects on crop diversification (for different areas and timeframes) have been started. They have been designed with different budgets (ranging from dozens of thousands to several hundred million US dollars), targeted at different ecological regions (but mostly in the mountainous and upland areas) and having diverse intervention approaches. Table 4 provides a list of selected projects that have been implemented as of 1998.

Table 4: Programmes and Projects in Vietnam

Name of project	Period of execution	Brief description of component on diversification
Vietnam's Agricultural Diversification Project (P004844)	1998-2004	Help small farmers in 18 provinces diversify agricultural production into rubber, livestock, crops to reduce rural poverty and maintain growth in rural incomes
Rural Income Diversification Project in Tuyen Quang Province (RIDP)	2002-2010	Improve the socioeconomic status of 49,000 poor households living in upland areas, especially ethnic minorities and women in Tuyen Quang Province
Sustainable and Profitable Crop and Livestock Systems for South-Central Coastal Vietnam (SMCN/2007/109)	2009-2012	Identify and facilitate adoption of promising resource-management practices for sustainable and profitable crop and livestock production systems best suited to local conditions and able to improve market engagement, focusing on Binh Dinh, Phu Yen and Ninh Thuan provinces with emphasis on coastal and sloping areas less than 400 metres above sea level
Ha Giang Development Project for Ethnic Minorities	1998-2003	Diversify income by developing on- and off-farm activities, intended for small-scale businesses and enterprises
Agroforestry for Livelihoods of Smallholder Farmers in Northwest Vietnam	2011-2016	Improve the performance of smallholder farming systems in north-west Vietnam through agroforestry by increasing productivity of associated crop and livestock systems, leading to more diverse and sustainable production systems and better income from tree products
Support Upland Farmers in Sustainable Agro-Forestry on shifting Cultivation (SC)	2008-2012	Support sustainable agroforestry/forestry cultivation on shifting cultivation areas nationwide and alleviate poverty by supporting settlement, changing cultivation from extensive to intensive, increasing land-use efficiency, diversifying crops and income
Agro-Ecology in the Northern Mountainous Regions (ADAM Project)	2008-2013	Use agroecological techniques to prevent decline of soil fertility Reduce poverty by diversifying crop and income sources and by getting more value from local tea production
Agroforestry and Sustainable Vegetable Production in Southeast Asia Watersheds (LTRA-5)	2005-2009	Agroecological model integrating vegetable crops with trees or trees with vegetable crops
Sustainable Cocoa Enterprise Solutions for Smallholders (SUCCESS) Alliance Program in Vietnam	2004-2010	Increase smallholder incomes by introducing sustainable, diversified cocoa-based agroforestry systems
Pro-Poor Partnerships for Agroforestry Development Project	2009-2015	Establish framework for sustainable, profitable agroforestry development in Bac Kan Province targeting poor rural households
Climate Change Affecting Land Use in the Mekong Delta: Adaptation of Rice-Based Cropping Systems (CLUES) (SMCN/2009/021)	2012-2015	Increase adaptive capacity of rice-production systems in Mekong Delta Region by providing farmers and management agencies with technologies and knowledge that will improve food security in the Mekong Delta
Building Resilience to Disasters and Climate Change Risks for Men and Women	2012-2016	Building resilience to disasters and climate change by improving the capacity of local people in disaster management and climate-change adaptation Demonstrate model on diversifying crops such as melons, peanuts, cassava, etc.

2.1 Analysis of programmes and projects

As mentioned above, there have been quite a few projects related to agricultural and crop diversification. For further details, please see the annexes, which provide a detailed list of related projects and descriptions of both design and implementation. In this analysis, we focus on representative projects and lessons learned for future projects as well as policy implications (Table 5).

Table 5: Strengths and Weaknesses of Programmes and Projects

Project Strengths	Weaknesses
AGRICULTURE DIVERSIFICATION PROJECTS (INCLUDING INCOME DIVERSIFICATION)	
Vietnam's Agricultural Diversification Project (P004844)	
<ul style="list-style-type: none"> • The high-quality rubber plantation was an important outcome and made it substantially different from the government's other programmes supporting rubber • Long-term credit for 19,788 households from Vietnam Bank for Agriculture and Rural Development (VBARD), a total of VND 286 billion (US\$17.8 million) • Inclusion of farmers in participatory research and extension (e.g. pilot fruit tree development and establishment of nurseries) is essential to target outcomes to specific farmer needs • Introduction of smallholder crop and technical package, promoting a mixture of farm activities (e.g. investment in rubber, livestock and food crops) • Tree-crops considered environmentally suitable for degraded, deforested highlands; focus on introducing sustainable management (e.g. production on sloping and degraded lands) 	<ul style="list-style-type: none"> • No balance between rubber, crops and livestock for more effective diversification • No measures to allow quick and effective response to market changes • Ineffective coordination measures to strengthen linkages between credit and non-credit activities • Late provision of training to local institutions and communities on participation procedures • Key performance indicators regarding outcomes (e.g. farmers' income) and outputs (e.g. areas of rubber established and rehabilitated, numbers of cattle and pigs) not well defined Outcomes need to be related to project inputs with strong causal linkages to outcomes and to be accurately defined
Rural Income Diversification Project (RIDP) in Tuyen Quang Province	
<ul style="list-style-type: none"> • Very successful in terms of design and implementation; interventions are multi-dimensional, including land use, market, technologies, finance, institutional change; project design is useful to any household involved • Activities for food security and income diversification undertaken by individual households very likely to be sustained and scaled up, as farmers become better adapted to producing for market and national and local market channels are gradually expanding in rural areas • RIDP represented a step forward in IFAD's strategic thinking in the country: the project moved away from focusing on subsistence-level agricultural production to engaging in rural income diversification and enterprise development 	<ul style="list-style-type: none"> • Project component/modalities not aligned with government programs, not efficiently supported • RIDP not engaged in mobilizing private sector to enhance market opportunities for farmers and create business connections for local micro-entrepreneurs; failed to develop rural enterprises • Lacked focus on building physical markets in communes, providing marketing information support, seeking out market opportunities and involving private-sector investors in project activities • Over-reliant on government agencies to develop small businesses, without involving private sector; local small and medium enterprises promoted but lacking connections outside Tuyen Quang, which is rather isolated

Sustainable and Profitable Crop and Livestock Systems for South-Central Coastal Vietnam (SMCN/2007/109)	
<ul style="list-style-type: none"> • Project well designed for sandy soils and local conditions: planning pasture, livestock husbandry and cashew production • Capacity building through scholarships, training researchers and extension agents • Economic analysis of crops highlights potential improvements, and investigations into plant nutrition are notable for future research and extension • Demonstration models already beginning to spread 	<ul style="list-style-type: none"> • Project experiments conducted in both Vietnam and Australia, but no information on the link between the two • Limited measures introduced to enrich sandy soil • Lack of focus on strategy for scaling up and out; project needs balance between this and technical aspect
Ha Giang Development Project for Ethnic Minorities (HPM)	
<ul style="list-style-type: none"> • Major positive change is adoption of scientific and technically proven technologies and practices; plentiful and subsidized supply of improved crop seeds, planting materials, inputs and animal health services; adoption of integrated pest management practices; cooperation among farmers under farmer field schools and group extension systems Result: many poor/food insecure now self-sufficient • Increased yields of main food crops: about 16% to 36%, increase 40% for typical lowland or highland irrigated paddy, over 100% for paddy in many better areas, 10% to 30% for maize and soybean 	<ul style="list-style-type: none"> • Whether improvement in income from increased yields can be secure if farmers have to deal with increasing adverse effects of climate change not examined • Not successful with income-diversification and credit activities • Major implementing institution, Women's Union, not meeting expectations Staff of Women's Union in villages heads of groups and chiefs were trained but training programs and transfer of training were ineffective
Agroforestry for Livelihoods of Smallholder Farmers in Northwest Vietnam	
<ul style="list-style-type: none"> • Kinh people account for over 90% of population at this elevation—considered more advanced in adapting and accessing new farming technologies • Labour available, traditionally hardworking • Good knowledge of cultivating traditional and some newly imported species (e.g. hybrid eucalyptus and macadamia from Australia and fodder grass species) • Land relatively flatter compared to other elevations • Land and climate suitable for wide range of crops <p>OTHERS:</p> <ul style="list-style-type: none"> • Good infrastructure in terms of transport, services and information exchange • High-yielding and resistant crop varieties available • Local people keen on adopting any farming innovation that can bring higher incomes • Modern cultivation techniques available 	<ul style="list-style-type: none"> • Inappropriate farming techniques, especially in farm management, postharvest practices and processing of farm products • Uneven quality of agricultural products owing to different input levels and varieties • Low and unstable prices of agricultural produce as well as limited market access, resulting in low incomes and low investment in farm development
Support Upland Farmers in Sustainable Agro-Forestry in Shifting Cultivation	
<ul style="list-style-type: none"> • Also supported new cultivation techniques for substantial amount of rice, which is important for poor and food-insecure households • Advantage of being government, meaning more agricultural land allocated to households, forestland converted to agricultural land, land-use certificate issues • Well implemented under command-control mechanism through the “political system” from central to communal level 	<ul style="list-style-type: none"> • Monitoring and evaluation not stressed • Conflicts in project design: supposed to plan appropriate areas for crops/trees suitable for each situation, but focused on concrete numbers, such as 70% agricultural crop, 10% industrial crop, 10% fruit tree and pasture land and 10% products for traditional and spiritual purposes • Distorted local implementation through bureaucracy and red tape

CROP DIVERSIFICATION

Agro-Ecology in the Northern Mountainous Regions (ADAM project)

- Integrated with multi-dimensional interventions (technical, institutional and financial) to increase added value through environmentally friendly agriculture techniques
 - Project designed to make significant improvement in tea cultivation (total tea area is 130,000 ha), which suffers from low yields and bad reputation due to chemical contamination and unsustainable cultivation, thus improve well-being of tea farmers
 - Introduction of successful direct mulching technique, which prevents soil erosion and runoff
 - Project designed to reduce greenhouse gas emissions by sequestering carbon in the soil (in roots of cover crop plants), but no clear description of how this is performed
 - Implementing team lacks knowledge of English
 - Inappropriate, unrealistic budget planning, leading to slow, difficult implementation: project must submit budget to adjust costs
 - Models can only be evaluated after 4-5 rotations to lead to other dissemination activities, a problem for such a project designed to end in 2013 (but it is continuing at this moment)
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Agroforestry and Sustainable Vegetable Production in Southeast Asia Watersheds (LTRA-5)

- Work on vegetable-agroforestry compatibility advancing rapidly; new findings narrow the focus and advance socioeconomic work on adoptability of specific technologies
 - Drip irrigation is successful and spread quickly
 - Analysis of market value chain identified several areas for further study, particularly concerning the introduction of indigenous species
 - Participatory approach more likely to achieve success with indigenous people than traditional technology transfer used with recent migrants
 - Innovative strategies (e.g. publication of technoguide, pamphlets, and video documentation of farming practices) enhanced farmer's awareness and knowledge of vegetable-agroforestry systems
 - Policy analyses determined that overall policies are supportive but incentives for good environmental practices are best negotiated at local rather than national level
 - Insufficient in stimulating smallholder investments; incentives disproportionately shared among large and small farmers
 - Need to disseminate conservation practices used by SANREM farmers for many years more widely (as shown by computer simulations of soil erosion)
-

Sustainable Cocoa Enterprise Solutions for Smallholders (SUCCESS) Alliance programme in Vietnam

- Enthusiastic adoption of cocoa-based agroforestry system
 - Nursery systems in place and continue to be disseminated in and outside project area
 - Buying network established for cocoa consumption, including international traders and buyers, cooperatives formed
 - Farmer's investment portfolio well anticipated
 - Private-public partnership model positive
 - Market distortions minimized; private and public stakeholders empowered to act on own behalf in lasting and competitive fashion
 - Biodiversity increased in cocoa-based agroforestry systems (MARD 2008)
 - Cocoa production area developed robustly during project, but after; in some cases, farmers ran into obstacles and abandoned cocoa plantation
 - Contracting system weak: local farmers cannot bargain satisfactory with local contractors
 - Adequate training needed for further expansion: farmers have no knowledge about this new crop
 - Optimal densities not studied, resulting in high humidity, with high level of plant diseases; farmers still apply intensive pesticides
-

Pro-Poor Partnerships for Agroforestry Development Project

- Considerable impact from Agribusiness Promotion Investment Fund: improvement of income for about 3000 farmers
 - Greater involvement of Women's Union as provider of financial services; Assuming ownership of the assets of the Agro Forestry Development Funds also contributed to long-term sustainability of project activities
 - Target area small, project cycle too long (8 years), substantial costs for salaries and management for this type of project
 - Coordination between components and associated implementing agencies (e.g. agricultural advisory service and technology transfer) needs improvement in terms of complementarity to reinforce project impact
 - Monitoring and evaluation based on monitoring outputs, insufficient attention to improving income, assets and livelihood of target groups
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AGRICULTURAL DIVERSIFICATION IN RESPONSE TO CLIMATE CHANGE AND DISASTER MANAGEMENT

Climate Change Affecting Land Use in the Mekong Delta: Adaptation of Rice-Based Cropping Systems (CLUES) (SMCN/2009/021)

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| <ul style="list-style-type: none"> • Scattered alternate wetting and drying conducted on 191 ha; farmers interested because this irrigation method saves VND 2.5 million per ha • Community participatory seed selection is successful approach to selecting rice clones suitable to changing climate • Successful experiments on rice-shrimp and rice-fish systems | <ul style="list-style-type: none"> • Farmers tend to blame natural environment for yield losses and income, but root causes are socioeconomic: increases in labour costs and of other inputs while prices for produce are low; project has limited approach to addressing socioeconomic constraints that can hinder adoption of rice technologies • Heavy harvest losses of broken rice-straw due to heavy rain and storm not considered • Weak linkages for sharing experiences or cooperating within community; project has limited measures to deal with this (personal communication, Professor Le Quang Tri, Project Director) • Little impact on policy and institutional aspects |
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Building Resilience to Disasters and Climate Change Risks for Men and Women

- | | |
|--|---|
| <ul style="list-style-type: none"> • A rare Oxfam project using crop/income diversification as an intervention • Crops (watermelon) and livestock (goats) suitable to local ecological and socio-economic conditions of Ben Tre Province identified • Credit solution also included, which facilitated other project components | <ul style="list-style-type: none"> • Limited market solutions/interventions despite farmer uncertainty about market (based on past experience) • Next crops threatened by pollution from old polythene stuck in soil of harvested watermelon gardens • Small area and number of households |
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Note: Many of these projects are ongoing, so the strengths and weaknesses listed here do not necessarily reflect the final outcomes.

3. Conclusions and recommendations

In general, there have been many development projects related to agricultural diversification in Vietnam, with budgets ranging from thousands to several hundred million US dollars, targeting different ecological regions with a variety of approaches. Most have focused on the mountainous and upland areas, and overall, most have been successful and have made positive contributions to poverty reduction, social development and environmental improvement. From an economic perspective, these projects have contributed significantly to the reduction of poverty in Vietnam over the last 15 years, especially in the mountainous regions in the north, with an average increase in household income of 6% (Minot et al. 2006). Financial analyses indicate that there have been substantial increases in land productivity (yield/ha), labour productivity (net income/hour worked) and the overall net income of rubber, crop and livestock farmers who participated in these projects. They have also contributed tremendously to social stability by creating jobs (more seasonal jobs), allocating secure long-term and stable land-use rights and encouraging investments to increase production and ensure food security. Environmental contributions have become apparent as diversified agroforestry systems take effect to improve local climate conditions, mitigate the adverse effects of climate change and contribute to the reduction of greenhouse-gas emissions.

The scale of intervention has also differed widely among projects: government-funded projects or those that used loans from the World Bank, IFAD, etc., such as the Vietnam agriculture diversification project 1 and the governmental shifting-cultivation project,

have remarkable level of intervention in many provinces. These projects have had a tremendous impact on income and diversification for the rural poor, particularly for the households of ethnic minorities.

Some projects have focused on environmental conservation at the design stage. The ADAM project has encouraged farmers to use less chemical fertilizer for tea production on a vast area of 130, 000 ha in regions heavily contaminated by chemical fertilizers. Thus, at the landscape level, the ADAM project has contributed significantly to environmental conservation as well as producing cleaner tea products. The CLUES project has also achieved important results with the participatory selection of rice varieties (27 salt-tolerant lines, 12 genotypes with rapid recovery from stress and 14 high-yielding genotypes with submergence tolerance). They are ready to be made available in the Mekong Delta by the government, farmers and private enterprises.

The projects that target multiple interventions also appear to be successful. For example, the RIDP project in Tuyen Quang Province has devolved decision making and financial management to communes and village institutions, and convinced the provincial government to promote the decentralization of small-scale infrastructure and agricultural services to all communes in the province. The project focuses on many areas such as diversifying cultivation systems and livestock production, forest land use, savings and credit groups, intra-village infrastructure, and education and rural youth training. This strategy **optimizes** household situations by involving people in all possible aspects of the project.

Large World Bank projects on agricultural diversification tend to be on time with disbursements, but they have other shortcomings such as weak coordination with local authorities and inappropriate and inefficient monitoring and evaluation over a large number of provinces. The differences in the ecological and socioeconomic conditions of different provinces mean that a single monitoring and evaluation system or a single method of subsequent implementation is not going to work. This has resulted in several cases where spending has been seriously violated, as in the case of Gia Lai Province (see the annex for further details) or where management has been poor, as happened in the case of the government's shifting-cultivation project.

Many projects are poorly coordinated with other, ongoing projects, or they inherit the results of previous projects implemented in the same locality. There are many large government projects for agriculture and rural development; however, projects related to crop diversification have not addressed how they should be linked, how they can carry on from previous projects and build on them, particularly when final evaluations are made. An example is the weak cooperation and coordination between the JICA and ACIAR projects that were implemented at the same time in the same place.

The involvement of the private sector and trials with mechanisms for cooperation (i.e. public-private partnerships) with farmers for the adoption of advanced technologies, extension, etc., is a weak point in both past and ongoing projects. The cocoa project of Agricultural Cooperative Development International/Volunteers in Overseas Cooperative Assistance (ACDI/VOCA) is an excellent initiative in connecting farmers with traders at many levels, but it lacks the government participation. The private sector has huge resources (mainly finances, land and human resources), but it has not been

mobilized for agricultural diversification projects. There are many companies that have very large agricultural production areas (tea, coffee, rubber, etc.) both public and private. It is recommended that future agricultural diversification projects target these sectors. The involvement of public entities with significant land and tree resources would have an enormous effect on climate change, and thus Vietnam's nationally appropriate mitigation action in the future.

Many projects have been successful in selecting drought- and salinity-tolerant crops and varieties that can adapt to increasingly severe climate conditions. There are also agroforestry systems that require less irrigation. The participatory selection of varieties with farmers (CLUES) and the use of appropriate varieties and clones suitable to local weather condition (ACIAR project in coastal provinces) have excellent approaches to help farmers adapt to changes in the local climate. The CLUES project also tested alternate wetting and drying and showed lower CH₄ emission rates. These diversification projects have provided important evidence about ways to adapt to climate change, to mitigate the effects of climate change and to reduce greenhouse-gas emissions. There is other significant evidence that is not documented in this report, but the coffee-based agroforestry system in the Central Highlands (Dak Lak and Lam Dong provinces) with durian, shade trees such as pepper's poles, cashew, etc., has shown not only remarkably higher economic benefits (in comparison with the mono-culture coffee plantation), but also stable yields, less irrigation demands due to low evaporation rates and wind speed in the systems, and a potentially high rate of carbon sequestration through the accumulation of biomass in the system.

Several projects have touched upon the issues of reducing carbon emissions and payment for environmental services by suggesting the adoption of low-carbon-emission cultivation systems. However, there are several issues that have either not been addressed or remain unclear:

- There is no study that quantifies the environmental values of agroforestry models (such as carbon sequestration, biodiversity, watershed, etc.). It is recommended that such studies be carried out to lay the foundation to incorporate payment for environmental services into policy.
- There is no documentation about how payment for environmental services can improve household incomes and to what extent.
- There is nothing to indicate how the values of payments for environmental services differ among different systems of crop diversification. In addition, many large projects, which are implemented at a national level, do not seem to mainstream and translate adaptations to climate change, which lay the foundation for the country's nationally appropriate mitigation action.

Areas with high rates of poverty can be expected either to have problems with natural conditions (such as poor soil), topography or poor infrastructure, or to be vulnerable to natural disasters. Projects that understand and address these conditions at the beginning are more likely to make a successful intervention. **Indigenous knowledge** about crop cultivation and dealing with natural disasters would be the key to success. The ACIAR project in the Central Coastal region is an example of this.

Supporting decentralized participatory research and the dissemination of knowledge about the best sustainable agricultural practices by relying on existing farmers' organizations and networks (including women's organizations and networks) is an interesting approach. The CLUES project in the Mekong Delta is an example of successful participatory selection of rice clones.

Many technical and research projects are implemented by foreign institutions and are more research oriented, without being balanced by a strategy for scaling up and out. With the main staff located outside Vietnam, it is hard for projects to be managed efficiently, and there is a lack of understanding of local contexts and interaction with local government and communities. Although the technical achievements are important, the impact is very limited. Also, it appears that a large share of project funding is used for travelling and meetings.

Most projects recognize that there is a dominant farming system with mono-cultivation of staple crops on sloping land. The lack of diversity in the farming system and its components make smallholders vulnerable to market fluctuations. Furthermore, the risk of pests and crop failure in a mono-cropping system is high. More diversified farming systems and crop patterns, along with agroforestry, provide solutions by diversifying farming products while addressing environmental problems, providing farmers with more income options and contributing to food security. However, the projects all stop at food security and offer no further solutions to marketing or improving the well-being of the farmers as one of the strategies to move out from the poverty trap, and to help Vietnam escape from the middle-income trap, by addressing related issues such as farm size, transportation, marketing and branding. It is important for future projects to design interventions that help give farmers competitive advantages in agricultural production and processing, moving local produce up the value chain, promoting the growth of agriculture and the rural sector at a pace that will permit farming and rural enterprises to be viable options for the rural poor, preventing the marginalization of ethnic minorities, and engaging the private sector in creating marketing and business opportunities for the rural poor.

Market solutions are not adequately covered in these projects, particularly solutions that increase added value for farmers in the domestic and global value chains. Issues that support marketization to increase added values, such as food safety and geographical indication are rarely addressed. Also, there is little research—and little updated research—on the crop diversification index for diversifying household income (the Simpson Diversity Index) or the Specialization Index to measure diversity at the national level. The diagram in Figure 1 shows the crop diversity of Vietnam 15 years ago, when the Central Highlands, Southeastern provinces and the Northwest had high Simpson Diversity Index.

It is surprising that there have been very few crop-diversification projects in the Central Highlands, where there are many poor ethnic-minority groups. That area also has a high potential for crop diversification to improve the livelihoods of the local people. It is recommended that future projects include these provinces.

Vietnam is one of the countries most afflicted by the adverse effects of the climate. This is more pronounced for the agricultural sector and rural population: approximately 70%

of the country's inhabitants rely on low-technology agricultural production. The Vietnamese government has formulated a plethora of policies—from laws to strategies, plans and projects—at the national and provincial levels. This is evident in the national strategy to adapt to and mitigate climate change, to the national target programmes, followed by the national action plan. The government has issued the *Green Growth Strategy* (in 2012), the *Strategy on Agricultural Restructuring towards Raising Added Value and Sustainable Development* (in 2013) and the *New Rural National Program*. Current and past projects on crop diversification are not only consistent with but also help make these agricultural development policies concrete by increasing and stabilizing farmer incomes and promoting efficient adaptation to the climate change.

By supporting decentralization and poverty reduction, many projects have secured the government's political and financial support, which sets a sound basis for achieving project objectives. Many project modalities are aligned with and support the efficient functioning of government programs (such as RIDP and agricultural diversification project 1). However, in the future, projects need to ensure that participatory planning forms an integral part of the local socioeconomic development plan, and to re-examine some of their procurement and disbursement practices to make them more consistent with those of the government. For instance, the relationship between IFAD's support for infrastructure and the government's Program 135 will need to be carefully managed.

At the ministerial level, MARD has also issued four important policies: (1) the *Action Plan Framework Response to Climate Change in Agriculture for the period 2008-2020*,⁴ (2) the *Action Plan on Climate Change Response of the Agricultural Sector for the period 2011-2015 and Vision to 2050*,⁵ (3) the plan for *Mainstreaming Climate Change into Strategic Development and Implementation, Plans, Programs, Projects in the Agriculture and Rural Development Sector for 2011-2015*⁶ and (4) the *Program of Greenhouse-Gas-Emissions Reduction in the Agricultural Sector to the Year 2020*.⁷ In response to these policies, local and international NGOs have carried out many projects that support the government in achieving the objective of integrating climate change into agricultural development policies, including many crop-diversification projects, as shown in this report. However, with regard to the response to climate change, project results are far from sufficient for achieving a national effect. The lessons learned from these projects, however, play an important role in shaping or redirecting national policies related to agricultural development and climate change. In addition, as shown above, interventions for reducing greenhouse-gas emissions have been assessed and reported for rice-related systems. Other agroforestry practices that occupy a large area (such as coffee-agroforestry in the Central Highlands), fruit trees, etc., have not been studied. It is

⁴ Decision No. 2730/QĐ-BNN-KHCN (dated 05/09/2008).

⁵ Decision 543/QĐ-BNN-KHCN (dated 23/03/2011).

⁶ Directive No. 809/CT-BNN-KHCN (dated 28/3/2011): the general objective is to promote further activities on mitigating and adapting to climate change by integrating climate-change issues into the processes of building, approving and implementing strategies, planning, plans, programmes and projects for agriculture, forestry, salt production, fisheries, irrigation and rural infrastructure over the country, in line with NTP-RCC, by actively participating in reducing emissions of greenhouse gases and proactively adapting to climate change.

⁷ Decision 3119/QĐ-BNN-KHCN (dated 16/12/2011): The general objective is to reduce by 20% the total emissions of greenhouse gases in the agriculture and rural development sector (18.87 million tonnes of CO₂e) by 2020 and, simultaneously, to ensure the growth target for agriculture and rural development and reduce the rate of poverty rate according to the sectoral development strategy.

recommended that research and development related to climate change be conducted for major intercropping systems and diversification of multiple-crop rotations.

In recent years, the government has been focusing on how to increase added value for farmers' agricultural products to lift the country out of the middle-income trap. It is evident that international financial institutions and the Vietnamese government have embarked on many large projects in the past—and they still do. However, NGO projects on crop diversification, which generally focus on small target areas and on poverty alleviation, have made an important contribution to the discourse on development for the whole country.

Successful at the outset: RIDP and cocoa production seem to be the projects with the most impact, because they had interventions in many aspects of farm and rural. RIDP boosted on-farm production through a traditional package of agricultural and livestock support, including small-scale irrigation and roads, farmers' field schools, field demonstrations, livestock breeding, veterinary services, etc. The savings and credit groups supported by the project provided a reliable, simple and rapid source of credit for the poorest villagers so that they could take up the crop and livestock activities introduced by the project. Increased outputs of hybrid paddy, maize, poultry, pigs and cattle significantly enhanced food security, and the sale of surplus quantities and other market-oriented products generated additional household income. In addition, the project invested in long-term vocational training for rural youth to qualify them for non-farm employment. This training proved effective and there is good potential for it to be replicated and scaled up. In addition, both the RIDP and cocoa-production projects have components to facilitate marketing, which support farmers in marketing their product. While the cocoa project made connections with domestic and international traders and buyers, RIDP's market-oriented production was a new concept that was introduced to both smallholder farmers in Tuyen Quang and to local government. The project addressed the questions of improving the production of crops and livestock and connecting farm production to nearby markets.

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Photographs



Coffee-cinnamomum plantation, Dak Lak Province
Photo by Hoang Dinh (2001)



Coffee-Paulownia cropping system, Dak Lak Province
Photo by Hoang Dinh (2001)



Coffee-Azelia xylocarpa system in Dak Lak Province
Photo by Hoang Dinh (2001)



Coffee-rubber cropping system, Dak Lak Province
Photo by Hoang Dinh (2001)



Coffee-custard apple system, Central Highlands
Photo by Hoang Dinh (2004)



Coffee-durian intercropping, Central Highlands
Photo by Hoang Dinh (2012)



Coffee-*Leucaena leucocephala*-pepper, Central Highlands

Photo by Hoang Dinh (2012)



Plums in Sapa, Northwestern Region

Photo by newzing.vn (2014)



Rambutan in Tien Giang, Mekong Delta

Photo by newzing.vn (2014)



Star apples in Tien Giang, Mekong Delta

Photo by giongcay.com (2014)

Annex 1. Projects implemented by government agencies and NGOs in Cambodia

Project name Timeframe	Implementing agency	Funding agency	Brief description or specific-crop-diversification component
<u>Strengthening the Cambodian and Australian Vegetable Industries through Adoption of Improved Production and Postharvest Practices (HORT/2006/107)</u>			
2010-2013	Cambodian Agricultural Research and Development Institute (CARDI) (www.cardi.org.kh) General Directorate of Agriculture (GDA) (http://www.maff.gov.kh) Royal University of Agriculture (RUA) (http://www.rua.edu.kh)	Australian Centre for International Agricultural Research (ACIAR) (http://aciar.gov.au)	Partnership between 2 Australian organizations: NSW Department of Primary Industries and Charles Sturt University; 3 Cambodian organizations: GDA, CARDI and RUA; and 1 International organization: AVRDC. Seeking to build on predecessor HORT/2003/045 and to implement a seed-to-plate approach to vegetable research and development in Cambodia, and in doing so, enhance Cambodian vegetable farmers' ability to meet domestic demand for high-quality, nutritious tomatoes, chillies and leafy vegetables. Objectives: <ul style="list-style-type: none"> • more fully map supply chains for tomatoes, chillies and leafy vegetables • improve product quality and supply through delivery of technical packages on production, disease management and supply chain management • build capacity of research and extension staff in vegetable production and postharvest research, and plant pathology • better understand gaps in vegetable extension material and produce an appropriate suite of materials suitable for use with farmers and supply chain participants
<u>Market-Focused Integrated Crop and Livestock Enterprises for North-Western Cambodia</u>			
2012-2016	University of New England (UNE) (http://www.une.edu) NSW Department of Primary industries (NSW DPI) (www.dpi.nsw.gov.au) CARDI (www.cardi.org.kh) Department of Animal Health & Production (DAHP), Sri Lanka (www.daph.gov.lk) Maddox Jolie-Pitt Foundation (MJP) (mjpasia.org) Royal University of Agriculture (RUA) (www.rua.edu.kh) University of Battambang (UBB) (www.ubb.edu.kh)	ACIAR (http://aciar.gov.au)	Implemented in North-Western (NW) Cambodia (Battambang and Pailin), to identify and evaluate novel crop-cattle integration options to increase profitability and which are consistent with intensification, processing and marketing opportunities in NW Cambodia. Project will shift the focus from subsistence-based food-security interventions to sustainable food security through diversification, generation of cash income and commercialization. Objectives: <ul style="list-style-type: none"> • identify and explore potential for intensification, processing and marketing in NW Cambodia through understanding the livelihood and operating environment of current and alternative whole-farm crop/cattle production systems • review current soil status with regard to degradation under the range of existing farming systems and identify crop/cattle management options that meet economic, social and environmental goals • evaluate opportunities and technologies for crop/cattle production systems in the context of declining soil fertility in partnership with 200 focus households • assesses and develops options for adaptation to climate variability and climate change for crop/cattle farming systems in NW Cambodia and NW NSW Australia. Engaging commercial and education sectors as well as research and extension to ensure development and delivery of feasible alternative commercial crop and livestock enterprises.

			<p>Results indicate that farmers burned crop residues, aggressively tilled soil, and lacked crop diversity and fertilizer, leading to declining soil fertility, soil erosion, high production risks and declining profitability. Cropping systems of target areas:</p> <ul style="list-style-type: none"> • early wet-season crop planted after isolated rainfall February-March with high failure rate • main wet-season crop planted in July-August, harvested October-November at peak rainfall • soil full of water after main wet-season harvest but not utilized • crops like sunflower can be successfully grown in dry season using residual soil water • crops can be grown for forage or silage in dry season with production coinciding with cattle-feed gap <p>Three possible cropping per year identified:</p> <ul style="list-style-type: none"> • dry season (Nov-Feb): sunflower (dual purpose: crop-forage) • early wet season (Mar-Jun): maize, mung bean, peanut • main wet season (Jul-Oct): maize, peanut, soybean
<p>Helping Address Rural Vulnerabilities and Ecosystem Stability (Cambodia HARVEST) (snapshot1, snapshot2)</p>			
2011-2015	<p>Fintrac (http://fintrac.com) Sub-contract with local NGOs</p>	<p>United States Agency for International Development (USAID) (www.usaid.gov)</p>	<p>In provinces around Tonle Sap Lake, where there is high percentage of poor and food-insecure families. Currently working with over 55,000 clients in more than 300 villages in Battambang, Kampong Thom, Pursat, and Siem Reap provinces.</p> <p>Goals: to improve food security, strengthen natural resource management and resilience to climate change, and increase capacity of public and private sectors and civil society to support agricultural competitiveness.</p> <p>Main components:</p> <ul style="list-style-type: none"> • crop diversification • rice value chain • aquaculture • natural resource management • social inclusion and nutrition • policy <p>Specific objectives:</p> <ul style="list-style-type: none"> • increase incomes for 70,000 rural households • accrue economic benefits for 150,000 people • develop income-generating activities for 8,500 "extreme poor" households • diversify cropping systems for 31,500 households • generate \$25 million in incremental new agricultural sales <p>In crop-diversification component, project has introduced horticulture including home gardens for seasonal vegetable production in dry season on rice fields close to houses and on commercial farms (> 1,000 m²) on rice fields with year-round irrigation. Commercial crops include cucumber, bitter gourd, cabbage, etc.</p>

ANNEX 1. PROJECTS IMPLEMENTED BY GOVERNMENT AGENCIES AND NGOS IN CAMBODIA

Sustainable Rural Livelihood Improvement (annual reports) (success stories)			
2011-2016	Society for Community Development in Cambodia (SOFDEC) (www.sofdec.org)	Swiss Interchurch Aid (HEKS) (www.heks.ch)	<p>Aimed at improving food security and incomes of around 5,000 farmer families in Kampong Chhnang and Kampong Speu provinces.</p> <p>Objectives:</p> <ul style="list-style-type: none"> village empowerment through organizing and strengthening community committees and developing village development plans improved rice and vegetable production of farmers enhanced livestock production of farmers integrated rice-based farming systems access to good-quality water for human consumption, animal use and crop production income generation through access to markets for agricultural and handicraft products <p>Objectives 2 and 4 related to crop diversification in rice-based farming systems. Introduction of new production techniques and quality seeds of rice and vegetables/cash crops (maize, mung bean, sesame, watermelon, pumpkin, sweet potato, taro, etc.). Two approaches: strengthening existing cropping systems and introducing new crop production based on market and local context.</p> <p>Common cropping system includes crop rotation of rice/non-rice (rice-mung bean, watermelon, sesame) and non-rice/non-rice (sweet melon-maize, mung bean-sesame). Also introduced no-till practices (using water hyacinth as cover crop) and supported production and postharvest facilities together with water wells, while improving access to cash credit.</p>
Promoting Climate Resilient Water Management and Agricultural Practices in Rural Cambodia (project summary) (country profile) (success story)			
2009-2013	MAFF-PSU (www.maff.gov.kh/)	<p>United Nations Development Programme (UNDP) (www.kh.undp.org/)</p> <p>Global Environment Facility (GEF) (www.thegef.org/gef/home)</p> <p>Royal Government of Cambodia (www.cambodia.gov.kh)</p>	<p>The first project designed to respond to priorities identified in Cambodia's NAPA, its aim was to make Cambodia's agricultural sector less vulnerable to changes in water availability resulting from climate change and to contribute to broader goal of enhancing adaptive capacity to prevent food insecurity induced by climate change. Implemented in two provinces; Preah Vihear (Choam Khsan District) and Kratie (Chit Borei District) to increase awareness of climate change, demonstrate climate-resilient practices in agriculture and water-resource management, and integrate responses into provincial, district and commune development plans to improve rural livelihoods of target beneficiaries. Combined water resources and diversified farming systems:</p> <ul style="list-style-type: none"> More than 2,000 households get water for rice farming, home gardening and animal care. Around 1,500 households benefit from project's pump wells, community ponds, rain-water harvesting containers and solar- and wind-powered pumps. More than 3,600 families adopted adaptive measures, such as rice varieties, water harvesting, seed purification, dripping systems, integrated farming systems, rice-intensification, and early-warning information in livelihood activities. Around 11,000 families get knowledge on climate change and adaptation through the project's on-going awareness raising campaigns. <p>Conducted demo fields of improved rice varieties adapted to climate change (submergence- and drought-tolerant) and vegetable growing (e.g. mung bean and tomato).</p>

Cambodia Community Based Adaptation Programme (CCBAP) (annual report)			
2010-2015	UNDP (www.kh.undp.org)	Sweden (https://sweden.se) Australian Department of Foreign Affairs and Trade (AusAID) (www.dfat.gov.au)	<p>Implemented in 20 provinces (Preah Sihanouk, Kampot, Ratanak Kiri, Mondul Kiri, Banteay Meanchey, Otdar Meanchey, Takeo, Kratie, Kampong Chhnang, Kampong Cham and Pursat, Steung Treng, Koh Kong) to reduce vulnerability and increase adaptive capacity to manage risks of climate change. Aiming to reduce vulnerability of agricultural sector to climate-induced changes in water availability and to enhance capacity of vulnerable communities in building resilience, mainstreaming climate change in commune development planning and documenting good practices of climate-change adaptation.</p> <p>Activities:</p> <ul style="list-style-type: none"> improve necessary capacity within NGOs, community-based organizations and local communities to implement community adaptation measures mainstream adaptation to climate change at commune level document good practices and share lessons learned to influence changes of policy and programme development <p>450 vulnerable communities targeted in flood/drought-prone areas in collaboration with relevant government agencies (ministries of Agriculture and of water resources, forestry administration)</p> <p>One focus on resilient agricultural techniques, with training provided on system of rice intensification (SRI), home gardening, animal and fish raising, benefiting 10,578 people, of whom 4,838 are women. Introduced rice varieties suitable to local growing conditions, e.g. early growth duration (Chulsa, IR504...) and other climate-resilient cultivars. Also tried to diversify cultivars. Home-garden activity built capacity of project farmers and supported seeds/seedlings (Chinese cabbage, eggplant, cucumber, pumpkin, watermelon, papaya, mango...) and other production inputs. Provision of seeds or seedlings based on farmer request. Successful with small-scale production (for household consumption); some commercial problems with marketing and water shortage.</p>
Cambodia Climate Change Alliance (CCCA)			
2010-2014	Ministry of Environment (MoE) (www.camclimate.org.kh/index.php/trust-fund.html) Sub-contract with other institutions and local NGOs	Sweden (www.government.se) DANIDA (http://um.dk/en/danida-en/) UNDP (www.kh.undp.org) EuropeAid (https://ec.europa.eu/europeaid/home_en) Parallel Contribution: GEF-LDCF (www.thegef.org/gef/lDCF) In-kind contribution: Royal Government of Cambodia (www.cambodia.gov.kh)	<p>Comprehensive and innovative approach to climate change in Cambodia. Includes unified engagement point for development partners and multi-donor financing facility to provide resources for capacity building and implementation at national and local level. Anchored in government's National Climate Change Committee (NCCC), the mandated government coordinating and policy support entity for all aspects of climate change. Aims to strengthen NCCC capacity to fulfil its mandate to address climate change and to enable line ministries, local government institutions and civil organizations to implement priority climate-change actions.</p> <p>Supported project include:</p> <ul style="list-style-type: none"> Building Capacity of Institutions to Help Farmers Better Adapt to Climate Change and Climate Variability in Cambodia", implemented by Royal University of Agriculture (RuA), objectives: <ul style="list-style-type: none"> assess performance of improved Cambodia rice variety Rieng Chey (noted for general drought tolerance) assess performance of improved Cambodia rice variety Chul'Sa (short maturity, adapted to regularly flooded areas)

ANNEX 1. PROJECTS IMPLEMENTED BY GOVERNMENT AGENCIES AND NGOS IN CAMBODIA

			<ul style="list-style-type: none"> – evaluate performance of selected livestock forage for income diversification, and introduce forage crop variety for animal feeding in drought and flood-prone areas – monitor and analyse climate variability in three target districts • Building Resilience against Climate Change for Small Scale Farmers and Local Authorities in Ratanakiri Province, implemented by Cambodia Center for Study and Development in Agriculture (CEDAC), aiming to contribute to eradication of extreme poverty and hunger among small-scale farmer families in Ratanakiri Province, through enhancing resilience against climate change. Identified inadequate technical and local institutional capacity as one of the greatest obstacles to achieving project objectives, especially knowledge of climate change related to agricultural practices. • Adaptation to Climate Change through Alternative Livelihood in Community Forestry, implemented by Forestry Administration, MAFF. Designed to build capacity within forestry sector through supporting effective participation of community forestry management committees and commune councils in newly established cantonment-level community forestry planning and co-ordination committees; implementing related climate-change adaptation pilots (bio-digesters and home gardens).
Food Security and Livelihood Improvement			
2006-2008	SRER KHMER (http://srekhmer-cambodia.org)	Canada International Development Assistance (CIDA) (www.international.gc.ca/international/index.aspx?lang=eng)	<p>Funded by Food Security Initiative Fund of Canada International Development Assistance (FSIF-CIDA). Two-year project in Banan, Sangker and Thmor Korl districts, Battambang Province. Objective: improve livelihoods of 14 poorer farmer groups.</p> <p>One component was integrated homestead production (crop and livestock), with vegetables among the integrated practices. Supported seeds of vegetables (Chinese kale, bunching onion, long bean, petsai, water convolvulus, eggplant, papaya, etc.) for home gardens to improve availability of nutrition for family, especially children, with some surplus sold for income.</p>
Improving Livelihood of Small Farmers in Tramkok (ILFARM-Tramkok)			
2002-2005	Cambodian Center for Study and Development in Agriculture (CEDAC) (cedac.org.kh)	Japan International Cooperation Agency (JICA) (www.jica.go.jp)	<p>Implemented in Tramkok District, Takeo Province to improve livelihoods of 600 subsistence farmers by enhancing capacity to sustainably intensify and diversify agricultural production.</p> <p>Four outputs:</p> <ul style="list-style-type: none"> • Farmers trained in ecological farming techniques and integrated farm management. • Farmers in key target villages and neighbouring villages exposed to innovations adapted and/or developed by project farmers. • Agricultural development led by farmers' network established in project area. • Farmer resource centre established and accessible to farmers. <p>First outcome: integrated farming systems with training on SRI and multi-purpose farm, including livestock (chicken and pig), fish culture and home garden (vegetables and fruit trees) for household consumption and income generation. Most vegetables included long bean, bottle gourd, bitter melon, ivy gourd, leaf amaranth, chili, winged bean, water convolvulus and wax gourd.</p>

Integrated Women's Empowerment Project (IWEP)			
2005-2008 (I)	Agricultural Development Denmark Asia (ADDA) (www.adda.dk) SREER KHMER (http://sreerkhmer-cambodia.org)	Danish International Development Agency (DANIDA) (http://um.dk/en/danida-en/) Agricultural Development Denmark Asia (ADDA) (www.adda.dk)	Implemented in five districts of Siem Reap Province. Objectives: <ul style="list-style-type: none"> improve standard of living for poor farming families train women in practical farming together with dissemination of knowledge on better production methods (of chickens and pigs as well as vegetables) give women a chance to save money and obtain cheap loans (micro-loan) boost women's position in family, village and local society raise awareness about AIDS, domestic violence and trafficking Main activities: <ul style="list-style-type: none"> training of trainers on food security and gender supporting scholarships conducting farmer field schools (FFS) establishing village women self-help groups Two FFSs in each target village (vegetable growing and livestock raising) with 14 weekly meetings of 25 to 30 farmers. Demonstrations carried out during FFS to teach techniques through practical work (compost making, pest and disease management, and treatment and vaccination of livestock). Supported vegetable seeds (tomato, string bean, Chinese cabbage, eggplant, etc.).
Economic and Social Relaunch of North-West Provinces (ECOSORN)			
2008-2010	Agricultural Development Denmark Asia (ADDA) (www.adda.dk)	EuropeAid (http://ec.europa.eu/europeaid/how/finance/dci/food_en.htm)	Objective: to contribute to poverty reduction through increased household income, mainly from increased agricultural production through economic and social development of rural population in 3 north-west provinces (Siem Reap, Battambang and Banteay Meanchay), in way that accrues equitably to both men and women. Primary beneficiaries: smallholder farmers and their families in project area. Three results to be achieved: <ul style="list-style-type: none"> intensified and diversified lowland rainfed farming systems intensified and diversified lowland irrigated farming systems intensified, diversified and expanded upland farming systems Specifically supported rice, home gardens (vegetables such as eggplant, leek, lettuce, cauliflower, cabbage and fruit trees) and upland crops (mung bean, soybean, peanut, cucumber, watermelon, maize, sweet potato and cassava). Also introduced crop rotation.
Improving Food Security and Market Linkages for Smallholders (MALIS)			
2011-2015	FAO (www.fao.org) MAFF (www.maff.gov.kh) NGOs	EuropeAid (http://ec.europa.eu/europeaid/how/finance/dci/food_en.htm)	Funded under the EU Food Security Thematic Programme for 3.5 years. Focus on community based organizations (CBOs) such as agricultural cooperatives, farmers' associations, women's groups and rice banks. Project activities: FFSs, farmer business schools, improved nutrition and disaster risk reduction. Combines capacity building and institutional strengthening with a strong commercial orientation for sustainability.

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			<p>Objective: to improve food security and nutrition for vulnerable smallholder farmers in two provinces (5 districts in Otdar Meanchey Province: Anlong Veng, Trapaeng Prasat, Banteay Ampil, Chong Kal and Samrong; 4 districts in Preah Vihear Province: Kuleaen, Chey Sen, Rovieng and Tbeng Meanchey) by improving farming systems, household income and family feeding practices.</p> <p>Expected achievements:</p> <ul style="list-style-type: none"> • Increased smallholder capacity to diversify production, increase productivity, and build resilience. At least 7,500 vulnerable farmers in approximately 300 farmer groups receive direct support in agricultural production; indirect beneficiaries learn from others' success. • Improved market linkages, value addition and profitability for targeted smallholders. Basic business module for FFSs, extended business training in farmer business schools for selected groups, agricultural fairs and strengthening of CBOs to build market linkages. • Improved family feeding practices and nutrition, targeted primarily at mothers and caregivers of children under 2 years old. Food-based approach on improved complementary feeding, diversified diets and small-scale food processing. Training 160 government and NGO staff from implementing partners and 300 community-level health workers to ensure that they are competent to deliver quality training to beneficiaries. • Strengthened institutional capacity of local authorities, implementing partners, CBOs and agricultural cooperatives. Multidisciplinary training for farmers and farmer groups as foundation for sustainability. Lessons learned are shared locally and recommendations made to shape agricultural and nutrition-related practices and policies at sub-national level.
Improve the Food Security of the Farming Families Affected by the Volatile Food Prices			
2009-2011	<p>FAO (www.fao.org) MAFF-GDA (www.maff.gov.kh)</p>	<p>EuropeAid (http://ec.europa.eu/europeaid/how/finance/dci/food_en.htm)</p>	<p>Objective: to improve food security of vulnerable households affected by volatile food prices in 10 provinces through sustainable increases in productivity, enhancing access to agricultural inputs and services, diversifying and improving feeding practices, and strengthening management. Implemented with the General Directorate of Agriculture and the Fisheries Administration of the Ministry of Agriculture, Forestry and Fisheries; Ministry of Water Resources and Meteorology and the Ministry of Women's Affairs.</p> <p>Major components: sustainable crop production and intensification of rice and vegetables, strengthened management of postharvest rice, fisheries, water, and nutrition.</p> <p>Beneficiaries: at least 80 000 food-insecure households and smallholder rural producers with potential for rapidly expanding their food and agricultural production (access to land of less than 1 ha, with adequate labour).</p> <p>Specific results:</p> <ul style="list-style-type: none"> • 50,000 households benefiting from distribution of quality inputs for rice production (seed and fertilizer), training on improved agriculture practices and farmer-to-farmer learning • around 9,000 households (of the 50,000 selected) received equipment, storage facilities and training on improved postharvest management

Tonle Sap Poverty Reduction and Smallholder Development Project (reports and recommendations)			
2010-2017	MAFF (www.maff.gov.kh) National Committee for National Democratic Development (NCDD) Secretariat and the National Information Communications Technology Development Authority (NiDA) NGOs	Asian Development Bank (ADB, loan and grant) (www.adb.org) IFAD (loan and grant) (www.ifad.org) Government of Finland (http://valtioneuvosto.fi/etusivu/en.jsp) Government of Cambodia (www.cambodia.gov.kh)	Overall goal: to improve livelihoods of resource-poor households (196 communes) in four target provinces (Kampong Cham, Kampong Thom, Siem Reap and Banteay Mean Chey) in the Tonle Sap Basin by 2020, benefiting about 630,000 households (approximately 2.5 million people). Objective: to increase agricultural productivity and improve access to markets in these four provinces. Expected improvements: better agricultural support and improved access to rural financial services, increased diversification of household economic activities, creation of on- and off-farm livelihood opportunities and enhanced rural infrastructure. Five sections: <ul style="list-style-type: none"> improving rural infrastructure strengthening rural financial services improving agricultural productivity creating enabling environment Crop diversification included establishing and training farmer extension, adaptive research, marketing groups and demonstrations of improved rice varieties (Phka Rumduol, Phka Rumdeng, Sen Pidao...) and vegetable production after wet-season rice (chili, eggplant, melon, bitter gourd, cucumber, etc.), based on farmers' request and local growing conditions.
Agriculture Sector Development Program Loan (ASDP) (completion report)			
2003-2009	MAFF (www.maff.gov.kh) Ministry of Economy and Finance (MEF) (www.mef.gov.kh)	(ADB (loan) (www.adb.org) Japan (technical assistance) Royal Government of Cambodia (www.cambodia.gov.kh)	Mainly implemented using loan from ADB and technical assistance from Government of Japan, in four provinces (Takeo, Kampot, Kampong Cham and Kampong Speu) to promote sustainable growth of market-based agriculture and improve agricultural productivity. Objectives: <ul style="list-style-type: none"> improve ability of smallholders to raise productivity and diversify into high-value products improve market environment for private agro-based enterprise growth strengthen institutional capacity for competitive agricultural commercialization Also promoted increased participation of poor and women in agricultural production, marketing, and post-production. Effective in achieving its objectives, especially in relation to providing extension support under component 1. Beneficiaries: total of 52,176 farm households received one or more training sessions (compared with target of 56,000). Adoption surveys indicate that most commonly used technologies are paddy (83%), chicken raising (76%) and vegetable production (65%).
Rural Livelihoods Improvement Project in Kratie, Preah Vihear and Ratanakiri (RULIP)			
2007-2014	MAFF (www.maff.gov.kh)	IFAD (grant) (www.ifad.org) administered by United Nations Office for Project Services (UNOPS) UNDP (www.kh.undp.org)	Targeting poor people in 84 poor communes in three provinces (Kratie, Preah Vihear and Ratanakiri), to improve livelihoods of poor people with little or no land, indigenous peoples and ethnic groups, and households headed by women, particularly those with young children and/or many dependents. Objective: to make positive and sustainable impact on agricultural development. Beneficiaries: about 22,600 poor households (30% of the population of the designated area).

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			<p>Objectives:</p> <ul style="list-style-type: none"> • capacity-building • skills training • technology transfer • improvement of food security, agricultural productivity and natural resource management • income generation through on-farm and off-farm activities • development of market-oriented production <p>Participants will also have a role in monitoring project performance and assessing impact on their communities.</p> <p>Through the grant, IFAD supports project activities that will help poor rural people</p> <ul style="list-style-type: none"> • gain access to more advanced agricultural technology to improve household food security and incomes and agricultural productivity • diversify on-farm income opportunities • form linkages with private-sector markets and development • build capacity of commune councils and village-based organizations to plan and monitor economic development activities <p>MAFF capacity to formulate pro-poor policies and poverty-reduction programmes also enhanced</p>
Tonle Sap Technology Demonstrations for Productivity Enhancement (TSTD)			
2009-2012	MAFF (www.maff.gov.kh) NIRAS A/S (www.niras.com)	ADB (Technical Assistance Special Fund) (www.adb.org) Republic of Korea e-Asia and Knowledge Partnership Fund (www.adb.org/site/funds/funds/e-asia-and-knowledge-partnership-fund) Finland (http://formin.finland.fi/public/default.aspx?contentid=201875&contentlan=2&culture=en-US) Royal Government of Cambodia (www.cambodia.gov.kh)	<p>Technical assistance implemented in 4 Tonle Sap provinces (Banteay Meanchay, Kampong Cham, Kampong Thom and Siem Reap) to diversify and improve income of smallholders, marginal farmers and poor households in the Tonle Sap Basin. Outcome: increased access of smallholders, marginal farmers and poor households to good agricultural practices, technologies and information.</p> <p>Expected outputs:</p> <ul style="list-style-type: none"> • demonstrated good agricultural practices and technologies and training • piloting selected food crops, livestock, fisheries, and water management technologies • established physical rural ICT facilities <p>Two components;</p> <ul style="list-style-type: none"> • pilot demonstration of productive, profitable and biosecure technologies • promotion of development and application of rural information and communication technology (ICT) for adoption and to improve market access, thereby influencing productivity, diversification and competitiveness. <p>Technology demonstration included agricultural diversification (vegetable production, livestock, aquaculture and mushroom), introduced important food crops (bitter melon, yard-long bean, cucumber, tomato, sweet and hot pepper, eggplant, chaisim, bok choy, Chinese kale, cauliflower, sweet corn and watermelon, in cooperation with seed company to supply vegetable seeds.</p>
Farming systems research for crop diversification in Cambodia and Australia (final report)			
2004-2008	New South Wales Department of Primary Industries (NSW DPI)	ACIAR (http://aciarc.gov.au)	Implemented in 2 Cambodian provinces (Battambang and Kampong Cham) with 153 on-farm experiments and demonstrations: variety evaluation (43), insect pests and diseases (19), reduced

	www.dpi.nsw.gov.au CARDI (www.cardi.org.kh)		tillage (22), agronomy and farming systems (69). Collaborative effort of CARDI and NSW DPI researchers with government departments, especially Department of Agricultural Extension and provincial department of agriculture in target provinces. Objectives: <ul style="list-style-type: none"> • identify and overcome constraints to adoption of non-rice upland crops in Cambodia and non-cereal crops in north-eastern Australia by analysis of on-farm data and experimentation • develop simple diagnostic and analysis tools that farmers and advisers can use to monitor performance of crops and how they fit into the farming system • produce appropriately packaged technical and financial information
Enhancing productivity of major upland crops in some of the Greater Mekong Sub-region (GMS) countries: Vietnam, Lao PDR and Cambodia			
2005-2008	CARDI (www.cardi.org.kh) Cuu Long Delta Rice Research Institute (CLRRI) (www.clrri.org/ver2)	Rockefeller Foundation (www.rockefellerfoundation.org)	Objectives: <ul style="list-style-type: none"> • develop and improve suitable crop varieties for different ecological environments • develop sustainable farming systems based on improved practices of crop production to supply sufficient food for the entire year, increasing farm family income and sustainable natural resource management <p>Project focused on 2 major crops: maize (from Mexico and CARDI) and cassava (from Thailand, Malaysia and Cambodia) and 3 minor crops: mung bean (CARDI Chey), soybean (DT84) and sesame (local variety white sesame). Implemented at CARDI, stations in target province and on farmers' fields.</p>
Diversification and intensification of rainfed lowland cropping systems in Cambodia			
2007-2012	University of Queensland (www.uq.edu.au) CARDI (www.cardi.org.kh)	ACIAR (http://aciarc.gov.au)	Objective: to increase range of crops grown under rain-fed lowland conditions by promoting non-rice crop technologies for efficient water use and high financial return to growers—achieved by adding non-rice crop after main wet-season rice crop (i.e. rice/non-rice double cropping). Key research issue was water: how to select appropriate soil and water environment in wet season for the following non-rice crop, particularly peanut, soybean, and mung bean, and how to ensure adequate water. Target group: small-scale lowland rice farmers with favourable water availability in 5 provinces (Takeo, Kampot, Kampong Cham, Kampong Thom and Battambang). Limited water may be available from underground or on-farm ponds, as supplementary irrigation to non-rice crops. Key points: assessment of cropping risks and economic evaluation of new technologies.
<u>Local Agricultural Research and Extension Center (LAREC)</u>			
2011-2015	Society for Community Development in Cambodia (SOFDEC) (www.sofdec.org)	HEKS (http://www.heks.ch)	Established at Cheung Kreav commune, Kampong Chhnang Province. Objective: to contribute to poverty reduction and food security of rural families by providing improved agricultural technologies, practices and input supply. Research in the centre conducted in centre and on farmers' fields—mainly on local crop varieties or combination between improved varieties/breeding line and indigenous ones, Focus on selection of local crop varieties, chicken breeding, sustainable land management, seed/breed production and breeding of early growth duration rice (fragrant and non-fragrant).

ANNEX 1. PROJECTS IMPLEMENTED BY GOVERNMENT AGENCIES AND NGOS IN CAMBODIA

			<p>Crop diversification:</p> <ul style="list-style-type: none"> • improvement of Cambodian glutinous rice varieties • improvement of submergence-tolerant and floating rice varieties • identification of good-quality watermelon varieties • identification of high-quality Khmer pumpkin varieties • evaluation and selection of high-yielding mung bean varieties
<u>Enabling Households to Apply Necessary Cultivation for Economic Development (ENHANCED)</u>			
2012-2015	Adventist Development and Relief Agency (ADRA Cambodia) (www.adracambodia.org)	AusAID (aid.dfat.gov.au) ADRA Australia (www.adra.org.au)	Implemented in Baray district, Kompong Thom Province, building on base of agricultural knowledge in rice, vegetables and fruit, animal production and other rural livelihoods to give households opportunities to make improvements and changes that will result in sustainable increases in value of products and incomes. Emphasis on increasing positive contributions of women in family livelihood choices and production; 5,900 beneficiaries.
Capacity Development of Rural Farmers for Food Security Project			
2001-2006	SRER KHMER (http://srerkmher-cambodia.org)	Norwegian People's Aid (NPA) (http://www.npaid.org)	<p>Providing both technical and financial support to Srer Khmer since 2001 to implement the project, based in Malai district, Banteay Meanchey Province</p> <p>Objectives:</p> <ul style="list-style-type: none"> • support FFSs, farmer life schools and farmer action research organized by farmer trainers • strengthen village-based associations and farmer trainer networks through training, experimentation, cross/exchange visits and meetings <p>Main activities:</p> <ul style="list-style-type: none"> • conducting FFSs • establishing farmers' associations • integrating homestead production • supporting family ponds • conducting field demonstrations/experiments
Integrated Farming and Marketing for Livelihood Improvement Project			
2007-2008	SRER KHMER (http://srerkmher-cambodia.org)	New Zealand Agency for International Development (NZAID) (www.aid.govt.nz)	Establishing self-help groups in 16 villages; providing technical training on agricultural activities (livestock, aquaculture, vegetable and rice production) and field demonstrations of early growth duration rice to benefit approximately 480 direct beneficiaries and 2,400 indirect beneficiaries for two years, as well as supporting vegetable and rice seeds for project farmers.

Annex 2. Projects implemented by government agencies and NGOs in Lao PDR

Annex table 2.1: Brief overview of projects implemented by government agencies and NGOs in Lao PDR, involving crop diversification

Project name Timeframe	Implementing agency	Funding agency	Brief description or specific-crop-diversification component
Improving the Resilience of the Agriculture Sector in Lao PDR to Climate Change impacts (IRAS/ NAPAUFU)			
2011-2016	National Rice Research Programme (NAFRI) (www.nafri.org.la) Department of Agricultural Extension and Cooperatives (DAEC)	GEF	Implemented in 4 districts of 2 provinces (Outhumphone and Champhone districts of Savannakhet Province; Phiang and Paklai districts of Xayabouly Province) to minimize food insecurity resulting from climate change and farmers' vulnerability to extreme flooding and drought events, with small crop diversification component. Objectives: <ul style="list-style-type: none"> • establish knowledge base on impact of climate change on agricultural production, food security and vulnerability; strengthen local coping mechanisms • strengthen capacity of sector planners and agricultural producers to understand and address risks and opportunities related to climate change for local food production and socioeconomic conditions • develop community-based adaptive agricultural practices and off-farm opportunities within suitable agroecological systems • adapt monitoring and learning as a long-term process
Vegetable Management Modules for Extreme Drought and Flood Conditions in the Study Sites of the IRAS Project			
2014-2015	Horticulture Research Center (HRC)	Global Environment Facility (GEF) (www.thegef.org/gef)	Phieng district, Xaiyabuli Province chosen to conduct the project. Vegetable-management modules contained selection of vegetables (Kangkong, coriander, chili, yardlong bean, amaranth, lettuce, dill, Chinese mustard), market planning, suggested cultivation techniques (seedlings, soil, transplanting, weeding, watering, fertilizing, pest management). Tested for smallholders under irregular weather events, extreme drought and flood, and Lao conditions. Objectives: <ul style="list-style-type: none"> • improve knowledge, incomes and livelihood of participating farmers • establish demonstration farms and knowledge transfer to other farmers
Climate Change Training and Adaptation Module (CCTAM) on Crop and Ago-Forestry (under IRAS)			
2013-2014	DAEC	GEF (www.thegef.org/gef)	Specialists, experts and DAEC staff to draft and establish suitable training module for district agriculture and forestry office staff and farmers. Objective: to design cropping systems for targeted plants (cereals, beans, vegetables, fruit trees, industrial crops).

Rice Productivity Improvement Project (RPIP)			
2009-2011	NAFRI (www.nafri.org.la)	World Bank (www.worldbank.org/en/country/lao)	Objectives: <ul style="list-style-type: none"> • support to farmer seed groups and on-farm demonstrations • support to centres for rice research and seed multiplication
Northern Uplands Rice Farming Systems Research Project (NURiFaR)			
2008-2012	Northern Agriculture and Forestry Research Center (NAFReC) NAFRI (www.nafri.org.la)	Swiss Agency for Development and Cooperation (SDC) (www.sdcmekong.org)	Objectives: <ul style="list-style-type: none"> • formulate options for productive rice-based farming systems in the uplands • provide relevant recommendations that stakeholders have access to and can use, and which reflect their concerns
Developing Improved Farming and Marketing Systems in Rainfed Regions of Southern Lao			
2009-2013	NAFRI (www.nafri.org.la)	Australian Centre for International Agricultural Research (ACIAR) (http://aciarc.gov.au)	Testing rice, corn and bean varieties under different upland and lowland conditions Objectives: <ul style="list-style-type: none"> • diagnose and integrate assessment of farming and marketing systems • optimize, test and adapt crop and livestock technologies and marketing/extension approaches • share knowledge and pilot scaling out of varieties, crop and livestock technologies and marketing approaches • alleviate constraints posed by drought and uncontrolled flooding
Developing Multi-Scale Climate Change Adaptation Strategies for Farming Communities in Cambodia, Lao PDR, Bangladesh and India			
2010-2014	NAFRI (www.nafri.org.la)	ACIAR (http://aciarc.gov.au)	Screening rice varieties for flood tolerance Objectives: <ul style="list-style-type: none"> • adapt and apply available tools/methods to select and assess adaptation strategies for rice-based cropping systems • develop capacity in research and extension processes that support the building of adaptive capacity in rice-based cropping systems • select and evaluate suite of adaptation options for crop and water management suitable for dissemination at province level • derive and disseminate principles and policy recommendations to enable more effective design and implementation of adaptation programmes at multiple levels
Seed for Need: Climate-Smart Agriculture for Poor Rural Communities in Laos			
2013-2017	Agriculture Research Center (ARC) NAFRI (www.nafri.org.la) Bioversity International (www.bioversityinternational.org)	Bioversity International (www.bioversityinternational.org)	Implemented in 5 provinces (Bolikhamxay, Khammuang, Savanakheth, Salavan and Champassack), all of which are included in the government's priority list for the National Growth for Poverty Eradication Strategy. Activities: <ul style="list-style-type: none"> • household survey for diversity assessment, farmers' knowledge for climate-change adaptation and local seed systems • developing crop-suitability models and identifying climate-ready collections

			<ul style="list-style-type: none"> • Establishing farmers' experimental network • strengthening communication and raising public awareness • training and capacity building • monitoring and evaluation <p>Project is ongoing, household surveys have been completed.</p>
Mechanization and value adding for diversification of lowland cropping systems in Lao PDR and Cambodia			
2014-2018	ARC NAFRI (www.nafri.org.la) ACIAR (http://aciarc.gov.au)	ACIAR (http://aciarc.gov.au)	<p>Work with rice, corn and bean cropping systems in 8 sites which contrast in access to irrigation, agricultural services, and agribusiness. About 400 farmers and 40 small businesses to participate with researchers in testing and evaluating alternative cropping and postharvest systems, and assessing options for mechanization to increase labour productivity. Market-oriented approach to enable farm households to benefit as market opportunities increase and drive the demand for quality produce for domestic and export markets. Beneficiaries: as many as 6 million rural poor in the rainfed lowland systems in the two countries if innovations are fine-tuned, adapted and extended.</p> <p>Objectives:</p> <ul style="list-style-type: none"> • raise incomes of participating farmers by 30% through adoption of practices arising from the project • through focused learning programs and communication among farmers and small-scale agribusinesses, estimated 4,000 farmers to have adopted innovations and an additional 1,000 ha of non-rice crops to be planted within 5 years from project completion • evaluate agronomic and postharvest innovations for adding value • evaluate intensified, diversified, and market-oriented cropping systems to take advantage of mechanization and value-adding options
Community Biodiversity Development and Conservation (CBDC) and Biodiversity Use and Conservation in Asia Program (BUCAP) (CBDC-BUCAP)			
2007-2010	ARC Department of Agriculture (DOA) NAFRI (www.nafri.org.la) Oxfam Solidarity Belgium (www.oxfam.org.be) Plant Protection Center (PPC) Rice and Commercial Crop Research Center (R&CCRC) (technical and material support) Southeast Asia Regional Initiatives for Community Empowerment (SEARICE) (www.searice.org.ph)	Bioversity International (www.bioversityinternational.org) Norwegian Investment Fund for Developing Countries (Norfund) (www.norfund.no) Swedish International Biodiversity Programme (SwedBio) (www.sida.se/english)	<p>Implemented in 4 provinces (Luangprabang, Vientiane, Savannakhet and Champasack) with 36 experimental sites for both dry and wet seasons, including vegetables.</p> <p>Main activities: rice crossing, varietal selection, rice conservation, seed multiplication, self-assessment and cultivation of promising lines. Other activities related to conservation, development and use of plant genetic resources, such as farmers technical conference, school assessments, general and specific training of trainers, project management committee, national staff meetings, project assessment (baseline data), farmers' exchange, monitoring and technical backstopping.</p> <p>Major goal: to strengthen farmers' right to PGR—conservation, development and use—towards farmer empowerment for sustainable agriculture and livelihood systems.</p> <p>Objectives:</p> <ul style="list-style-type: none"> • improve conservation and development of PGR diversity • enhance seed security • improve livelihoods through sustainable use of PGR diversity • strengthen capacity among stakeholders to support farmers' management of PGR diversity

			<ul style="list-style-type: none"> strengthen farmers' management of their PGR at community, national and regional levels increase capacity of farmers to adapt to climate change scale up good practices in sustainable agriculture and conservation of agrobiodiversity empower farmers and their communities to influence policy increase participation of youth and women on agrobiodiversity conservation management promote local ownership of CBDC-BUCAP programme affect policy environment in regard to protection of farmers' rights over their PGR, with positive changes and actions at local, national, regional and international levels
Democratizing Agricultural Research and Extension (DARE)			
2011-2014	ARC DOA NAFRI (www.nafri.org.la) SEARICE (www.searice.org.ph)	Novib (www.oxfamnovib.nl/?id=EN)	<p>Implemented in 10 provinces, 20 districts and 60 communities for participatory plant breeding, on-farm conservation and seed production for rice, maize, garlic and peanut.</p> <p>Objectives:</p> <ul style="list-style-type: none"> baseline survey facilitate training for farmers for seasonal management of farmers' field schools in each target community strengthen capacity of researchers, plant breeders and institutions in adapting participatory methodologies for technology development and community innovations through biodiversity-based agriculture systems establish strong linkages and partnerships between farmers and relevant institutions responsible for agricultural food-production programmes as part of support system during implementation and after end of project contribute to development of agricultural policies that relate to all legal frameworks and regulations on biodiversity-based agriculture conservation and sustainable use
Agroforestry in Degraded Forestland after Shifting Cultivation in Northern Lao PDR: Thongkhang, Nan, Luangprabang & Huayyang, Xai, Oudomxay			
2000-2005	Forestry Research Centre (FRC)- NAFRI (www.nafri.org.la)	ASEAN-Korea Environmental Cooperation Project (AKECOP)	<p>Implemented at Agroforestry Research Station in Thongkhang, Nan District, Luangprabang Province; on-station and on-farm research at Huayyang, Xai, Oudomxay</p> <p>Objectives:</p> <ul style="list-style-type: none"> determine agroforestry techniques suitable for two geographical zones with specific local and socioeconomic conditions identify suitable species of commercial timber trees, fruit trees and crop species for agroforestry system: <i>Aquilaria crassna</i>, <i>Tectona grandis</i>, longan, prunus, <i>Litchi chinensis</i>, upland rice, soybean, Job's tears, maize, sesame, groundnut, pineapple

Annex table 2.2: Design and implementation of agriculture and crop-diversification projects in Lao PDR

Name of Project Design	Implementation, outcomes, beneficiaries
Vegetable management modules for extreme drought and flood conditions in the study sites of the IRAS project	
Phieng district, Xaiyabuli chosen to conduct project. Vegetable Management Module contained selection of vegetable types, market planning, suggestion of cultivation techniques (seedlings, soil, transplanting, weeding, watering, fertilizer and pest management) under irregular weather events. Tested for smallholders and Lao conditions.	Participating farmers improved knowledge, incomes and livelihood. Knowledge transfer through demonstration farms and participating farmers.
Improving the Resilience of the Agriculture Sector in Lao PDR to Climate Change impacts (IRAS/ NAPAFU)	
4 districts in 2 provinces: Outhumphone and Champhone districts, Savannakhet Province Phieng and Paklai districts, Xayabouly Province	Knowledge base on impact of climate change on agricultural production, food security and vulnerability, and local coping mechanisms strengthened. Capacities of sector planners and agricultural producers strengthened to understand and address risks and opportunities related to climate change for local food production and socioeconomic conditions. Community-based adaptive agricultural practices and off-farm opportunities demonstrated and promoted within suitable agroecological systems. Monitoring and learning established as long-term processes.
Climate Change Training and Adaptation Module (CCTAM) on Crop and Ago-Forestry	
Specialists, experts and Department of Agriculture Extension and Cooperation (DAEC) staff cooperating to draft and establish suitable module for DAFO and farmers	Training module on adaptation to climate change
Rice Productivity Improvement Project	
Support to farmer seed groups and on-farm demonstrations Support to rice research and seed-multiplication centers	
Northern Uplands Rice Farming Systems Research Project	
Options for productive rice-based farming systems in the uplands Relevant stakeholders have access to, and can use, recommendations, which reflect their concerns	
Developing Improved Farming and Marketing Systems in Rainfed Regions of Southern Lao PDR	
Diagnosis and integrated assessment of farming and marketing systems Optimization, testing and adaptation of crop and livestock technologies and marketing/extension approaches	

<p>Sharing of knowledge and pilot scaling out of varieties, crop and livestock technologies, and marketing approaches Alleviation of constraints posed by drought and uncontrolled flooding</p>	
<p>Developing Multi-Scale Climate Change Adaptation Strategies for Farming Communities in Cambodia, Lao PDR, Bangladesh and India</p>	
<p>Adapting and applying available tools/methods to select and assess adaptation strategies for rice-based cropping systems Developing capacity in research and extension processes that support building of adaptive capacity in rice-based cropping systems Selecting and evaluating suite of options for adapting crop and water management suitable for dissemination at provincial level Deriving and disseminating principles and policy recommendations to enable more effective design and implementation of adaptation programmes at multiple levels</p>	
<p>Seed for Need: Climate-Smart Agriculture for Poor Rural Communities in Laos</p>	
<p>Sites selected in 5 provinces: Bolikhamsay, Khammuang, Savanakhet, Salavan and Champassack), all included in Laos government's priority list on National Growth for Poverty Eradication Strategy. Activities:</p> <ul style="list-style-type: none"> • Household survey for diversity assessment, farmers' knowledge for climate change adaptation and local seed system • Crop suitability models and identification of climate-ready collections • Farmers' experimental network • Communication and public awareness • Training and capacity building • Monitoring and evaluation 	<p>Project ongoing Household surveys completed</p>
<p>Mechanization and Value Adding for Diversification of Lowland Cropping Systems in Lao PDR and Cambodia</p>	
<p>Project to work in 8 sites contrasting in access to irrigation, agricultural services and agribusiness Participation from about 400 farmers and 40 small businesses with researchers in testing and evaluating alternative cropping and postharvest systems</p>	<p>Incomes of participating farmers to be raised 30% through adoption of project practices Focused learning programmes and communication among farmers and small-scale agribusinesses leading to estimated 4,000 farmers adopting innovations; additional 1,000 ha of non-rice crops to be planted within 5 years from project completion Market-oriented approach to benefit farm households as market opportunities increase and to drive demand for quality produce for domestic and export markets As many as 6 million rural poor in rainfed lowland systems in the two countries could benefit from such innovations if fine-tuned, adapted and extended</p>
<p>Community Biodiversity Development and Conservation, and Biodiversity Use and Conservation in Asia Program (CBDC-BUCAP), LAO PDR</p>	
<p>Regional programme including Vietnam, Bhutan, Thailand and Philippines. Implemented in 4 provinces (Luangprabang, Vientiane, Savannakhet and Champasack) with</p>	<ul style="list-style-type: none"> • Improved conservation and development of PGR <ul style="list-style-type: none"> - 40 locally adapted lines developed by farmers through participatory plant breeding

<p>36 experimental sites for both dry and wet seasons, including vegetables.</p> <p>Main activities: rice crossing, varietal selection, rice conservation, seed multiplication, self-assessment and cultivation of promising lines</p> <p>Other activities related to PGR-CDU such as farmers technical conference, school assessment, general and specific training of trainers, national staff meeting, project assessment (baseline data), farmers' exchange, monitoring and technical backstopping</p>	<ul style="list-style-type: none"> - 27 good-performing local varieties selected through participatory varietal selection, maintained by farmers on project sites - 40-44 locally adapted lines developed by BUCAP farmers stored in government genebanks (10-15 in Pak Cheng rice seed centre, 27 local varieties in R&CCRC) - 13 local vegetable varieties rehabilitated and used by partner agricultural schools: 40-50 local varieties conserved by BUCAP farmers in every season - Average of 10 varieties now grown in community (up from 4 varieties/community at project start) • Enhanced seed security <ul style="list-style-type: none"> - Availability of high-quality seeds in community through farmers' seed system: 70%-80% of BUCAP farmers using own seed; estimated 10-15 districts and 50-60 new communities received rice seed from BUCAP farmers; set-up 8 farmer seed production groups (312 tonnes produced by BUCAP farmers from 2007-2010); in 2008, project partner sold 30,500 kg of farmer-developed seeds to government for distribution to 5 provinces affected by floods • Increased incomes for farmers <ul style="list-style-type: none"> - Household earnings from own-saved seeds around US\$60/cropping - Sales of rice seed by farmer partners 10% higher than normal rice grains - 2-3t/ha increased productivity due to availability of good-quality adapted seeds (Increase production yield 4-4.5t/ha tonnes up from 3-3.5t/ha at project start - Increased production from 1 to 2 crops (good harvest for 2 times dry and wet seasons) • Strengthened capacity-building among stakeholders <ul style="list-style-type: none"> - Increased number of communities engaged in conservation, development and use (CDU) of PGR: 686 farmer beneficiaries with 120 women farmer-partners; 37 farmer-trainers (9 women); 80 farmers as selectors (10 doing actual crossing); 8 seed-multiplication groups - PGR CDU integrated into agricultural school curricula: 9 teachers, 1 researcher involved in developing curriculum from three agricultural schools; final draft improved by different stakeholders (proposed to Science Department of Ministry of Agriculture and Forestry for approval), being taught for the third-year students in second semester this year (2014) - Pool of researchers and extension agents with knowledge and skill to support on-farm PGR CDU: 34 of PAFO & DAFO trainers, 4 researchers • Increased adaptive capacity of farmers to climate change <ul style="list-style-type: none"> - Varieties resistant to diseases and pests released; 7 varieties resistant to drought - Varieties tolerant to changing soil chemistry (acidity and salinity) released: 11 adapted to natural cultivation and changing temperature conditions, especially in northern provinces - Community seed banks established • Good practices in sustainable agriculture and conservation of agrobiodiversity scaled up <ul style="list-style-type: none"> - Number of farmers practicing agroecology-based farming: training of 22 staff members on self-assessment; 20 staff members attended vegetable course (7 attended Thailand) - Number of farmers and farmers' groups using FFS, PVS, PPB and SRI: 686 (including 210 women) • Farmers and communities empowered to influence policy environment <ul style="list-style-type: none"> - Developed farmers' self-confidence through participation in policy discussions (20 BUCAP farmers and 15 high policymakers participating); 1 farmers' technical
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	<p>conference;1 farmers' rights discussion; 2 national consolidation workshops</p> <ul style="list-style-type: none"> - Participatory plant breeding mainstreamed in national plant breeding program and extension system: agricultural research centres provided diverse segregating materials to farmers; technical back-stopping provided to project with researchers' salaries shouldered by government; PGR CDU as part of extension system in 4 provinces - Regulations implementing farmers' rights adopted: development of national plant-variety protection; irrigated rice research building on BUCAP experience; involvement of Department of Agriculture led to policy reviews; seed rules and regulations; exploring <i>sui generis</i> form of protection - Innovation: policy process (with research) + policy dialogues with farmers - Government resources allocated (budget, inputs, incentives, etc.) to community-based agrobiodiversity development and conservation (salaries, offices (equipment) and some facilities, amounting to 50,000,000 kip/year (US\$ 6,250/year) - Farmers' varieties recognized by local and national governments • Increased participation of youth and women on agrobiodiversity conservation and management <ul style="list-style-type: none"> - Women and youths using training skills on their farms on agrobiodiversity conservation and management: equal training for women and youths on agrobiodiversity conservation and management - women and youths benefiting from community seed banks; all processes of seed management transferred to women and the next generations (youths) - women and youths given positions in national and regional steering committees • Local ownership of CBDC-BUCAP promoted <ul style="list-style-type: none"> - Participatory planning processes implemented - Resource commitments from national institutions and organisations made to implement programme activities
<p>Democratizing Agricultural Research and Extension (DARE)</p>	
<p>In first year of phase I Being implemented in 10 provinces (6 in north, 1 in middle, 3 in south: Sayaboury, Houaphanh, Odomsay, Luangnamtha, Bokeo, Xiengkouang, Vientiane, Salavan, Sekong and Attapeu), 20 districts and 60 communities.</p>	<ul style="list-style-type: none"> • Completing baseline data survey • After training of trainers at national level, PAFO/DAFO have facilitated training for farmers for seasonal FFS/FS management for PGR CDU in target communities <ul style="list-style-type: none"> - Output: total = 10 provinces, 19 districts, 25 sites; total trainers = 30 persons (3 women, 10 farmers); total farmers attending = 550 participants (179 women) • Farmers can select good rice varieties/lines (rice: 9 promising lines, 10 stable; garlic: 2 varieties; peanut: 2 varieties) and exchange among themselves <ul style="list-style-type: none"> - 1000 booklets of seed degree - Farmers policy forum
<p>Agroforestry in Degraded Forestland after shifting cultivation in Northern Lao PDR:</p>	
<p>Thongkhang, Nan, Luangprabang Agroforestry Research Station Huayyang, Xai, Oudomxay</p>	<p>On-station research Community with 4 households</p>

Annex 3. Projects implemented by government agencies and NGOs in Vietnam

Annex table 3.1: Brief overview of projects implemented by government agencies and NGOs in Vietnam, 1998 to present

Project name Timeframe	Implementing agency	Funding agency	Brief description or specific-crop-diversification component
AGRICULTURE DIVERSIFICATION PROJECTS (INCLUDING INCOME DIVERSIFICATION)			
Vietnam's Agricultural Diversification Project (P004844)			
1998-2004	Minister of Agriculture and Rural Development (MARD) (www.mard.gov.vn/en) The Vietnam Bank for Agriculture and Rural Development (VBARD) (http://agribank.com.vn/english.aspx)	International Development Association (IDA) (www.worldbank.org/ida) French Agency for Development (AFD) (www.afd.fr/lang/en/home) Department for International Development (UK) (www.gov.uk/government/organisations/departement-for-international-development)	Implemented in 3 central highland provinces (Dak Lak, Gia Lai and Kon Tum), 8 central coastal provinces (Quang Binh, Quang Tri, Thua Thien Hue, Quang Ngai, Binh Dinh, Phu Yen, Khanh Hoa and Binh Thuan) and 7 northern provinces (Lang Son, Lao Cai, Nghe An, Phu Tho, Son La, Thai Nguyen and Vinh Phuc) to help small farmers diversify agricultural production into rubber, livestock, and crops. Objectives: to help Vietnam reduce rural poverty and maintain growth in rural incomes Budget: US\$ 84.3 million (IDA credit: US\$ 66.85 million; AFD credit: US\$ 16 million; Department for International Development: US\$ 1.86 million)
<u>Rural Income Diversification Project in Tuyen Quang Province (RIDP) (report on completion and results)</u>			
2002-2010	Tuyen Quang Provincial People's Committee (PPC) Department of Agriculture and Rural Development (DARD) (www.dardni.gov.uk)	International Fund for Agricultural Development (IFAD) (www.ifad.org) Department for International Development (UK) (www.gov.uk/government/organisations/departement-for-international-development) Swedish International Development Cooperation Agency (SIDA) (www.sida.se/english)	Implemented in 66 communes in 5 districts of Tuyen Quang Province to improve socioeconomic status of 49,000 poor households living in upland areas, especially ethnic minorities and women Budget: Total: US\$ 30.93 million (IFAD loan: US\$23.62 million; Department for International Development: US\$3.71 million; SIDA grant: US\$1.80 million)
<u>Vietnam - Second Agricultural Diversification Project (P084957) (Project 2)</u>			
2004-	MARD (www.mard.gov.vn/en) VBARD (http://agribank.com.vn/english.aspx)	IDA (www.worldbank.org/ida) AFD (www.afd.fr/lang/en/home) IFAD (www.ifad.org) Department for International Development (UK)	Implemented in 3 central highland provinces (Dak Lak, Gia Lai and Kon Tum), 8 central coastal provinces (Quang Binh, Quang Tri, Thua Thien Hue, Quang Ngai, Binh Dinh, Phu Yen, Khanh Hoa and Binh Thuan) and 7 northern provinces (Lang Son, Lao Cai, Nghe An, Phu Tho, Son La, Thai Nguyen and Vinh Phuc) to promote market-oriented agricultural diversification to increase and stabilize incomes of poor smallholders in central highland and coastal provinces; particular attention to participation of ethnic minorities and women.

		www.gov.uk/government/organisations/department-for-international-development	Budget: Total: US\$ 85 million (IDA credit: US\$ 55 million; AFD credit: US\$ 25 million; Department for International Development: US\$5 million)
<u>Sustainable and Profitable Crop and Livestock Systems for South-Central Coastal Vietnam (SMCN/2007/109) (final report)</u>			
2009-2012	Department of Agriculture and Food, Western Australia (DAFWA) (www.agric.wa.gov.au) Vietnam: many universities and research institutes	Australian Centre for International Agricultural Research (ACIAR) (http://aciarc.gov.au)	Implemented in Binh Dinh, Phu Yen and Ninh Thuan provinces to identify and facilitate adoption of promising resource-management practices for sustainable and profitable crop and livestock production systems best suited to local conditions and to improve market engagement, with an emphasis on coastal and sloping areas less than 400 metres above sea level. Capacity building through scholarships, training researchers and extension officers Budget: AUD 2,709,531
<u>Ha Giang Development Project for Ethnic Minorities</u>			
1998-2003	Departments of Agricultural Economy and Foreign Economic Relations of Ministry of Planning and Investment (MPI) (www.mpi.gov.vn/portal/page/portal/mpi_en) Ha Giang: PPC	IFAD (www.ifad.org) United Nations Development Programme (UNDP) (www.vn.undp.org) SIDA (www.sida.se/english) Department for International Development (UK) (www.gov.uk/government/organisations/department-for-international-development)	Implemented in Ha Giang Province (villages of Quan Ba, Yen Minh, Dong Van, Meo Vac, Xin Man, Hoang Su Phi and Bac Me) to diversify income by developing on- and off-farm activities as small-scale businesses and enterprises. Budget: US\$ 18.4 million (IFAD loan: US\$ 12.5 million; UNDP grant: US\$ 2.3 million; SIDA grant: US\$ 800,000; Department for International Development: US\$ 2.1 million; beneficiaries: US\$ 600,000)
<u>Agroforestry for Livelihoods of Smallholder Farmers in Northwest Vietnam (evaluation report)</u>			
2011-2016	World Agroforestry Centre (ICRAF) (www.worldagroforestry.org)	ACIAR (http://aciarc.gov.au)	Implemented in Son La, Dien Bien and Yen Bai provinces, North-West Vietnam to improve performance of smallholder farming systems through agroforestry and to increase productivity of associated crop and livestock systems, leading to more diverse and sustainable production systems and better income from tree products. Budget: US\$ 1,643,424
<u>Support Upland Farmers in Sustainable Agro-Forestry on the Shifting Cultivation</u>			
2008-2012	MARD (www.mard.gov.vn/en) Related decision No. 2945-QD-BNN-KL dated 5/10/2007 (www.kiemlam.org.vn/Desktop.aspx/Tainquyen/Quyetsinh/9E3F5D01D8AC4236B33F941F96920816)	Government of Vietnam (www.chinhphu.vn/portal/page/portal/English)	Implemented across total area of 1.2 million ha of shifting cultivation: 500-600,000 households, 1.5 million people in 1200 communes, 34 mountainous provinces to support sustainable agroforestry/forestry cultivation on areas of shifting cultivation nationwide; supporting settlement, to change cultivation from extensive to intensive, increase land-use efficiency, diversify crops and incomes and alleviate poverty. Budget: VND 3,046.9 billion (US\$ 145 million) and 310,500 tons of rice

CROP-DIVERSIFICATION PROJECTS			
<u>Agro-ecology in the Mountainous Regions of Northern Vietnam (ADAM Project) (overview)</u>			
2008-2013 (Check)	Agricultural Research for Development (CIRAD) (www.cirad.fr) Northern Mountainous Agricultural and Forestry Science Institute (NOMAFSI) (www.nomafsi.com.vn)	AFD (www.afd.fr) CIRAD (www.cirad.fr)	Implemented in Son La, Phu Tho, Yen Bai provinces to use agroecological techniques to prevent decline of soil fertility and reduce poverty through diversification of crop and income sources and getting more value from local tea production. Budget: €1.4 million in grant aid (AFD: €1 million; remainder funded by CIRAD)
Agroforestry and Sustainable Vegetable Production in Southeast Asia Watersheds (LTRA-5)			
2005-2009	North Carolina A&T State University (www.ncat.edu) ICRAF (www.worldagroforestry.org) Vietnamese partner: Nong Lam University in HCMC (en.hcmuaf.edu.vn)	North Carolina A&T State University (www.ncat.edu)	Agroecological model integrating vegetable crops with trees or trees with vegetable crops in watersheds areas, to develop economically feasible and ecologically sound vegetable-agroforestry systems and quantifying potential benefits. Budget: US\$ 1,200,000
Sustainable Cocoa Enterprise Solutions for Smallholders (SUCCESS) Alliance Program in Vietnam			
2004-2010 (Two phases)	ACDI/VOCA Vietnam (www.acdivoca.org/site/ID/vietnam) USDAfoodforprogress)	United States Agency for International Development (USAID) (www.usaid.gov) United States Department of Agriculture (USDA) (www.usda.gov) World Cocoa Foundation (WCF) (http://worldcocoafoundation.org) Mars Inc. (www.mars.com/global/index.aspx) ACDI/VOCA (www.acdivoca.org)	Phase I: Ben Tre, Tien Giang, Ba Ria Vung Tau and Binh Phuoc provinces Phase II: Dak Nong and Lam Dong provinces Objective: to increase incomes of smallholder farmers through introduction of sustainable, diversified cocoa-based agroforestry systems by providing seedlings and technology for planting, harvesting and processing cocoa; intercropping cocoa in agroforestry models. Budget: US\$ 5.5 million
<u>Pro-Poor Partnerships for Agroforestry Development Project</u>			
2009-2015	Bac Kan Province: Department of Planning and Investment, Department of Agriculture and Rural Development, Department of Science and Technology, Department of Natural Resources and Environment, Department of Education and Training,	IFAD (www.ifad.org) Global Environment Facility (GEF) (www.thegef.org/gef)	Implemented in 3 districts of Bac Kan Province to establish framework for sustainable and profitable agroforestry development, targeting poor rural households, mainly Nung, Dao, Mong and Tay ethnic minority groups. Budget: US\$ 25.33 million (IFAD loan: SDR 14.11 million [approximately US\$ 21 million]; GEF grant: US\$ 0.65 million)

	Department of Labour, Invalids and Social Affairs, and district sections		
AGRICULTURAL DIVERSIFICATION PROJECTS IN RESPONSE TO CLIMATE CHANGE AND DISASTER MANAGEMENT			
<u>Climate Change Affecting Land Use in the Mekong Delta: Adaptation of Rice-Based Cropping Systems</u> (CLUES) (SMCN/2009/021)			
2012-2015	International Rice Research Institute (IRRI) (http://irri.org) Can Tho University (www.ctu.edu.vn/en) and other Vietnamese institutions	ACIAR (http://aciarc.gov.au) Vietnamese partner: Can Tho University (Project Office) (www.ctu.edu.vn/en)	Implemented in 4 provinces in Mekong Delta Region (An Giang, Can Tho, Bac Lieu and Hau Giang) to increase adaptive capacity of rice-production systems and to provide farmers and management agencies with technologies and knowledge to improve food security in the Mekong Delta. Budget: AUD 3,889,406
Building Resilience to Disasters and Climate Change Risks for Men and Women (article)			
2012-2016	Oxfam (www.oxfam.org)	Government of New Zealand (www.govt.nz)	Implemented in 15 communes in Ben Tre Province to build resilience to disasters and climate change risks by improving capacity of local people in disaster management and adaptation to climate change by demonstrating model on diversifying crops such as melons, peanut, cassava, etc. Budget: US\$ 800,000

Annex table 3.2: Design and implementation of agriculture and crop-diversification projects in Vietnam, 1998 to present

Project design				Actual implementation outcomes		
Kind of measure	Technical aspects	Implementation	Monitoring & evaluation	Benefits	Beneficiaries	Unforeseen outcomes
AGRICULTURE DIVERSIFICATION PROJECTS (INCLUDING INCOME DIVERSIFICATION)						
Vietnam's Agricultural Diversification Project (P004844)						
Establish new rubber sector in country's poor central region by developing new small rubber-farm holdings (total of 60,000 ha) and rehabilitating and maintaining existing ones. Objectives: to help small farmers plant and maintain rubber trees. Will provide research and extension services. Research programme will identify best practices for rubber production and other crops best suited for project area's ecological and socioeconomic conditions.	Technical assistance for studies, smallholder rubber and livestock. Technical support and training for planting and cultivation	Subcomponents: <ul style="list-style-type: none"> Establish new rubber smallholdings: 60,000 ha, each household to have 1ha - 3ha under project credit support. Rehabilitate existing rubber smallholdings: 17,600 ha Rubber extension 	Establishing new and rehabilitating existing rubber smallholdings by 2004. Increasing number of cattle and pigs per farm household by 20% in target area by 2004.	30,395 ha of new private rubber smallholdings; 10,645 ha of existing rubber smallholdings rehabilitated Increased farm income for 100,000 families, increase in non-farm service jobs and increase in stability of regional income through widening sources of agricultural income. Increased participation of	Smallholders and subsistence shifting cultivators, including ethnic minorities in one of Vietnam's poorest regions. National institutional and administrative capacity improved	VBARD managing nine lines of credit under bank-financed projects with different lending terms and conditions. Not healthy for a commercial bank like VBARD because it results in inconsistencies in lending policy and operations. Project did not anticipate Vietnam's entry to World Trade Organization, which includes market development. Project has reclaimed

				<p>ethnic minorities in commercial agriculture.</p> <p>Increased land tenure security, environmental protection through covering bare hills with trees and reduction of slash-and-burn agriculture.</p> <p>Institution building: promotion of decentralization in public administration, promotion of participatory development, strengthening of extension and research capacity.</p>	<p>thousands of hectares of unused and barren land in the hills in central regions and turned them into high-value rubber plantations which CONFLICTS with project's component of natural resource management and biodiversity conservation.</p> <p>M&E system failing to achieve the quality anticipated in design. Monitoring at local level is weak, incorrect disbursement up to US\$ 200,000 in Gia Lai Province.</p> <p>Project covered large number of provinces, very difficult to manage.</p> <p>Slow decentralization from MARD leading to slow implementation.</p>	
Rural Income Diversification Project in Tuyen Quang Province (RIDP)						
<p>To meet objective of diversifying income sources of poor families:</p> <ul style="list-style-type: none"> invested in increasing crop and livestock production, building village roads to markets, forming savings and credit groups and providing vocational training for rural youth enhanced linkage between small farms and markets, with support to crop and livestock production, building access roads to markets <p>Also endeavored to promote micro-enterprises with a view to moving local production up the value chain.</p>	<p>Upland farming systems extension and research: introduced new varieties of crops and vegetables and livestock breeds suitable to local markets</p> <p>boosted on-farm production through traditional package of agricultural and livestock support, including small-scale irrigation and roads, farmers' field schools (FFSs), field demonstrations, livestock breeding, veterinary services</p> <p>increased output of</p>	<p>Key strategy:</p> <ul style="list-style-type: none"> five district project coordination units 66 communes set up commune development board 823 villages set up village development board to implement commune activities <p>Decentralization: supported activities of Women's Livelihood Fund and Village Infrastructure Development Fund.</p> <p>Participation: participatory rural</p>	<p>Project completed almost all activities, including on-farm production and infrastructures, was found to be up to local standards.</p> <p>Income diversification was achieved through combination of on- and off-farm economic activities designed for individual households, including upland farming, livestock, microfinance and micro-enterprise, village infrastructure, market access, etc.</p>	<p>Support to agricultural and livestock production greatly contributed to increasing food security. Project held field demonstrations (366 vs. 302 planned) and training sessions at farmers' field schools (2,689 training sessions vs. 2,735 planned) to introduce new varieties and farming techniques. Demonstrations attracted around 10,000 farmers (91%</p>	<p>Has improved socioeconomic status of poor households (about 215,600 people) living in upland areas in Tuyen Quang Province.</p> <p>Combination of new varieties, breeds and techniques increased productivity of rice, maize, poultry, pigs, cattle, etc.</p> <p>Average paddy</p>	<p>Fell short in connecting farmers to markets, particularly in building physical markets in communes, providing marketing information support and involving private sector in creating market opportunities (developing partnerships with private sector was not part of project design).</p> <p>No holistic approach to development of ethnic minorities in upland areas, particularly in regard to adapting programmes to socio-cultural specifics of ethnic minority groups.</p> <p>SIDA committed</p>

	hybrid paddy, maize, poultry, pigs and cattle significantly enhanced food security	appraisal. Group formation: supported only one savings and credit groups per village (each with around 20 members). Gender mainstream: women and ethnic people improve access to productive assets.		were women). Hybrid paddy, maize and soybean cultivation adopted extensively. 40,000 households reported increases of 14%-20% in crop productivity, partly thanks to demonstrations and farmers' field schools.	yield rose from 53 to 58 quintals/ha, average maize yield from 31 to 35.9 quintals/ha. Increased productivity shown by demonstration models encouraged more small-scale farmers to adopt new varieties and activities.	US\$ 5.3 million, but actual disbursement is 1.8 million.
Vietnam - Second Agricultural Diversification Project (P084957) (Project 2)						
(1) Crop production systems improvement (crop production and post-harvest activities, provide technical services and credit); (2) Livestock production (3) Market development services (4) Land allocation (5) Institutional strengthening	Crop production systems improvement: support to crop production and post-harvest activities, including continued support for smallholder rubber development, through the provision of technical services and credit.		(1) farmers adopt new crops and new and environmentally sound production and postharvest techniques (2) farmers adopt new livestock production and animal health techniques (3) farmers increase productive on-farm investments (4) farmers have increased access to information on agricultural markets, including prices (5) food safety and quality standards are promoted for agricultural produce.	No information available	No information available	No information available
Sustainable and Profitable Crop and Livestock Systems for South-Central Coastal Vietnam (SMCN/2007/109)						
<ul style="list-style-type: none"> Value-chain analysis for sustainable and profitable farming systems on the south-central coast Sustainable cropping systems for sandy soils of south-central Vietnam Better integration of beef cattle production with cropping systems 	Developed model of nutrient flow in local farming systems Trial list of forage species developed for integration into local cropping systems	Multidisciplinary research, on-farm trials, multi-stakeholder approach Detailed soil constraints and management package (SCAMP)	Research model: crop legume species for cashew/legume intercropping. Results suggested that early September was optimum window to intercrop	Farmers chosen to be involved in 'best-bet' research process (new forages, improved forage management and use, tree legume fences,	Farmers, extension staff, researchers Trend in cropping patterns to more diversification: popular food	

<ul style="list-style-type: none"> Improving utilization of water and soil resources for tree crop production in coastal areas <p>Small farms with little possibility for expansion. Unused land is sandy soil in lowlands and coastal strip. Crop productivity still low due to infertile land and shortage of water. Few options exist to improve incomes for most households other than increasing production from limited agricultural plots. In order to reach this goal, improvement of soil fertility based on locally available organic resources as well as application of appropriate farming systems in sandy zones are very important.</p>	<p>Cashew and/or mango intercropped with legumes such as peanut and soybean or non-legumes such as cassava on Aeolian and granitic sands</p> <p>Vegetable production systems (onion, garlic, tomato) on coastal sands</p> <p>Beef cattle integrated with forage and field crops</p>	<p>assessment at 37 sites on major soils in study areas to investigate soil constraints</p>	<p>legumes with cashew; peanut yield consistently higher across the 4 sowing dates than cowpea and mung bean (although cowpea showed some potential for this region)</p>	<p>forage preservation, controlled mating, preferential feeding, fattening techniques, and manure use)</p>	<p>crops include rice, peanut and cassava.</p> <p>Animals raised by most households: pig, buffalo, cattle and sheep.</p> <p>Average cattle numbers from 3.5 (in Cat Trinh and An Chan) to 14 (in Phuoc Dinh).</p>	
Ha Giang Development Project for Ethnic Minorities						
<p>Rural Infrastructure</p> <p>Agriculture, livestock and forestry development</p> <p>Income Diversification</p> <p>Social Development</p> <p>Building local capacity in small-business skills, developing channels for continuous identification of feasible businesses and establishing linkages with markets.</p> <p>Special emphasis on participation of rural women in income-diversification activities for which credit was made available. Savings and credit activity key element of income-diversification component to create more opportunities for target groups and support investment in their potential businesses to diversify their income and improve living standards.</p>	<p>Income diversification, supply of farming inputs (particularly improved seeds), forestry and herbal plants and technology-transfer models</p>	<p>Income diversification objective: to increase and diversify household income by identifying and funding a range of micro-enterprise options.</p> <p>Project designed to be completed in six years, with phasing of expenditures of 64% in the first three years.</p>	<p>Key indicators: roads and bridges, 20; water supply, 24; irrigation, 92; farmer extension, 132; animal health, 191; income diversification, 60; education, 70; health, 67; commune development fund, 78.</p> <p>Project has had significant, multi-component presence in at least 100 of 191 communes and substantive impact on estimated 50,000 households, comprising 285,000 people.</p>	<p>For small farm with 0.5ha single-season paddy, adoption of project technology would lift annual yield from 2.5t/ha to 3.8t/ha: from bare basic food subsistence to a surplus of 0.6t/year, worth some VND 1.2 million (US\$ 76) at current prices and possibly adding between 25% and 50% to family cash income.</p> <p>Where irrigation improvement allows second crop of paddy to replace rain-fed spring crop of maize on 0.5ha, effect would be output of 1.25t of paddy worth (VND 2.5</p>	<p>941 households have increment in income from 2000 to 2003: 40,000 farmers in 162 communes adopt improved farming practices and animal husbandry.</p> <p>Specific interventions: FFSs, clubs, village extension, network, inputs, seeds, livestock, irrigation water.</p>	<p>Negligible impact compared with project's overall impact</p> <p>Limited impact of income diversification, with a non-viable credit scheme</p> <p>Chequered experience with introduction of labour-saving technology</p> <p>Lack of linkages and failure to achieve meaningful diversification of earnings or substance in group formation</p> <p>Effectiveness rated as negligible</p>

				million) to replace maize output of 0.7t (worth VND 1.6 million): benefit of VND 900 000 gross and probably VND 600,000 net of additional direct costs in just one season.		
Agroforestry for Livelihoods of Smallholder Farmers in Northwest Vietnam						
<p>Develop best-practice agroforestry systems for three agroecological zones</p> <p>Improve availability of high-quality germplasm to enable expansion of agroforestry systems</p> <p>Enhance market access for agroforestry products and opportunities for adding value</p> <p>Improve extension methods and policy dialogues for successful dissemination of agroforestry systems</p>		<p>Establish best agroforestry practices:</p> <ul style="list-style-type: none"> • Design agroforestry systems to be tested with farmer co-operators, extension workers and national researchers using existing systems and practices as basis to introduce improvements • Establish agroforestry trials designed by stakeholders in different project sites; develop participatory monitoring and evaluation system • Manage and monitor agroforestry system trials • Establish farmer-demonstration trials (FDTs) of agroforestry systems by providing seedlings 	<p>Best-practice agroforestry systems and technologies that enhance smallholders' production systems for diversified and sustainable incomes in 3 agroecological zones:</p> <ul style="list-style-type: none"> • 7 community nurseries producing high-quality planting material for agroforestry systems • Value chains for promising agroforestry products analysed, market links established and improved, market training conducted, agroforestry producer groups established and several value-added activities piloted • Farmers' technical capacity enhanced, extension materials and methods developed in Vietnamese and local languages (Thai, Hmong) and recommendations formulated for improved 	<p>Project is at phase to evaluate economic benefits of agroecological and potential agroforestry systems (see link for details: www.worldagroforestry.org/downloads/publications/PDFs/WP13033.PDF)</p> <p>Project to identify types of agroforestry (i.e. home gardens with fruit trees, coffee with timber or fruit trees as shade (in Son La), cassava intercropped with Shan tea (in Yen Bai), cardamom under forest canopy (in Dien Bien).</p> <p>Potential agroforestry models (combination of staple crops for short-term income, grass strips for feed and protection from soil erosion, and trees for medium- to longer-term income.</p>		<p>Challenges: limited land resources, limited selection of species with high economic potential (market demand), lack of investment capital, pests and diseases, water availability, grazing and insufficient labour resources.</p> <p>Farmer co-operators had limited knowledge about agroforestry. Prior to project, none had participated in an agroforestry project.</p>

		<p>of trees and fodder grasses for testing with existing crops/species on farms</p> <ul style="list-style-type: none"> Evaluate trials to identify best-practice systems and technologies for delivering livelihoods and environmental improvements with respect to agro-ecological zones, socioeconomic contexts 	<p>implementation of policies related to expanding agroforestry options</p> <ul style="list-style-type: none"> Lessons learnt from project to be spread widely, also in other countries with similar conditions, through publications and sharing results at international workshops and conferences 	<p>Findings will help identify agroforestry systems with potential for wider adoption and will lay groundwork for design or redesign of effective agroforestry research in the region.</p>		
Support Upland Farmers in Sustainable Agro-Forestry on the Shifting Cultivation						
<p>Allocate land for agroforestry cultivation, develop rural infrastructure, support construction of irrigation systems, intensify and increase rotation</p> <p>Support cultivation technologies, agroforestry models (including selection of appropriate crops), animal husbandry for each economic and ecological region, and for marketing and processing.</p> <p>Establish service centres to support farmers in agriculture/forestry inputs, support in tax and finance to attract private sector to get involved in agroforestry production and processing in project areas.</p> <p>Support preferred credit for farmers.</p> <p>Support policy and monitoring for efficient use of area of shifting cultivation (SC).</p>	<p>Support cultivation technology— agroforestry, sloping agricultural land technology (SALT)— with demonstration models, selecting appropriate crops and medical herbs and other high-value trees/crops for farmers.</p> <p>Train on cultivation technologies on sloping SC land for farmers in project area.</p>	<p>Convert SC to stable plots with agroforestry and SALT techniques:</p> <ul style="list-style-type: none"> 2008: 4,600ha 2009: 6,900ha 2010: 11,500ha 2011: 11,500ha 2012: 11,500ha <p>Support irrigation, change crop patterns, intensify and diversify:</p> <ul style="list-style-type: none"> 2008: 74,000ha 2009: 111,000ha 2010: 185,000ha 2011: 185,000ha 2012: 185,000ha 	<p>Convert 360,000ha of SC area to afforestation with high-value species on rocky mountain area (200,000ha) of SC area in watershed, convert to natural regeneration (40,000ha), combination of afforestation and agroforestry, including annual crops.</p> <p>Intensify, diversify and develop forests on area of 840,000ha, using advanced cultivation techniques (SALT), intercropping, cash crops, industrial crops, fruit trees, pasture.</p> <p>Overall target is 70% agricultural crop, 10% industrial crop, 10% fruit trees and pasture land, 10% traditional and spiritual products</p>	<p>No report available yet.</p>	<p>No report available yet.</p>	<p>No report available yet.</p>

CROP DIVERSIFICATION PROJECTS						
Agro-Ecology in the Mountainous Regions of Northern Vietnam (ADAM project)						
<p>Control soil erosion and restore soil fertility by promoting direct seeding mulch-based system (DMC)</p> <p>Develop specific agroecological approaches for tea: restoring soil fertility prior to planting, reducing use of chemicals, improving use of manure and compost by growing cover plants under tea shrubs.</p> <p>Support training and study tours</p>	<p>Agroecological approaches: restoring soil fertility prior to planting, reducing use of chemicals, improving use of manure and compost by growing cover plants under tea shrubs</p> <p>DMC</p>	<p>NORMAFSI staff, Farmers in Phu Ho station and Van Chan District</p>	<p>Diversification: tree species relevant to diversify agricultural production at tea-field scale and generate regular or long-term additional income</p> <p>Targets: asses potential of various tree species inter-planted with tea:</p> <ul style="list-style-type: none"> for long-term economic diversification (high-value wood inter-planted with tea to be cut after 30 years) for generating additional mid-term/steady income from diversification of tea field production (fruit trees or rubber intercropped with tea) 	<p>Building (NORMAFSI), equipment, training, MSc training</p> <ul style="list-style-type: none"> collected 130 species/varieties of leguminous and mulching cover crops as well as annual crops (legumes or cereals) collected developed alternatives to farmers' cropping systems intercropped with tea designed optimum technical and economic statistical model <p>Two hectares of tea plantation also grown using soil restoration principles. Seeding implements appropriate for DMC method imported and tested.</p>	<p>Training for researchers; extension and technical support to farmers; model demonstration.</p> <p>Too soon to evaluate and scale up agroforestry model.</p> <p>28 models set up with different cultivation techniques: intercropping, using leguminous species for soil reclamation, balanced fertilizing. 5 systems successful and can be scaled up and out.</p>	<p>ACIAR project on farming systems on sloping land also conducted in Moc Chau District, but no cooperation between the two</p> <p>Many collected varieties not sown at end of optimum period, stored in ambient conditions that might affect germination</p>
Agroforestry and Sustainable Vegetable Production in Southeast Asia Watersheds (LTRA-5)						
<p>Technology: Developing economically feasible, ecologically sound vegetable-agroforestry (VAF) systems</p> <p>Markets: Conducting research on market value chain at local, regional, and national levels that builds on existing strategies</p> <p>Policy: Identifying options and frameworks</p>	<p>Developing economically feasible, ecologically sound VAF systems</p>	<p>Integration of vegetable crops with trees or trees with vegetable crops (VAF), under or beside them, simultaneously or in sequence. In Vietnam, Indonesia, Philippines,</p>		<p>Drip irrigation increased average yield of vegetables by 8%-11% and reduced labor input by 33%. Trial on tomato demonstrated advantage of drip</p>	<p>Intercropping technique has strong potential to improve quality of life for small-scale farmers.</p>	<p>Implementation of national policies was compulsory but often lacked technical guidelines.</p> <p>Local officials lacked flexibility and creativity to take advantage of national</p>

<p>that promote sustainable VAF and reward environmental services.</p> <p>Environment: Evaluating short- and long-term environmental and socioeconomic effects for farm families who adopt integrated VAF systems</p> <p>Gender: Ensuring women's involvement in decision making and sustainable production and practices</p> <p>Scaling up: Building host-country capacity to manage and disseminate integrated VAF</p>		<p>this involves high-value medicinal plants and vegetables (including bell pepper, bok choy, cabbage, cauliflower, melon and tomato) with cash-crop trees such as cashew. Project is researching techniques to enhance VAF, such as low-cost drip irrigation, reduced tillage, pest management, reintroduction of indigenous vegetables, soil enrichment; and offering local workshops to introduce improved cultivation and production practices.</p>		<p>irrigation as shown in improved yield of 19%. Based on farmers' experiences, adoption and impact of affordable drip-irrigation technology in Vietnam is mainly determined by climate, particularly rainfall pattern and growing season, in addition to other related technical and socioeconomic factors.</p>		<p>government policies and programmes, to overcome constraints faced by small farmers.</p> <p>National policy incentives targeted more to growth of state-owned enterprises and private commercial producers (e.g. contract farming), limiting opportunities for communes—hence, activities limited in home gardens for home consumption and local market.</p>
Sustainable Cocoa Enterprise Solutions for Smallholders (SUCCESS) Alliance program in Vietnam						
<p>Support farmers in growing cocoa in cocoa-based agroforestry systems</p> <p>Support smallholders, traders and enterprises in selling cocoa products to global market</p> <p>Increase local capacity in ensuring quality control in postharvest activities, particularly fermentation</p> <p>Strengthen market linkages in cocoa supply chain and improve fermentation quality</p>	<p>Support local smallholders in designing, planting, tending, harvesting of cocoa products in cocoa-based agroforestry models</p> <p>Provide training in cocoa cultivation to farmers to adopt cocoa production as part of their farming system</p>	<p>2004: Support seedlings and cocoa plantations in Ben Tre, Tien Giang, Ba Ria Vung Tau and Binh Phuoc; strengthen market linkages in cocoa supply chain; improve fermentation quality in the four initial provinces</p> <p>2008: Expand project in Dak Nong, Lam Dong and Dak Lak</p> <p>2010: Develop and support cocoa quality-</p>	<p>Number of seedlings provided to farmers</p> <p>Number of households involved in cocoa production</p> <p>Number of enterprises involved in fermentation operation</p> <p>Human resource capacity of government and nongovernmental agencies to effectively manage cocoa production; postharvest processing and marketing enhanced</p>	<p>5,147 smallholder farmers in central highlands received cocoa seedlings and training in cocoa cultivation and have adopted cocoa production; 60% ethnic minorities; cocoa area expanded to 1,400 hectares</p> <p>90,000 seedlings distributed to farmers</p> <p>ACDI/VOCA to train up to 120 private-sector fermentation</p>	<p>Local farmers, traders, enterprises in project area</p> <p>Extension staff, researchers of related universities and institutes</p>	<p>Market solutions not convincing enough to maintain and expand cocoa production area in several provinces, particularly Ben Tre, where many farmers have already replaced cocoa by other crops.¹ They expect a processing factory to be established in Ben Tre Province.</p> <p>Contacting system is weak. Extension needs adequate trainings since farmers have zero knowledge about this new crop.</p>

¹ Personal communication with DARD, Ben Tre.

		assurance systems; promote market linkages between farmers and cocoa industry; maximize yield in central highlands and promote sustainable practices		operations on improved fermentation techniques; model established for managing quality standards for fully fermented beans via the Centers for Applied Technology (CAT) in Ben Tre and Tien Giang 30 ethnic minority households supported on 40ha plot of land, developing cocoa in forest ecosystem 90 training facilitators and 130 cocoa clubs set up		
Pro-Poor Partnerships for Agroforestry Development Project						
<p>Self-targeting approach for poor communities in upland areas, whose livelihoods depend on cultivating hillside slopes and collecting non-timber forest products on small areas of forest land allocated to them.</p> <p>Objectives:</p> <ul style="list-style-type: none"> • Greater equity allocating forest land • More sustainable hillside farming systems • Diversified income-generating opportunities • Pilot payments for environment services. • Sustainable, equitable forest land management • Income opportunities for rural poor • Sustainable environmental opportunities 	<p>Agroforestry livelihoods and payments for environmental services. Adoption rate of agroforestry models and forage development is very high in target districts.</p> <p>Adoption of cultivating system on hillside slopes.</p>	<p>The project will establish supporting project management unit under DPI, responsible for financial and procurement management, information management, and monitoring and evaluation. Management of project components and subcomponents to be devolved to responsible line agencies or district, commune or community committees, using contracted national and</p>	<p>Rural poor households in uplands access markets through increased private-sector partnerships</p> <p>Poor, vulnerable households have profitable business opportunities:</p> <ul style="list-style-type: none"> • % increase proportion and value of marketed production in targeted communes • beneficiary satisfaction with agroforestry technical services and investment support • level of application of sustainable forest and land management practices 	<p>Adoption rate of agroforestry models and forage development very high in target districts</p> <p>Supported introduction of cultivation systems on sloping lands in 36 communes, benefitting more than 2,000 households, backed up by associated youth educational programs in 60 schools</p> <p>Promotion of pluralistic extension delivery systems</p>	<p>Farmers are members of Nung, Dao, Mong and Tay ethnic minorities</p>	<p>Development of appropriate sustainable technical models for poorer upland communes would be more challenging, with host of activities like road access and production and cultural preferences of ethnic minorities, poorer resource base, language barriers and limited skills.</p>

		international skills where necessary.	Upland poor communities secure access to, and derive sustained benefits from, productive natural assets Rural poor contribute to pro-poor agricultural, market-driven policy processes at subnational levels	facilitate access to knowledge and technology and attainment of skills necessary for achieving food security and market-led growth out of poverty 9,000 households benefitted from funding under Agro Forestry Development Fund; communes have issued more than 600 contracts for delivery of technical services		
AGRICULTURAL DIVERSIFICATION PROJECTS IN RESPONSE TO CLIMATE CHANGE AND DISASTER MANAGEMENT						
Climate Change Affecting Land Use in the Mekong Delta: Adaptation of Rice-Based Cropping Systems (CLUES) (SMCN/2009/021)						
<p>Objectives:</p> <ul style="list-style-type: none"> improve salinity and submergence resilience of locally adapted rice varieties and elite lines build capacity for quantification of soil nutrient cycling (including the emissions of greenhouse gases) from rice fields develop integrated soil, crop, nutrient and water management options identify biophysical, social and economic factors determining the capacity of farmers to adapt to climate change undertake in-depth analysis for land-use planning in coastal areas 	<p>Theme 2: Improving salinity and submergence resilience of locally adapted rice varieties and elite lines</p> <p>Theme 3: Managing resources for resilient rice-based systems coping with rapidly changing environments</p>	<p>Six bimonthly project meetings, 20 field visits, 1 local workshop, 2 trainings, 1 semi-annual and 1 annual workshop organized by project office in 2013</p> <p>Capacity building for project staff and local DARD partners accomplished through degree and non-degree training in Vietnam and abroad</p>	<p>Marker-assisted backcrossing expected to provide significant economic benefits to farmers expected.</p> <p>Use of short-maturing varieties, together with effective natural resource management and efficient cropping systems to enhance farmers' income and provide more opportunities for sustainable livelihoods.</p> <p>Sustained/enhanced rice production to contribute to foreign exchange via exports and benefit rural development.</p> <p>Increased capacity of</p>	<p>Established risk maps of saline intrusion and flooded area/developed land-use and soil map for Bac Lieu Province and for Mekong Delta.</p> <p>Assessed and analyzed climate change constraints; demonstrated alternate-wetting-and-drying in Bac Lieu Province with GIZ Bac Lieu for about 100 farmers.</p> <p>Using participatory approaches, selected 27 salt-tolerant lines including OM 5629 and OM 6677 and identified 12 genotypes with rapid recovery from stress such as MNR 1, MRN 4, MNR 3,</p>	<p>Farmers, extension staff, researchers.</p> <p>Training for total of 318 farmers in 4 provinces; also technicians.</p> <p>3 varieties selected and ready for farm use: OM3673 (short growth duration, tolerant to anaerobic seedling stage), OM10252 (submergence and salinity tolerant), and OM6328 (salinity tolerant and high yield).</p>	<p>Limited results on major strategies for active participation of farmers, local counterparts in provincial and district agriculture sectors and other potential collaborators for dissemination of adaptation and mitigation strategies for rice-based cropping systems.</p>

			<p>farmers and communities to mitigate negative impacts of climate change by using different economically feasible adaptation options.</p> <p>Capacity of policymakers to understand agricultural systems in context of climate change enhanced.</p>	<p>OM 6677, and OM 70.</p> <p>Evaluated 14 high-yielding genotypes with submergence tolerance in selected farmers' fields at Bac Lieu, An Giang, Hau Giang provinces and Can Tho city.</p> <p>Managed trials of 12 salt-sub-tolerant high-yielding genotypes in selected farmers' fields at Bac Lieu Province.</p> <p>Evaluated 12 rice genotypes with some tolerance to stagnant flood in selected farmer's fields at Hau Giang Province.</p> <p>Screened 300 local varieties (40 traditional, 200 improved and 60 IRRI) of Vietnamese germplasm for good survival and recovery under anaerobic conditions.</p> <p>Established different CH₄ emission rates as influenced by production factors. Emission rate of CH₄ in conventional field plots consistently greater than alternate-wetting-and-drying plots. CH₄ emission rates increased with plant age and reached highest rate at flowering, decreased with reduced water depth at harvesting. CH₄ emission rates with N fertilizer greater than with straw compost application at 6 t/ha.</p>	<p>Introduced conceptual model for land use analysis through Multiple Goal Linear Programming (MGLP).</p>	
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				Introduced upland crop integration in paddy fields, nutrient management, greenhouse-gas measurements and seeds of stress-tolerant rice varieties.		
Building Resilience to Disasters and Climate Change Risks for Men and Women						
Diversify income in the context of increasing influence of climate change by introducing suitable crops (such as watermelon) to adapt to and mitigate risk of climate change	Demonstrated model on diversifying crops such as melon, peanut, cassava Trained farmers to improve farming methods by introducing mulching with polythene to increase soil moisture, especially in dry season for watermelon cultivation, resilient to climate change	In first year (2009), Oxfam worked with 10 families, 9 of which turned a profit, ranging from 1.5 million Dong (US\$ 5) to 6.9 million (US\$ 345). Project has since been expanded to 50 local families.		Farmers trained to improve farming methods by mulching with polythene to increase soil moisture, especially in dry season. 15 communes provided with early-warning disaster equipment and other equipment worth over 1.4 billion VND (US\$ 66,000); training started on community-based disaster management and disaster risk reduction. 37 watermelon farming households received essential equipment; 237 breeding goats distributed to other farming families.	Marginalized farmers in 15 communes of Ben Tre Province	Farmers testified to an increase in production since intervention, but were uncertain about how to prepare for failure of watermelon crop. Polythene may become future hazard if management not taken seriously, because all harvested gardens had old polythene stuck in soil.

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