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Agricultural Knowledge Transfer and Innovation Processes in Vietnam's Northwestern Uplands: State-governed or Demand-driven?

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Abstract

This paper assesses processes of adoption of agricultural innovations introduced to the northwestern uplands of Vietnam since the late 1950s as a result of external driving forces and the motivation of adopting farmers. We found that innovations which meet the immediate needs of food security and income generation in the uplands are adopted by a high number of farmers, but tend to be less environmentally sound. Innovations driven by political and ecological interests, i.e. of the type "*adoption for political and social rewards*" and "*adoption for a sustainable environment*," are accepted by only a small proportion of farmers. Agricultural innovations that can satisfy both the agenda of the government and meet the needs of farmers are quickly disseminated and have a long lifespan in the uplands. "*Adoption for local consumption*" and "*adoption for cash income*" have currently reached their peak after a period of rapid growth in the recent past. Examples of this include intensive rice cultivation for household food needs and hybrid maize cultivation for market demand. This study further identified three main mechanisms of innovation diffusion, namely the *trickle-down mechanism*, the *ripple mechanism* and the *network mechanism* with their underlying communication models of "transmission," "interpersonal communication" and "social network" respectively.

Keywords: Knowledge Transfer System, diffusion mechanism, agricultural innovation adoption, Vietnam's Northwestern Mountainous Region

I Introduction

The Agricultural Knowledge and Information System (AKIS) concept has become a popular framework for analyzing agricultural innovation diffusion processes [Röling 1990; Engel 1997; Leeuwis and van den Ban 2004]. The AKIS concept depicts knowledge as part of the "triangular institutional arrangement"

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involving three major factors of research, education, and extension, whereby farmers are placed at the center of the triangle. Even though these factors and their primary functions are essential elements, they are insufficient for establishing a system of complex innovation-oriented institutional arrangements [Berdegué and Escobar 2001]. Well-functioning AKIS is now viewed as an ongoing process of institutional development and technical change involving a continuous interaction among all the relevant stakeholders, and an effective provision of services based on demand [Lemma and Hoffmann 2007]. In this paper we apply the AKIS framework to analyze the practical situation in Vietnam's Northwestern Mountainous Region (NWMR), with a particular emphasis on Son La Province, where dynamic institutional changes from cooperative to market-oriented production have played a determining role in innovation processes.

The NWMR is characterized by rugged topography, with high mountains, steep slopes and small valleys, and by heterogeneous socio-economic conditions, including ethnic diversity and social, political and economic disparities. The region has long been notorious for many difficulties and constraints, such as a lack of access to productive factors in agriculture and to alternative forms of employment, limited formal education and knowledge of the Vietnamese language, poor sanitation, and limited access to markets [Leisz *et al.* 2005; Minot *et al.* 2006]. Recently, however, the NWMR has become one of the most dynamic regions in the country, with profound changes occurring in socio-economic conditions, nature and landscapes, and traditions and cultures.

Since the era of agricultural cooperatives (*hop tac xa*), which replaced the individual farm household as the major socio-economic unit in the agricultural sector, the transfer of knowledge and innovations has played a leading role in the transformation of the region's agriculture. Recurring waves of technical innovations and new management practices have modified both technical and institutional configurations. During the cooperative period, subsistence agriculture was intensified by transferring "green revolution techniques" and enforcing collective management institutions. Since the "*doi moi*" (renovation) reform policies, subsistence production has rapidly shifted to a more market-oriented agriculture due to the combination of a dynamic policy environment, the commercialization of agriculture with increased access to lowland markets, and changing socio-economic conditions. The inter-regional interaction in general and the transfer of agricultural knowledge and innovations from lowlands to uplands in particular has been enhanced, often accompanied by negative impacts on the availability of natural resources and the quality of the environment. Focusing on the analysis of the AKIS in the NWMR during the last 50 years, this paper challenges the conventional assumption that the adoption of agricultural innovations in the uplands has been driven mainly by benevolent government policies and has generated a win-win economic relationship between the NWMR and other regions. We suggest, instead, that knowledge and

innovation transfers have been initiated as a result of multiple socio-economic driving forces and that for innovation policies and extension efforts to be successful they need to strike a balance between the government's interest and farmers' needs and priorities.

II Methodology

Our study's analytical framework was developed on the basis of the three sub-systems of (1) research and knowledge generation, (2) knowledge dissemination, and (3) knowledge diffusion and adoption. The analytical framework also took into account interactions and interrelationships of these sub-systems within the existing context of policy, market institutions and regional conditions (Fig. 1). The paper then analyzes knowledge generation in the category of rural stakeholders' motivation for adoption, the nature of knowledge dissemination by public and private actors, and local diffusion and adoption processes.

Our findings are based mainly on primary data collected from group meetings and open interviews with four categories of informants (Table 1) as well as on secondary data derived from official government documents and a review of the existing literature. The secondary data focused on the broad region of the NWMR, while the primary data narrowed the focus to the provincial, district and local level, with a specific in-depth study extending from Son La Province to Yen Chau District and finally to Muong Lum Commune.

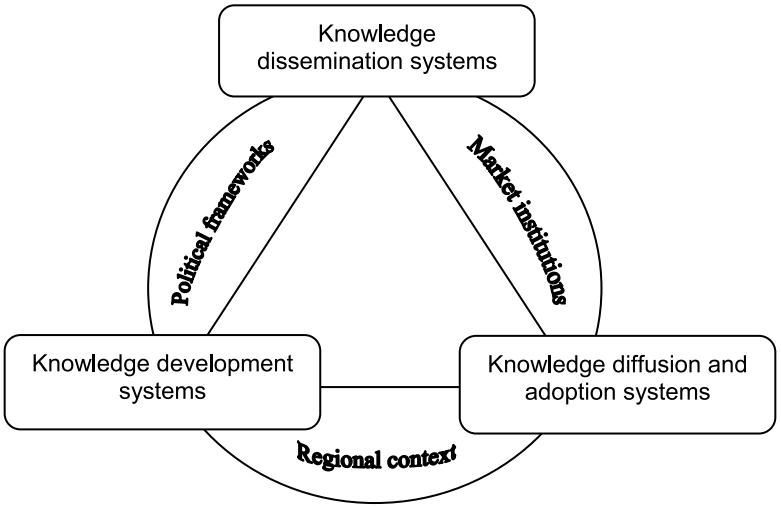

Fig. 1 The Study's Analytical Framework

Table 1 An Overview of Primary Data Collection from August 2007 to June 2009

Informants	Selection Criteria	Methods Used	No. of Events	Coding
Researchers from agricultural research institutes and universities	• Representing various agricultural research institutes and universities in Northern Vietnam • Directly involved in different agricultural research and transfer programs in the NWMR	Unstructured and semi-structured interviews; research conversations	20	IR1 to 20
Extensionists of the public and non-public extension system	• Representing the local extension system from the provincial to commune levels in Son La • Directly transferring technologies to upland farmers in Son La • Acting as field staff of various NGOs and development projects	Unstructured and semi-structured interviews	13	IE1 to 13
Individual farmers	• Representing the major ethnic groups of *Kinh* (ethnic Vietnamese), *Black Thai* and *H'mong* in Son La • Adopting different agricultural technical innovations introduced to their areas	Unstructured and semi-structured interviews; participant observation	36	IF1 to 36
Groups of farmers	• Representing specific key farmer groups: adopters of intensive rice techniques, hybrid maize growers, or upland field cultivators	Focus group work and discussion	12	GD1 to 12

The first category of informants includes researchers from different agricultural organizations actively involved in the research and knowledge generation process in the NWMR. These organizations include the Northern Mountainous Agriculture and Forestry Science Institute (NOMAFSI), the National Institute of Soil and Fertilizers (NISF), the Institute of Policy and Strategy for Agriculture and Rural Development (IPSARD), the General Institute for Economic Management, the Institute of Anthropology, the Department of Science Technology — Ministry of Agriculture and Rural Development (DST–MARD), the Vietnam Forestry University, and Hanoi University of Agriculture (HUA). Respondents from this category provided various viewpoints from the supply side on innovations introduced to the NWMR. Their reflections on knowledge generation and the underlying institutional setup provided a basis for further discussion on the knowledge transfer process and its varying impacts on the region.

The second category of informants comprises of staff from the public and non-public extension system at central, provincial and local levels who act as central nodes in the knowledge transfer process. The respondents provided the details of innovations introduced to the NWMR and insights into the pluralistic and multi-actor operations of the knowledge transfer system. In addition, they shared their perspectives on knowledge diffusion and adoption in local communities in the period of enhanced market economy. Their views of the local tradition, culture, and norms provided information for determining how local factors influenced extension impact. Additionally, their subjective assessments of farmers'

conceptions and capacity towards adoption of innovations were the major information sources for the discussion of effects of the knowledge transfer system on the regional agricultural development.

The third and fourth categories of informants are individual farmers and groups of farmers from the *Kinh, Black Thai* and *H'mong* ethnicities in Son La Province. Respondents in these categories provided the users' perception of attributes of introduced innovations and their perspectives on innovation diffusion and adoption. In interviews and focus group discussions they also addressed a number of reasons that caused the failures of many innovations. They helped determine important local factors that formed the diffusion networks and enhanced diffusion mechanisms in different local communities.

III Results

III-1. *Benevolent Government Policies: Initiation of a Wave of Innovations in the NWMR's Agricultural Sector*

Vietnam's political system has altered dynamically during the second half of the twentieth century due to the enforcement of a series of government policies associated with the State's reconstruction and transformation into a socialist country [Castella *et al.* 2006]. This transformation can be better understood by identifying three main phases, namely 1) the cooperative period (1958–1985), 2) the transition period (1986–1995) and 3) the market-economy period (since 1995). During the cooperative period, the NWMR was considered to be a backward area with abundant natural resources and great potential for future economic development. Following up on earlier attempts by French colonial power, a development strategy has been pursued of integrating the NWMR into the lowland economy and supporting ethnic minority groups in catching up with the *Kinh* majority since the first five-year plan from 1961 to 1965 [Hardy 2003]. The government introduced a series of policy measures aimed at increasing agricultural productivity by promoting advanced technologies, enhancing forest exploitation, and ensuring food security [Bui Dung The *et al.* 2004; Friederichsen and Neef 2010]. The agricultural innovation wave in the NWMR's agriculture began at the early stage of the cooperative era, starting with the introduction of "*advanced technologies for food security*," which emphasized the intensification of food crop cultivation (Fig. 2). During this period, capital-intensive and productivity-enhancing techniques such as improved varieties, pesticide application, large-scale mechanization of land preparation and harvesting, a second cropping season, and irrigation systems were introduced to the region for the first time. This agricultural innovation wave was followed by the introduction of "*advanced technologies for commodity production*." Both "*advanced technologies for food security*" and "*advanced technologies for commodity production*" were practiced mainly in agricultural cooperatives and state farms [Sikor and Dao Minh Truong 2002; Castella *et al.* 2006].

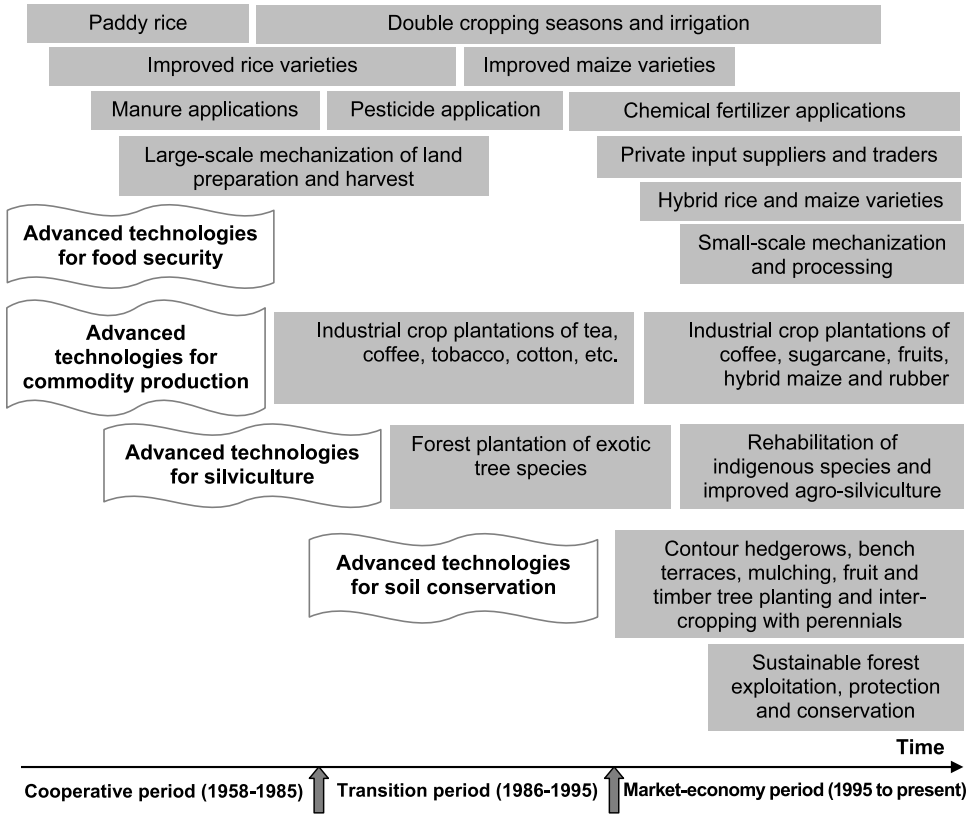

Fig. 2　Periods of the Introduction of Different Types of Agricultural Technical Innovations to the NWMR

Source: Own draft based on [Pham Manh Cuong *et al*. 2003; Tran Duc Vien 2003; Morris *et al*. 2004; Castella *et al*. 2006; Pandey *et al*. 2006; Sekhar 2006; Folving and Christensen 2007; IF1–16 2007 and GD5–12 2008].

The *doi moi* policy was launched in 1986 with the implementation of a series of agricultural reform laws. The agricultural reform officially reinstated the farm household as the major agricultural production unit, thus legally underpinning and reinforcing the decollectivization process that had started already in the early 1980s [Kerkvliet 2005]. The adoption of Decree 100[1)], followed by Resolution No. 10[2)], and later the allocation of land and forest area under the Land Law of 1993 gradually allowed farmers to

1) Decree 100, issued in January 1981, was the first policy action marking the departure from the cooperative to the individual or household production system. Land was contracted to households for rice and other cash crop productions based on the age of household members, which could present their capacity to provide labor.

2) Resolution No. 10 was the policy amended in April 1988 by the Politburo of the Communist Party of Vietnam. The amendments adjusted the land allocated to households to be proportional to the number of members in the household and reduced the cooperatives monopoly to 20% of the cooperative's previous land areas. Under Resolution No. 10, households obtained the right to utilize their farmland for ten to fifteen years for annual crops and longer for tree crops.

manage agricultural land individually, while obtaining more or less long-term, certified land use rights [Neef 2001; Henin 2002; Morris *et al.* 2004]. The Fixed Cultivation and Sedentarization Policy (*dinh canh dinh cu*) reinforced from 1986 onwards attempted to speed up the transition from swidden agriculture to more permanent systems through the introduction of new farming practices, such as planting of fruit trees [Novellino 2000; Castella *et al.* 2006; Friederichsen 2009]. The program "stabilized" a number of the semi-migratory ethnic minority communities, such as the *H'mong* by "encouraging" upland cultivators to develop a stable farming system and to settle in permanent locations either in the same area or in more fertile and accessible areas at lower altitudes [Sikor 1998; Castella *et al.* 2006]. The agricultural innovation wave continued under these new Land and Sedentarization Policies with the introduction of various technologies, resulting in the expansion of intensive cultivation of food crops in the whole region [Sikor and O'Rourke 1996; Sikor and Dao Minh Truong 2002; Henin 2002; Rapin 2003; Pandey *et al.* 2006]. Finally, "*advanced technologies for silviculture*" were promoted in order to respond to the severity of upland deforestation caused by logging, slash-and-burn cultivation and over-exploitation, as well as to fulfill various local and national requirements and to fall into line with the "*doi moi*" policy [Morris *et al.* 2004]. Forest plantations with exotic tree species were established in the region alongside the continuous promotion of industrial crop plantations [Jamieson *et al.* 1998; Henin 2002; Castella *et al.* 2006].

The dynamics of innovation processes has gained further momentum since 1995 with the strong commitment of the government to alleviate rural poverty, to enhance rural development, and to steer the country towards a market economy. In the late 1990s, poverty in rural areas remained a big challenge for national socio-economic policy. The government tried to address the rural poverty by developing a range of national programs aimed at improving the standard of living in rural areas, e.g. "Subsidized Credit Program for the Poor," "Re-greening the Barren Lands and Denuded Hills," "Reforestation of Five Million Hectares," and "Multi-Sectoral National Programs for Hunger Eradication and Poverty Reduction" [Jamieson *et al.* 1998; Beckman 2001; Dao Van Hung 2004; Morris *et al.* 2004; Bui Dung The *et al.* 2004; Pandey *et al.* 2006; ADB 2006]. The government also has instigated the "Socio-economic Development of Six Especially Disadvantaged Provinces in the Northern Uplands program" as a program specifically targeting the NWMR. The most recent policy to be implemented, which targets poverty reduction, is a broad-based national strategy for poverty reduction and social equity — the "Comprehensive Growth and Poverty Reduction Strategy" (CPRGS).The CPRGS shows a commitment to poverty reduction over the long term as well as the elimination of inequality between rural and urban areas and lowlands and uplands [Nguyen and Steward 2005]. Government policies geared towards establishing a market-based rural economy have reduced many trade barriers between the uplands and

lowlands, among regions throughout the whole country, and between Vietnam and the global economy [Painter 2005]. This market liberalization has enabled a more vigorous flow of trade and exchange among regions, promoting a shift from subsistence agriculture to a more cash-oriented form of production in the northern uplands [Pham Manh Cuong *et al.* 2003; Pham Thi Mai Huong *et al*. 2009]. Within this political context, the agricultural innovation wave progressed, reflecting the interdependent effect between the government's policy framework and the market's driving forces. "*Advanced technologies for soil conservation*" have been promoted primarily by government intervention (Fig. 2). In the category of "*advanced technologies for silviculture*," there has been a focus on both exotic tree plantation and indigenous forest rehabilitation [Jamieson *et al*. 1998]. Recently, the rehabilitation of indigenous species, sustainable forest exploitation and conservation, and improved agro-silviculture have gradually replaced the previous emphasis on planting exotic tree species introduced during the late cooperative era [IR10 2007]. In the category of "*advanced technologies for food security*," the level of food crop intensification has been upgraded by introducing hybrid varieties and chemical fertilizers. The government's subsidy programs have provided farmers with better access to hybrid rice and maize seeds and to chemical fertilizers [IR9 2007]. In addition, private input suppliers and traders have gained increasing influence. Traders often provide hybrid rice and maize varieties and chemical fertilizers as a package in their services. Land preparation and harvesting techniques have become mechanized, and agri-processing has been introduced. Hand tractors, threshers, rice mills, and drying machines have gradually replaced traditional methods and tools, such as animal traction, hoes, ploughs, and rice mortars [IF4 2007]. Intensive rice and maize cultivation technologies were thus introduced to the NWMR as a means of both ensuring local food security and serving market demands.

III-2. *Ambiguity of the Innovations Introduced*

Since the introduction of the innovation series of advanced technologies for food security, the impacts of transferred knowledge on the region's socio-economic development and environmental conservation have remained a controversial issue. A large proportion of respondents in the researcher group strongly believe that "*modern technologies*" have made significant, positive contributions towards increasing productivity and reducing the perceived intellectual gap between ethnic minorities and the *Kinh* majority. Benefits in terms of productivity increase, especially in rice and maize cultivation, were considered to be the major indicator, if not the only one, for measuring the success of the innovation transfer process. This optimism concerning the pre-eminence of the innovations introduced is clearly evident in this statement made by a senior researcher at the NOMAFSI: "The introduction of intensification technologies in paddy rice cultivation has helped to increase productivity by an average of 7 per cent

annually during the last 20 years. Uplanders now have enough rice for their consumption and regional food security is largely guaranteed" [IR8 2007]. In fact, uplanders also acknowledged that a number of innovations have great potential to improve productivity [IF8–15 2007; IF19–35 2008]. Farmers have benefits in terms of coping with land scarcity and labor shortages [Novellino 2000]. These benefits extend to the potential in creating opportunities for the uplanders to access new markets and to analyze their own livelihood situations and interests with the help of external actors [Alther *et al.* 2002; IR8 2007].

The negative impacts of the innovations introduced, however, have also been exposed by several scholars as well as in the interviews with upland farmers. The "*modern technologies*" are often criticized for their low *relative advantage* compared to existing techniques. "*Advanced technologies for silviculture*" are telling examples; forest plantations with exotic tree species such as eucalyptus, acacia and teak have low timber yield and reduce the potential for harvesting non-timber forest products [GD1–2 2008]. These tree species are also notorious for degrading the soil and for not providing the same ecological functions as indigenous tree species [Clement *et al.* 2006]. Improved agroforestry or agro-silviculture systems, e.g. integrating forest trees, agricultural crops, livestock and aquaculture (Subsection III-1), could provide significantly higher productivity and income per unit of land, resulting in decreasing pressure on natural forests. However, adopting such systems would require adequate land area, suitable topographical conditions and certain input resources, whereas the farmers' conditions remain too diverse and limited with regard to resource endowment [Sekhar 2006].

Many of these innovations are characterized by a *high level of complexity*, as they are often linked with intensification, specialization and commercialization [Folving and Christensen 2007]. The introduction of "*advanced technologies for commodity production*" to the NWMR is intended to substitute low-value staple crops with high-value perennial crops. However, adoption of these techniques causes severe food shortages, makes access to output markets difficult and increases farmers' exposure to risks [Pham Manh Cuong *et al.* 2003; Yanagisawa 2004]. Taking the case of Yen Chau District as an example, many perennial crops were promoted in this area during the late transition period, including fruit, coffee, cotton, and mulberry. Among them, mulberry was a prototypical example for the high level of complexity involved in the innovations introduced, as mentioned in the group interviews with *Black Thai* farmers: "The district introduced mulberry plantations and silkworm raising to replace upland rice. For three years (from 1993 to 1995) we replaced 15 per cent of our upland rice with mulberry. The mulberry trees grew very well, but the silkworms died frequently. The quality of the silk cord was not good enough, and we did not know where to sell the silk" [GD1–3 2008; IF17 2008]. While extension workers had only emphasized the fast growth of the mulberry trees and its potential to control soil erosion,

farmers struggled with silkworm mortality, low silk quality and lack of market access. As a consequence of this failed innovation, mulberry was downgraded from "a key economic crop" to a non-valuable crop and was completely abandoned in the mid-1990s.

A number of these newly-introduced innovations are also characterized by *low compatibility* with existing local practices and techniques. One typical example is hedgerows from *Leucaena leucocephala* for soil conservation, which were introduced to the *H'mong* villages in *Muong Lum*. *H'mong* farmers often use standing stones or standing rows of stones to prevent soil erosion, which fits well with the upland field cultivation system because it does not harm the upland maize crop. Hedgerows of *Leucaena*, however, compete with maize in taking up nutrients and water. They grow very quickly and then occupy a relatively large area, often invading the maize area. *Leucaena*'s fast-developing root system negatively affects maize growth. In addition, it is not easy to establish and maintain *Leucaena* hedgerows, as it requires considerable labor and rather complicated techniques [GD4 2008].

Other innovations, especially in the categories of *advanced technologies for commodity production*, *silviculture*, and *soil conservation,* are considered to have *limited trialability and observability* in terms of marketing opportunities, economic benefits, and long-term impacts [GD2–7 2008; IF32–36 2008]. *Acacias* were planted in many barren hill areas in the late 1990s and farmers now seriously worry about their profitability: "Even now, we still don't know whether we will earn any money or not, as Acacia trees need at least 10 years before the timber can be harvested" [GD1–2 2008]. Marketing opportunities for products deriving from innovation adoption, such as plantations of perennial crops and fruits and winter crops, are also hard to foresee. For instance, potato — a crop introduced for cultivation in the paddy rice fields in the winter season — is hard to find a market for, as one *Black Thai* farmer mentioned in the interviews: "As potato was not a crop of ours before, we don't know how to cook it, where to sell it and what we can do with it" [GD7 2008]. *Colza* (*Brassica rapa*) — another winter crop — has experienced the same fate as the potato, as *H'mong* farmers stated: "The cadres recommended that we plant *colza* for selling seeds to the market. After earning relatively high profits in the first two years, we then put large investments into inputs and machines for processing. From the third year, no one came here to buy *colza* seeds and we could not do anything except stop growing it" [GD9–10 2008]. This uncertainty regarding profitability, market opportunities, and long-term impacts often leads to farmers becoming mistrustful of future innovations and therefore resisting adoption.

In sum, the innovations introduced often display considerable ambiguity. On the one hand they make a significant contribution towards increasing agricultural productivity. On the other hand, they have proven to be inappropriate in terms of technical, socio-economic, and agro-ecological factors as well as ecological adaptability, environmental conservation, and marketability. Recently, however,

several Vietnamese researchers have started to acknowledge the heterogeneity of the uplands and the need for diverse solutions rather than simple technological models. One senior scientist interviewed stated that "in the uplands, all the components in the production system are integrated and entities do exist alongside the surrounding communities" [IR10 2007]. The "forest cannot be separated from the forest communities, and reforestation also cannot be separated from other livelihood activities of the uplanders" [IR10 2007] and where "soil erosion in the upland fields benefits their rice paddy fields" [IR6 2007]. Thus, the communication of crop-specific recommendations without consideration of solutions that include the whole land use system in the region seems neither workable in the uplands nor suitable in the NWMR ecological context.

III-3. *Three-Phase Development of the Knowledge Transfer System and Its Approaches*

The agricultural knowledge transfer system has developed in three phases. This occurred in an almost synchronized way with the transformation of the national policy framework (Fig. 3). During *the coop-*

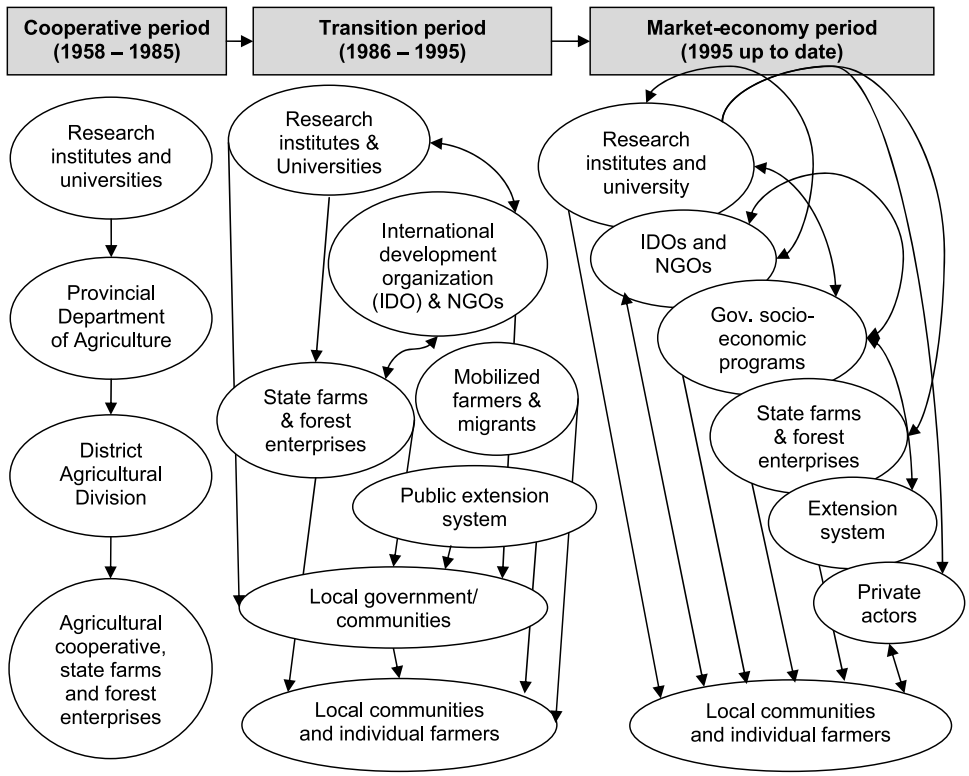

Fig. 3 Periodical Development of the Knowledge Transfer System

erative period, governmental research institutes and universities played the dual role of knowledge generators and knowledge transmitters. Knowledge flowed in one direction from the generators to the users, as illustrated by the arrows in the figure. Knowledge from research institutes and universities was transferred to the agricultural cooperatives and their production brigades through the agricultural management system, i.e. provincial and district agricultural institutions, state farms, and forest enterprises. Farmers were usually passive recipients in the knowledge transfer system, as agricultural cooperatives dominated the whole processes [Bryant 1998].

During *the transition period*, several new actors entered the transfer processes and interaction between actors occurred as illustrated by the curved double-arrows in Fig. 3. Under the legal institutional framework of "*doi moi*," state farms and state forest enterprises began to play a role in the knowledge transfer system. On the one hand, they were the leading development actors in the knowledge generation process, especially in advanced technologies for silviculture [Jamieson *et al.* 1998; Sikor 2001]. On the other hand, they became involved in the knowledge dissemination process in different ways. They were co-implementers of a number of governmental programs at the local level in which they acted as knowledge deliverers, especially with regard to forest-related techniques [Morris *et al.* 2004; Bui Dung The *et al.* 2004; Sowerine 2004]. They also performed the role of local knowledge centers demonstrating technical innovations for visiting farmers. Farmers acknowledged that state farms and state forest enterprises used to be sources of knowledge and innovations for them [IF2–7 2007]. With the full normalization of relations with the United Nations in the early 1990s, international donor NGOs began to step into the development cooperation stage [Dosch and Ta Minh Tuan 2004]. In the field of agriculture, these organizations became actively involved in the knowledge transfer system and interacted with the country's public organizations, such as research institutes, universities, state farms and forest enterprises [IE5–10 2008], and started to introduce participatory extension approaches to the knowledge transfer system. At the same time, farm households were re-established as the main units of agricultural production, with the government gradually allocating land use rights to farmers. In this way, farmers began to function as carriers of knowledge from one region to another, constituting a fertile ground for other private actors in the transfer system during the next stage of the market economy. At the end of this period, the public extension system was established in 1993 from the central to district level [Poussard 1999].

The market-economy stage is the period in which truly dynamic development has occurred with the pro-active involvement of private actors, and the continuing active participation of other actors [IE4–8 2008]. Interactions have occurred among these actors, and the exchange and integration of knowledge have been practiced within the transfer system (illustrated by double-arrows in Fig. 3) [Hoang Xuan

Thanh and Nguyen Viet Khoa 2003]. The combined actions of these different actors at local community level, together with the land allocation processes and free-market policies and the policy of "*xa hoi hoa khuyen nong*,"[3] have resulted in the dynamic development of knowledge and new modes of technology transfer. There has also been a growth of corresponding extension approaches along with increasing diversity in processes of adoption among upland farmers [Thai Thi Minh *et al.* 2010; Schad *et al.* 2011]. However, key actors — the government organizations — continue to adhere to supply-driven approaches, which is one of the major reasons for the ambiguity of transferred knowledge and innovations.

In this stage, the knowledge transfer system horizontally encompasses three main actor groups, each of which applies a different approach. The government actors focus on promoting technology for food security and agricultural modernization, based on the principle of transferring advanced techniques via demonstration models established among key farmers (often the better-off ones) in order to prove their success. This is coupled with the use of input subsidies as an incentive for adoption [Van de Walle and Gunewardena 2001; Dalsgaard *et al.* 2005; Goletti *et al.* 2007]. Private actors, which include agricultural extension staff acting as sales agents, individual service providers, traders, commercial companies and mass organizations, often use commercial and agricultural commodity promotion approaches of various kinds. These include contract farming, extension provided free of charge and farmer trials, and selling inputs together with training [Goletti *et al.* 2007]. These approaches are generally designed to address specific target groups in the NWMR. Most knowledge transfer activities have directly targeted the *Kinh* migrants and better-off farmers, who are considered to be progressive, rather than ethnic minority groups. The transferred knowledge focuses on prevalent crops and agro-economic crops, especially wet rice cultivation and other cash crops. International development organizations and NGOs have a quite different approach to innovation dissemination, favoring the participation of local farmers and communities. Their focus is on exchange of knowledge with and among farmers, and on improving the performance of indigenous farming systems by blending local knowledge with external knowledge systems. Their main target groups are poor ethnic minority households and communities in the remote areas [IE11–13 2008].

3) "*Xa hoi hoa*" (literally: *socialization*) is a multifaceted concept in Vietnamese that cannot easily be translated into English. This concept tends to conjure up the idea of "the social orientation of the individual to become a good and productive citizen." In the Vietnamese conception — socialization has broader meanings associated with the desired interactions between government, society and the individual [Shanks *et al*. 2003]. Thus, "*xa hoi hoa khuyen nong*" means that (agricultural) extension is in fact the responsibility of society as a whole and that all organisations have a part in increasing production, improving technologies, spreading production knowledge, etc. [Beckman 2001].

III-4. *Diffusion Mechanisms in Local Communities*

Diffusion is a further step by which innovations are spread in local communities. In this article, we categorize innovation diffusion in terms of three major mechanisms, namely 1) the *trickle-down mechanism*, 2) the *ripple mechanism*, and 3) the *network mechanism*. The *trickle-down mechanism* is a quantity-oriented approach employed mainly by the formal extension system which includes public organizations at central, provincial, district and communal levels. To a certain extent, this mechanism is also employed by semi-formal actors such as mass media and mass organizations at all levels, and grassroots staff of public agricultural organizations. It is assumed that through, this mechanism innovations are developed and transferred following the principles of a linear model and trickling down from the target groups of medium-income and better-off households to other groups of farmers.

By contrast, the *ripple mechanism* is a more quality-oriented approach to promoting indigenous knowledge and its integration with other knowledge domains, and is mainly employed by international development projects and NGOs. The *ripple mechanism* follows a more or less participatory approach to innovation development and transfer, by which innovations are developed and diffused outward from the core area, i.e. the farmer groups or villages specifically targeted by the development programs. Innovations are developed through the process of knowledge exchange among farmers and between internal and external sources. Knowledge spreads outward from the core target groups to other individuals in the same communities and to other communities through strategic use of farmer-to-farmer exchange. This diffusion mechanism has proved its potential as a communication approach capable of enhancing farmers' knowledge and self-esteem, strengthening social networks, and improving the appropriateness and adoption of innovations. Yet, the success of the *ripple mechanism* is often confined to pilot areas with the support of sound financial and human resources from several actors involved in intensive farmer extension and training programs.

The *network mechanism* is the main mechanism for diffusing innovations developed by farmers. It is based on individuals' self-motivation to develop and adopt innovations in order to serve particular needs or to solve certain problems at an individual level. In the *network mechanism*, successful farmers developed innovations that were diffused by interpersonal and community communication networks. In many cases, innovations were spread in communities through the interpersonal communication channel between early adopters and potential adopters. In many other cases, innovations are diffused first from observations made by the potential adopters and additionally by interpersonal communication with previous adopters. In some cases, community leaders promote the expansion of innovations, which often speeds up the diffusion as it becomes a collective decision-making process within the adoption process [GD5–12 2008; IF25–32 2008].

These diffusion mechanisms have occurred alongside periodic shifts in the knowledge transfer system. In the case of a remote commune such as *Muong Lum*, the *network mechanism* was particularly evident in *H'mong* villages, especially before the communal extension worker was officially employed in 2000 [GD4–10 2008], while the *trickle-down mechanism* has dominated other *Black Thai* villages since the cooperative era [GD6–12 2008; IE4 and 7 2008]. This difference in predominant diffusion mechanisms between *Black Thai* and *H'mong* communities is due to a combination of historical, socio-cultural, geographical and political factors. The *Black Thai* migrated from Southwest China several hundred years ago and were thus among the first groups to populate the NWMR. They settled within rather well-defined boundaries and established geographically stable and hierarchically structured communities characterized by closely knit social networks and patron-client relationships. They occupied the most favorable areas, mainly in the valleys with large fertile lowland fields located close to water sources [Neef 2001; Tran Duc Vien 2003]. Having benefitted from living in more accessible areas, they have a major population presence in the region and better skills in using the *Kinh* language. They are thus better integrated into national political developments and play a more prominent role in the local administrative system [Sikor and Dao Minh Truong 2002]. They are considered by the *Kinh* to be one of the most progressive ethnic minority groups in the NWMR, which has helped to increase their political and social status [IR 7–8 2007]. As a result, they also have been drawn more into the mainstream extension approaches, and their stratified, hierarchical society has proven very conducive to the trickle-down mechanism of innovation diffusion. The *H'mong*, by contrast, were one of the last groups to arrive in the NWMR and thus had to settle mainly in higher mountain zones that are often difficult to access and relatively hard for the local government to control. In contrast to the *Black Thai* ethnic group, the village has rarely been a major unifying economic and social unit for the *H'mong*, with each household being a rather independent economic and social entity [Vuong Duy Quang 2004; Neef 2005]. With their "semi-nomadic" tradition, the *H'mong* spread over large geographical regions, establishing wider relative and friendship networks along patrilinear clan structures [Boothroyd and Pham Xuan Nam 2000; Corlin 2004]. While considered by mainstream *Kinh* society and the local administration as rather "backward" and "primitive," the egalitarian and individualistic social structure of the *H'mong* and their extensive networks beyond village borders has been more compatible with the network mechanism of innovation diffusion.

III-5. *Farmers' Motivation for Adoption*

The final stage of the AKIS in the NWMR is adoption, in which farmers accept and integrate an innovation into their agricultural practices. We found four main types of farmers' motivation in the adoption

process, namely: "*adoption for political and social rewards*," "*adoption for local consumption*," "*adoption for cash income*" and "*adoption for a sustainable environment*." Adoption in the early stages of upland development was decided for strategic reasons by either communities or individual farmers in order to benefit from incentives such as political and cultural gains or material and financial subsidies [Clement *et al.* 2006]. This can be classified as "*adoption for political and social rewards*." This type is often found in the adoption of all those innovations promoted by the government involving input subsidies and other financial, material or social incentives. It has commonly failed or shifted to other types after short-lived adoption. Its target groups are mainly financially and socially advantaged farmers and disadvantaged groups [IE3 2007]. The financially advantaged groups are better-off and active farmers, who are able and willing to adopt these high-cost innovations. The socially advantaged farmers are individuals with either a high social position, such as former or current local leaders, or a good relationship with the local authorities, such as close relatives and friends of the latter. These farmers are given opportunities to adopt these innovations and thus to benefit from the subsidies provided for adoption. In many extension programs, both financially and socially advantaged farmers are so-called "model farmers" [IE4 and 7 2008]. The disadvantaged group, mainly the poor or the so-called "backward" ethnic minorities, are often beneficiaries of social welfare. They are provided with "special support in the form of inputs and finance" from the government or non-profit organizations to enable them to adopt these innovations. One typical example is hedgerows for soil erosion control, which were adopted largely in order to attract the additional benefits associated with participation in development projects or to be eligible for land titling programs and reforestation technologies [Neef 2001]. Hedgerow adoption gives farmers more advantages with regard to forest-land allocation and official acknowledgement of their land-use rights. "*Adoption for political and social rewards*" is sometimes undertaken in order to protect farmers' social interests, as illustrated by one villager who explained why he adopted the new breeding scheme for pig production: "To promote local pig breeds, we were advised to cross Mong Cai sow and boar. This crossing is not good. Others already stopped following the recommendation, except me. I have to do it because I am a group leader. I must keep my prestige intact" [IF3 2007]. In the closed societies in the rural areas, many farmers prefer to act according to what is considered normatively correct, rather than what is rationally accurate according to a comparison of costs and benefits for different choices [Clement *et al.* 2006]. This is commonly found in many cases of early adopters, who have tried innovations without undertaking an economic analysis.

"*Adoption for local consumption*" is commonly found with innovations that uplanders can apply to increase productivity to satisfy their consumption needs, such as "*advanced technologies for food security*" promoted by the government since the cooperative era. Adoption often occurs after the first round of

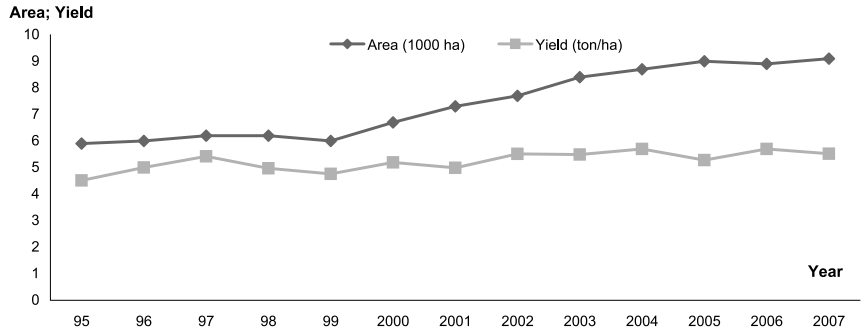

Fig. 4 Area and Yield of the Second Rice Crop in Son La Province
Source: [General Statistic Office 2008]

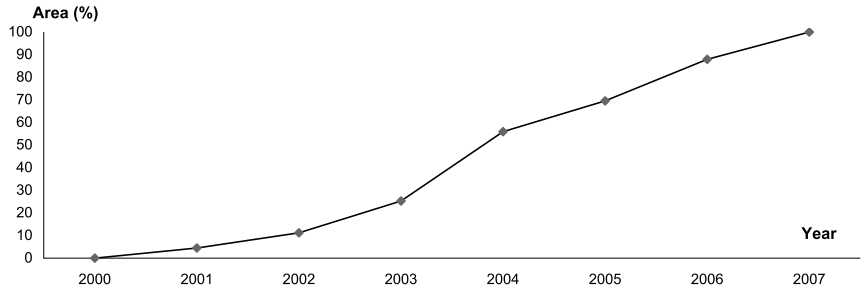

Fig. 5 Share of Paddy Rice Area with a Second Rice Crop in Muong Lum Commune
Source: [IE8 2008]

"*adoption for political and social rewards*" involving a local, demand-oriented selection of innovations. Adoption rates have significantly increased since the mid-transition period and have recently peaked. This is exemplified by the rapid adoption of hybrid rice varieties of Chinese origin. These varieties have increased food security but have also made farmers more dependent on continuous seed supplies. Moreover, they potentially entail negative environmental effects due to the relatively high requirement for agrochemicals [Novellino 2000; Tran Duc Vien 2003; IF 8–10 and IF 14–16 2007]. The second rice crop has been widely adopted by upland farmers in Son La province since 1990s, increasing more than one third during the eight years from 1999 to 2007 (Fig. 4). In the case of *Muong Lum*, areas of the second rice crop increased from zero in 2000 to 45 hectares in 2007 (Fig. 5). This area is said to be the maximum as it is nearly equivalent to the communal paddy rice area [IE8 2008]. This example of the rapid increase of the second rice crop area shows that satisfying households' food needs and local consumption remains the top priority under the transition process from subsistence to a more market-

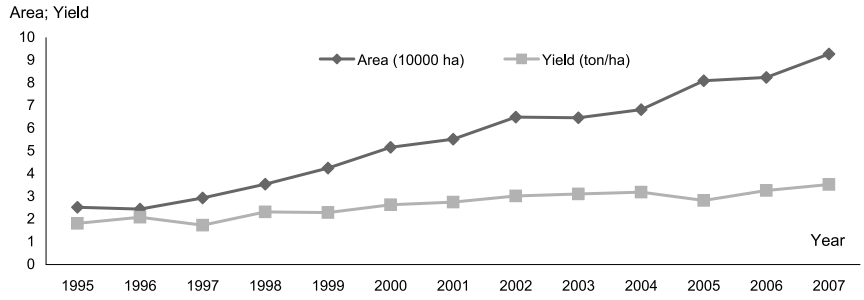

Fig. 6　Area and Yield of High-Yielding Maize in Son La Province from 1995 to 2007
Source: [General Statistic Office 2008]

oriented agricultural production system. In many areas of the NWMR, the subsistence production still dominates and adoption of innovations that ensure households' food security is a main target for the majority of uplanders [GD5–9 2008]. Hence, "*Adoption for local consumption*" has a long lifespan and targets almost all farmers.

"*Adoption for cash income*" is a response of upland farmers to market demand, generated mostly by the lowland society as incomes rise and people increasingly want a greater share of animal protein in their diet. The adoption of hybrid maize varieties is the most prominent example of this type of innovation adoption. These varieties have been introduced to the region since the early 1990s. However, the turning point of adoption in the Northwest, especially in Son La (Fig. 6), started in the late 1990s due to the growth of maize demand to supply the rapidly expanding large-scale feed industry and the related introduction of exotic pig breeds in the Red River Delta areas [Yanagisawa 2004; Dao The Anh *et al.* 2005; Friederichsen and Neef 2010]. Maize is becoming the most important cash crop in the region, and is said to remain the major focus of farmers' activities, as confirmed by many maize growers in Son La recently: "We will continue to expand as much hybrid maize area as possible and apply more chemical fertilizers to gain better harvests, as the maize price is currently increasing." Hybrid maize varieties can increase yields significantly; however, they are also highly uniform and need large doses of fertilizer. Maize is also a highly erosion-prone and fertility-depleting crop in sloping upland areas [Nelson *et al.* 1998]. The adoption of hybrid maize varieties can satisfy farmers' immediate need for income generation but then tends to become a less environmentally friendly option. The adoption is said to have a medium lifespan due to its harmfulness to the environment and the lack of certainty regarding market demand.

"*Adoption for a sustainable environment*" is considered to be the second round of "*adoption for political and social rewards*," as it includes the introduction of "*advanced technologies for silviculture and*

for soil conservation." This form of adoption is also said to be friendly to the environment, but costly for farmers, as is the case with adoption of improved agro-silviculture. This technology is one of the most efficient and sustainable land use systems for the highly fragile ecology in the NWMR. However, it requires a relatively large land area and intensive, long-term labor and capital investments. The improvements in agro-silviculture are thus confined to a small number of better-off farmers, mainly *Kinh* migrants who can afford to meet these requirements. Currently, adoption begins with a very small number of wealthy farmers in the NWMR who can afford to harmonize their economic interests with the political agenda. Erosion control measures on sloping cropland have not been propagated successfully, mainly due to the low immediate comparative advantages and the long period of time that elapses before positive impacts become visible.

IV Discussion

The transfer of knowledge to the NMR has been driven, first, by the government's primary goals of enhancing food security and promoting the modernization of upland agriculture. It is clearly evident that, for most government officials, technology development and promotion are assumed to be a linear process. While this mindset was particularly prominent in the cooperative period, it has persisted throughout the transition period and continues to be the predominant approach under the market-economy period. Most technologies are still developed in a specific area in the lowlands or in the highly controlled conditions of research stations, or within extension models with a "linear assumption" regarding socio-economic and natural conditions. The technologies have then been transferred to the NWMR to satisfy imposed political agendas, with the intention that upland farmers should adopt them spontaneously without any technical or socio-economic reservations. Friederichsen [2009], for instance, reports on an interview with two *H'mong* farmers in Son La province, who referred to newly introduced rice varieties as "government rice" (*lua nha nuoc*), thus expressing the connection between the state and a specific innovation. In this process, the indigenous knowledge, which has been developed and practiced by local inhabitants over generations through the accumulation of real-life experience and experimentation, has been largely neglected during the innovation process. A prominent example is the case of the composite swidden system — described extensively for the *Tay* ethnic group in north-western Hoa Binh Province — which has proven superior to most external innovations in terms of combined economic, social and ecological benefits [e.g. Le Trong Cuc and Rambo 2001; Tran Duc Vien *et al.* 2009]. The social reality of ethnic minorities and topographical conditions of the NWMR has also simply been assumed to be similar to the ethnic and topographical uniformity in the specific region

where these technologies were developed [Beckman 2001]. After the on-station or site-specific applied research processes, technologies have often been transferred to the NWMR with limited or no adaptive research and with the assumption of trickle-down diffusion in local communities [Dalsgaard *et al.* 2005; Friederichsen 2009]. Innovations have therefore been introduced mainly in the form of single or unified recommendations or as a "fixed package" [Peters 2001]. Upland farmers, especially in the very remote villagers, often have had no choice but to adopt these "packages," as mentioned above in the cases of growing mulberry in the upland fields, raising silkworms in *Black Thai* villages, and cultivating *colza* in rice fields in *H'mong* hamlets (subsection III-2). The process of knowledge transfer has been dominated by "production-oriented" approaches, which cover the production phase but contain no points of linkage to the overall value chain of processing, marketing, and consumption. Upland farmers are then put in the position of having to find markets for their products, while their perception of the market is limited to home and/or local community consumption, "some place where the middlemen re-sell our products"; their access to markets is only through the local trader network [GD8–10 2008]. Consequently, farmers frequently bear economic losses and experience high vulnerability when adopting innovations too quickly, as demonstrated in the cases involving the planting of perennial crops or fruits, and winter crops. To sum up, agricultural knowledge development and transfer processes in the NMR were dominated by linear policy-driven approaches involving innovations that were not always beneficial but threatening local people's livelihood and creating environmental degradation [Jamieson *et al.* 1998; Vo Quy 1998; Le Trong Cuc 2003; Bui Dung The *et al.* 2004]: this places upland farmers on the horns of a dilemma.

Having experienced the failures associated with the adoption of many innovations, upland communities seem to strategically adapt their mode of adoption in order to cope with the linear policy-oriented approaches entailed in the knowledge transfer processes [Sikor and Dao Minh Truong 2002]. Friederichsen [2009] found in his study of the NRWM that new materials, practices and technologies are being integrated into upland farming practices rather than simply replacing them. The *ripple* and *network mechanisms* in the diffusion of adoption driven by the local communities increasingly serve to make up for the limitations of the *trickle-down mechanism* in terms of quality and effectiveness. These mechanisms that have become more prominent since the market-economy period also encompass the process of adjusting the innovations and selecting the most helpful elements that meet the local communities' interests and needs. The dynamic development of a local private trader network since the early 2000s is another institutional change in this adoption scheme that assists upland farmers in dealing with the neglect of the market chain in the "production-oriented" approaches employed by the knowledge transfer system. The win-win collaboration between farmers and the trader network in

terms of supplying inputs and marketing products is an appropriate local adjustment for the self-sustaining process of innovation in the region, especially in the cases of maize and rice [IF2–7 and 12–16 2007; IF32–36 2008; IE7–8 2008; GD4–12 2008]. Farmers' motivation in adopting innovations clearly demonstrates their great efforts in selecting the technologies that best match the local socio-economic and ecological systems. Farmers can first try out innovations on the basis of adoption for political, cultural and financial incentives. However, the expansion and sustainability of the innovations are obviously driven by farmers' motivations based on either local consumption or cash income or on creating a sustainable environment. It can thus be argued that upland farmers and their communities have formulated a form of "demand-oriented" approach to the diffusion and adoption of innovations. These approaches constitute the second part of the knowledge transfer processes in the NWMR by which upland farmers have shown their partnership in the "innovation game."

The differences in lifespan and farmers targeted among the four adoption types ("*adoption for political and social rewards*," "*adoption for local consumption*," "*adoption for cash income*" and "*adoption for a sustainable environment*") are the corollary of the existence of both linear policy-oriented and demand-oriented approaches in the innovation processes. More specifically, farmers' interests and the agenda and interests of the government are the determining factors affecting the lifespan and the kind of farmers targeted in the four types of adoption (Figs. 7 and 8). The government's long-term intention is to ensure food security, to promote agricultural commodity production and, finally, to reduce environmental degradation. The government's interests are thus relatively uniform and equally high among

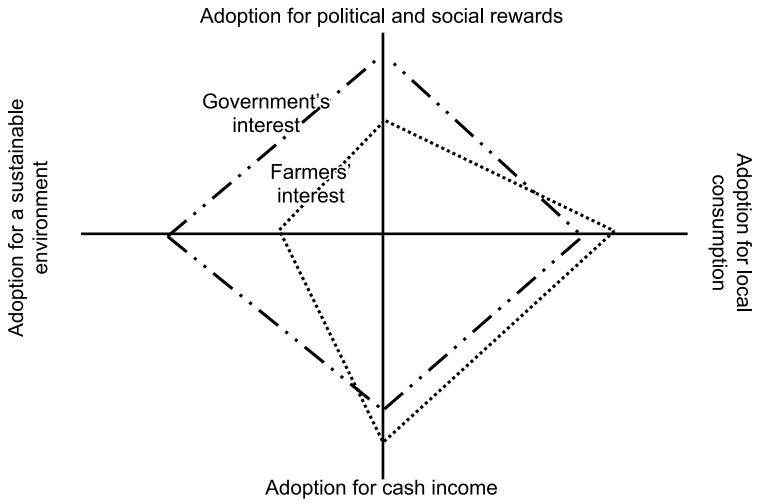

Fig. 7 Correlation between Government and Farmer Interests in the Adoption Types

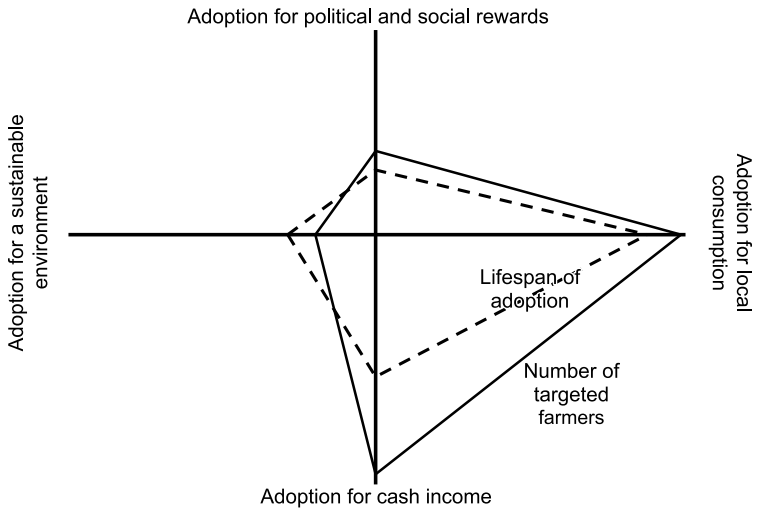

Fig. 8　Number of Targeted Farmers and Lifespan of Different Adoption Types

the four types of adoption as illustrated by the line in Fig. 7. Farmers, on the other hand, plan for their own production, mainly to safeguard their immediate needs for household food and cash income. Farmers' interests are thus distributed in an unbalanced way across the various types of adoption, with moderate interests in the "*adoption for political and social rewards*" type, minor interests in the "*adoption for a sustainable environment*" type, and the strongest interests in the "*adoption for local consumption*" and "*adoption for cash income*" types, as illustrated by the dotted line in Fig. 7.

"*Adoption for political and social rewards*" and "*adoption for a sustainable environment*" have been on the government's political agenda since the mid-1980s. These adoption types, however, are not to the benefit of farmers: they involve high labor and capital costs, they are time consuming, they give rise to socio-economic vulnerability, and they fail to meet uplanders' immediate needs. These adoption types thus hardly cover a large number of farmers and rarely last for a longer lifespan, as illustrated by the solid and dashed lines in Fig. 8 respectively.

Conversely, the government and farmers have nearly the same level of interest in "*adoption for local consumption* and *for cash income*." Currently, under the terms of the institutional support provided as part of the policies of individualization in agricultural production and marketing, every upland household can freely make decisions on innovation adoption and select whatever technologies are considered to be appropriate for them [IF32–35 2008; GD4–12 2008]. Farmers will obviously select those innovations that they are interested in and that instantaneously satisfy their needs for food and cash income. "*Adoption for local consumption* and *for cash income*" is attracting ever greater interest

from farmers. The common interests of the government and farmers embodied in "*adoption for local consumption* and *for cash income*" are an ideal condition for the rapid expansion of these adoption types. The government then gives more effective institutional support through improving the physical, financial and market infrastructure, while farmers and relevant implementing stakeholders (such as the extension system, private companies and the local trading system) then take these supports and use them in an efficient way to horizontally and vertically scale out the adoption process. Agricultural innovations that can satisfy both the agenda of the government and the needs of farmers are quickly disseminated and have a long lifespan in the NWMR.

V Conclusion

The NWMR's realities are far more complex than is usually imagined, represented, or enshrined in laws. It is the region with the highest ethnic, environmental and economic diversity and presently the most dynamic development. Innovations in agriculture and their adoption are dynamically transformed and shaped by the comprehensive combination of socio-economic, cultural and political driving forces. Adoption types which are able to satisfy both the government's agenda and farmers' needs are then quickly expanded and have a long lifespan in the NWMR. "*Adoption for local consumption*" and "*adoption for cash income*" are currently reaching a peak after rapid growth, as in the cases of intensive rice cultivation for household food needs and of hybrid maize cultivation to satisfy market demand. The fate of newly introduced innovations, therefore, depends on the ability to satisfy farmers' aims and socio-economic conditions. Successful diffusion is likely to occur when farmers' interests and the government's agenda match.

The economic linkages and interdependencies between the NWMR and other regions arise mainly from differences in their respective natural resource endowment and the trade potential generated by these variations. Knowledge transferred to the NWMR is the first step in the process of these inter-regional economic interactions. An understanding of the movement of transferred knowledge in the current context of the NWMR's dynamic socio-economic development is crucial for improving mountain people's economic opportunities to ensure that they receive a fair return from the adoption of these technologies. We conclude that future innovation processes need to address both the ecological fragility of upland areas and the livelihood concerns of their inhabitants in order to foster a more sustainable regional development.

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Appendix

Interviews with Researchers (IR)

Code	Participant	Topic	Location	Date
IR1	Vu Thanh Hai — Hanoi University of Agriculture (HUA)	Introduction of winter crop to Yen Chau	Gia Lam, Hanoi	2007/9/25
IR2	Pham Thi Huong — HUA	Introduction of horticultural innovations	Gia Lam, Hanoi	2007/9/25
IR3	Nguyen Van Vien — HUA	Rice and maize Farmer Field School in Yen Chau	Gia Lam, Hanoi	2007/9/25
IR4	Trinh Thi Mai Dung — HUA	Introduction of horticultural innovations	Gia Lam, Hanoi	2007/10/3
IR5	Trieu Van Hung and Le Hong Khanh — Ministry of Agriculture and Rural Development (MARD)	Agricultural research and extension in Vietnam	Hanoi	2007/11/5
IR6	Bui Huy Hien; Tran Duc Toan; Pham Quang Ha; and Didier Orange — National Institute of Soil and Fertilizer (NISF)	Soil research in the Northern Upland	Tu Liem, Hanoi	2007/11/5
IR7	Vuong Xuan Tinh — Institute of Anthropology	Anthropology research in the Northern Upland	Hanoi	2007/11/6
IR8	Le Quoc Doanh — Northern Mountainous Agriculture and Forestry Science Institute (NOMAFSI)	Agricultural research in the Northern Upland	Hanoi	2007/11/6
IR9	Dang Kim Son, Institute of Policy and Strategy for Agriculture and Rural Development (IPSARD)	Research and extension policies	Hanoi	2007/11/6
IR10	Tran Huu Vien; Pham Xuan Hoan; Vuong Van Quynh — Vietnam Forestry University	Forestry research in the Northern Upland	Xuan Mai, Hanoi	2007/11/7
IR11	Nguyen Tu Hai — NOMAFSI	Ongoing research in the centre	Chieng Pan, Mai Son, Son La	2007/11/19
IR12	Luu Duc Khai — General Institute for Economic Management	Communal institutional arrangements	Yen Chau, Son La	2007/12/11
IR13	Melvin Lippe — The Upland Programs, SFB 564	Participatory research for joint research on modeling land use history	Chieng Khoi, Yen Chau, Son La	2008/1/8
IR14	Iven Schard — The Upland Programs, SFB 564	Research methods	Hohenheim, Stuttgart, Germany	2008/3/15
IR15	Melvin Lippe — The Upland Programs, SFB 564	Joint work on land use history and modeling	Hohenheim, Stuttgart, Germany	2008/3/29
IR16	A group of junior researchers and their assistants — The Upland Programs, SFB 564	Various issues related to conducting researcher in Yen Chau	Yen Chau, Son La	2008/8/7
IR17	Melvin Lippe — The Upland Programs, SFB 564	Join writing on land use history and modeling	Yen Chau, Son La	2008/8/8
IR18	Le Quoc Doanh — NOMAFSI	Research on agriculture in the Northern Upland	Phu Tho town	2008/8/19
IR19	Ha Dinh Tuan — NOMAFSI	Research on green-crop fodder for ruminants	Phu Tho town	2008/8/19
IR20	Iven Schard — The Upland Programs, SFB 564	Conducting research in Yen Chau	Yen Chau, Son La	2008/9/12

Interviews with Agricultural Extension and Veterinary Staff (IE)

Code	Participant	Topic	Location	Date
IE1	Quang Thi Dao — Yen Chau Agricultural Extension Station	Innovations introduced to Chieng Pan	Chieng Pan, Yen Chau, Son La	2007/9/28
IE2	Lo Xuan Chinh — Yen Chau Agricultural Extension Station	Introduction of unisexual tilapia to Chieng Khoi	Chieng Khoi, Yen Chau, Son La	2007/9/30
IE3	Dao Thi Bien — Yen Chau Agricultural Extension Station	Extension work in Yen Chau	Yen Chau, Son La	2007/9/28
IE4	Me Van Dung — Yen Chau Agricultural Extension Station	Extension activities in Muong Lum commune	Yen Chau, Son La	2008/1/10
IE5	Nguyen Thanh Huyen — National Centre for Agriculture and Fisheries Extension Center	Crop extension program in the Northern Upland	Hanoi	2008/7/7
IE6	Nguyen Minh Linh — National Centre for Agriculture and Fisheries Extension Center	Livestock extension program in the Northern Upland	Hanoi	2008/7/8
IE7	Me Van Dung — Yen Chau Agricultural Extension Station	Function and operation of extension staff	Muong Lum, Yen Chau, Son La	2008/8/29
IE8	Me Van Dung — Yen Chau Agricultural Extension Station	Commune socio-economic development	Muong Lum, Yen Chau, Son La	2008/9/30
IE9	Vang A Giong — animal health worker in Muong Lum	Annual vaccination in Oc Oc village, Muong Lum	Muong Lum, Yen Chau, Son La	2008/10/10
IE10	Lo Ken — Son La Agriculture Extension Center	Cage and floating fish raising systems	Son La	2008/10/27
IE11	Ha Van Kieu — Yen Chau Animal Health Station	The mandate of communal animal health workers	Muong Lum, Yen Chau, Son La	2008/11/5
IE12	Luong Thi Thuc — Yen Chau Agricultural Extension Station	Extension work in Chieng Dong commune	Yen Chau, Son La	2008/11/8
IE13	Lo Van Thanh — Yen Chau Agricultural Extension Station	Extension work in Yen Son commune	Yen Chau, Son La	2008/11/8

Interviews with Individual Farmers (IF)

Code	Participant	Topic	Location	Date
IF1	Ha Thi Vang — *Black Thai* Farmer	Innovations in mango cultivation	Chieng Pan, Yen Chau, Son La	2007/9/28
IF2	Nguyen Van Ngan — *Kinh* farmer	Innovations in crop production	Chieng Pan, Yen Chau, Son La	2007/9/28
IF3	Le Van Phu — *Kinh* farmer	Innovations in pig production	Chieng Sang, Yen Chau, Son La	2007/9/29
IF4	Lo Van Peng — *Black Thai*	Innovations in pigs and mechanics	Co village, Son La	2007/9/30
IF5	Ha Van Khanh — *Kinh* farmer	Innovations in pig production	Chieng Sinh, Son La	2007/9/30
IF6	Pham Van De — *Kinh* farmer	Innovations in cover crop	Chieng Pan, Yen Chau, Son La	2007/10/13
IF7	Phan Van Nguyen — *Kinh* farmer	Innovations in cover crop	Chieng Pan, Yen Chau, Son La	2007/10/13
IF8	Vu Lao Pha — *H'mong* farmer	Household farming system	Muong Lum, Yen Chau, Son La	2007/10/14
IF9	Vu Lao Cau — *H'mong* farmer	Household farming system	Muong Lum, Yen Chau, Son La	2007/10/14
IF10	Lo Thi Sum — *Black Thai* farmer	Farming system and daily life	Tu Nang, Yen Chau, Son La	2007/10/16
IF11	Vu Lao Cau — *H'mong* farmer	Follow up to the IF9 interview	Muong Lum, Yen Chau, Son La	2007/10/18
IF12	Me Van Hong — *Black Thai* farmer	Mango innovations and adoption	Tu Nang, Yen Chau, Son La	2007/11/18
IF13	Ha Van Hai — *Black Thai* farmer	Innovations in pig production	Chieng Co, Son La	2007/11/19
IF14	Quang Thi La — *Black Thai* farmers	Innovations in agriculture	Muong Lum, Yen Chau, Son La	2007/11/20
IF15	Ha Van Keo — village headman	Innovations in rice cultivation	Chieng Khoi, Yen Chau, Son La	2007/11/21
IF16	Lo Van Hung — *Black Thai* farmers	Innovations in cover crops and fruits	Sap Vat, Yen Chau, Son La	2007/11/21
IF17	Ha Van Phuong — male *Black Thai*	Management in Chieng Khoi Lake	Chieng Khoi, Yen Chau, Son La	2008/1/13
IF18	Ha Van Keo — village headman	Cassava cultivation in Put village, Chieng Khoi	Chieng Khoi, Yen Chau, Son La	2008/1/14
IF19	Ha Van Pheng — *Black Thai* farmer	Household farming system	Muong Lum, Yen Chau, Son La	2008/1/21
IF20	Ha Van Nhot — *Black Thai* farmer	Household farming system	Muong Lum, Yen Chau, Son La	2008/1/22
IF21	Ha Tri — *Black Thai* farmer	Household farming system	Muong Lum, Yen Chau, Son La	2008/1/23
IF22	Ha Van Cau — *Black Thai* farmer	Household farming system	Muong Lum, Yen Chau, Son La	2008/2/19
IF23	Ha Van Ua — *Black Thai* farmer	Household farming system	Muong Lum, Yen Chau, Son La	2008/2/20
IF24	Ha Van Thinh — *Black Thai* farmer	Household farming system	Muong Lum, Yen Chau, Son La	2008/3/13
IF25	Hoang Hong — *Black Thai* farmer	Household farming system	Muong Lum, Yen Chau, Son La	2008/3/14
IF26	Mua A Chia — *H'mong* farmer	Household farming system	Muong Lum, Yen Chau, Son La	2008/3/19
IF27	Song Van Long — *H'mong* farmer	Household farming system	Muong Lum, Yen Chau, Son La	2008/3/20
IF28	Mua A Sang — *H'mong* farmer	Household farming system	Muong Lum, Yen Chau, Son La	2008/3/21

IF29	Vu Lao Di — *H'mong* farmer	Household farming system	Muong Lum, Yen Chau, Son La	2008/4/14
IF30	Vu Lao Long — *H'mong* farmer	Household farming system	Muong Lum, Yen Chau, Son La	2008/4/15
IF31	Le Van Phu — *Kinh* farmer	Market-oriented pig production	Yen Chau, Son La	2008/8/6
IF32	Vang A De — *H'mong* farmer	Innovations in agriculture	Muong Lum, Yen Chau, Son La	2008/8/27
IF33	Vu Lao Cau — *H'mong* farmer	Innovations in agriculture	Muong Lum, Yen Chau, Son La	2008/8/27
IF34	Vu Lao Su — *H'mong* farmer	Innovations in agriculture	Muong Lum, Yen Chau, Son La	2008/8/27
IF35	Vu Lao Co — *H'mong* farmer	Innovations in agriculture	Muong Lum, Yen Chau, Son La	2008/8/27
IF36	Bui Van Sang — Muong farmer	Cage and floating fish raising	Phu Thuong, Lac Thuy, Hoa Binh	2008/12/7

Farmer Group Discussions (GD)

Code	Participant	Topic	Location	Date
GD1	7 *Black Thai* persons	Land use history and soil fertility	Chieng Khoi, Yen Chau, Son La	2008/1/9
GD2	12 *Black Thai* farmers	Land use system and problems	Chieng Khoi, Yen Chau, Son La	2008/1/11
GD3	8 *Black Thai* farmers	Input-output in upland fields	Chieng Khoi, Yen Chau, Son La	2008/1/12
GD4	4 *H'mong* farmers	Soil and forest management	Muong Lum, Yen Chau, Son La	2008/8/12
GD5	4 *H'mong* farmers	Agricultural innovations and diffusion	Muong Lum, Yen Chau, Son La	2008/8/28
GD6	4 *Black Thai* farmers	Agricultural innovations and diffusion	Muong Lum, Yen Chau, Son La	2008/8/29
GD7	4 *Black Thai* farmers	Timeline of agricultural innovations	Muong Lum, Yen Chau, Son La	2008/9/9
GD8	4 *Black Thai* farmers	Maize and rice input/output flow	Muong Lum, Yen Chau, Son La	2008/9/10
GD9	4 *H'mong* farmers	Innovations in rice cultivation	Muong Lum, Yen Chau, Son La	2008/9/11
GD10	4 *H'mong* farmers	Maize-rice, cattle-goat input-output flow	Muong Lum, Yen Chau, Son La	2008/9/11
GD11	5 *Black Thai* farmers	Timeline of maize and rice innovations	Muong Lum, Yen Chau, Son La	2008/9/13
GD12	4 *Black Thai* farmers	Timeline of maize and rice innovations	Muong Lum, Yen Chau, Son La	2008/9/14