AGRICULTURAL TRANSFORMATION & FOOD SECURITY 2040

ASEAN Region with a Focus on Vietnam, Indonesia, and Philippines

Vietnam Country Report

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Abbreviations

AERR	ASEAN Emergency Rice Reserve
AFTA	ASEAN Free Trade Area
AMIS	Agricultural Market Information System
AMPLE	Agriculture Multi-Market Model for Policy Evaluation
APTERR	ASEAN Plus Three Emergency Rice Reserve
ASEAN	Association of Southeast Asian Nations
ATIGA	ASEAN Trade in Goods Agreement
BULOG	Bureau of Logistics
EAERR	East Asia Emergency Rice Reserve
FAO	Food and Agriculture Organization of the United Nations
FAOSTAT	Food and Agriculture Organization of the United Nations Statistics
FDI	Foreign Direct Investment
GDP	Gross Domestic Product
GHG	Greenhouse Gases
IEFR	International Emergency Food Reserve
IFPRI	International Food Policy Research Institute
IMPACT	International Model for Policy Analysis of Agricultural Commodities and Trade
IPCC	Intergovernmental Panel on Climate Change
KKP-E	Kredit Ketahanan Pangan dan Energi
KPEN-RP	Kredit Pengembangan Energi Nabati & Revitalisasi Perkebunan
KUPS	Kredit Usaha Pembibitan Sapi
KUR	Kredit Usaha Rakyat
PPP	Private-public Sector Partnership
TFP	Total Factor Productivity
VIP	Vietnam, Indonesia, Philippines
WDI	World Development Indicators
WTO	World Trade Organization

Executive Summary

Major findings

Vietnamese agriculture and fisheries sectors have performed well over the last two decades and have recorded sustained growth of 3–4 percent over the period. The rice and aquaculture subsectors have been particularly successful. From 1990–2010 paddy production doubled, while aquaculture production increased nearly 20 fold. Both subsectors have seen a strong performance in exports. In parallel, industrial crops have also greatly expanded, particularly rubber and coffee, which have also found strong export markets. This good performance has been accompanied by a sharp fall in the national poverty rate during same period

The limited amount of land suitable for agriculture is a major resource constraint for Vietnamese agriculture, so that productivity per ha is a key consideration for the growth of the sector. The current situation of agriculture in Vietnam is still strongly influenced by the small size of the landholdings that were created following the 1988–92 "Doi Moi" reforms that launched the major growth of the sector detailed in the main report. The emphasis on equity in land holdings led to the creation of a large number of small farms on which, given a weakness of rural markets at the time, the best way for a farming family to survive was to produce the family food needs.

Today, markets are developed, and, except for land designated by the government as rice land, farmers are free to select the crops they wish to grow. Impressive increases in rice production achieved during the last two decades, primarily in the Mekong and Red River deltas, the country's two rice bowls, have not, however, resolved the problems associated with the large number of small holdings with limited earning potential. But the legacy of the past remains, with the government still prescribing rice national self-sufficiency approach as the best way forward and prescribing lands that are only allowed to produce rice. One consequence of this approach is that income from specialized rice farming on very small farms (typically 0.1ha in the Red River area) is particularly low and continues to fall further behind that of other segments of the population as the economy grows. Already for many of these farmers rice is a part time occupation and unless the restrictions on diversifying out of rice are eased, the country faces the risk of only the old continuing with rice cultivation. Increasing rice productivity, cropping intensity and farm mechanization could somewhat ameliorate this situation but with yields already at a fairly high levels the scope is limited.

The current land policy designating rice areas has costs for farmers and costs for Vietnam. The costs for farmers are mainly linked to lost opportunities to plant and sell higher value crops such as horticulture crops where this is possible. The costs to Vietnam are lost opportunities to export a greater volume of higher value commodities than rice.

Looking to the future, improving farm productivity and generating higher incomes for farmers will depend on the creation of larger size farm units through the consolidation of existing farms and better access to finance to enable crop diversification and intensification. In addition, farming activities will become more attractive if the government would recast current food security policy and relinquish altogether the prescription prohibiting certain areas from producing anything but rice and allowing farmers to choose their own cropping patterns or at least rotate rice with other crops. This will put the improvement of current land policy at the center of coming government efforts to maintain sector and income growth in agriculture in the coming years.

The government will also have to take account of another change that is occurring, which is a change in the Vietnamese diet. While rice is currently, and will likely remain, the primary source of caloric intake in the Vietnamese diet,

as incomes continue to grow per capita rice consumption will continue the gradual decline that has been observed for the last two decades[1]. Rice remains of extreme importance, however, for the poor, but urban dwellers, with higher incomes, are already moving to other food sources including wheat based products and higher protein products, particularly meat and fish. Government policy still gives great importance to rice production over any other crop. Expectations of a decline in the importance of rice in the coming years from the current dominant level will enable more balanced national agricultural policies to be developed in the future.

In contrast to the ongoing fall in per capita rice consumption, meat demand, particularly beef, is rising rapidly while fish demand shows minor growth. Production of fish is many times current consumption but high prices probably reduce urban consumption so the balance is exported. Presently domestic production of animal feed is already grossly below demand and the requisite imports totaled over $2 Billion in 2011 suggesting that there are opportunities for more local production of feed grain inputs, particularly maize. Pork production has been highly successful and domestic production currently supplies 90 percent of demand, though diseases have set back production.[2]

As the previous discussion indicates, Vietnam is in a very favorable food security position from the perspective of food availability; it produces sufficient quantities of most food items to satisfy local demand though there is a growing deficit of corn used as animal and fish feed. The success of Vietnam's agricultural sector can be judged by the ability to meet local demand while also exporting large quantities of rice and fish. Various scenarios of future GDP, population, and changing diets indicate that Vietnam will still be able to continue to meet most domestic demands and have surplus production for exports. The main food security issue remaining is therefore that of whether people have enough income to purchase their food needs. The more important issue for Vietnam is poverty rather than food availability. With adequate incomes the people are food secure. It is worth noting, however, that there has been a sharp fall in poverty during the last two decades and the current "food poverty" situation is manageable and expected to improve with time as economic growth progresses.

The success of industrial crop production in recent years, mainly rubber and coffee, has been noticeable but it has been consistently threatened by unstable international market prices which have complicated investment decisions. However, high yields and good productivity suggest that Vietnam has a competitive advantage in these crops so that they have good long term prospects. To safeguard production in the medium term, suitable arrangements need to be introduced to maintain investment in tree planting and renewal, particularly for the growing number of small commercial farmers.

Looking ahead, the proposed shift in land policy mentioned above will encourage the creation of farms of a size big enough to spread costs, increase incomes, and have sufficient security of tenure to encourage capital investments by commercial farmers in infrastructure and machinery that will help Vietnam remain competitive in the coming years. However this change in land policy will not be sufficient to safeguard the future of the sector. The country report outlines six additional critical areas where the government should play a key role in the coming years by providing support for market friendly reforms that will facilitate the farmers' professional activities and suggests the orientation of an action program in each case to remedy each potential problem. In addition to land policy improvement they cover:

Support for the development of the post-harvest value chain by private sector investors and managers is inadequate. Compared with regional middle income comparators Vietnam is still backward in the development of post-harvest facilities by the private sector to increase the value added from domestic and export marketing of agriculture and fishery products. This results in lost opportunities for Vietnam and reduced marketing opportunities for farmers. The government can assist in this area by ensuring that the investment climate is geared better to encourage investment by the private sector, in a level playing field with State

1 Vietnam's National Institute of Nutrition reports per capita consumption falling from 164 kg/annum to 136 kg/annum from 1990–2010. GSO gives a figure of as low as 116 kg /capita/annum for 2010 based on household surveys.
2 Currently blue ear disease has been widely observed in the pig subsector.

Enterprises particularly regarding access to land, access to production for processing, access to credit and marketing channels.

Support for the rehabilitation and upgrading of irrigation systems and introducing more sustainable systems of management of system operations. These activities are needed in order for farmers to have the flexibility to introduce remunerative cropping patterns linked to the market demand. At the same time government needs to work to help upgrade water use efficiency so that Vietnam is best prepared for possible future limitations in water availability from climate change and other reasons. It will also be important to introduce good economic analysis into government investment assessments of irrigation to try to upgrade the investment efficiency in the sector.

Work to upgrade national agriculture and fisheries research capacity and outputs. Vietnam has already adopted a high level of technology in those sectors which need to be supported by a high level and capacity of research if progress is to continue. The government can play an important role in bringing about an upgrading of research in Vietnam and encouraging the private sector to participate in this effort. A vibrant and effective research system will be critical to enable Vietnam maintain its cutting edge in growth and development of the rural areas in the coming years as the country is faced with multiple challenges from technology and climate change. Without a strong national research and problem solving capacity closely linked to political decision makers on a real time basis, Vietnam could easily drop back into a minor league and lose the forward momentum already gained.

Safeguarding the livestock and fisheries sector production and supporting growth. Livestock development is threatened by animal health and product security issues and environmental impacts which must be dealt with quite urgently, in a situation when market pressures are increasingly intense given a high growth in demand for livestock products. While fishing and linked industrial activities should be firmly anchored in the private sector, the government needs to continue to play a supporting role if the high growth rate envisaged is to be achieved. Areas of support could include (1) assistance with fishing boat design and safety; (2) improving and in some instances consolidating value chains, supply channels, disease control and environmental management within the full range of aquaculture options; (3) increase training of workers, restructuring and in some instances relocating fishing villages, strengthening fisheries inspection capacity; (4) improving management through co-management options partnering fishers and local communities.

Upgrading the food safety system. As in many other countries, after a number of food safety scares, Vietnam faces a serious problem of consumers' distrust in the quality of national food products, particularly products of animal origin. Newspapers report concerns over diseases such as SARS, HPAI, PRRS, and residues of pesticides, antibiotics in fruits vegetables and fish. Increased urbanization has increasingly separated the consumer from the production side of the food chain and reduced the possibility for the consumer to understand and verify the production process. This has all combined to increased consumer concern on food safety issues and put at risk several export lines from Vietnam, particularly in the fisheries sector. This problem can get worse and can easily undermine production and growth for the next 30 years unless the government takes a firm position on food safety issues and, in partnership with the private sector puts into place effective measures to remedy the current situation.

Climate change. Designing and implementing mitigation measures. While the country study has assessed that not too much negative impact on food supplies is expected on Vietnam up to 2040 due to climate change, current models predict that serious impacts could start around 2050. In preparation for future effects it would be advisable for the government to monitor carefully evolving changes being caused by climate change to best determine the timing and type of mitigation measures that should be introduced. It will be important to exercise caution and careful phasing when considering high cost public expenditures to build dykes and embankments to deal with slow, long term and uncertain threats of sea level rise otherwise scarce resources can easily be wasted on measures taken too early in the

expected climate change cycle. The government should also further strengthen institutional capacity to manage climate change through continued improvement in its unique resource allocation framework for climate expenditures and through integrated management of its coastal zones.

Strategies for agricultural transformation

Our review of Vietnam's future includes a vision of continued solid growth of the agriculture livestock and fisheries sectors and an upgrading of the rural areas and rural incomes through the widespread growth of commercial farming. This vision could be achieved provided the government takes the necessary supporting measures, and farmers have the incentives to transform their production systems. Vietnamese farmers have already demonstrated their high capacity to adopt advanced agricultural technologies and Vietnamese businessmen have shown proclivity to market products and compete in the international market. The challenge is to ensure the sustainability of this performance and to allow this high income growth for farmers to maintain a reasonable balance between rural and urban incomes.

This transformation will require a continued restructuring of agriculture. The main restructuring measures described in more detail the Country Report include:

- Changes in the land policy. Commercial farmers will require farms of a size that is big enough to spread costs and have sufficient security of tenure to encourage their investment in their farms to increase the efficiency of their operations. Over time a broad land consolidation program should be implemented to facilitate expanding farm areas taking advantage of continuing departures from the rural areas. The full and timely implementation of the government's ongoing Land Administration and Management program to upgrade the administration of land management can greatly facilitate this process.

- Border price transmission to farmers. The government should make every effort to ensure that prices available to farmers are not unduly distorted by government administrative actions.

- The growing disparity of income between rural and urban workers will result in farmers being more demanding on the profitability of farming, and less able to accept government directed cropping patterns. Over time, government should give farmers more freedom to choose their own cropping patterns particularly in those rice designated areas which are amenable to flexible cropping rotations. The Government should start moving away from a centrally planned directed approach to cropping towards a more market based approach.

- The aging of the population, the continuous flight of younger people from the rural areas, and the development of bigger farm sizes should lead to increased mechanization of farming activities to increase labor productivity. The Government research system should work with the private sector to test and demonstrate opportunities to make farming more profitable through increased mechanization.

- Government should facilitate investments by the private sector in value chains, including the processing of farm produce, in order to maximize the market opportunities for farmers and the value added in Vietnam. Vietnam is currently very backward in this area.

- Government needs to rethink the investment policy in the rural areas particularly regarding support for irrigation schemes. Investment priorities in irrigation need to be determined on the basis of economic priority. This should lead to more support for rehabilitating and upgrading existing schemes by incorporating a better flexibility and water control in operation so that farmers can have a choice in cropping patterns based on market demand.

- Government should support the restructuring efforts by moving decisively on food safety issues, especially for field crops, and fish and meat products. Current arrangements are clearly not working. Responsibility for food safety needs to be better coordinated and led by a high level in government.

Inadequate action is this domain will severely set back the development and growth of the sector.

- Disease control. Government will need to continue to work on improving disease identification and control measures in the various sectors to avoid major setbacks in production and growth.
- A key factor for the continued high growth of the aquaculture subsector is development of marine aquaculture. The Government needs to ensure a strong effort by the national research system to help resolve technical problems currently hindering this expansion.
- Agriculture/fisheries/livestock research. Improvements must be introduced in the national research system if the vision is to materialize. The current problems have already been well analyzed and the strategy must now be to implement identified reforms to improve relevance, efficiency, effectiveness, impact and sustainability of research. Reforms will require a reassessment of current funding levels for research that are low by regional standards.

A strategy to address climate change impacts must include the continued support for current efforts to monitor the evolving impact of climate change on Vietnamese agriculture so that mitigation measures can be introduced as needed to safeguard sector performance.

Chapter 1. Introduction

In the past thirty years, Vietnam's agricultural sector has undergone a dramatic change both on the demand and supply side. As per capita income has steadily risen and the incidence of poverty dropped rapidly, the average Vietnamese's diet has undergone a major shift. Rice consumption per capita has declined while the consumption of meats, fish, horticultural products, etc. has risen. On the supply side, Vietnam has gone from a net importer of food in 1980 to a major exporter of rice and fish products. Its average annual growth rate of agricultural GDP has been 3.6 percent, a level surpassed only by China, out of the other major agriculture producers. This impressive growth was driven by agriculture TFP growth of 2.3 percent. In addition to enhancing food security, this healthy agricultural growth has led to a sharp reduction in poverty.

Activities pertaining to agriculture, livestock and fisheries have been transformed into a more dynamic sector of the economy due to improved productivity arising from the use of advanced technologies, more widespread mechanization, and improved quality of production. However the sustainability of past achievements and the continuation of growth are not certain. This report looks more closely at the achievements of the past and the factors affecting food security now and in the future. The report also assesses the critical areas that need attention to ensure continued progress in the sector as Vietnam moves beyond lower middle income status and starts converging towards the national objective of achieving a fully developed economy status.

Chapter 2. Macroeconomic Economic Performance 1980–2011

The eight developing ASEAN countries (Cambodia, Indonesia, Laos, Malaysia, Myanmar, the Philippines, Thailand, and Vietnam) grew at an average annual rate of 5 percent during the thirty-one year period 1980–2011. Their GDP combined grew from US$380[1] billion in 1980 to US$1.7 trillion in 2011. Vietnam, Indonesia, and the Philippines account for about 60 percent of total GDP of developing ASEAN.

As a result of this rapid growth, per capita incomes in developing ASEAN have risen impressively from US$1,067 in 1980 to US$2,877 in 2011. In parallel, incidence of absolute poverty (incomes below US$1.25 per day) has dropped from around 175 million (42 percent of total population) in the early 1990s to around 80 million (15 percent of total population) in 2011.

The region's dramatic progress during the past thirty plus years, however, must not mask the remaining large number of absolute poor, with many more millions living just above the poverty line (between US$1.25 and US$2.00 per capita per day). Most of the poor live in rural areas. Robust agricultural development is thus not only critical to the food security of the population but key to achieving the goal of inclusive growth.

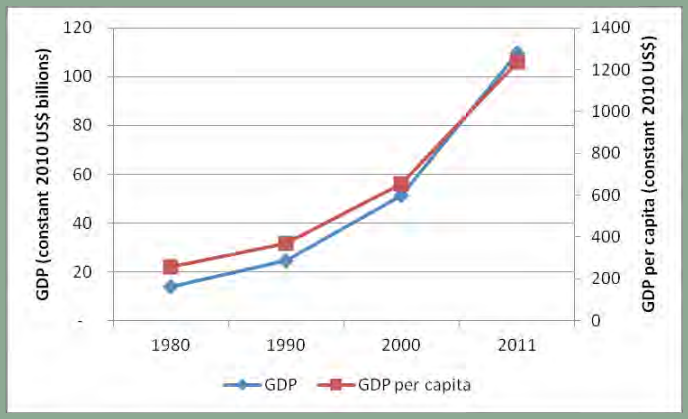
Vietnam was one of the fastest growing economies in the world between 1980 and 2011, when it exhibited an average annual growth rate of 6.9 percent. Its total GDP grew eight-fold from US$14 billion to US$110 billion. A dynamic agricultural sector has fueled growth in rural incomes and made the country a net exporter of agricultural products. At the same time, with declining population growth, its per capita income rose from US$259 per year to US$1,235 per year. Its poverty rate[2] fell even more dramatically from 58 percent in 1993 to only 9 percent in 2010, one of the most impressive reductions in the world.

1 Unless otherwise noted, all dollar figures are in constant 2010 US dollars.
2 Based on the national poverty rate.

While this study is focused on Vietnam, to gain a better perspective of regional growth and possible competition from neighboring countries, the study team also developed optimistic and pessimistic scenarios for the ASEAN countries and for each of the three countries of focus—Vietnam, Indonesia, and the Philippines. Under the optimistic scenario, developing ASEAN countries would continue to exhibit impressive growth both in GDP and per capita income, while their total population would rise from 593 million to 732 million in 2040. Their combined GDP would total US$9,825 billion (6.4 percent of global GDP), growing at an average annual rate of 6.2 percent. Equally impressive, GDP per capita would rise from US$2,877 to US$13,428, with 87 percent of the population attaining middle class status (per capita income of between $10.80–$100 per day at constant 2010 PPP international dollars).

After a slow start in the seventies and eighties, Vietnam found a successful policy mix which led to rapid growth. Following a period of centralized planning after the 1976 reunification of the country, Vietnam introduced a major market based reform program ("doi moi" or renovation) at the end of 1986. Of particular relevance to the present study was the decision to let the market set prices for most commodities and the formalization of land tenure arrangements based on long term "cultivation" rights for family farms by issuing "land use right certificates" to farmers, creating self-managed state owned enterprises and allowing private firms to function and compete openly. Another noteworthy aspect of the overall economic reform was the decision to decentralize considerable authority to the provinces though, unlike the Philippines and Indonesia where this process was done "with a big bang," Vietnam adopted a much more gradual approach. This involved a process of shifting from a centrally planned economic management to a market based approach, splitting the function of production and trade management from centrally planned state management.

Figure 2.1: Vietnam's GDP and GDP per capita 1980–2010



Source: BIMF World Economic Outlook.

Later state budget allocation and management was increasingly decentralized.

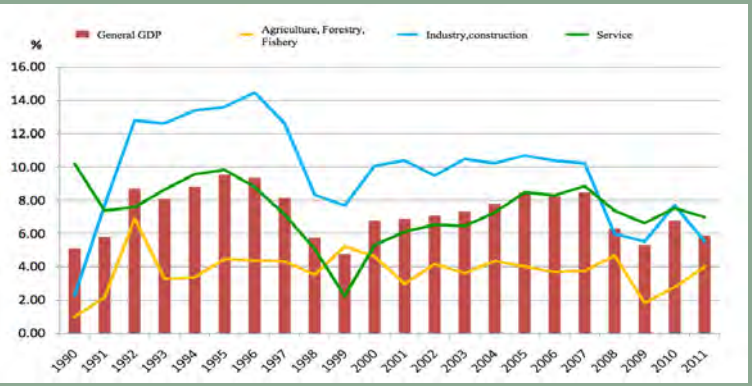
The high growth that followed the introduction of reforms started transforming the country. The reforms were very successful in creating a high growth environment for Vietnam. GDP growth, which averaged 6.2 percent in the 1980s, increased at an average rate of 8–9 percent per year in the nineties until interrupted for about two years due to the onset of the Asian financial crisis. Growth resumed shortly thereafter, albeit at a more modest rate of 6–8 percent in the 2000's. Economic development during this period was partly driven by strong performance in the agricultural sector where there was a strong growth in food production and agriculture exports. Fisheries and aquaculture were strong areas. As described above, Vietnam was also exceptionally successful in rapidly reducing poverty during this period. Social indicators also improved.

Agriculture sector growth was good but that in other sectors was even better. The recent history of Vietnam's economy and the evolution of growth in the key sectors of agriculture, industry and services over the last two decades are clearly shown in the graph by IPSARD in Figure 2.2 showing the contribution of each of these sectors each year from 1990 to 2011 based on GSO data. It can be seen that agriculture, consolidated as agriculture forestry and fisheries, has shown steady growth over the years but at a much lower level than the economy as a whole, and much lower than industry, construction and services. The main growth driver of the economy over the years has been industry and construction as can be expected. Services have generally kept up with national growth rates.

Agriculture's share of GDP fell as the other parts of the economy grew faster. Until the recent slowdown, Vietnam was one of the fastest growing economies in the world. Between 1980 and 2011, it exhibited average annual growth rate of 6.9 percent. Its total GDP grew eight fold from US$14 billion to US$110 billion during the same period. This growth was driven by Vietnam's high investment and total factor productivity growth rates. A dynamic agriculture sector has fueled growth in rural incomes and made the country a net exporter of agriculture products. At the same time per capita income rose from US$259 per year to US$1,235 and, the poverty rate fell even more dramatically as described above. This sharp dramatic reduction in poverty is partly attributed to success in improving agriculture productivity and achieving more inclusive growth. And, yet despite the rapid development of the agriculture sector, the agriculture share of GDP has dropped by half in the past twenty years, from 39 percent in 1990 to 21 percent in 2011 as the rest of the economy grew at an even much higher rate. Key economic and social data are summarized in Table 2.1.

The most recent (2012) indicators still show a generally positive picture of the economy but also highlight growing risks and uncertainties as Vietnam adjusts to middle income status and tries maintain the successful growth

Figure 2.2: GDP growth 1990–2011 and breakdown of sector contributions



Source: GSO data, presented by Dr. Nguyen Tuan. FAO Agriculture Outlook Conference, 2012.

Table 2.1: Key economic and social data on Vietnam

	1980	1990	2000	2011	1980–2011
GDP (constant 2010 US$)	14	25	51	110	-
GDP per capita (constant 2010 US$)	259	369	652	1235	-
average ten-year GDP growth rate (ending in given year)		5.9%	7.6%	7.2%	6.9%
population (millions)	54	67	79	89	-
urban population (millions)	10	14	19	28	-
rural population (millions)	44	54	60	61	-
average ten-year population growth rate	-	2.2%	1.6%	1.1%	1.6%
% of population in poverty (below $2/day)	-	86%	78%	43%	-
% of population in poverty (below $1.25/day)	-	64%	50%	17%	-
Gini index		35.7	37.6	35.6	
average ten-year TFP growth rate	-	2.7%	3.3%	2.2%	2.7%
agriculture as % of GDP	-	39%	25%	21%	-

Sources: IMF WEO, World Bank WDI, Centennial calculations

path achieved in the past. The 2011 per capita income showed continued growth with the level reaching $1235, up from $1174 the year earlier. Centennial projections for 2012 are for $1291. The 2008–09 global economic crisis seems to have caused only a temporary setback. Following a GDP growth of 5.3 percent in 2009, the economy grew by an estimated 6.8 percent in 2010 and current projections are in the 5–5.5% range for 2012. The rapid recovery was supported by a high level of investment and a there was a strong revival in exports. Foreign direct investments and remittances continued to remain buoyant. Exports in 2010 and 2011 grew at over 20% by value in each year, with exports of the non-oil sector, including agriculture and fisheries, doing particularly well, having registered close to 25–30 percent growth in 2010. The recovery of the real sector of the economy following the crisis was impressive.

An assessment of the success of Vietnam's strong recovery must, however, be balanced on the downside by the recognition that Vietnam has also been beset by higher inflation during this period sending confusing price signals within the economy. The annual inflation rate was hovering at double-digit levels in 2010 and 2011 and Vietnam's currency has been under pressure at times. Foreign exchange reserves declined and Vietnam's sovereign rating was downgraded by some foreign rating agencies in 2011 because of some concerns on macroeconomic management. A debt default by one of the largest state owned enterprises highlighted

Box 2.1: SOE's often operate in an uneven playing field and squeeze out the private sector

In Vietnam, SOEs tend to get preferential access to banking credit, procurement contracts, and research and development compared to their peers in the private sector. One example is the US$2.0 billion in loans extended by government to SOEs in 2010. Another example is the analysis and data generated by more than 300 government controlled research institutes that are made available exclusively to SOEs. Yet another example is the claim in some quarters that he large State Economic Groups are influencing and interfering with important government policy decisions. Unlike the private sector, the SOEs at times face a soft budget constraint, meaning that the state bails them out when they are in financial stress. Under these circumstances, SOEs, despite their operational inefficiencies, can out-compete and crowd out the private sector. Since a vibrant private sector is crucial for a modern, industrialized country, the current policies are dissuading both local and foreign investors from entering the field. Moving forward the government will have to ensure a level playing field if it expects the private sector to value to Vietnam's industrial and agricultural growth.

Source: Vietnam Development Report 2012

potential problems in the large SOE sector. The government took action in 2011 to address emerging problems and several measures to address current problems have already been implemented and a positive assessment of the results has been made by international organizations. Inflation was already down to single digits by 3Q of 2012. Regarding ongoing reforms, as highlighted in the 2011–15 development plan, attention is currently being particularly directed to (i) State Owned Enterprise (SOE) Reform, (ii) investment efficiency; and (iii) financial sector reform.

Prior to the Doi Moi reforms the economy was totally dominated by State Owned Enterprises. The Agriculture sector relied on SOE's for input supply, product marketing and, to the extent it existed, for agroprocessing. Since the introduction of the Doi Moi reforms there has been a consistent rise in the role of the private sector. However the SOE sector still remains an important and influential part of Vietnam's economy, in competition with the private sector. Now, many SOE's are increasingly seen as a growing source of inefficiency, weak competitiveness, and a constraint to private enterprise development based on their performance. For the agriculture sector, successful SOE reforms would encourage the growth of private sector participation in the post harvest value chain in the agriculture sector which is sorely needed in Vietnam and will be an important part of preparing the sector for the challenges of the future. Some of the typical issues of concern linked to SOE performance were highlighted in the 2012 Vietnam Development Report in a section analyzing Vietnam's further development towards a full market economy as described in Box 2.1.

Concerns on the efficiency of the use of capital in Vietnam, particularly by SOE's, were highlighted in the 2012 Vietnam Development Report and have been highlighted at various times by the the government. It was noted inter alia that investment capital output ratios by the Public and Private sectors and by State investments in different sectors showed a decreasing efficiency of investment over the last decade reaching levels which were high enough to cause concern of a misallocation of resources in several sectors. The third area which is an ongoing focus of attention is the reform of the State-owned commercial banks (SOCBs) which dominate the banking system (approximately half of the system). The adequacy of the capital base of these banks and their generally weak loan portfolios are currently under review by the Vietnamese authorities.

Chapter 3. Macro Economic Scenarios: 2012–2040

The Centennial Group model[1] was used to investigate possible economic scenarios for the 2012–2040 period. Finally two scenarios were selected for detailed analysis based on past performance of Vietnam, an optimistic scenario based essentially on a continuation of the current high growth, and a pessimistic scenario based on a poorer performance. The optimistic economic growth scenario is based on Vietnam's historical performance during the last decade, including a brisk investment rate, and a continuing convergence beyond the current middle income status towards a developed industrial economy. Average growth in this scenario would be 7.1% from 2015–2040 mirroring the growth performance achieved over the last two decades. Under this optimistic scenario, the model projection showed that by 2040, over 90% of the population would have reached middle class status, bolstering a strong domestic market in addition to the vibrant export market. This scenario assumed a solid evolution of policies including a good national performance in upgrading the efficiency of investment, building up a strong financial sector, successful SOE reform, a strong and dynamic private sector role in the economy, continued social harmony, and buoyant international economic conditions. The achieved investment rate over the period is projected to average 38%, similar to that achieved over the 2005–10 period, and still an unusually high rate reflecting the heavy investment needed in infrastructure to maintain economic growth and a continuing strong investment in the real economy.

The continued high rate of growth in the optimistic scenario would totally transform the Vietnamese economy and society. In 1980, Vietnam was one of poorest countries in the world. By 2040, Vietnam could have a per capita income of almost US$7,800, a more than six fold increase over 2011 (and 29 times that of 1980). Absolute poverty would have been eradicated. The country's economy will have become one of the top thirty in the world. The country's population growth will slow down to 0.1 percent p.a, with the country's age profile beginning to mature. Instead of having abundant labor, the country will see initial signs of labor shortages particularly in rural areas and low wage sectors. About 50 percent of the population will live in urban areas. Finally, share of agriculture in national GDP will drop from 20 percent in 2011 to only 7% percent in 2040. However rural wages will be a multiple of today's level and disparities between urban and rural wages will begin to narrow. While partly fueled by the country's above average investment rate, economic growth will be driven more and more by productivity growth. In summary, by 2040 Vietnam would have completed its transition to a modern and competitive economy, and a more affluent and mainly urban society.

The pessimistic economic growth scenario assumes an average growth of 4.4% with Vietnam lingering in the "middle income trap" and unable to break out into the higher growth patterns achieved in the past. Vietnam is assumed to follow the kind of restrained growth pattern followed by many other middle income countries after reaching middle income status. By 2040 around 60% of the population would have reached middle class status, considerably less than in the optimistic scenario above. GDP/capita on a real exchange rate basis reaches only $3,657 by 2040 ($9,793 in PPP terms) less than one half of the optimistic scenario. The investment rate is 34% of GDP over the period but investment efficiency tracks current low efficiency levels such as those achieved by many SOE's today. SOE's remain in control of a large part of the national assets and expansion of the private sector is crowded out by this SOE dominance in many sectors. Weaker enterprise performance causes an increasing number of loan defaults making banks more hesitant to finance expansion.

1 See Annex 1 for a more detailed description of the Centennial Group model.

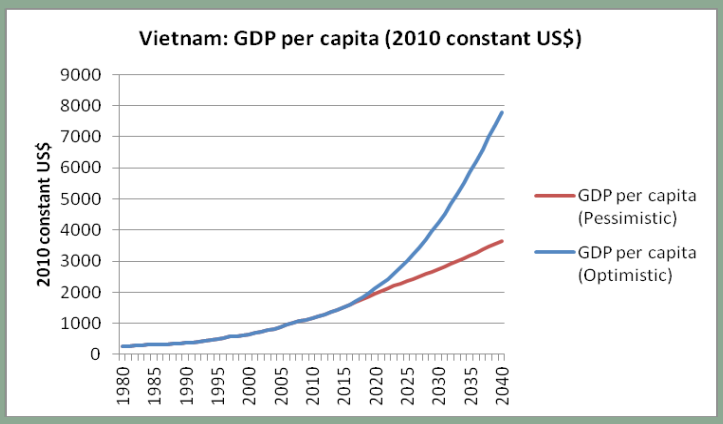
The results from the centennial model simulations described above are summarized in the following tables showing the 2040 outcome of the economic variables simulated and for selected variables, graphs showing the pattern of the 1980–2040 changes:

Table 3.1: Vietnam macroeconomic scenarios

	2011	2040 (optimistic)	2040 (pessimistic)
GDP (constant 2010 billion US$)	110	811	380
GDP per capita (constant 2010 US$)	1,235	7,791	3,657
average GDP growth rate (2011–2040)		7.1%	4.4%
average TFP growth rate (2011–2040)		4.3%	2.3%
% of population at least middle class	10%	96%	61%
poverty below $1.25 per day[1/]	9%[1]	negl.	negl.
poverty gap	2.4%	0%	0%
population (millions)	89	104	104
urban population (millions)	28	52	52
rural population (millions)	61	52	52
agriculture as % of GDP (high TFP)	21%	7%	15%
agriculture as % of GDP (low TFP)	21%	5%	12%

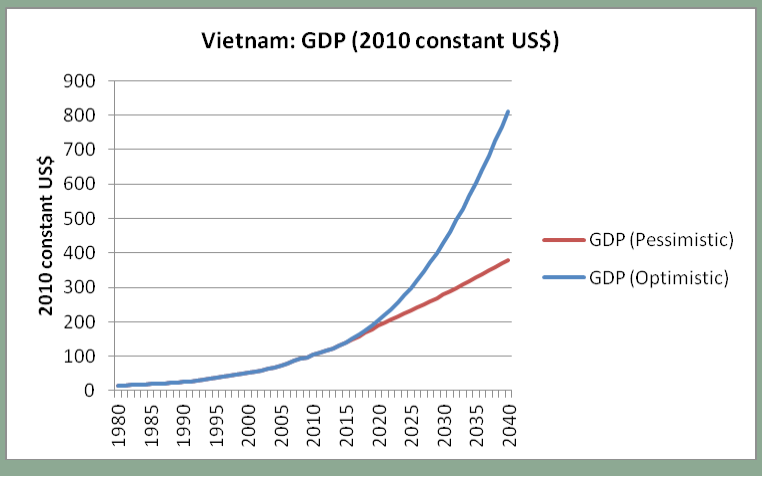
Source: Economic Projections from the Centennial Model 2012–2040
1/ WDI

Figure 3.1: GDP/capita scenarios



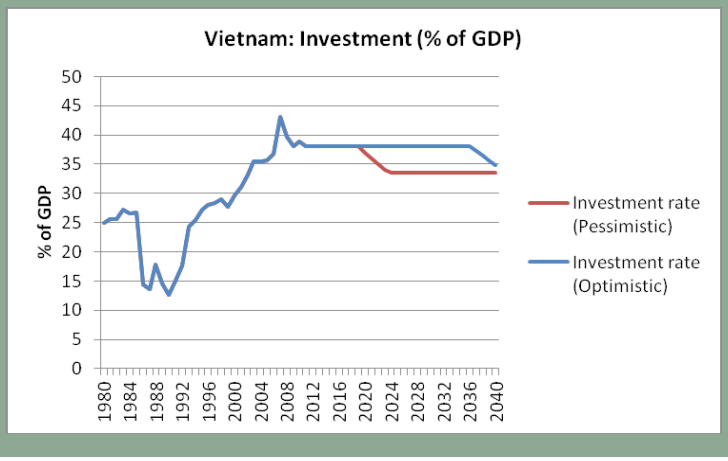
Source: Centennial Model.

FIGURE 3.2: GDP SCENARIOS



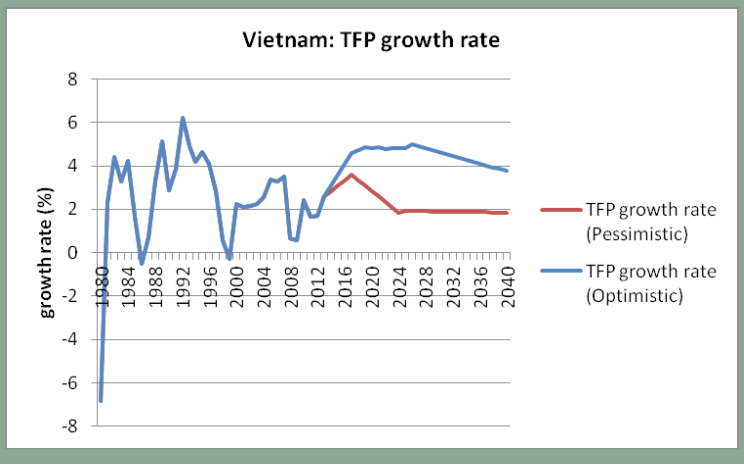
Source: Centennial Model.

FIGURE 3.3: INVESTMENT AS % OF GDP



Source: Centennial Model.

FIGURE 3.4: TFP GROWTH RATE SCENARIOS



Source: Centennial Model.

Chapter 4. Agricultural Sector Performance (1980–2011)

The ASEAN countries enjoyed a robust growth of 2.7 percent per annum in agriculture between 1985–2010. ASEAN compared favorably with the global agricultural growth rate (2.4 percent) during 1980–2011; however, this growth rate lagged that of China (4.3 percent) and India (3.1 percent). The region's rich resource endowment (arable land and water) combined with relatively low wage rates have allowed most ASEAN countries to benefit from robust global demand. As the overall GDP growth rate (5.0 percent) was even higher than agriculture, the share of agriculture declined. From 1985–2010 this share went from 22 to 12 percent.

Presently five out of the eight ASEAN developing countries have a surplus trade balance in agricultural products; the rest are net food importers and must rely on international trade to feed their population. Indonesia enjoys a buoyant and rising overall agricultural trade surplus largely driven by the phenomenally rapid increase in oil palm exports; Vietnam has gradually increased its exports largely due to rice, fisheries, rubber and coffee; but the Philippines is facing a rising deficit.

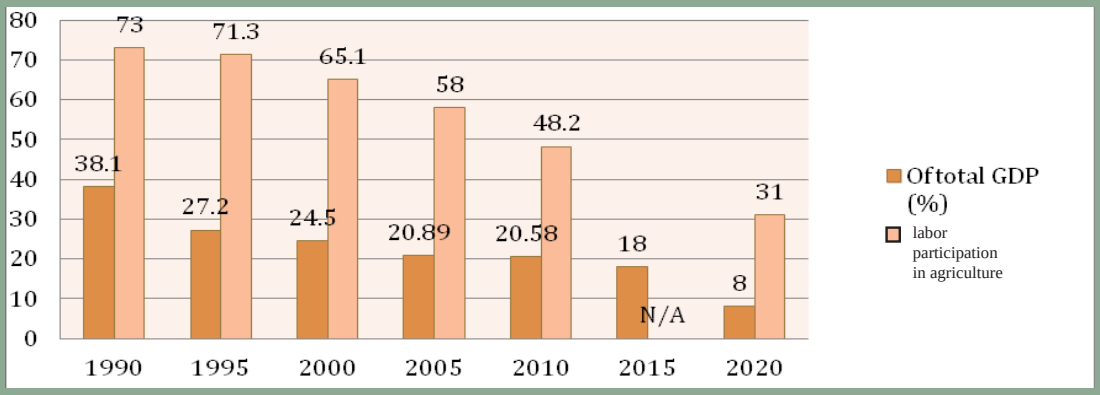
Rice is an important factor in ASEAN trade. According to the US Department of Agriculture 2012 estimates, the top ten rice exporting countries include four ASEAN members: Thailand (8.0 million tons), Vietnam (7.0 million tons), Cambodia (0.95 million tons), and Myanmar (0.75 million tons). By comparison, ASEAN importers in 2010 were: Philippines (2.6 million tons), Malaysia (1.0 million tons), and Indonesia (0.8 million tons). Overall, ASEAN countries enjoy a large and even rising surplus of rice that is exported around the world.

Vietnam. In the past thirty years, the country's agricultural sector has undergone a dramatic change both on the demand and supply side. As per capita income has steadily risen and the incidence of poverty dropped rapidly, the average Vietnamese's diet has undergone a major shift. Rice consumption per capita has declined while the consumption of meats, fish, horticultural products, etc. has risen. On the supply side, Vietnam has gone from a net importer of food in 1980 to a major exporter of rice and fish products. Its average annual growth rate of agricultural GDP has been 3.6 percent, a level surpassed only by China, out of the other major agriculture producers. This impressive growth was driven by agriculture TFP growth of 2.3 percent. In addition to enhancing food security, this healthy agricultural growth has led to a sharp reduction in poverty. This section describes the current situation of the agriculture, livestock and fisheries sectors in Vietnam and some of the key issues that may hold back these sectors in the coming years. We start with an overview of the key food crops and industrial crops, and recent performance, bringing out which crops have been more successful. We then cover livestock and fisheries. Finally we review selected issues which will be important for the sustainability and sector growth in the coming years.

Overall sector performance

In 1990, before the rapid growth inspired by the doi moi reforms, agriculture contributed 38% to the GDP and provided employment for some 73% of the workforce. The high workforce/GDP ratio (1.9 in 1990) is indicative of the relatively lower value added by agricultural workers compared with other sectors of the economy at the time. By 2010 the contribution of the sector had dropped to just over 20%, and employment to 48% of the workforce. During these two decades agriculture grew consistently but the industry and service sectors grew faster leading to the relative drop in the contribution of the buoyant agriculture sector. In 2010 the workforce /GDP ratio was higher at 2.5, indicating a widening gap between productivity of agriculture and the other main sectors driving the economy.

Figure 4.1: Contribution of agriculture to Vietnam economy



Source: MARD/GSO.

The continued growth of the agriculture sector of 3–4% over many years since the nineties (see Table 4.2) is a creditable performance compared to regional comparators (Philippines has achieved 2.0% and Indonesia 3.0%). This sustained growth has led to food surpluses and reduced poverty in the rural areas. The parallel high growth in industry and services, which have achieved a growth rate of three to four times that of agriculture has tended to increase the income gap between rural and urban areas and increased the rate of rural to urban migration. Agriculture has slowly had its dominant role in the economy reduced as the other sectors have grown faster. This is consistent with the experience in many other countries, and may presage an increased interest in part time farming by segments of Vietnam's rural population. There are some signs that this is beginning to place in the Red River region. Rice dominates the national agricultural production. The following tables

Table 4.1: Agricultural sector statistics 2011

% of labor force in agriculture	48%
total VN land area (ha)	33,121,000
total ag. area (ha)	9,400,000
total annual crop area (ha)	6,200,000
total rice sown area (ha)	7,651,000
total rice land area (ha)	4,100,000
average paddy yield (tons/ha)	5.53
total rice production (paddy, t)	42,324,000

Source: MARD and GSO.

Table 4.2: Agriculture growth performance 1995–2010

	average annual growth rate of Vietnam's agricultural GDP (percent)
1995–2000	4.01
2001–2005	3.83
2006–2010	3.3

Source: MAR

list some key facts about agriculture in Vietnam today and recent growth performance:

Food and industrial crops

While rice has been and remains the dominant crop, agricultural diversification has also contributed significantly to the success of the agricultural sector. Rice covers some two thirds of the area planted to annual crops. During the major growth period following the "privatization" of land use between 1990 and 1998, while the rice cultivation area increased by 20 percent, crop diversification took hold among a farming community exercising newly granted freedoms. The area under industrial crops nearly doubled, while areas planted to annual crops such as fruit crops, vegetables, and legumes increased by more than 50 percent. Vietnam is now a major exporter of coffee and rubber, and is now the largest exporter of cashew kernels, having overtaken Brazil and India. (India, however, remains the largest producer.) Livestock production has been promoted and has expanded

to cater for a domestic market where consumption has doubled in 10 years. Vietnam is currently a major producer of pork and chickens (see Tables 4.1 and 4.2 below). There is also a strong growth in beef production but from a low base.

After rice, the other major annual crop with a significant land occupation in 2010 was maize covering about 1,100,000 ha. Other key crops included: (i) rubber: 760,000ha; (ii) Coffee: 548,000ha; (iii) Cassava: 496,000ha; (iv) cashew nuts: 360,000ha; (v) sugar cane: 260,000ha; (vi) peanuts: 249,000ha; (vii) coconut: 139,000ha. In the recent period crops being more favored by farmers (i.e. with an increasing area planted) in the 2003–10 period include maize, rubber, coffee, cashew nuts and tea. Crops which have been less favored by farmers include cotton, jute and sugar cane. It is likely that these shifts have been partly in response to market signals since WTO membership has tended to sharpen market signals in Vietnam. Cashew nuts have been developed into an increasingly important export since the early nineties. Maize has become an important crop for animal feed and as a secondary food crop when rice is too expensive. Average yields of most crops recorded over the 2000–10 period have generally shown a steady growth totaling some 20–30% over the period with a few exceptions such as cotton. Crops which have shown an unusually good performance include Cassava (average yield growth of 100% from 2000–2010 based mainly on the introduction new varieties) and Maize (average yield growth of 48% 2000–2010 based mainly on better dissemination of hybrid varieties supported by public and private sector extension). This suggests a solid performance by supporting services and research in Vietnam over the period (in addition to the favorable climatic situation experienced).

Food crops

Some details of performance by different food crops 1990–2010 are given in Table 4.3.

Figure 4.2 showing the growth of rice production in Vietnam from 1990–2010 underlines the dramatic success of Vietnam's rice policy. The rice sown area has reached a ceiling of around 7.0–7.5m ha, while yields have continued to grow leading to a continuous growth in production[1]:

The rice crop occupies some two thirds of the agricultural land in Vietnam. In the best conditions, three crops of rice are now possible from the same plot of land. This occurs mainly in parts of the Mekong Delta Region. The most productive crop is Winter-Spring paddy where paddy yields of 6–6.5t are now common. The area under this crop has grown by some 50% in the last two decades and yields by the same amount, leading to an increase of 150% of production during this 20 year period. Winter Spring paddy accounts for about 50% 0f Vietnam's rice production. The later Summer-Autumn paddy has doubled in area during the same period and yields have grown by some 35% leading also to a 150% increase in the production of this crop. At 4.8t of paddy/ ha (2010) this crop is less productive than the earlier Spring crop because of a shorter season and less conducive climatic conditions. Finally the Winter Paddy crop, a short season crop, was planted on 28% less area in 2010 compared with 1990. With yields of around 4.6t of paddy/ ha this is the least productive irrigated rice in Vietnam.

Nationally there were around 6m ha of rice planted in 1990 and this figure had grown to around 7.5m ha by 2010. During this same period national production more than doubled from 19mt of paddy to 40mt with the use of better seeds and better crop management. However the statistics indicate that the rate of growth of production has been slowing in recent years and may be reaching an economic limit with the current technologies available. The average yield of all types of paddy in 2010 was 5.32t/ha, and in 2011 5.53t/ ha.

1 "Moving the Goal Posts: Vietnam's Evolving Rice Balance and Other Food Security Considerations" by Steven Jaffee, NguyenDo Anh Tuan, Nguyen Ngoc Que, Dao The Anh, Nguyen The Dzung, Nguyen Ngoc Mai, Vu Nguyen, and Nguyen Anh Phong. This paper, which is full of interesting analysis of Vietnam's rice sector, was derived from a collaborative research program dealing with "Vietnam Rice, Farmers, and Rural Development: From Successful Growth to Sustainable Prosperity". The research program benefited from the generous support of the Canadian International Development Agency (CIDA) and the Global Food Crisis Response Program.

TABLE 4.3: MAJOR FOOD CROPS, AREAS UNDER CULTIVATION, YIELDS, AND TOTAL NATIONAL PRODUCTION (1990–2010)

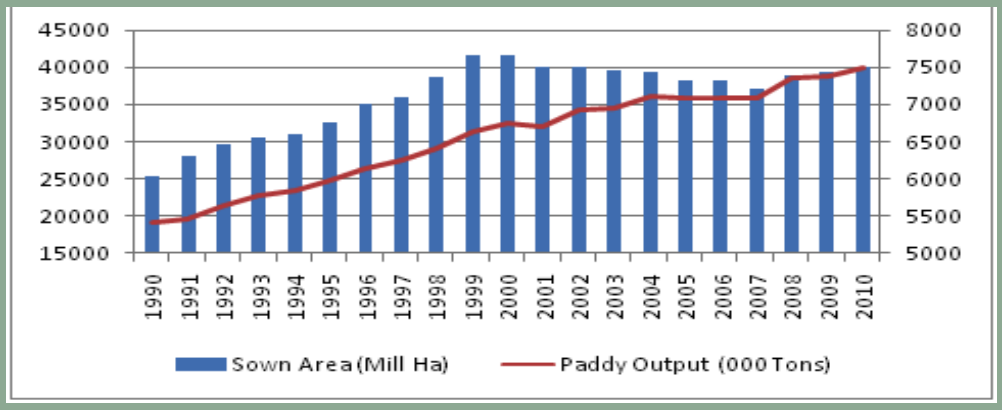
	unit	1990	1995	2000	2005	2010
Winter–Spring paddy						
area under cultivation	1000 ha	2,073.60	2,421.30	3,013.20	2,941.70	3,086.10
productivity/yield	quintal/ha	N/A	44.30	51.70	58.90	62.30
production	thous tons	7,865.60	10,736.60	15,571.20	17,330.20	19,218.10
Summer–Autumn paddy						
area under cultivation	1000 ha	1,215.70	1,742.40	2,292.80	2,349.30	2,436.00
productivity/yield	quintal/ha	N/A	37.30	37.60	44.30	47.60
production	thous tons	4,090.50	6,500.80	8,625.00	10,436.20	11,595.70
Winter paddy						
area under cultivation	1000 ha	2,753.50	2,601.90	2,360.30	2,037.80	1,991.60
productivity/yield	quintal/ha	N/A	29.70	35.50	39.50	46.10
production	thous tons	7,269.00	7,726.30	8,333.30	8,065.10	9,175.10
maize						
area under cultivation	1000 ha	431.80	556.80	730.20	1,052.60	1,126.90
productivity/yield	quintal/ha	15.54	21.10	27.50	36.00	40.90
production	thous tons	671.00	1,177.20	2,005.90	3,787.10	4,606.80
sweet potatoes						
area under cultivation	1000 ha	321.10	304.60	254.30	185.30	150.80
productivity/yield	quintal/ha	60.08	55.35	63.36	81.50	87.30
production	thous tons	1,929.00	1,685.80	1,611.30	1,443.10	1,317.20
cassava						
area under cultivation	1000 ha	256.80	277.40	237.60	475.20	496.20
productivity/yield	quintal/ha	88.62	79.72	83.60	157.84	171.70
production	thous tons	2,758.00	2,211.50	1,986.30	6,716.20	8,521.60
sugar cane						
area under cultivation	1000 ha	144.60	224.80	320.30	266.30	266.30
productivity/yield	quintal/ha	413.27	476.47	497.70	561.30	598.80
production	thous tons	5,405.60	10,711.10	15,044.30	14,948.70	15,946.80
peanut						
area under cultivation	1000 ha	201.40	259.90	244.90	269.60	231.00
productivity/yield	quintal/ha	10.59	12.87	14.50	18.10	21.00
production	thous tons	213.20	334.50	355.30	489.30	485.7
soya-bean						
area under cultivation	1000 ha	110.00	121.10	124.10	204.10	197.8
productivity/yield	quintal/ha	7.87	10.36	12.00	14.30	15.00
production	thous tons	86.60	125.50	149.30	292.70	296.90

Source: annual reports of the Ministry of Agriculture and Rural Development & General Statistics Office & FAO

MAIZE

In response to growing demand for maize (both for human consumption and as animal feed for livestock and fisheries) farmers have changed their cropping pattern and the harvested area of this crop went from 431,800 hectares in 1990 to 1,126,390 hectares in 2010 (FAOSTAT). Maize is primarily used as a fodder crop but also as a secondary cereal crop replacing rice whenever prices are too high for the household to afford buying it on the open market. Maize is also a commonly consumed food crop in the NW mountain areas, which are less suitable for rice production. Yields have shown an impressive growth in recent years, but at 4.1 t/ha, although in line with regional norms (comparable yields in Indonesia are 4.4 t/ha and in Thailand 4.0 t/ha), they are still well below their potential (e.g. Malaysia's yields are 5.7 t/ha). Despite the impressive expansion of area and production of maize (from 670,000 tons to 4.6 million tons

FIGURE 4.2: NATIONAL PADDY OUTPUT AND PLANTED AREA, 1990 TO 2010



1990–2010) the country must resort increasingly to feed grain constituent imports ($2.3 billion in 2010) to meet local demand for feed grain given high growth in the livestock and aquaculture sectors. Unless yields can be improved, or the maize area can be expanded, the gap between supply and demand is bound to increase further.

Cassava

Cassava started out as a food crop but in recent years production has shifted to industrial use in much the same way as in Thailand[2]. Changes between 1990 and 2010 were: production increased from 2.27 million tons to 8.5 million tons; harvested area from 256,000 ha to 496,000 ha. In addition to the area expansion another factor contributing to the growth was the introduction of improved varieties that were developed by the Vietnamese research establishment and the demand pull and support from the processing industry. Average yields doubled between 2000 and 2010 from 8.9 tons/ha to 17.2 tons/ha. As has been the experience with other crops, the addition of a processing option (in this case the production of cassava as starch processing, animal feed and bio-ethanol) has enabled the country to benefit from considerable value addition and the creation of well paid jobs in rural areas. Cassava is now an important source of cash income to small farmers, who either use it for animal feeding or for sale to starch factories.[3]

Other food crops

Wheat is not grown in Vietnam, but wheat flour is a major imported item. Wheat bread is increasingly popular in urban areas and imports of wheat flour have been increasing rapidly and were valued at $787 million in 2011. Wheat now partly substitutes for rice in many urban diets. Other important food crops include peanuts, soybeans, sweet potatoes and sugar cane. Of the four crops, soybean has shown the best growth in the 1990–2010 period, with a doubling of yields and an 80% increase in the area planted leading to close to a fourfold increase in production. Good production increases have also been recorded for peanuts and sugar cane, mainly through yield increases; planted areas have only increased marginally. Sweet potatoes are one food crop for which production is less today (35% less) than it was 20 years ago.

Perennial crops

The trend over the last five years of production and land use data from 2005–11 are presented below for the major perennial crops. There has been a major expansion of rubber planting, while coffee and pepper planted area has increased moderately. Tea, cashew, and fruits area remained fairly steady:

2 This section is partly based on analysis contained in a discussion paper, Making Markets Work for the Poor: The Participation of the Poor in Agricultural Value Chains—A Case Study of Cassava, September 2005—Nguyen Do Anh Tuan and Luigi Cuna.

3 (Hoang Kim, Nguyen Van Bo et al. 2010).

TABLE 4.4: PERENNIAL CROPS' PRODUCTION STATISTICS 2005–11

indicator		unit	2005	2009	2010	2011	growth 11/10
tea	area	1000 ha	122,5	134	129,4	126,3	-2,40
	yield	tons/ha	5,9	6,7	7,3	7,7	6,36
	production	1000 tons	570	750,4	823,7	888,6	7,88
coffee	area	1000 ha	497,4	538,5	548,2	570,9	4,14
	yield	tons/ha	1,8	2,0	2,1	2,2	1,91
	production	1000 tons	752,1	990	1105,7	1167,9	5,63
rubber	area	1000 ha	482,7	620	740	834,2	12,73
	yield	tons/ha	1,5	1,7	1,7	1,7	-0,06
	production	1000 tons	481,6	646	754,5	811,6	7,57
pepper	area	1000 ha	49,1	50	51,3	55,4	7,99
	yield	tons/ha	2,0	2,2	2,5	2,4	-2,99
	production	1000 tons	80,3	95	111,2	109,4	-1,62
cashew nut	area	1000 ha	348,1	420	372,6	360,3	-3,30
	yield	tons/ha		1,0	0,9	1,0	12,94
	production	1000 tons	240,2	300	289,9	318	9,69
fruit crop area		1000 ha	767,4	820	776,3	694,9	-10,49
perennial crop area		1000 ha	2468,2	2710	2617,8	2642,0	0,92

Source: MARD

INDUSTRIAL CROPS

The two major industrial crops involving private farmers are rubber and coffee. The current situation of these crops, and current issues are as follows:

RUBBER[4]

In 2011, the total rubber planted area in Vietnam reached 834 thousand ha, a year on year rise of 11.4%. This is about 4% of the world planted area of rubber. Of this area, the harvested area in Vietnam reached 472 thousand ha, making up 56.5% total rubber planted area in Vietnam. The balance was not harvested, typically being not yet ready for harvesting or too mature. The rubber crop has shown dynamic growth in Vietnam. From 2002–2011, the total rubber area rose an average of 6.9%/year. In the past decade, Vietnam planted new areas and replanted old and stunted rubber areas with harvest rubber area ratio of about 57–70%. Rubber production is part of the food security story in Vietnam because some 40% of rubber production currently comes from small farms as a useful cash crop. In addition the rubber plantations provide labor opportunities for rural workers. An added interest is that many of the rubber tree areas are planted in hilly zones where poverty is more prevalent.

The major issues for the rubber sector are the limited amount of land available for planting in Vietnam and the volatile international prices which greatly complicate planting and investment decisions. Shortages of suitable land in Vietnam have led some Vietnamese investors to expand operations by planting in Laos and Cambodia. So far some 30,000 ha have been designated for this expansion in these countries. There is no easy answer to the price volatility issue. For example the 2011 Q1 NY price was 400% (4 times) the 2009 Q1 price and current (2012 Q3) prices are a long way from the projections for the price made only a few months ago based on expected demand from China. However latex yield in Vietnam has generally been at the high end of world production and costs are competitive suggesting that Vietnam will maintain a competitive advantage in rubber production. In 2011, the average latex yield in

4 Statistics and information developed from the 2012 Vietnam Rubber Report.

Vietnam reached 1.72 tons/ha which is higher than global averages (1.14 ton/ha) and among the highest yield of large natural rubber producers in the world.

Coffee[5]

Coffee comes second to rubber as a strong export crop and one which is widely cultivated by small farmers bringing important cash income as part of the family revenue. Around 1 million farmers grow coffee as part of their agriculture, and in addition the sector creates temporary jobs for some half million laborers. Vietnam's coffee production and exports have shown a steady progression over the last two decades. With a current planted area of 570,000 ha (2011) Vietnam is now the second largest producer in the world after Brazil and fourth in terms of planted area after Brazil, Indonesia and Columbia. Export value in 2011 was recorded as $2,69B, some 61% more than 2010 because of a sharp rise in export prices, with an export tonnage of 1.22mt. Although coffee is grown widely, in 25 of the 63 Provinces, 85% of the production is in 5 Provinces in the Western Highlands, centered around Daklak.

Robusta coffee is the main variety grown in Vietnam, but efforts are now being made to introduce Arabica in some of the higher zones. Current production of Arabica is around 5% of total production.

Major issues for the coffee sector include: (i) the current mature age distribution of the trees which can result in a sharp fall off in production in a few years unless a major replanting program can be introduced; (ii) the generally poor quality of planting material that can be made available to farmers; (iii) continuing pest/disease problems; (iv) the limited free land available for extending planting to new areas; (v) the high financial risks for farmers who want to renew their trees in a sector of high price variability. In addition the post-harvest value chain is weak and leads to some excessive losses during the drying and processing stage. Overall there is a need for investment in the sector but investors are wary to proceed without some risk mitigation support.

5 Basic data and information on the coffee sector was supplied by MARD and Vietnam Coffee-Cocoa association members.

Livestock

Vietnam has managed to make major changes to its livestock sector over the last two decades to stimulate production, and in the process achieved substantial increases in animal numbers and productivity. After 2000, through active support from the government, the livestock sector's development took off rapidly (see Production Tables below). The government intensified its attention for and investments in the sector, and at the same time some major direct foreign investments were made in feed milling and livestock operations. In parallel the consumption of all animal products started to increase rapidly due to increased affluence of the people of Vietnam. Between 2000 and 2005 dairy imports increased from 307 million to 715 million USD to meet domestic demand. As animal production increased so did the need for animal feeds and there was a major increase in the imports of animal feed as local production did not keep pace with demand. Here there was an even stronger increase in value from 597 million USD earlier to 2300 million USD in 2011. This serves as an illustration how vast the growth in this period was. The following tables show production performance of poultry, pork and beef and animal products from 1995–2011.

Table 4.5: Livestock production

year	1995	2000	2005	2008	2010	2011
poultry (million)	108.0	147.1	160.0	176.0	218.2	232.7
poultry Meat 1000 ton	197	287	322	448	621	390
maize equivalent[2]	227	331	372	517	717	450

The effort to satisfy high demand growth since 2000 triggered some selected government support to remedy the shortages. For dairy this support was especially in Artificial Insemination and import of dairy breeds to upgrade the traditional Yellow Vietnamese cattle and increase its dairy potential. The growth in overall livestock production was a combination of increasing animal numbers and productivity increase due to better feed and genetics. These develop-

Table 4.6: Pork production

year	1995	2000	2005	2008	2010	2011	2012
pork ('ooo ton)	1007	1409	2288	2806	3036	3099	2840
maize equivalent ('ooo ton)	1359	1902	3089	3788	4098	4184	3834

Source: MARD

Table 4.7: Dairy products

year	1995	2000	2005	2008	2010	2011	2012
dairy cows (1000)	18.7	35.0	104.1	107.9	128.4	142.7	155.0
fresh milk 1000 ton	20.9	51.4	197.8	262.2	306.7	345.4	350

Source: MARD

ments often happened in the backyards of farmers in small villages, where in the past only a small number of animals for self-sufficiency and selling of surplus were kept. However this rapid expansion under these conditions has had a number of downsides: the close proximity of animal-animals and animal-humans has increased the risk of disease transmission and made control of diseases difficult due to poor biosecurity. It was exactly in this period that HPAI[6] was found to be present in Vietnam and found the conditions in Vietnam to become endemic. It also caused negative environmental effects. The government now makes efforts to encourage a better separation of animals from people and animals from animals.

Livestock sector Issues

Current issues for the sector are mainly focused on animal health and food safety concerns and the effect on the environment of many of the traditional systems of livestock development while trying to meet the growing consumer demand. There are no easy solutions to the current problems being faced of this rapidly growing sector.

Animal health

Vietnam needs to continue to make progress on animal health issues. The World Organization for Animal Health (OIE) in its Terrestrial Animal Health Code has recommendations on how this world animal health standard setting body sees the ideal veterinary services. This is with a Chief Veterinary Officer (CVO) with, if not the same status as a minister, then at least the authorization to talk to the various ministers involved in the livestock sector (Industry and Trade, Public Health) and a single line of command all the way down to the veterinarians operating at village level. Unfortunately in many countries decentralizations have eroded this line of command. In Vietnam there is an additional particularity in that the People's Steering Committee on the advice of the government veterinarians will or will not declare the outbreak of a disease. Also the reports from the provincial veterinary services to the central level veterinary department are scrutinized by the Steering Committee. For Vietnam to build up an efficient and effective veterinary services there is need for up to date veterinary legislation, on which the politicians can shed their light to agree with the underlying principles of how the veterinary services operates; the outcome of the veterinarians' work process should however not be influenced by politicians without the required technical knowledge and experience in the field of animal diseases.

Safety of livestock products

Vietnam has an increasing number of incidents of non-conformity with food safety standards and needs to take bold action to remedy this: the formation of a national food safety council with far stretching authority, also towards the ministries involved, is a step to be taken. A new law on Food Safety was gazetted on the 4th of July 2011. MARD is only mentioned in 1 article, whereas most food safety infringements are usually related to products of animal origin. Such a law should refer to the existing veterinary legislation to spell out what is expected from the veterinary services in terms of their contribution towards food safety assurance.

6 HPAI: Highly Pathogenic Avian Influenza

Currently ensuring food safety from on farm production up to consumption is split between MARD for production, Industry and Commerce for processing, storage and packaging and Ministry of Health for the effect of the products of animal origin on the consumers. There are as anywhere questions about the competence of each party in different segments of the value chain, areas that are undercovered and in general this system does not lead to sufficient assurance on the food safety control systems. In the European Union specialized agencies have been set up in all member states, in which the control and inspection functions of these three ministries have been brought together in one agency, usually with its director at ministerial level. This means that the 3 ministries can continue to fulfill their core tasks and don't need to be a judge over their own work: especially in crises or serious shortcomings in the normal technical functioning of a ministry its control and inspection department might be tempted or even told to cover up. Vietnam has too many technical issues in all three sectors to be addressed to expect the ministries to be able to also make fair and unbiased judgment on its systems, procedures and processes. Current ideas are to try to address deteriorating animal health and food safety problems through the introduction of a series of Good Animal Husbandry Practices (Viet GAHP[7]) designed address the specific conditions of livestock development in Vietnam. For example development (herd expansion) is to be mainly limited to take place in locations, which are distant from human centers where animals can optimally produce, where the environment is saved through the application of measures to process the waste and biosecurity can be maintained. The government also aims at farmers associating to create larger units and economics of scale. For all of these developments to take place considerable investments are required which the average livestock farmer does not possess and which the state budget can also not pay for. New private sector investment in commercial livestock farms therefore seen as a possible way forward.

Besides the government's role in food safety assurance the private sector will also have to start taking responsibility for its own products and production methods, whereby the government does the control on the control.

Declining profit margins in the livestock sector

The rapid increases achieved in livestock production have come at a price to the environment and there are continued concerns with non-compliance with food safety requirements. In addition, recent years have seen stagnating producer prices and increasing costs for livestock farmers leading to decreasing profit margins per animal. Livestock farmers are being increasingly forced to increase their numbers of animals if they want to stay in business and improve on their management. Calculations from the CARD project[8] showed that a smallholder in 2008 would need at least 8 sows to have a profitable pig breeding enterprise; this number is bound to have increased during the last 4 years with the vast increases in stock feed and other prices.

The government has an active policy to promote private investment in agriculture. In 2010 Decree 61 set out a SME policy, which for particular branches would give tax relief and government support in case it engages in advanced technologies in the agricultural sector. Livestock farmers are being encouraged to take advantage of the provisions of this new policy to help them expand operations to more profitably sized units.

Challenges for the Vietnamese livestock sector: the declining number of traditional farms

There is wide gap between the ideal models of the future and the traditional production model. It is one thing to set up pilot model pig farms in each province, far from the population, with a progressive farmer, treating the waste water, complying with the 17 aspects of VIET-GAHP, it is another thing to assist the current 3.418.000 farmers keeping pigs to modernize their farms. The technical and financial challenges are such that sector representatives estimate is that in 2040 only around 10–12% of these farmers will still be pig farmers. In the other livestock sectors similar issues exist. The wave of the future will be the corporate farming

7 http://www.thucphamantoanviet.vn/a-aproducers-and-traders/b-pork-chicken/a-quality-assurance-systems/pork-poultry-vietgahp/1200_-_pork_-_sops_for_on_farm_-_pork_production_-_version_2.pdf

8 "For the Cause of Agriculture and Rural Development in Vietnam", pers comm. Mr. Keith Milligan, former Technical Coordinator of CARD

sector, which is so far quite underdeveloped in Vietnam. Current estimates are that less than 5% of the aggregate livestock production comes from the corporate farming sector. It is to be expected that in the years to 2040 this share will increase to somewhere between 30 and 50% as already happened in other countries in the region, where these developments started earlier than in Vietnam.

Consumer behavior and choice: Vietnamese consumers have strong preferences

Consumers in Vietnam will form an important driver for the production sector to achieve food security. It was found that both income and price elasticity of fresh fruit and vegetables expenditure from supermarkets were much higher than those from traditional retailers. Also in the case of meat consumers are prepared to pay higher prices for meat products from supermarkets. It might be caused by a quality difference, but most likely to food safety concerns of the increasingly affluent urban Vietnamese consumers. Therefore consumer preferences are a strong reminder to the sector to give meaningful guarantees to the consumers about product quality and safety: the ongoing depressed milk consumption and choice for local products after the melamine scandal in China proves how difficult it is to regain lost trust.

Vietnam is considered an "early supermarket penetration" country, part of the 'third wave'. This means that there is tremendous interest from foreign investors to become part of this growth. Modern retail channels, be it supermarkets or fast-food chains, will play a major role in future growth and will determine increasingly what type of a product is required. Also in Vietnam the working middleclass needs convenience and cannot afford to trek every day to the wet markets to purchase its meat, fruit and vegetables. Also the better-informed consumers realize that street vending and wet markets do not have the conditions to deliver a hygienic product. There are currently 636 supermarkets, 120 commercial centers and over 1000 convenience stores according to the Ministry of Industry and Trade. This still does not seem to fulfill the demand. Local retail will need to receive some protection from the foreign investors by the government to create a level playing ground: the might of the established internationally operating retailers is too big for them to compete. Local retail is important to conserve a place for the local products on the shelves and in the consumption pattern of especially the urban consumers.

Environmental concerns

The number of livestock in the settlements has reached levels under which the environment suffers. Major investments are made to promote biogas, but these reach only a fraction of all farmers and the effluent still has to be disposed off in a responsible manner. Moving livestock production away from the people is a laudable move, but due to land and money restrictions not possible for all. Simple slurry and manure storage structures have to be designed, whereby composting with the now often burned rice straw would produce a tradable soil improvement commodity: compost. The technology to process manure and straw, even using worms such as Californian tiger worms to speed up the process has to be developed, extended and promoted.

The continuous maize production on the sloping lands in the North is leading to erosion, in some places already severe erosion. Most of these areas are inhabited by ethnic minorities. The maize cultivation should be strongly embedded in a farming system of ruminant production, whereby the soil on the slopes if not through terracing then at least through grass strips is stabilized and farmers can use maize stover and cut grass from the anti-erosion strips to feed their livestock. Through these interventions the increase in numbers of ruminants through the close combination and integration with crop production is feasible.

Helping traditional livestock farmers

Vietnam has managed to make major changes to its livestock sector, whereby tremendous increases in animal numbers and productivity have been achieved. The drive to modernization has paid off in terms of self-sufficiency through increased production. There is however still a large number of livestock farmers, which due to age, lack of land and finance or simply because they are not interested who

will continue to depend upon the old way livestock keeping. With their children being educated and most probably opting for a life outside agriculture they form a large group of "last generation" livestock farmers. This group should not be forgotten in all the strategies. Their strong point is the type of product they produce, for which a premium price can be gotten when it is brought in the right form to the market. This forms the best chance for this group to secure their livelihood through livestock production. Certain measures will have to be taken to achieve this.

Technical Details on each of the issues listed above are in the Livestock Appendix.

Chapter 5. Fisheries and Aquaculture

Introduction

The fisheries and aquaculture sectors in Vietnam, which cover marine fisheries, inland fisheries and aquaculture, are a complex and important contributor to the country's economy and food security. They provide employment and foreign exchange earnings and essential animal protein for a large part of the population. Total national production is currently (2011) around 5.3m tons. There has been a major growth of the sectors during the last two decades. Marine capture fisheries increased over three times from 728,000 tons to about 2.0 million tons from around 1990 to 2010 while aquaculture increased nearly 20 fold from 162,000 tons to about 3.1 million tons. In addition, reports indicate that at least another 200,000 tons is derived from inland capture fisheries although this is probably underestimated (see below). Exports of part of the national production have been buoyant reaching some US$6 billion in 2011. The export volume represents about 40% of the total yield with the balance consumed domestically and contributing about 30% of the animal protein consumed in the country as compared to about 40% for Southeast Asia. It is estimated that rough 4.5 million people are directly or indirectly engaged in aquaculture and fisheries activities.

Fisheries and aquaculture: current situation

Marine fisheries. Out of the marine catch reported for 2011 of 2.0 million tons from Vietnam's roughly 1 million km2 Exclusive Economic Zone (EEZ) 15% is exported (high value including tunas), 20% is consumed fresh as food, 35% goes to animal/fish feed (smaller species including juveniles) and fish meal and 30% is used for fish sauce (mainly sardines).

Regarding the fishing potential in the EEZ, estimates have been made of the standing stocks and maximum sustainable yields (MSY). The latest estimate of the standing stock by Vietnam's fisheries experts is about 5mt of which the MSY is estimated to be 2.15mt. Since the total 2011 catch was reported at 2.0 million tons from Vietnam's marine fisheries, these statistics suggest that the current yield is nearly at the MSY, which means that the standing stock is currently being fished near the currently estimated MSY. Due to the excessive fishing pressure in near-shore areas (roughly 80% of the estimated 130,000 fishing vessels with under 90 HP engine capacity in Vietnam fish within about 24 nautical miles (nm) of the shore which represent 25% of the EE) , it is likely that the near shore areas at least are over-fished.

To help with fisheries management the government monitors the vessel engine capacity being used to fish in different areas. Under the 2010 Prime Minister Decree 123/2006/ND-CP, fishing is currently restricted to areas and is being controlled in reference to fishing boat engine capacity. Within 1–6 nautical miles (nm) from the shore, only boats with engine capacities up to 20 HP are permitted to fish; between 6–24 nm boats with engine capacities 20–90 HP are permitted; and, from 24 nm up to 350 nm, those above 90 HP are permitted to fish. With regard to the current level of "mobilized boat horsepower" in Vietnam's waters, it has been increasing progressively especially over the past 20 years. During this period boat engine capacity fishing in the EEZ has increased over 400 fold from about 17,000 HP reaching some 8 million HP in 2011. According to available statistics from MARD, the catch per unit HP has more than halved during this period from about 0.8 tons/HP/year to about 0.36 t/HP/year, though the production per vessel has at the same time increased from about 9 to 22 tons/vessel/year. It has also been reported that the size and thus the value of the fish caught has also declined.

Ongoing government actions to limit overfishing in marine areas. To reduce fishing pressure during critical breed-

ing periods, the 2011 Prime Minister's Decision 89/2011/TT-BNNPTNT established closed fishing seasons in specific areas within the EEZ. In addition, the 2005 Prime Minister Decree 27 supports the establishment of marine and inland waters protected areas that are important breeding, nurturing and biodiversity conservation areas. These and several other decrees and decisions have been promulgated in reference to the statutes in Vietnam's 2003 Fisheries Law. Considering their recent enactment, it will take time to see the benefits of these actions.

Until any new information is available which could change the situation, the Government's current plan is to try to limit the fish catch to the currently estimated MSY of about 2.15 million tons. This will require controlling the number of fishing boats by controlling the issuance of fishing licenses for which at present there are no effective controls. These controls need to be put into place. An ongoing government plan to reduce number of fishery vessels operating in the EEZ in order to protect the resource is shown in Table 5.1.

Table 5.1: Planned change in number of fishing vessels '000 (2008–2015)

capacity	2008	objective 2015	change (%)
non-mechanized	10	0	-100%
up to 20HP	60	24	-60%
20 HP to 50 HP	25	16	-36%
50 HP to 90 HP	10	16	+60%
above 90 HP	25	24	-4%
total	130	80	-38%

Source: 2010 MPI and CU Report

Inland fisheries is perhaps the least understood sector in terms of yields as well as their relative importance to various stakeholder groups. Nearly all fish caught from inland capture fisheries are consumed domestically. The yield has been reported to be relatively stable at about 200,000 tons for many years. However detailed field assessments conducted by the Tropical Biology Institute of Ho Chi Minh City suggest that actual yields from inland fisheries could be much higher. For example the institute monitored production from the seasonally flooded 45,000-ha Omon-Xano area in Can Tho and An Giang Provinces in the Mekong Delta and found that production ranged from about 300–450 kg/ha/year depending on differences in annual hydrology. Extrapolating that yield to the average 1.3 million ha flooded area in the Delta conservatively—assuming about 50% of the yield from the Omon-Xano area—shows a possible annual yield ranging from about 200,000 tons to nearly 300,000 tons per year from the Delta alone. It is considered likely therefore that the overall annual yield from inland capture fishes for the whole country is much larger than reported in the official statistics possibly up to double that reported.

The importance of inland capture fisheries varies significantly among rural households. Beneficiaries can be land holders who are also involved in agriculture, or others whose income is derived mainly from day labor and other occupations. For these the fish catch can be either for subsistence, household consumption or possibly for supplemental income. There is another group whose main income is derived from more-or-less full time fishing with the majority of their catch sold for cash income. Overall inland fisheries provide an important supplement to nutrition and food security for people who have access to the fishing areas.

Aquaculture

There are three kinds of aquaculture practiced in Vietnam: freshwater, brackish water and marine aquaculture. The total production in 2011 was of 3.1 million tons as noted above. In terms of overall yield, about 82% of current aquaculture production is from freshwater, 15% from brackish water and 3% from marine systems. About 70% of the total yield is estimated to be from the Mekong Delta followed by 12% from the Red River Delta with small percentages from other regions of the country.

Freshwater aquaculture (82% of production) takes many forms that include pond, pen and cage culture of single

species as well as fish polycultures that fully utilize the nutrient niches in the ponds. Current production is around 2.4mt/year. For pond aquaculture, integrated fishing farming with animal husbandry and agriculture where the wastes of each activities become nutrient for others is practiced in Vietnam as is rice/fish-or-freshwater prawn farming. There is a long and successful experience of this type of aquaculture in Vietnam. For those integrated systems, generally fish polyculture in ponds is conducted where species are stocked together to take advantage of available nutrients and feeds. Nevertheless, over the past decade, freshwater aquaculture has been dominated by the rise of Pangasius catfish whose production in monoculture grew from about 114,000 tons to the current level of about 1.2 million tons or a compounded increase of about 27% per year. Pangasius now represents about 40% of the total aquaculture value and is the highest foreign exchange earner, about 30% of total export sales for the country from fisheries and aquaculture at about US$2 billion in 2011. On the downside, the rapid expansion of Pangasius production is also associated with major increases in water pollution of surface waters due to the discharge of water from regular exchanges.

Brackish water aquaculture (15% of production) mainly involving shrimp farming (indigenous Penaeus monodon and exotic Penaeus vannamei from the central eastern Pacific) reached about 400,000 tons in 2011. It is a high risk/high reward endeavor because of disease risks. The farming of the indigenous Black Tiger Shrimp (Penaeus monodon) dominates and represents about 60% of the brackish water yield followed by fish (25%), other shrimps (11%) and other crustaceans (14%). Although Black Tiger Shrimp represented 13% of the total aquaculture production in 2008, it represented 28% of the value that year. In comparison to Pangasius which represented about 50% of aquaculture yield, it equaled 40% of the total value that year. Because of the disease risk with shrimp cultivation and the consequent high financial risks, the expansion particularly of intensive shrimp aquaculture is discouraged by the government.

Marine aquaculture (3% of production). Marine aquaculture is the least developed form in the country, producing about 70,000 to 80,000 tons in 2011 or 2.4% of the total from aquaculture that year. Production is in its early stages of development and includes the culture of lobsters, grouper cobia, clams, seaweeds, barramundi and a number of other species. The expansion of marine aquaculture development has been slow so far because there are many technical constraints to overcome. Nevertheless, there is enormous scope for its development, provided that sites are carefully selected to avoid or resolve conflicts with other uses of the sea area, carrying capacity limits are not exceeded and the investments can be targeted for areas that have acceptable risk to coastal storms. Toward developing an approach to rational coastal development, the Government is in the process of formulating and implementing integrated spatial management plans for near-shore areas. Three other important dimensions to marine aquaculture development are that (i) it can be developed in areas adjacent to land with poor soils for agriculture where there are few other employment opportunities, (ii) provide alternative employment to sea fishing and (iii) use filter-feeding organisms such as clams, mussels and scallops and seaweeds that do not require feed and can actually improve water quality through the assimilation of excess nutrients into growth.

Table 5.2: Fisheries products industrial units—2000–2010

	unit	2000	2005	2006	2007	2008	2009	2010 (e)
no of Plants		225	439	470	490	544	568	570
capacity	1,000 ton	500	1,300	1,500	1,700	2,100	2,200	2,200
export	1,000 ton	300	634.5	821.7	942.4	1,240	1,216	1,300

Fisheries processing

Vietnam's fisheries product processing industry is relatively modern producing diverse products, with some 570 industrial plants and thousands of manually operated units producing products with a value of around US$6 billion per year for export (2011).

Since 1990, fisheries product processing industry has been upgraded with modern technology with high standards of food hygiene and safety. But the industry also faces shortage of raw materials both in quantity and quality. The number of plants that fully meet the standards to export to the US market were 534, China 518 and Korea 515, and EU 393. The industry has been modernizing in order to comply with the requirements of importing countries and application of quality management systems such as HACCP, ISO, Cleaner Production, and Standard for Fisheries TCN.

The organized industry is subjected to strict standards and inspection by NAFIQUAD and International Organizations which has helped enterprises in applying modern production process and in generating a large number of products of high quality for global markets. The enterprises can process nearly 1,000 different type of products most of them are tiger shrimp, white shrimp, catfish, tuna, and squid of all types. Although the share of added value products has been increasing, about 50% are still primary products. The exports are mainly produced on foreign orders with lower added value, packaging and carry trademark of foreign companies. Vietnam is generally a supplier of raw materials for foreign processors for processing into their value added products.

Table 5.3: No of export approved fisheries processing units

	markets	Feb 2012
1	USA 1/	534
2	EU/Switzerland/ Norway	393
3	Japan	534
4	Korea	515
5	China	518
6	Canada	304
7	Brazil	79
8	Russia	34

1/ Units meeting Vietnam's national technical regulations requiring HAACP.
Source: NAFIQAD, Vietnam

Current challenges facing fisheries and aquaculture

Marine fisheries. The main issue for marine fisheries is that production from this sector has approached, if not, exceeded the maximum sustainable yield in most if not all fishing grounds so that scope for growth in production is now limited. Main efforts are now in improving efficiency and protecting the sustainability of the resource as well as strengthening the monitoring system. Although there is no specific data quantifying evidence of pressure on the food chain from high quality and higher valued species, what has been witnessed is an average reduction in the size of the various species fished. Also, particularly for inshore fisheries, observations indicate that, among the smaller fishes caught. many are juveniles of larger sized species. Current issues include:

- dealing with the danger of overfishing;
- inadequate on-board equipment on fishing boats for preserving catches which is currently leading to reduced revenues for fishers for up to 70% of the catch;
- inadequate marketing arrangements and quality standards of market products is resulting in reduced output values;
- closer attention to quality standards in on-shore processing facilities to safeguard output values;
- need to eliminate to the degree possible rejections of Vietnam export products by importers on quality grounds;
- need to tighten government capacity to implement existing fisheries legislation, particularly as regards licensing of fishing boats operating in the EEZ.

Technical details on each of these issues are in the Fisheries Appendix.

Inland fisheries. The major current issue for inland fisheries is the potential conflict between measures being taken by the provincial and central authorities to protect farming from damage from flooding by building protective dykes which have been observed to destroy inland fish breeding grounds and reduce the inland fish yield. Floodplain fisheries are also under threat from changes in the water flows caused by upstream hydropower and irrigation dam projects that reduce the flow to the delta areas, particularly in the Mekong region. The issues involved are complex and involve technical social and economic tradeoffs for which the outcome is often difficult to predict as well as international cooperation for some. However the issues involved underline the importance of carrying out adequate social economic and technical assessments before projects which can change existing water flow regimes are implemented.

Aquaculture offers the greatest promise for expanded aquatic product production in Vietnam, though is facing a number of major challenges that will need to be met if the sector can continue to increase production in decades to come. The main issues currently being faced are:

1. The uncertain availability of quality seed for the diverse range of species needed including crustaceans, mollusks, finfish, seaweeds, holothurians, etc. taking into account the purity of strains and inadvertent or intentional hybridization, and improved breeding capabilities;

2. The inadequate organization of the widespread distribution of quality seed;

3. The organization and distribution of feed at a competitive price. For some basic varieties such as finfish and crustacean in particular, feed represents a high percentage of the operating cost. In the case of the Pangasius catfish which the is species of highest aquaculture production in Vietnam (about 35%), the cost of feed is approximately 90% of the operating cost with a profit margin of less than 3% of gross revenue underlining the importance of efficient feed utilization.

4. Disease. Most forms of aquaculture are threatened by disease. Except for shrimp aquaculture, effective prophylactic measures are generally available and their proper use understood. However mistakes are made from time to time which can undermine the confidence in the product.

5. Inadequate Coastal Zone Planning and Management is one factor limiting the current expansion of marine aquaculture which is one of the major potential growth areas. This planning is critical to assure all coastal needs are met so as to resolve conflicts and potential infringements among the various uses—e.g., urban, transport, energy, aquaculture, tourism, critical habitat protection, etc.

6. Environmental Management. One of the major challenges with all forms of aquaculture concerns their impact on the environment and the environment's impact of the aquaculture itself including water quality from their own emissions. Water quality is the key environmental factor which needs to be managed proactively.

7. Technical Details on each of the issues listed above are in the Fisheries Appendix

Near term government plans for fisheries sector development

Current government objectives and strategy for the sector are described in the government "Strategy of Vietnam's Fisheries Development to 2020" that outlines a path forward to protect and develop the sector through modernization and technical support. Among the current near term goals are by 2020 to have fisheries contributing 30–35% of the agriculture/fisheries GDP, and for the sector to maintain an annual growth rate of 8–10%. Production by 2020 is envisaged to reach 6.5–7 million tons which would be around 1.5–2 million tons over the 2011 level. The key driver of future growth is expected to be aquaculture which

is expected to reach 65–70% of total output by 2020. The annual target export earnings for 2020 is US$8–9 billion or US$2–3 million over the 2011 US$6 billion in exported fisheries products. In addition, it is projected that the number of people engaged in these sectors should rise from the current 4.5 million to 5 million. Extrapolation from the 2020 government's strategy provides a good basis to help establish the 2040 vision for the sector described later in the report.

Chapter 6. Agriculture Sector: Related Export and Import Performance (2007–2011)

The Vietnamese agriculture and fisheries sectors make an important contribution to the economy and bring in a substantial positive trade balance. Recent export and import performance from 2007–2011 are shown in the following tables.

Major agriculture export products by value are rice, rubber, coffee and cashew nuts. Fish and forestry products are also major export items. The total export value has been rising sharply over the last five years particularly in 2010 and 2011. By 2011 the total value of exports reached $25 billion which was about double the export value achieved in 2007. During the same period imports of inputs and other agricultural products also rose but at a lesser rate reaching $15.9 billion in 2011. The positive trade balance in 2011 was recorded as close to $9 billion. We note that export values were particularly favorable for Vietnam in 2010 and 2011 driven by high international commodity prices, and that Vietnam was able to take advantage of these high prices. Key imports supporting the agriculture sector and key imported food items are shown in the table below. The largest import items by value linked to the sector

Table 6.1: Agricultural exports 2007–11

	2007		2008		2009		2010		2011	
indicators	quantity	value	quantity	value	quantity	value	quantity	value	quantity	value
	ton	(mio USD)	ton	(mio USD)	Ton	(mio USD)	ton	(mio USD)	ton	(mio USD)
1. agricultural products		6,274		8,749		7,797		10,258		13,663
in which										
coffee	1,229	1,911	1,060	2,111	1,139	1,678	1,218	1,851	1,220	2,691
rubber	715	1,393	658	1,604	720	1,182	782	2,388	846	3,283
rice	4,558	1,490	4,742	2,894	5,817	2,595	6,886	3,248	7,187	3,703
tea	114	131	104	147	133	178	137	200	131	198
nuts	190	685	165	911	175	840	195	1,135	178	1,476
pepper	83	271	90	311	135	347	117	421	125	736
vegetable and fruit		306		406		420		451		628
sugar	12	5								
milk and milk products		35								
animal and vegetable oil		48								
cassava and cassava products			1,410	364	3,253	557	1,700	564	2,613	948
2. fisheries		3,763		4,510		4,207		5,016		6,077
3. forestry products		2,641		3,072		2,736		3,665		4,130
Total		13,235		16,475		15,337		19,527		24,982

Source: MARD
Note: gaps in the tables are for quantities that are negligible.

TABLE 6.2: AGRICULTURE RELATED IMPORTS 2007–11

	2007		2008		2009		2010		2011	
indicators	quantity	value	quantity	value	quantity	value	quantity	value	quantity	value
	ton	(mio USD)	Ton	(mio USD)	ton	(mio USD)	ton	(mio USD)	ton	(mio USD)
1. agricultural products	5,527.00	4,150.80	4,188.00	5,864.00	6,290.00	5,642.00	6,382.00	7,009.00	7,384.00	9,045.20
wheat powder & paddy wheat	1,298.00	367	701	293	1,260.00	345	2,213.00	568	2,314.00	787
sugar	32	9.8								
animal feed		1,181.00		1,747.00		1,765.00		2,173.00		2,320.00
animal and vegetable oil		485		666		496		704		952
rubber	195	379	186	497	308	410	299	638	355	922
cotton	210	267	266	416	301	392	357	674	330	1,083.00
milk and milk products		462		542		516		708		838
Salt				25		24		32		17.2
vegetable and Fruit				205		279		294		289
fertilizers	3,792.00	1,000.00	3,035.00	1,473.00	4,421.00	1,415.00	3,513.00	1,218.00	4,385.00	1,837.00
- U RE	740	200	707	286	1,444.00	417	988	318	1,236.00	476
- S A	984	137	722	184	1,104.00	156	683	97	889	193
- D A P	651	263	434	379	933	374	704	350	678	419
- N P K	260	77	170	99	337	132	244	95	321	149
other fertilizers	1,157.00	323	1,002.00	524	577	335	894	357	1,260.00	600
pesticide and materials		383		474		488		549		631
2. fisheries				306		282		337		544
3. woods and wood products		1,016.00		1,098.00		905		1,152.00		1,312.00
total imported products and materials		10,270.00		9,514,000				12,158.00		15,935.00

Source: MARD

are mostly linked to agro-processing, agriculture inputs, livestock fattening, or consumption which in 2011 were (i) animal feed at $2.3 billion; (ii) animal and vegetables oils at $952m; rubber inventory at $922m; (iii) wheat products at $787m. Major inputs for agriculture that were imported in 2011 were (i) fertilizers at $1.8 billion; and (ii) pesticides at $600m.

FOOD PRODUCTION AND CONSUMPTION BALANCE AS OF 2010/11

THE FOOD BALANCE AND FOOD SECURITY IN 2010/11

Thirty years or so ago food security at the family level was greatly influenced by the level of food production by farmers for their own consumption given that some 80% of the population lived in the rural areas and markets were little developed. Since then there has been sharp fall in poverty as the economy has grown at a rapid pace. And markets have developed well in most regions. Given the excess food production in the country today and the good existing food product distribution system, Vietnam's food security

concerns in 2012 are more related to access to food than to food availability in the country. This links the problem to poverty and more particularly to food poverty. This section notes that there has been good progress bringing food security to the Vietnamese people over the last two decades, but in 2008 there were still an estimated 6m people who were "food poor" and many children under 5 who are growing up lacking a proper nutrition in their diet. While this figure of 6m will have been reduced since 2008 as the economy has grown, it can be expected that there are still many Vietnamese who do not have a sufficient income to provide an adequate nutritious meal for their families without some income support in cash or in kind. The food poor are generally adequately assisted by government programs but continued efforts are still required on the food security front along the lines of the current government strategy to ensure food security for the poor. The following section reviews current food production and consumption issues in the country, highlighting the link between poverty and food insecurity. Later the prospects for food security for the Vietnamese population up to 2040 are reviewed (see below).

The evolution of national rice production

The rice balance: production levels 1986–2010/11

In Vietnam, given the importance in the diet, food security and the food balance is closely linked first to the availability of, and access to, rice. Other key commodities are fish and livestock products which are being consumed more extensively as incomes are rising. To get a historical perspective on the rice production performance in Vietnam, we have traced the estimated rice balance in the country over the last 25 years. As can be seen in the table below, this shows a consistent excess of production after the turn around in production that started in the late eighties[1]. By 2011 this excess was three times that in 1990 at an estimated 8.4mt taking the most conservative assumptions on losses and uses. This high level of rice production has allowed the increasing exports of rice. While the accuracy of the production statistics are not known, trade records are usually more dependable and these confirm the excess of production indicated by the production and consumption figures. Compared with an estimated average national consumption of around 120kg/per person /year in 2010 (GSO), actual national rice production per capita in 2011 was around 200–250kg of rice grain for each person even after highly conservative adjustments are made for satisfying seed retention needs of the farmers for the following season's crop, feed for animals and a generous allowance for post harvest losses. This comfortable excess of rice production over national needs underlines that unless there are dramatic changes in the current production pattern Vietnam is in a highly secure position regarding rice production for national consumption. In addition the national retail market for food products is now quite well developed which adds a huge safety factor to the food security calculation. This has allowed Vietnam to pursue an active export program to ASEAN partners and worldwide. 2011 exports had reached a high point of over 7mT of rice (Table 6.3).

The above data are difficult to assemble because of the broad range of rice growing conditions in Vietnam. The selected values must be considered to be an approximate estimate describing this broad rice production situation in Vietnam by taking averages of what is actually happening on different farms. Yields will vary widely in different regions and according to the seeds used, the season of planting, whether the crop is irrigated or rainfed, the skill of the farmer in managing his farm, input use, etc. Apart from production figures there are three key variables which can impact results as they do in this table. These are:

- Estimates of post harvest losses: current post harvest losses are estimated by MARD (NIAP) and others to be around 10–12% on average or around 4.5–5.0 mt of paddy at current production levels. We have assumed 12% in the above table in order to maintain a conservative estimate of the rice

1 This table, and some subsequent data, are adapted from a paper from a collaborative research program dealing with "Vietnam Rice, Farmers, and Rural Development: From Successful Growth to Sustainable Prosperity". The table uses MARD data adapting work by NIAPP. The research program benefited from the generous support of the Canadian International Development Agency (CIDA) and the Global Food Crisis Response Program. The authors were: Steven Jaffee,,Nguyen Do Anh Tuan, Nguyen Ngoc Que, Dao The Anh, Nguyen The Dzung, Nguyen Ngoc Mai, Vu Nguyen, and Nguyen Anh Phong.

TABLE 6.3: VIETNAM'S RECONSTRUCTED NATIONAL RICE BALANCE, 1986 TO 2010 ('000T)

	1986	1990	1995	2000	2005	2010	2011
paddy production	16003	19225	24964	32530	35833	39973	42300
seed	480	769	999	1301	1075	1199	1199
post harvest Loss	1920	2307	2995	3253	3903	4796	5076
feed	480	577	749	976	1792	1999	1999
rice available	7394	10372	13468	17550	19393	21633	22840
national reserves	100	100	200	1179	831	869	
industry demand	180	207	269	351	582	649	
rice for consumption	7245	7169	9610	11043	11173	11685	
excess supply	-132	2896	3389	4977	6807	8430	
rice export	0	1624	1988	3477	5255	6828	7187
rice import	132	0	10	40	50	100	
estimated carry over stocks (excess production after all uses accounted for)	0	1272	1411	1540	1602	1702	

outcome. This compares with a typical regional performance of around 10% (Thailand) and an advanced performance (Japan) of 4–5%. But losses can be even higher than 12%. A 2006 DANIDA funded study found that post-harvest losses of rice in the Mekong River Delta (MRD) were typically nearly 14% , and in the Red river Delta (RRD) and other regions 11.6%.2. Clearly there are major opportunities for an improved performance in Vietnam. This can be expected to be achieved in the coming years and success in this area can be an added factor contributing to Vietnam's food security in the future.

- Intensity of land use for rice growing. In some irrigated areas (in the Mekong Delta Region) three crops of rice are grown. In rainfed areas only one crop of rice is grown. The current intensity of land use is around 1.8 on designated rice land areas and we have assumed this will be maintained in the coming years.

Hulling efficiency. This represents the percentage weight of rice obtained from paddy rice by hulling. In Vietnam it is commonly assumed to be 60–65%. We have assumed 62%.

REGIONAL COVERAGE

There are significant regional differences in rice production levels and the apparent local food security in different parts of Vietnam. Most of the rice grown Vietnam is in the two rich deltas of the north and south—in the Red River Region and the Mekong Delta region, respectively. About 52% of Vietnam's rice is produced in the Mekong River Delta and another 18% in the Red River Delta. These are now among the regions with the lowest poverty as a percentage of the population, and the strongest food security. The Northern Mountains, North-Central Coast, and Central Highlands are the poorest regions, with the Northwest part of the Northern Mountains the region with the highest risk in the country. The areas around Ho Chi Minh City in the Southeast region and the South Central Coast Region both have below average poverty rates. Most of the regions are in surplus as far as rice production is concerned except for the two poorer regions, for which rice is brought in from (mainly) the Mekong Delta Region or people turn to other crops for sustenance. The following table shows the regional rice production situation and rice consumption needs of each region as of 2009. The Mekong Delta region is seen to be creating enormous surpluses beyond what is consumed locally i.e. close to 350% of local consumption needs in that region and is the source of mush of the rice that is exported (see index of self sufficiency in the table below). The major

2 Apart from rice, the DANIDA report noted average loss rate of the country for corn: 18–19%, soybean 6.2 to 14%, peanut 8.5 to 15.5% vegetables: 20%)

TABLE 6.4: RICE BALANCE BY REGION (2011)

	paddy production (mill Tons)	rice available (mill tons)	rice requirement (mill tons)	rice balance (mill tons)	Index of Sufficiency in 2011
countrywide	42.30	22.84	13.83	9.01	1.65
Mekong Delta	22.21	11.99	3.40	7.74	3.52
RRD	7.19	3.88	3.05	0.76	1.27
N/S Central	6.76	3.65	2.92	0.52	1.25
NE/NW	3.30	1.78	1.68	0.01	1.06
CH	1.07	0.58	0.77	-0.20	0.75
SE	1.44	0.78	2.01	-1.25	0.39

Source: Updated from Research consortium calculation from GSO consumption data

rice deficit region is the highly urbanized Southeast Region where only 40% of rice needs are met locally.

CURRENT FOOD CONSUMPTION AND NUTRITION PATTERNS

In Vietnam there is a considerable amount of data available on food consumption by different income groups and in different regions of the country from surveys by the National Institute of Nutrition (NIN) and the GSO through Household surveys. The government tracks actively the evolving state of nutrition in the country and takes proactive measures to improve nutrition. UN agencies are active in support of nutrition policies including FAO and UNICEF, as well as bilateral agencies from the Development Partners. There is a National Food Security Strategy and a National Nutrition Strategy in place in 2012, with plans for improving the current situation and perspective plans through 2030. Key Ministries involved are: Ministry of Health, Ministry of Agriculture and Rural Development, Ministry of Industry, Ministry of Education and Training, Ministry of Culture, Sport and Tourism, Ministry of Labor, Invalids and Social Affairs.

A recent survey (NIN 2010) shows that in 2009 the average daily energy intake of the Vietnamese population was 1,925 kcals and it had just about remained the same as two decades before. However there is a difference in the consumption patterns between the two periods. In the later period, as people have become richer, there were less carbohydrates and more protein and lipids in the diet. Over the years, the diet has changed, and become more healthy.

Cereals are still the main source of energy in the Vietnamese diet providing 60–65% of total energy compared with 75–78% in the eighties. The most important cereal is still rice which is the staple food in Vietnam. Trends in food consumption in Vietnam are tracked by the Ministry of Health through the National Institute of Nutrition (NIN) and the Ministry of Planning through detailed household surveys. Records from the last two decades reported by NIN from their nutrition situation reports and from the GSO from household surveys over the last decade are summarized in the following table. NIN data is from 1990–2010. GSO data from 2000–2010 is presented after the NIN data. It is noted that there is a considerable divergence between the two reports for the situation in 2010, particularly for rice, meat and vegetables (see footnote).[3]

POVERTY AND FOOD SECURITY[4]

The 2008 household survey (GSO) found that there were 12.49m people who were "poor" in Vietnam, and therefore had limited resilience in the face of an economic downturn, and 6m who were food poor i.e. without sufficient income to feed their families adequately leading to nutrition deficiencies. While these figures have declined over the intervening years there are still a large number of people in Vietnam

3 We note a significant divergence between the NIN and GSO rice and meat consumption data in 2010. This is partly because the 2010 HH survey cohort was adjusted from 2002–8 results to reflect better the evolving urban/rural balance in Vietnam compared with previous cohorts.
4 In addition to MARD/GSO data this section also benefitted from discussions with IFAD staff

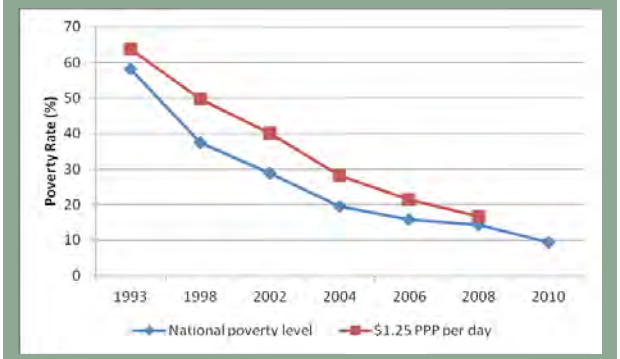
TABLE 6.5: TRENDS IN PER CAPITA CONSUMPTION OF FOOD PRODUCTS KG/CAPITA/YEAR (1990–2010)

	1990		1995		2000		2005		2010	
	NIN data	GSO data	NIN data	GSO data	NIN data	GSO data	NIN data	GSO data	NIN data	GSO data
rice	164	--	159	1	144	144	140	140	136	116
fruits	9	--	12	--	22	--	22	--	22	--
fish	15	--	16	--	16	16	19	17	22	17
meat	9	--	13	--	19	15	26	17	31	22
vegetables	62	--	64	--	65	28	69	29	--	26
wheat	10.9	--	16.28	--	24.83	--	38.85	--	--	--

Source: NIN and GSO

who are "food poor" and rely on assistance to make up the food balance. Many of these hope for the continued strong growth of the agriculture sector to enable them to escape from poverty. We note that poverty is very much a rural phenomenon with some 70–80% of the poor living in the rural areas. Agriculture and rural development is closely linked to all Vietnam's poverty alleviation efforts. A good growth in agriculture has an immediate payoff in reduced poverty and therefore reduced food poverty. Vietnam's rural development efforts through a series of National Target Programs (see below) have also played an important role in the poverty alleviation programs. Vietnam has been very successful in poverty alleviation efforts in the last two decades as can be seen from Figures 6.1–6.3.

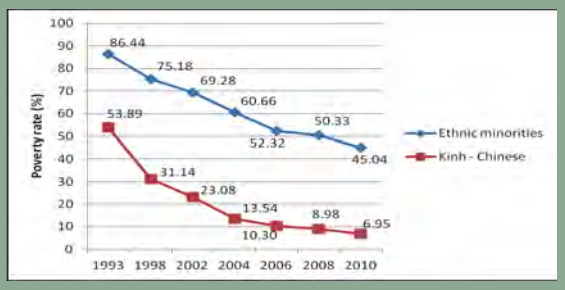
FIGURE 6.1: EVOLUTION OF THE NATIONAL POVERTY RATE 1993–2010



Source: MARD/GSO.
Note: Figures are based on GOV's poverty rate, which in 2010 was adjusted to 400,000 dongs (rural) and 500,000 donts (urban) per person per month.

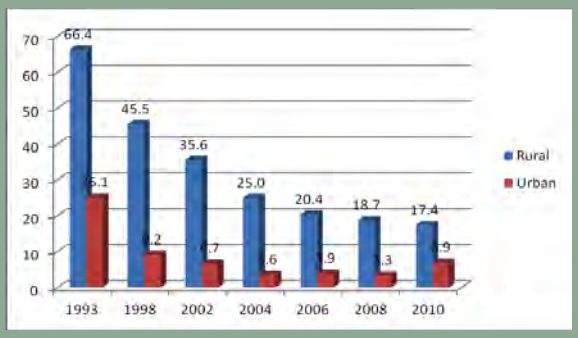
The GOV Household Surveys show that poverty, and hence food security issues, have become increasingly concentrated among ethnic minorities living in mountainous areas, who make up nearly 15 percent of the population. In 2008, 50 percent of minorities lived below the poverty line, compared to only 9 percent of Kinh-Hoa majorities. By 2010, ethnic minorities accounted for 65 percent of individuals in the poorest welfare decile, up from 53 percent in 2006. However poverty in Vietnam has been in sharp decline during the last two decades, in both rural and urban areas, but particularly in urban areas. Overall there has been (i) good progress in reducing poverty, allowing an improvement in food security, but (ii) there has been a slower rate of decline among the ethnic minorities and (iii) in the rural areas compared with the urban areas. The evolution of the poverty rate during the last two decades (i) overall; (ii) among ethnic minorities compared with the Kinh/Chinese majority; and (iii) between rural and urban areas are shown in the flowing graphs. The government poverty rate (see footnote) is the primary definition used here. In 2012 this was adjusted by the GOV to better reflect current economic conditions in Vietnam bringing it closer to the commonly used threshold income of $1.25/person/day. For comparison purposes Centennial also shows the simulated performance of the $1.25 threshold for Vietnam:

Figure 6.2: Evolution of Vietnam's poverty rate by ethnic group 1993–2010



Source: GSO based on GOV poverty line.

Figure 6.3: Trends in Vietnam's rural and urban poverty (% poor) 1993–2010



Source: MARD/GSO.

Government has a long term strategy to maintain economic and food security for the poor which has generally been successful and needs to be supported. In the last two decades three main social security interventions have been or are being developed in Vietnam and, as a counterpart to economic development, these form the basis of efforts which help maintain economic and food security for the poor. These are: (i) active labor market policies to facilitate entrance in the workforce; (ii) social insurance; and (iii) direct social assistance for the needy. When fully implemented, current plans are that this would be by around 2020, these programs will provide a broad safety net for the poor.

In the meantime the major driver of poverty alleviation and food security for the poor is agriculture and rural development which has been the main factor driving down the rural poverty rate in the last two decades. So far the continuous reduction in the occurrence of poverty that has been achieved in the last two decades suggests that government strategy is successful so far and, if continued, should lead to good progress in the future.

Apart from broad national social security programs the GOV has developed a series of "National Target Programs" to spur local economic development and help the rural poor and the disadvantaged. Program 135, provides support to communes facing hardship in ethnic minority and mountainous areas. Programs 132 and 134 target vulnerable ethnic minorities using different criteria. Program 132 aims at distributing agricultural and residential land to ethnic minority households in the Central Highlands, so as to bring landholdings up to a specified minimum. Program 134 targets all ethnic minorities. In addition to providing land, this program provides financial support for housing construction and utilities (mainly clean water) for the poor. The National Target Programs have been an important part of the government's efforts to reduce poverty and upgrade food security for the poor in the rural areas.

As the previous discussion indicates, Vietnam is in a very favorable food security position; it produces enough quantities of most food items to satisfy local demand though there is a growing deficit of maize used as animal and fish feed. The success of Vietnam's agricultural sector can be judged by the ability to meet local demand while also exporting large quantities of rice and fish. Various scenarios of future GDP, population, and changing diets indicate that Vietnam will still be able to continue to meet most domestic demands and have surplus production for exports. Thus unlike some of the other ASEAN members, food security is not a major issue for the country.

There are two basic elements to current food security in Vietnam: (i) to what extent is the production in the country sufficient, together with any incremental imports, to cover the basic food needs of the population; and (ii) to what extent do the people of Vietnam have access to food when

they need it (either because they produce themselves it or because they have sufficient income to buy it in local markets). Our conclusion on these two issues is summarized below:

Adequacy of local food production

- Rice: as described in this report, current net national production of rice, allowing for post harvest losses, retention for seed, and animal feed diversion of low quality production is around 200–250kg/capita compared with consumption of 116kg/capita (GSO) or 136kg/capita (NIN). The current level of production thus provides a very secure supply for Vietnam. Excess production is exported.

- Meat: Current national production of meat and meat products is close to current demand except for 5–10% of consumption needs which is imported. However this hides a major shortage of locally produced animal feed which has to be imported at considerable cost to maintain the local production of animal products (imports of animal feed, currently running at around $2.3 billion/year). Given the rapidly rising demand for meat and meat products the inadequate national production of animal feed is already a concern.

- Vegetables, fruits and other food items: current local production is adequate.

- Fish and fish products: local production is fully adequate, in addition providing for substantial exports.

Access to food by the population

- The main issue involved here is whether the level of income is adequate for people to buy food if they do not produce it for themselves. In Vietnam, incomes are tracked by the government statistical services through periodic surveys. There are two income levels which are immediately relevant to food security: (i) the number of people who do not have an income sufficient to buy sufficient food for themselves and their families; (ii) the number of people who are "poor" and therefore have limited resilience in the face of an economic downturn. In Vietnam the 2008 household survey found that there were 12.49m people who were classified as "poor" of which some 6m were classified as "food poor" i.e without sufficient income to feed their families adequately leading to nutrition deficiencies and stunting in children. These figures are considered to have declined since 2008 but there are surely still a large number of people who are 'food poor' in 2012.

- These 6m people in 2008 who were food insecure and depended basically on support to maintain food security

- The government has, with government funds and with the support of UN agencies and donors, numerous programs in place to offset food shortages caused by food poverty.

Chapter 7. Government Policies and Strategies Driving Performance

Over the last three decades government policies have generally been very supportive of the agriculture/livestock/fisheries sectors and these policies have stimulated an impressive continued growth of the sectors, a sharp reduction in the national poverty rates, a strong measure of food security and an excellent export performance. For agriculture the major turnaround in sector performance occurred in the eighties when Vietnam turned away from the system in place involving the management /involvement by the government of all the factors of production to a return to family farming and an acceptance of the role that the market could play in Vietnam. The government introduced a broad ranging "renovation program" (doi moi) which transformed the economy and stimulated an extraordinary growth of industrial production, construction, services and agriculture. As part of this reform, the government introduced private farming by granting land use rights to farmers. As described by Thomas Wiens,[1] the doi moi reforms that had the greatest impact on rural areas included:

1. Dismantling the collective system and returning agriculture to family farming on the basis of long-term leases.

2. Abandoning administered pricing.

3. Devaluing the exchange rate and maintaining a managed float, exposing the farm sector to levels and fluctuations in international prices.

4. Partitioning the single state bank into sectoral banks, including an agricultural bank offering credit not only to state enterprises and collectives but also to individual family farms at positive and roughly nondiscriminatory real interest rates.

5. Reducing the size of public sector employment and nearly eliminating direct subsidies to state enterprises, including state farms, resulting in the contraction of wage-earning opportunities for rural families and the return of many dismissed employees to farming.

6. Giving formal recognition, legal status, and encouragement to the private sector, which absorbed other former state employees.

Farmer's response was immediate and dynamic. In the period since the reforms were first introduced, agricultural production and productivity increased rapidly as has been seen from the production time series above.

Government policies of the last two decades have continued to successfully support Agriculture sector growth. The ex-post assessment of the performance of the 2001–5 socio economic development plan was able to record a growth of the agriculture sector of 3.8%, considerably less than the overall country GDP growth of 7.5% over the period, but still a positive performance for the agriculture sector. Production increased across the board not only for rice but for most other crops. Food production increased by around 1 million T/year even though there were decreases in food production areas planted (by 220,000ha) as farmers responded to price signals and sought increased labor productivity through diversification to other crops, or abandoned land that was not productive. New seed varieties reached 90% of rice areas, 80% of maize areas and 60% of sugarcane.

The 2006–10 socio economic plan continued this more market based growth of the sector. Crop statistics indicate a continuing successful growth for the sector during this period although there was a sharp setback in 2009 when sector growth fell to the unusually low rate (for Vietnam) of 2%

1 See Chapter by Thomas B. Wiens in "Agriculture and rural poverty in Vietnam" ed. David Dollar: WB 1998.

following the international financial crisis. Current figures are that growth averaged 3.3% during the plan period.

Current objectives for the agriculture sector have been broadly set out in the ongoing 2011–15 plan adopted by the government. There are six major goals:

Goal 1: Sustainable, high quality growth of the sector with improvement in productivity, quality and competitiveness of products.

This is certainly a worthy goal. Current labor productivity in Vietnamese agriculture is currently assessed as very low compared with regional comparators and needs to increase if wages are to be increased. For example value added per worker 2006–8 was about one half that in Thailand and Indonesia during the same period and 35% less than China and Laos[2]. Also the quality of Vietnamese products is generally at the low end of the quality spectrum compared with peers which can reduce marketing options for Vietnamese products. Vietnam needs to move up market, particularly in the quality of export crops. In addition domestic marketing will increasingly be affected by quality assessments by consumers as wages grow and consumers have more choice.

Goal 2: Improve living standards and conditions of population living in rural areas, especially the poor.

Since living standards are recorded as being lower in the rural areas compared with the urban areas and poverty is essentially a rural phenomenon as described elsewhere in this report (see chapter xx) it is important to make efforts to upgrade these social aspects. The challenge will be finding a cost effective way of achieving this within the budgetary constraints faced by Vietnam. Among the priorities should be dealt with are the nutrition deficiencies experienced by some groups in the rural areas (as is now well tracked by the National Institute of Nutrition: see chapter x) and the development of employment in rural enterprises.

Goal 3: Develop infrastructure to meet requirement of the agricultural production and serve people living in rural areas.

There were constant improvements in the provision of basic rural infrastructure during the 2005–10 Plan period and prior to that: By 2011:

- Electricity network: in 2011, 99.8% of the 9075 communes and 95.5% of villages have electricity.
- Road access: 99% of communes have road access by car to the commune office.
- Schools: In 2011, 99.5% of communes have primary schools (2006: 99.3%) ; 93.2% of communes have a secondary school (2006: 90.8%); 12.9% of communes have a high school (2006: 10.8%); 96.6% of communes have a kindergarten/ preschool (2006: 88.3%)
- Health: In 2011, 9016 communes (99.39%) have clinics, 7055 communes (77.8%) reached the national standards of social health, 94.2% of villages have a doctor (in 2006, 89.2%).

It will be important for further investments in infrastructure to be cost effective and replicable, and within the budget realities of Vietnam.

Goal 4: Strengthen competitive capacity and international integration of the sector.

Improved competitive capacity and international integration can be achieved partly (i) by ensuring that international price signals drive investment and production decisions in the rural areas; and (ii) ensuring that there is a level playing field for potential investors and ongoing operators in the rural areas between State operated enterprises, and local and international private sector investors and operators. Current government policy is supportive of these measures, and these policies need to be maintained.

2 See Jaffee. Transforming Vietnamese Agriculture and rural areas in a dynamic setting. FAO Agricultural Outlook Conference 2012.

Goal 5: Use and protect natural resource and the environment in a sustainable and efficient manner.

This is a most important objective for the coming years if the sector is to continue to grow. Land and water pollution from agriculture, aquaculture and living areas, is of increasing concern and a real health risk in some regions and can undermine food security based on local production and exports. Existing laws and regulations are generally adequate to achieve a satisfactory outcome. They need to be applied by the authorities responsible.

Goal 6: Improve the efficiency of the sector development management, ensuring its dynamism and effectiveness.

This will also be an essential prerequisite for success.

One important area that has not been included as a specific goal by MARD for 2011–15 where special efforts are required in the coming period and beyond is the need to work to improve food safety. This should be given high priority if food security is to be safeguarded (see above for a discussion on food safety issues).

The government has already introduced impressive market reforms and has been guiding the agriculture sector successfully forward to production levels which compare favorably with many regional comparators. Efficient market solutions are being sought when problems arise. The government is slowly but steadily trying to unbundle state controls and raise the profile of the private sector. However looking ahead, there are several factors which could be a potential threat to a continued satisfactory level of economic performance by the agricultural sector and the continued achievement of food security by Vietnam.

Key issues that may constrain growth

There will be many problems facing the sector which can constrain growth. Current more near term issues impacting agricultural production and growth include (i) land ownership and use, and the small farm size; (ii) the need to upgrade irrigation and flood protection systems; (iii) the need to upgrade national agriculture research; (iv) the need to expand the value chains; (v) the need to upgrade food safety; (vi) climate change issues.

Land for agriculture

Unlike some other ASEAN countries, the availability of undeveloped agricultural land in Vietnam is extremely limited and the population density is one of the highest in the world. Land availability is a limiting factor for Vietnamese agriculture and there is almost no opportunity for horizontal expansion of cropping so that the optimization of land productivity is a key factor when assessing growth potential. Vietnam currently has about 9.4m ha of land used for agriculture of which around 6.4m ha is used for growing annual crops and 3.0m ha for perennial crops. Two thirds of the annual cropland is rice land which is planted with up to three crops of rice but an average of nearly two crops (1.8 in 2011). Aquaculture is developed on about 750,000 ha. Farms are now mostly privately run using land on long term leases from the government. Most farms are split into several quite dispersed plots, up to 20 units in extreme cases, but typically 4–5 units, leading to considerable inefficiencies in land use and management.

Table 7.1: Arable land per capita (Ha per thousand people)

	1980	1990	2000	2010
Indonesia	118	109	95	98
Philippines	110	88	64	57
Vietnam	109	79	78	71
ASEAN	165	145	122	116

Source: World Bank World Development Indicators

An immediate near term issue for the sector will be the upcoming expiration before 2015 of the current 20 year agreements giving farmers the usufruct rights over their

land. It is expected, but not certain, that GOV will decide to renew long term extensions to existing beneficiaries. This will allow a smooth transition to a new contractual period. A new long lease could then encourage capital investments and improvements at the farm level which can upgrade farm incomes and productivity. Beyond that, a major land issue that will have to be faced in the coming years beyond improved land registration is farm size. Farm holdings in Vietnam are generally small and split into several parcels of land. This leads to inefficient farming operations, poor productivity, and low income generation. It also reduces the opportunity for introducing farm mechanization which will be needed to offset future expected labor shortages in the rural areas. The restructuring and modernization of farming during the next three decades should involve a program to facilitate the increase in farm sizes through land consolidation. This will permit farmers to generate more income and make farming a more attractive proposition and hence improve the sustainability of the sector.

Major objectives that need to be achieved include (i) a stability of rights to use land for a period of time which encourages investment by farmers; (ii) land consolidation that can lead to efficient commercial farms; (iii) more flexible arrangements to access land for economic use.

Irrigation and flood protection

Irrigation is a key part of the food production story in Vietnam and has played an important part in the success of Vietnam's efforts to upgrade agricultural production in the last two decades. According to FAO, the irrigation potential in Vietnam is 9.4 million ha of which in 2012 close to one half has been developed. Investment in irrigation and flood protection has been a major focus of the government since the '70's with some 80% of the capital investment funds available to the agriculture sector allocated to improving and expanding irrigation, and protecting flood prone areas from damage. Early post-1975 growth in irrigation was in small and medium irrigation schemes, while during the period 1985–1990 investment was concentrated in large irrigation and multipurpose schemes. The total irrigated area expanded at a rate of 2.9 percent/year in the period 1980–1987, while later it grew to 4–5 percent/year.

The actual area currently equipped for irrigation, the state of repair of the irrigation systems and other statistics on irrigation in Vietnam are uncertain because of confusion on definitions and weaknesses in data collection. To remedy this the GOV has recently started a new nationwide census of irrigation but results are not yet forthcoming. FAO records that in 2005 the total equipped area for irrigation was about 4.6m ha or 50 percent of the potential. Other sources record smaller areas but this may be because they do not include small scale private irrigation. FAO detailed the type of existing irrigation schemes as 1.6m ha in small irrigation systems (< 5 000 ha), 1.2m ha in medium irrigation schemes (5 000–50 000 ha) and 1.7m ha of large irrigation schemes (> 50 000 ha). About 2.1m ha were pump irrigated. Around two-thirds of the total irrigation area is in the two large deltas (in the Red River delta, and in the Mekong delta). Supporting these irrigation networks are an estimated 5,600 reservoirs which store water and supply water when needed, supplementing water diverted directly from rivers. Over 11,500 pumps lift water to higher ground when water levels are too low to reach fields.

Many hydraulic works are now 30–40 years old and have not been well maintained so that much rehabilitation or refurbishment is needed. Many systems do not fully irrigate the area for which they were designed. A recent survey estimated that on an average only about 68% of irrigation design areas are currently serviced with water on many large schemes. Reasons for this under utilization include: construction funding shortfalls; water availability shortfalls; under-capacity of systems; planning or design changes or deficiencies; incomplete construction of works, including lack of secondary or tertiary canal systems; system damage or degradation; and poor system operation. Dam safety also gives cause for concern.

Currently, budgets for operation and maintenance of headworks and main canals are provided by the State while for secondary and on-farm canals, funds are provided from provincial budgets or farmer contributions. All these contributions are often insufficient. The recent exemption of many

farmers from paying irrigation service fees (ISF) has introduced further uncertainty into the budgeting of operation and maintenance (O&M).

Major current issues for irrigation include the unsatisfactory budgets available for system operation and maintenance, the efficiency of public investment in support of irrigation, and flexibility of current systems to respond the needs of the future which will involve the diversification of cropping with flexible water requirements. It is likely that rehabilitation and improvement of existing systems should now take priority over horizontal expansion.

The 2009 Viet Nam Water Sector Review launched by a group of donors led by ADB lists many issues facing irrigation including the need to (i) balance tradeoffs between the economic efficiency of improving existing infrastructure versus expansion of new irrigated areas; (ii) the need to rehabilitate existing infrastructure, much of which is 30–40 years old and suffers from inadequate expenditure on O&M; (iii) achieve sustainable financing for O&M and rehabilitation of irrigation facilities, given that central and provincial government budgets are insufficient for major refurbishment and the current government subsidy for irrigation service fees limits the ability of irrigation management companies (IMCs) to fully cover O&M; (iv) the need to improve irrigation service coverage, given that an average of only about 68% of irrigation design areas are currently serviced; (v) manage water quality and reduce nonpoint source pollution from fertilizers and pesticides, which pose a public health risk in many areas; and (vi) effectively manage multipurpose reservoirs for irrigation, hydropower, and water supply.

Flood protection. Extensive Sea Dykes and expansion of mangrove protection forests are currently under consideration in the South to mitigate the impact of sea water rise linked to climate change effects. This will be the major feature of flood protection work up to 2040 and beyond which will be difficult to prioritize. This work will be costly (3–4 billion) and it needs to be scheduled in accordance with scientifically measured needs with specific measurable benefits in order to avoid a misallocation of scarce investment resources.

Agricultural research

Reforms have started but much remains to be done if research is to be able to help Vietnam respond effectively to upcoming challenges.

The impressive increases in agriculture production over the last two decades have been supported by the national research efforts which have brought many scientific solutions to help gain improvements in agricultural production, building on “doi moi” policy reforms. Research has contributed in plant breeding programs, introduction of new breeds, diversification of crops and improved pest and disease management. In the fisheries sector impressive gains have been made through adaptation and development of intensive aquaculture systems. In forestry the introduction of fast growing trees such as acacia, development of agroforestry systems and intensification of bamboo production has given rise to a large (although highly over-capacity) pulp and paper industry. The operational environment for research is constrained by a number of major issues such as (i) low research funding; (ii) poor policy environment; and, (iii) structural issues that impact on research relevance, efficiency, effectiveness, impact and sustainability.

Research funding

There are three government sources of funding for agriculture research; (i) Ministry of Science and Technology (MOST); Ministry of Agriculture & Rural Development (MARD); and, (iii) Provincial Governments. Provincial government funding has increased substantially over the last 5 years as a consequence of the Government of Vietnam’s decentralisation policies. Much of provincial government funding support is used at the technology transfer/extension end of the research spectrum, and in many instances research institute knowledge and skills have enabled them actively compete with National and Provincial Extension Centres to become preferred extension service providers.

Compared with other Asian countries Vietnam has for a long time been at the lower end of research funding on a percentage of GDP basis. The low levels of less than 0.1%

in the early 1990s gradually improved to around 0.2% of GDP in the early 2000s. Funding in 2012 is estimated to be marginally less than 0.2% of GDP. By contrast in 2002 the average of 10 Asian countries, excluding Vietnam, was approximately 0.45% of GDP. Vietnam is a clear outlier in the low allocation of funding to agriculture research compared with peers, which is a very unsatisfactory situation for a country operating with such a high level of technology in agriculture as Vietnam is today.

The Asian Development Bank has been helping Vietnam to address this problem of inadequate funding by providing considerable support for agriculture research (and technology transfer) since 2000 with the Agriculture Sector Development Program (ASDP) followed by the Agriculture Science & Technology (AST) Project providing loans supporting the agricultural research program totalling US$90m. The government has had plans to increase the funding for agriculture research by 11–12% per year, but while some increases have been made in nominal terms increases have barely kept pace with inflation and as the GDP has increased the percentage of GDP for research has been either static or marginally falling. An ongoing plan to upgrade and retain staff by doubling and then tripling salary of researchers is unlikely to have major impacts on the availability of direct operational funds for research project delivery unless total research funding is substantially increased.

In 2011 the total budget for agriculture research was VND646.9 trillion (US$31.5m). Of this VND526.2 Trillion (81%) was under MARD control and 19% under MOST management

Key issues for Vietnam's research organization

Key issues are examined within the context of an evaluation the overall performance of the National Agriculture Research System, covering (i) Relevance of current Research; (ii) Efficiency in the allocation of funds; and (iii) effectiveness (see details in the research Annex). The Conclusion: The Impact now being achieved by research could be starting to diminish, partly because the issues being dealt with are more challenging. The skeleton for a sustainable national agriculture research system is in place. However low levels of investment, a disconnect between research and the market for research outputs and outcomes, a closed research system, inability to recruit and retain competent researchers coupled with over-investment in land and buildings and high overhead costs has the potential to threaten sustainability. Options for the way forward should address sustainability. Specific recommendations for future action are presented in Appendix 1.

Value chains

Vietnam's value adding chain is surprisingly small for a country with such an important agriculture production, and as a result its value added contribution is limited compared with similar countries. This results in lost economic opportunities for Vietnam's agriculture sector. According to some estimates (World Bank staff), food and beverage manufacturing as % of primary agriculture value added in Vietnam is only around 20% compared to 85% in Thailand, 96% in Chile and 120% in Mexico. Because of this lack of development there is a major opportunity for investors to develop the value chain in Vietnam, and bring more value added to within the country. At the same time this would improve market opportunities for Vietnamese farmers who lose a lot of market value for their products because of the limited choice of outlets for their production.

For existing processed products, quality in general is not high except in some enclave areas, and goods produced are monotonous with lower competitiveness, value, and export prices. Most agricultural products (coffee, cashew nuts, rubber, fruits and vegetables, seafood) are still exported as semi-processed or preliminarily processed, with low value added, and without a reputed brand name (which usually adds value) and modern packaging. For example, coffee kernel (Robusta) which is highly appreciated, only 17% of exports of this reaches the high quality (and high value) end of the market, while tea processing accounts for only 55%, vegetables 10%, meat export 1% of the total amount of each agricultural product. Part of the problem is the poor quality of raw materials supplied by producers.

MARD estimates that there are over 5,000 industrial processing units in operation in the country linked to the sector, including over 2,000 agricultural processing, 570 seafood processing and 2,500 forest product processing facilities. During 2000–2010 period some important progress was achieved in expanding capacity: rubber production capacity increased from 294,000 to 800,000 tons of dry latex/year year, sugarcane from 73,700 to 106,750 tons of sugarcane/day, cashew nuts from 220,000 to 800,000 tons of raw materials/year, and animal feed capacity from 2.9 to 12 million tons. In the last few years many enterprises have also been investing in modern technology and equipment, processing of products with high added value, applying technical regulations, standards (ISO, HACCP) and gradually improving their quality and competitiveness. More and more processing companies are exporting products to USA, EU, Japan, South Korea, typically as rice, coffee, cashew nuts, pepper, rubber, seafood. However there is still a long way to go, and there are many challenges for potential investors.

A majority of agro-processing plants is located in remote and underdeveloped areas that have contributed to improving economic well being of rural society engaging directly about 1.5 million workers, and tens of millions of labor for production of materials and services, contributing greatly to poverty alleviation in rural areas. But there are so many households and small and medium scale agro-processing enterprises with outdated technology and primitive processes and unskilled labor. Application of standards, technical specifications, quality and food safety aspects are not high on their agenda. Access to credit, especially to small facilities remains a serious constraint with SOEs having a preferential treatment from the government agencies and banking sector. The supply of raw materials for agro-processing industry is unstable and generally of low quality with high risk of poor hygiene and food safety thereby requiring large imports for many commodities (e.g., fruit and vegetables, cashew, milk, sugar).

In the context of Vietnam's comprehensive networks of scientific and agricultural research and development institutions (RDIs) and universities, mobilizing knowledge for successful investing is a challenge. But barring a few major institutional networks, many RDIs lack capacity to do relevant applied research and technology transfer (see detailed assessment on research in Appendix xx). Actual R&D outputs from the system are not commensurate with the needs of Vietnam's economy. The R&D system has not been able to bring about any major breakthroughs for improving the productivity, quality and added value of agro-products. Some institutions have developed new R&D and technologies, but technology transfer and knowledge application process are weak and cumbersome. In most cases, new technologies developed do not reach the intended beneficiaries. Therefore, applied technology research has not yet had much of an impact, for example, on rice harvesting and milling, tea plantation, mulberry silk raising, vegetable growing, fruits or livestock products, etc. Further, the extension network is rather weak at the grass-roots level. There are not enough technicians for the transfer of techniques and technology to the farming and agro-processing community.

Despite a plentiful labor force, the human resources, especially qualified personnel for production and business management are in short supply. The industry generally faces a shortage of skilled and trained workers and in recent years. It is of concern that the number of people choosing to study agriculture, forestry and fishery subjects has been decreasing. This is possibly because of the general low level of compensation in the sector. The share of trained rural workers is quite low (15.5% in 2010), while the competitive advantage of cheap labor is decreasing. This leads to low productivity and poor quality of agro-products that do not meet the requirements of domestic and foreign consumers.

Food quality and safety

In Vietnam's food chain, problems with food safety and hygiene issues are quite widespread. Unlike the situation in more advanced countries the agro-processing plants in Vietnam do not often associate closely with their raw materials suppliers upstream, thus do not provide support and guidance to farmers in accessing advanced technology and knowledge on best practices. Poor handling practices, overuse of fertilizers and pesticides, injecting impurities in raw materials, misuse of antibiotics, and banned chemicals

Box 7.1: Vietnamese consumers are wary on food safety issues

For many consumers in Vietnam, official guarantees of food quality and safety are not yet sufficient. Many consumers will still not buy frozen meat and to a certain extent ready to cook products. Freshly slaughtered meat bought in the wet market is only frozen by many consumers themselves after being bought fresh. There is an acute awareness among consumers of certain characteristics of the products and practices in the production process, which are potentially harmful for the consumer. People associate industrially produced eggs with a bad taste from fishmeal, pale yolks and high cholesterol. Many are prepared to pay a premium price of up to 50% extra for the eggs of village chickens, under the assumption that these will be free from such substances. White broiler poultry meat is associated with the presence of antibiotic residues, brown broiler or local chicken meat not. For many, the proof is in the color of the feathers, therefore brown broilers are usually sold alive on the wet market. Also pork is often associated by consumers with antibiotic and growth promoter (Beta Agonists).

Source: Centennial team

in the post-harvest product preservation continues to pose a high risk to food supply and there needs to be more of a dialogue on these issues between raw material suppliers and the processors. Further, the waste treatment facilities and environmental protection is inadequate.

At present, in 2012, the marketing process is very different and leaves space for many potential quality and food safety gaps. The government makes efforts to spread "Good Agricultural Practices" that will lead to the production of known quality and safe food, but consumers are still not convinced. Currently consumers often choose a middleman/trader they think they can trust in the traditional markets, who will inspire confidence on the safety of the food purchase. Fish and poultry are often presented alive and slaughtered in front of the consumer, and the consumer can be in this way involved in the outer safety and quality aspects but still cannot be sure of e.g. residues. This is clearly not a sustainable long term solution and in time the wet markets will be gradually reduced in number and the consumer will have to rely more on systems and practices designed to achieve the safety and confidence that they seek. For supermarket purchases, the consumer will have to rely on the supermarket's own systems to assure the quality and safety in a way that is consistent with national and international standards and acceptable practice. Most supermarkets in the world adhere to the application of Good Practices in production, manufacturing and livestock veterinary services. But government services' inspections are seldom capable of detecting residues of pesticides, antibiotics or growth promoters and they must rely on the control systems in place.

Some examples: the rate of occurrence of food poisoning in Vietnam is 750–800 times that of advanced countries (WHO 2007) and the ratio of suspension cases on Vietnam's food exports by Japan's customs service has been increas-

Table 7.2: Relative rejection rate for imports to the EU and the US for Vietnam, 2002–2008

European Union					United States				
total	fish and fishery products	fruit and vegetables	nuts and seeds	herbs and spices	total	fish and fishery products	fruit and vegetables	nuts and seeds	herbs and spices
high	high	high	low	medium	medium	medium	medium	low	low

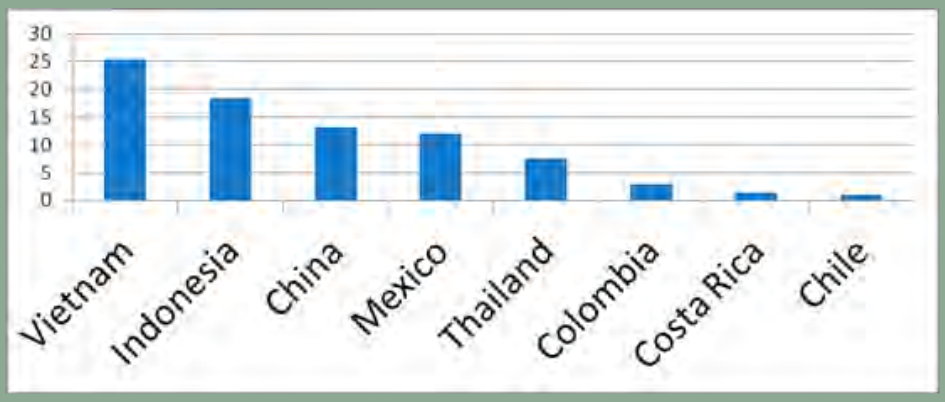
Source: UNIDO—Meeting Standards, Winning Markets- Trade Standards Compliance Report 2010

Table 7.3: Specific Rejections 2002-2008 by US/EU for VIP countries plus Thailand and Value of total exports in period

Exporting Country	US:Number of rejections recorded 2002-2008	US: Value of imports during 2002-8 period $B	EU:Number of rejections recorded 2002-2008	EU: Value of imports during 2002-8 period $B
Vietnam	367	7.6	64	9.8
Thailand	280	17.0	95	15.0
Indonesia	269	9.9	40	16.5
Philippines	238	5.7	17	4.1

* UNIDO: op cit.

Figure 7.1: Food product rejections on imports by the USA 2006–2008 (no. per million in trade)



Source: Dr. Nguyen Do Anh Tuan, Center for Agricultural Policy IPSARD- Vietnam's Agriculture: Performance, Problems and Perspectives based on data from UNIDO—Meeting Standards, Winning Markets—Trade Standards Compliance Report 2010.

ing year by year (JICA)[3]. Currently, Vietnam cannot export honey to the EU market due to residue issues. Incidents such as the use of formaldehyde to improve the shelf-life of rice noodles and concerns over "toxic" soy sauce, have further undermined confidence and done little to reassure buyers at home and abroad of food quality. Recent official studies also found high levels of lead, copper and E coli in vegetables grown in "safe zones" in Northern provinces, attributed to excessive use of fertilizer, pesticides and improperly composted manure. Also there are ongoing concerns about increasing concentrations on carcinogenic dioxins in the food chain, related to Agent Orange herbicide spraying during the US-Vietnam war. The following table from work by UNIDO assesses the level of risk of rejection by the US and EU of some of Vietnam's food exports:

Rejections of imports of various Vietnamese products by the US, EU and Japan for not meeting required standards continue at a relatively high rate compared with many other countries, but the rejection rate is on the decline. Recorded rejections in the above cited UNIDO report for US and EU (similar data for Japan are not available from the UNIDO analysis) were as shown in Table 7.3.

The above situation notwithstanding, the conditions in the seafood sector, which is a strictly regulated export sector, are better. In Vietnam, in 2011, all 534 industrial scale units met mandatory requirement of HAACP certification compared to 80 units in 1990. But nevertheless, according to the 2010 UNIDO Trade Standards Compliance report, in

3 JICA has been providing technical assistance to Vietnam to help improve the quality of exports of food products, particularly products from aquaculture.

both the EU and the US markets, Vietnam, Indonesia, China, India and Thailand are amongst the countries with the greatest number of rejections of fish and fishery products during 2002–2008 period, collectively accounting for over 45% of total Rejections. For Vietnam, prominent causes for EU rejections include microbiological contaminants and veterinary drug residues. For Vietnamese fish and fishery products, the labeling and unregistered process/manufacturer reasons were high on the list of US rejections. Frequently these determinations were accompanied by other aspects of non-compliance, notably filthy/unsanitary and microbiological contamination. Other UNIDO data for Vietnam also suggests that Vietnam does not compare well with regional and other comparators on food product ejections of imports by the USA as shown in the following table:

Current Vietnamese procedures: who tracks potential problems? At present there are three main groups involved in Vietnam in tracking food quality:

1. Veterinarians and technical specialists under MARD are responsible for controlling the production part;

2. inspectors of Ministry of Trade and Industry check the part of transport, storage and processing; and

3. the Ministry of Health monitors whether there are people with disease symptoms that could be referring to contamination of food of especially animal origin with foreign substances or pathogens.

For this system to work well there has to be an intensive contact between the different parties and exchange of information, warnings and follow up reports to achieve a complete tracking and tracing system. Experience anywhere in the world has taught that such a system requiring close interaction between various Ministerial bodies. Without an apex management ensuring proper coordination between the parties, the system does not work. There are usually gaps occurring between the inspections in the chain, problems in the communication and often disputes about competence and responsibilities. The parties involved in the current food safety system in Vietnam recognize that these symptoms are already appearing in Vietnam and that improvements are required.

In general, the system lacks adequate capacity and resources to operate an effective food safety and market surveillance system. The National Agro Forestry and Fisheries Quality Assurance Department (NAFIQAD) of MARD is the state governing body for quality and safety of agricultural, forestry, fishery and salt products. NAFIQAD is a professional organization with 6 ISO/TECH 17025 accredited labs and 63 local competent authorities. But it does not have adequate capacity (staff, skills and budget) to carry out its responsibilities effectively in a fast growing sector.

Food safety: how do others do it?

One recent example is the EU which is a major importer and exporter of food products. In 2002 the EU launched a White Paper on food safety in the EU, in which it was suggested that a unified food safety assurance body be formed from the various ministerial teams responsible for food safety in each country, and the principles of self- control through the application of "Hazard Analysis Critical Control Points" approaches already widely used in industry be applied towards food safety. This would put the government only controlling the self-control systems in industry and the responsibility for food safety at the production level solidly with the producers. For this to work a major effort would be required to ensure that rules of origin were developed which truly captured sources of production so that problem areas could be traced back to where they originated.

A modern system to ensure food safety needs to be developed in Vietnam rather urgently for the future. To help Vietnam deal with the current serious distrust by consumers in the quality of local products, particularly those of animal origin, Vietnam could move towards the formation of a National Food Safety Council, which hierarchically should be at a similar level as a Ministry. Through a Good Agricultural Practices (GAP) assurance system at producer level, food producing organizations would have to provide transparency on producers' use of chemicals and adherence to withholding periods, and provide the opportunity

for tracking and tracing through an improved system of Rules of Origin/animal identification. After applying all the pre-requisite program of safety assured inputs from GAP certified farms, agro processors would develop and adhere to their own Good Hygiene and Manufacturing Practices, putting into place a HACCP system to monitor the remaining critical control points. The industry would train their staff to apply this in their daily procurement, production, storage and distribution processes. To make this system work the government would have to prevent unfair competition by preventing non-HACCP certified companies to continue operating, otherwise no companies would be prepared to invest in the development of such a system.

With the high level of informal production and trading in Vietnam it will initially be hard to establish such systems but looking ahead to 2040 a system like this will be needed if Vietnamese agriculture is to (re)gain the confidence of consumers, and importers from other countries. If it leads to a competitive advantage because the product with a HACCP label can be sold at premium prices in supermarkets, of which the urban consumers will increasingly make use, there will also be a financial incentive for farmers and the food processing industry to develop and adhere to such food safety assurance systems in the future.

Climate change factors

Climate change is underway in Vietnam and beginning to affect agriculture and fisheries, but change is slow and major impacts are not expected before around 2050. In the meantime the situation needs careful monitoring.

Climate change is already underway in Vietnam and it is projected that average surface temperature will rise by 0.8–1.3°C by 2050, total rainfall will increase by 5–10% by the end of the century, with 20% larger variations between wet and dry seasons. Sea level is projected to increase by 28–33 cms by 2050. Global supplies of food are not likely to be threatened by modest temperature rise of 1°C because of positive yield response in the higher latitudes. Crop yields in Vietnam are expected to decline under a 1°C rise expected around 2050: for rice by 3.4–6.7% and other crops by 0.3 to 3.7%. Mekong, the granary of Vietnam, could lose in some simulations as much as 590,000 ha of rice area and combined with the yield impact, this could lead to a decline in rice production 2 to 7 M tons of rice per year if no adaptation is undertaken. Fishery sector will be impacted but not damaged. Increased habitat in the wet season will counter the reduction in the dry season and increased saline intrusion resulting perhaps in a small increase in overall production. In the plantation forestry sector average yields are expected to increase marginally but with increased variability across various districts. Livestock sector is likely to be confronted with more disease problems leading to a loss of productivity.

Overall impact of CC on agriculture sector is likely to be quite modest with a 1°C rise. A productivity increase of 10–13% over next 30–40 years would fully compensate for all foreseen yield and area loss effects. Changes underway in diet preferences away from rice and towards poultry, fruits and vegetables will further dilute the impact of these changes.

Vietnam agriculture has been continuously adapting to past climate change and has now produced a significant exportable surplus of rice. Vietnam agriculture is poised to reach a new high level of performance and to increase farm incomes. Among key policy actions needed would be steps to soften the informal quota system that applies for rice production, shifting to higher quality rice, and encouraging crop diversification to higher value added crops in response to consumer demand. These actions supported by farm level adaptation will effectively counter all anticipated CC impacts on agricultural production to 2040–2050.

Autonomous response actions are well known and contribute to the growth of the sector, whether there is CC or not. In the crop sector these include delays in winter-spring rice planting in Red River delta, switching to drought resistant crops such as cassava and maize and in the Central region, changing to heat and salinity tolerant varieties in the Red River Delta, expanding a fish/rice rotation in the Mekong and improved water management systems. In the fishery sector, upgrading of ponds and changes in water/salinity management practices and use of new salinity tolerant

species are needed. In the plantation forestry sector, shifting production from unfavorable to favorable areas and changing varieties will be needed.

Soft—policy and institutional—planned adaptation measures options are many. Government can enhance farmers' ability to plan the growing season based on detailed and timely information about temperature and rainfall and the knowledge to use this information. Strengthened agricultural research and extension will play a crucial role in adaptation to CC, since new varieties tolerant to salinity, flooding and draught, and new practices to reduce waste, increase efficiency and reduce emissions will be needed to be developed, tested and disseminated. Among these soft measures would be the introduction of water charges and delivery of effective veterinary services. Provision of strengthened veterinary services to counter increased threat of livestock disease would be needed.

Hard planned adaptations—involving public expenditures—to expand irrigation and especially to build new sea dykes or coastal embankments need to be implemented after considerable site and threat specific due diligence, given their huge costs, the large uncertainty in predictions and slow pace of sea level rise. The first priority would be improve the utilization of existing irrigation infrastructure, which is little better than 60–70%. Potential for expanding irrigation is nearly exhausted in the Red River delta, where the emphasis is on rehabilitation and upgrading, and constrained by flooding and saline intrusion in the Mekong. Irrigation expansion in the Mountainous regions is prohibitively expensive. Potential to expand irrigation in the Central region is estimated to be about 700,000 ha by 2050. Restoration of mangrove forests as a natural barrier to flooding and storm surges forms part of a planned response in coastal areas, perhaps in the form of "green" dykes, of which as much as 6000 kms may have to be raised or built to protect against sea level rise to 2100, if it and when happens.

Estimates of financial costs of adaptation are indicative upper ranges only. To generate the estimated 10–13% productivity increase in the crop sector, investment costs have been roughly estimated to be $6.3 Bn. In the fishery sector costs are estimated to be $150M annually. No estimates are available for the cost of enhanced veterinary services to counter increased livestock disease. Estimated cost of strengthening and adding about 2000 km of sea dykes, embankment and associated mangroves, although it is not certain that all these would be needed by 2050, is roughly about $2.2 Bn.

With high social vulnerability household food insecurity can persist despite national food self sufficiency. The lowest 20% of households will face inequitable risks and damages and see disproportionate decline in real standards of living when the combined impact of lower yields, cost of autonomous response measures and increased variability of food retail prices hit them. In the mountainous regions of the NW and Central High lands where poverty rates are high, large segments of the population in these regions could feel more food insecure with CC. Without irrigation, which is costly to build in these regions, productivity is low. Their resilience is best enhanced through income augmentation by facilitating diversification to higher value crops. In addition, prompt actions are needed to compensate for unexpected loss due to CC events. Vietnam has begun piloting an index based crop insurance program aimed at the poorer segments.

A decision framework to guide the process of developing an optimal response strategy would require judgments about the urgency, severity and probability of climate threats being averted and cost of likely damage and adaptation and scope for recovery of costs from beneficiaries and social impact. Vietnam is piloting a methodology to make such choices, the first results from which should be available in 2012.

With virtually no progress on global GHG reductions since Koyoto, the world may well be on way to a 4–7°C warming by 2100 when the food situation could become really unmanageable. The totality of climate actions underway will not hold the world to a 2 degree C rise by 2100. While the Koyoto commitments called for a reduction of GHGs by 5.2% below 1990 level by 2012, emissions globally have increased by 36% to date. Even the softer Copenhagen 2009 agreements which would have limited global emissions to 44 Gtons CO_2e by 2020 are already showing a slippage of 5 Gtons. With a 3°C or higher rise, even in the higher latitude regions, all major crops are projected to

show decline in yields of 16–29%. In the lower latitudes, yield declines are of the order of 20–40%.

The fate of Vietnam agriculture in the period 2050–2100 rests squarely on what the world does now to control green house gas emissions since Vietnam itself contributes very little (1.1%) to global GHG emissions and there are long lags in the green house gas system. While low GHG technologies are known or even being piloted in rice irrigation, livestock management as well as in fisheries, all taken together and implemented successfully, will at best reduce the GHG contribution of Vietnam agriculture by roughly 20% of the sector's emissions. However, with reforestation planned to achieve 47% tree cover by 2020 and by arresting land use changes in primary forests, Vietnam could make a meaningful contribution to sequestering carbon.

Vietnam is steadily building its institutional architecture to deal with CC since 2009 and legislation, institutions and programs in all key sectors—10 ministries and 35 departments—are being systematically set up. This phase of will be complete by 2013. Similar structures and process are to be replicated at various tiers of local government but some selectivity in roles and responsibilities between various tiers is called for. Local Governments will have a primary role in implementation of adaptation measures and this is a critical need to be addressed. Community empowerment and engagement is fundamental to the adaptation process to help ensure full awareness of CC and how it unfolds, as well as rapid learning and dissemination of lessons to others. The NGO community is deeply involved in this sphere. There is scope to enhance the systematic engagement of the scientific community which is spread out over 15 institutes.

Primary conclusions of this study are that Vietnam needs to accelerate the uptake of well known and currently practiced autonomous adaptation measures by farmers, to fully counter the impact on yields and land available for agriculture due to climate change projected to 2050. High cost public expenditures to build dykes and embankments to deal with slow, long term and uncertain threats of sea level rise need to be undertaken with due caution, and appropriate phasing. Negative social impacts on the poorer segments of the population need to be countered with diversification to higher value crops and promotion of non farm income opportunities, including appropriate payments for eco services provided by them and through crop and livestock insurance. Vietnam's institutional capacity to manage climate change can be further strengthened through continued improvement in its resource allocation framework for climate expenditures and through integrated management of its coastal zones and further enhance regional collaboration among with riparian states of the Mekong delta to focus on impact of climate change on water availability.

Chapter 8. Major Future "Drivers" and Trends 2012–2040

Looking ahead, there will be several factors driving production and consumption trends in Vietnam during the upcoming 2012–40 period. We have identified: (i) changing demographics; (ii) increasing and rapid urbanization; (iii) evolving trade agreements; (iv) changing diets; and (v) changing food security concepts and the place of self sufficiency.

Demographics

Changing demographics will influence food demand in Vietnam in the future and cause an aging of the labor force. Vietnam's population of 89 million has experienced a rapid decline in birth rates during the recent past and further declines are being projected by GSO/UN. This would imply the population is likely to level off at around 104 million. Presently the population is made up of ethnic Vietnamese (86% of the total); the rest are some 54 ethnic minorities residing in hilly areas and comprise the poorest segment of the population. With rapidly declining birth rates and rising life expectancy, the country is gradually starting to age; projections show that by 2040 fewer than 32 percent of the people will be under the age of 25 while 20 percent will be over 60.[1] Changes in the age profile combined with growing rural-urban migration have started to affect labor availability in the agricultural sector and with time this may become a major constraint. Another potential issue is the country's population density, which is one of the highest in Southeast Asia.

There will be three additional developments affecting labor supply for agriculture as well as food consumption patterns. First, the majority of people will live in urban areas. Second, a steady and significant rise in rural wages as a result of three mutually reinforcing factors: (i) rural to urban migration and the gradual ageing of the rural population; (ii) availability of higher paying off-farm jobs (services, agribusiness) in rural areas; and (iii) overall higher income and wage levels in the countries as a result of higher economic growth and higher productivity. The only way agriculture can remain profitable at these higher wage levels will be to sharply increase productivity and shift to higher-value crops. In each instance the migration to urban areas as more and more laborers leave their farms in search of employment in the cities will impact labor availability for farm work and exert pressure on the provision of urban services.

Changes in the demographics of other ASEAN countries may affect the scope and direction of future rice exports from Vietnam. UN projections generally indicate a rapid slowdown in the growth rate of population for the ASEAN member countries and two VIP countries, with only the Philippines continuing to register a relatively high population growth rate of 1.4 percent per year. However, in the case of Indonesia the forecasts present an issue. The UN expects average annual growth rates for the next thirty years of 0.6 percent per year resulting in a total population of 290 million by 2040. By contrast, some Indonesian forecasters are considerably more pessimistic about the success of family planning and expect a decline in population growth rate to

Table 8.1: Vietnam's population will continue to increase and become more urban

	2000	2011	2040
population (millions)	79	89	104
urban population (millions)	19	28	52
rural population (millions)	60	61	52
% of population in urban areas	24%	31%	50%
labor force (millions)	42	53	60
ag. employment as % of total employment	65%	52%	

Source: UN Population Division; World Bank WDI; Centennial Group estimates.
Note: 2011 agricultural employment figures are actually for 2010.

1 Vietnam Development Report 2006: Social Security.

only 1.2 percent, which leads to a total of 54 million more Indonesians in 2040. Clearly such a big difference in total population will have major consequences for food demand security.

Urbanization

The current rate of urbanization in Vietnam of 29–30% is low compared with regional averages of 40–42% but urbanization in Vietnam is now proceeding quite rapidly, driven by the flight of younger workers from the rural areas in search of higher paid employment in industry, services and construction in urban areas. In the early nineties the urbanization rate was estimated to be close to 20% (GSO) but now GSO projections are that the level could well reach over 50% (52%) by 2040. From a situation of excess labor in the rural areas since the nineties, in 2040 a tighter labor market in the rural areas can be expected. This will encourage investment in mechanization in the coming years which should lead in turn to higher labor productivity. However the increased settlement in urban areas and the parallel growth of industry will also require land to be converted to urban and industrial use, and in many cases taken out of agriculture. It will be advisable to protect some of the best agricultural land through zoning the land for continued agricultural use while allocating poorer quality agricultural land for urban and industrial use.

Global and regional trade agreements

With all ASEAN countries except for Laos being members of WTO, trade between members should be able to move freely provided it complies with existing health safety regulations. Any further development of trade will thus depend on either further global agreements under WTO or regional specific agreements under ASEAN. Even though the economies of the ASEAN member countries are fairly similar, there is considerable scope for increasing intra-regional trade. However, years of negotiations aimed at a free trade area have only yielded limited results. It would seem that there is concern among some members that without tariff and non-tariff barriers' to protect local producers, they will not be able to compete with the internationally traded goods on price, product quality and safety standards.

A study by the World Bank shows that, in the case of VIP countries, hidden trade barriers (mostly import restrictions) and extra payments or bribes are (Table 18) are significant; this is likely to be a challenge to closer trade integration. At the country level, traders in Vietnam still appear to struggle with hidden trade barriers, while in the Philippines both trade barriers and extra payments are a constraint; conditions in Indonesia are slightly better but here too trade barriers are an issue. Rapid relaxation of barriers and elimination of extra payments are preconditions to the expansion of trade.

Table 8.2: Trade barriers and bribes are significant issues in VIP countries

	trade barriers	irregular payments
Vietnam	1.00	0.78
Indonesia	0.75	0.47
Philippines	0.98	1.00

Note: 1.00 signifies major problems and 0.00 the absence of any problems.
Source: World Bank: Transparency, Trade Costs, and Regional Integration in the Asia Pacific, November 2007

A more detailed assessment on the regional implications for ASEAN members of the evolving reduction of trade barriers is in Chapter 5 of the "Overview Report", the companion volume to this country study.

Changing diets

The increased rate of urbanization described above and increased incomes resulting from the strong pace of economic development will have a significant impact on the type of food consumption in Vietnam in two ways. First, urban consumers are observed to eat less rice as a basic food compared with rural consumers and to increase their consumption of higher protein products like fish and meat, and fruits and vegetables. In addition both urban and rural consumers can be expected to change diets as incomes

grow, along similar lines. This will affect the national consumption rate of key commodities over time. Per capita rice consumption can be expected to fall while other food items will be in greater demand. These changing demand factors compared with supply scenarios are analyzed below.

Approach to food security and self sufficiency

From primary concentration on the volume and stability of food supplies in the 1970s, the concept of food security has gradually evolved to include food access by the poor. This study adopts FAO's widely accepted formulation of food security that defines it as a "condition that exists when all people, at all times, have physical, social, and economic access to sufficient, safe, and nutritious food that meets their dietary needs and food preferences for an active and healthy life".

In most ASEAN countries—including VIP countries—food security is an important plank of national agricultural policy and is often equated with self-sufficiency. The focus of food security and self-sufficiency is primarily on rice. Countries have a much more open policy towards other food commodities, such as corn and wheat.

An interventionist food policy regime in grain markets was firmly entrenched in Asia during the 1970s, with the direct involvement of the governments. This involvement included the following: accumulation and release of buffer stocks to stabilize prices; monopoly controls over international trade; restrictions on domestic movements of grain; cheap credit and access to transportation for the parastatals; and limits on private storage. Such a regime may have been necessary in the 1970s owing to initial conditions of grain markets, but these conditions no longer hold.

The GOV still maintains a strong policy linkage between national food security and national self-sufficiency in rice. The current policy is that best way to ensure food security is to aim at national self-sufficiency in rice. The evolution of this self-sufficiency policy in the coming years has major implications for the development of agriculture in Vietnam. For example a relaxation of the self-sufficiency objective and a reliance on trade to cover any rice deficiencies could allow a different use of land by some farmers and a higher value of production by the sector, depending on market prices. Possible options in this direction are analyzed in the next section covering the demand and supply of food crops.

We note that self-sufficiency in rice was an important consideration for Vietnam in the past because internal markets were not well developed and many consumers preferred to rely on their own production for food security rather than consumer retail market access. However now retail markets are well established and this consumer concern in Vietnam is already diminishing. Recent surveys (Jaffee, et al) showed that many rice farmers in the Mekong delta now sell their rice production at harvest and repurchase rice supplies from retail suppliers when needed[2].

2 Jaffee: op cit.

Chapter 9. The Vision of Agriculture and Fisheries Sector as it can be in 2040

With the right policies, in 2040 Agriculture and Fisheries can be a large and dynamic sector of the economy as a result of greatly improved productivity in agriculture/livestock and fisheries from the use of advanced technologies (inputs such as seeds, fertilizers, disease control), more widespread mechanization, and improved quality of production. Food security will remain at a high level because of the high level of technology that will be adapted by Vietnamese scientists for use in Vietnam from international and national sources. Sector exports will also continue grow as farmers diversify into higher value crops, while maintaining significant rice exports to ASEAN and other importers. The major challenge will be to satisfy the burgeoning internal demand for pork and poultry, a result of the greatly increased purchasing power of consumers in a rapidly growing economy.

Farms can be expected to be bigger on average than they are today as commercial farming has become more important and many farmers will have taken advantage of government plans to support land consolidation programs. With more efficient farming units from land consolidation, farm incomes can be expected to be greatly improved, allowing rural salaries to match urban levels more closely. However there will also remain a large group of older farmers involved in part time farming who continue farming as a food security endeavor. Key changes in the sector which will upgrade or change performance:

- Changes in the diet: With rising incomes, Vietnamese consumers will be consuming less rice, more protein (meat and fish), and more nutritious fruits and vegetables. Consumers will also be demanding higher quality products. Farmers will have changed their cropping patterns to respond to these changing food consumption patterns and industrial demands for these higher value and higher quality crops which will also increase value added and farm incomes.

- Shift to animal feedcrops: In response to the substantial increase in the demand from local feedmills for raw materials for animal feed to support the high growth in demand for meat, some 1.5–2.0 million ha of farmland will include crops to be used as feedgrains (mainly maize) in the farming rotation, a doubling of present areas planted to feedgrains.

- Industrial crops: Rubber and coffee will still be popular industrial crops for farmers, adding to farmer incomes. A major investment in replanting rubber and coffee plantations with high quality cultivars will have upgraded industrial crop production and safeguarded Vietnam's export prospects.

- Value chain: The private sector will have greatly expanded investment in the post-harvest value chain and transformed the prospects for marketing of farm outputs, adding value to Vietnamese agriculture. Apart from value added through processing, a key improvement will be the development of a national cold chain which will transform the marketing and storage of perishable food items.

- Research: Major reforms in the national agriculture research system will have stabilized and upgraded staffing and redirected the focus of research to be less theoretical and more supportive of solving technical and financial problems at the farm level.

- Aquaculture development: The current high rate of growth of aquaculture will have been maintained by a shift towards marine aquaculture in the extensive

coastal areas of Vietnam which will become the major driver of growth in the sector.

- Disease control improved: While crop and livestock diseases will still be of concern, the upgrading of research and of the capacity of the veterinary and technical services will have greatly improved early disease identification and management and reduced losses to more acceptable levels.

- Food safety improved: Vietnam will have established an effective first class food safety agency with modern laboratories and a strong professional cadre that is capable of ensuring quality and consistency for all agricultural products both for the domestic market and exports. Rejections by foreign partners and complaints from domestic consumers have been reduced to a minimum.

- Irrigation upgrading: following the implementation of a well-focused investment program over many years irrigation schemes have been upgraded to permit high standards of water control and water use efficiency, saving water and allowing farmers to diversify cropping patterns and maximize the economic use of irrigation investments.

Food production and consumption scenarios for 2040

The key crop for food security will remain rice but rice consumption per capita will continue to fall as incomes increase. In this section we analyze consumption of various food items using the centennial model optimistic and pessimistic scenarios described at the start of this report: i.e. the 2040 Centennial optimistic scenario and the 2040 Centennial pessimistic scenario. In addition to rice, we model other key commodities such as protein rich foods: pork, beef, chicken and fish. Fruits and vegetables will also be in high demand but these are already widely produced in Vietnam and increased production is responsive to market demand. Wheat is a popular imported item which is in high demand and which is not produced in Vietnam.

Table 9.1: National consumption of selected food commodities (mt/year)

	2010	2040 (optimistic)	2040 (pessimistic)
rice	10.46	9.19	10.16
beef	0.17	0.33	0.27
pork	1.58	3.07	2.53
poultry	0.37	1.04	0.65
fish	2.63	3.39	3.23

Source: Centennial Model

Table 9.2: Per capita consumption of selected food commodities (kg/capita/year)

	2010	2040 (optimistic)	2040 (pessimistic)
population (millions)	90.2	104.1	104.1
consumption per capita (kg) of:			
rice	115.9	88.3	97.6
beef	1.9	3.2	2.6
pork	17.5	29.4	24.3
poultry	4.1	9.9	6.3
vegetables	27.4	38.7	33.6
fruit	11.8	29.1	19.2
eggs	2.2	2.9	2.8
fish	29.2	32.6	31
tofu	6.2	7.2	7.1
sugar	5.3	8.9	7.2
oil	4.1	6.1	5

Source: Centennial Model

Consumption projections from the centennial model for 2040 with comparisons for 2010 are summarized below in the following tables giving the estimated aggregate national consumption and per capita annual consumption estimates:

Rice

As described above, in 2011 Paddy production was reported by MARD to be 42.3mt, reaching a peak production level of more than double the 1990 production level of 19mt. After with-holding for seeds, feed and allowing for losses, some 22.8mt of rice were available for consumption export

and storage in Vietnam. This amount of rice is equivalent to 224% (i.e. more than double) of Vietnam's rice needs for human consumption of 10.2mt in that year. This current excess of production over internal needs gives a correct impression of the high level of rice security in Vietnam on a national supply and demand basis at the present. This high level of security allows Vietnam to export substantial quantities of rice, bringing in valuable foreign exchange. Rice exports currently account for some 35% of agricultural exports (i.e. excluding wood and fisheries exports).

Scenarios for paddy production in the coming period up to 2040 must provide for many different eventualities. The primary variables will be the amount of land that is used for paddy production and the number of rice rotations on the land. Current government strategy for food security is based on a policy of self-sufficiency to ensure that 3.8m. ha of ricelands are designated as such and must be used for rice production. The Provincial governments have also assessed the amount of land needed for rice security and have proposed that 3.6m. ha would be sufficient.

At this stage we do not know whether the government will maintain the current self-sufficiency policy for rice as a core element of the national food security policy through 2040. We do know that the policy is costly and because it constrains the diversification of agriculture in some areas as described above. The self-sufficiency policy can also be expected to reduce the prospects for the growth of the sector in the coming years by preventing some market based changes in cropping by some rice farmers. Already it is estimated that some 400,000–600,000 ha could now be "released" for the cultivation of other crops if farmers find a financial interest in diversification. Current average levels of rotation of about 1.8 can be assumed up to 2040 as a conservative assumption (meaning that the number rice crops grown on the same plot of land will average 1.8 crops). If 3.6–3.8m ha are dedicated to rice this implies some 7m ha of planted rice area at current levels of activity (actual for 2011 was 7.6m ha)

Another key variable which will affect rice production through 2040 is the yield levels being obtained by farmers for each of the three rice crops being planted: the Spring paddy, Autumn paddy and the Winter paddy and the balance between these three crops. Recent yields were recorded as follows for 2010 (see chapter 5): Spring paddy: 6.2t/ha, Autumn paddy 4.8 t/ha, winter paddy 4.6t/ha. For statistical purposes the yields are averaged out every year by MARD. The 2011 average for the three crops was 5.5t/ha.

What will this average yield figure be in 2040?

The average yield in 2040 is unlikely to be less than the 2011 yield of 5.5t/ha given the success of Vietnamese farmers in the past in taking advantage of new varieties and improved cultivation techniques proposed by MARD and the highly successful fertilizer application programs. Over the last several years, yields have been growing every year. Farmers have improved their farming techniques, research has provided better yielding seeds and government support has been continuous. From 1996–2005 yield growth averaged 2.9% per year. From 2006-2010 the yield growth rate fell as yield growth limits started to be reached, but was still 1.7%/year.

In addition any land taken out of production for other uses in the coming years will most likely be at the lower end of the yield spectrum which would tend to increase the average remaining yields. Given past performance it would be highly conservative to assume an average paddy yield of 6.5t/ha by 2040 compared with the present yield level of 5.5t/ha in a pessimistic rice production scenario for 2040. This implies a yield growth of 0.65%/year from 2012–2040 compared with the current growth rate of 1.7%/year. An optimistic scenario would assume new progress by the research establishment in more exotic rice varieties such as hybrid rice or C4 rice. With advances in these technologies a 2040 yield of 8.0 t/ha can well be envisaged in an optimistic rice production scenario for 2040, implying a yield growth rate of 1.5%/year up to 2040. 8T/ha is, of course "aiming high" but not an impossible outcome given past performance and future prospects.

Area of land required for rice self-sufficiency today and in 2040. At present government policy is that 3.8m ha of agriculture land be zoned as "rice land". Given these projected

yield levels for the two 2040 scenarios we now assess the amount of land required to be dedicated to rice production in Vietnam if self-sufficiency is to continue to be the national policy for food security in the future. In making this assessment we are not advocating a self-sufficiency policy (because it will reduce sector growth) but we make the assessment in order to understand better the amount of land that can be available for diversification with projected levels of production. This analysis is carried out for 6 scenarios as follows:

1. For 2011, assuming GSO reported consumption demand for rice and standard retentions for: seeds, feed for livestock, and post-harvest losses. Current estimates for the National Reserve and for industry. (One simulation)

2. For 2011, assuming NIN reported consumption demand for rice and standard retentions for: seeds, feed for livestock, and post-harvest losses. Current estimates for the National Reserve and for industry. (One simulation)

3. For 2040, assuming centennial projections for consumption demand for rice under a high economic growth scenario for 2012–2040 and standard retentions for: seeds, feed for livestock, but middle income country standards for post-harvest losses; conservative estimates for the National Reserve and for industry; both "optimistic" and "pessimistic" 2040 yields for paddy of 8t/ha and 6.5t/ha. (two simulations)

4. For 2040, assuming centennial projections for consumption demand for rice under a low economic growth scenario for 2012–2040 and standard retentions for: seeds, feed for livestock, but middle income country standards for post-harvest losses; conservative estimates for the National Reserve and for industry. "Optimistic" and "pessimistic" 2040 yields for paddy of 8.0t/ha and 6.5t/ha. (two simulations)

The results of this analysis again underline the strong position of Vietnam regarding current and projected rice food security for its population. We note that, until now, the excess production over local needs has been exported by Vietnam without too much difficulty and has provided a welcome buffer to regional production. In coming years however there may be increasing competition for the type of "low cost" rice that is the Vietnam market niche, if as expected, other low cost producers such as Myanmar,

TABLE 9.3: RICE LAND NEEDED TO SATISFY INTERNAL DEMAND FOR RICE (2010 AND 2040 SELF-SUFFICIENCY SCENARIOS)

	2010: GSO consumption data	2010: NIN consumption data	2040:[34] high VN economic growth 2012–40, and pessimistic future yield projection	2040: [5] high VN economic growth 2012–40, and optimistic future yield projection	2040: [6] low VN economic growth 2012–40, and pessimistic future yield projection	2040: [7] low VN economic growth 2012–40, and optimistic future yield projection
planted area of rice land needed for self-sufficiency. (ha)	4.8m ha.	5.5m ha.	3.9m ha.	3.2m ha.	4.0m ha	3.3m ha
net rice land needed with 1.8 cropping intensity (ha)	2.7m ha.	3.1m ha.	2.3m ha.	1.8m ha.	2.2m ha	1.8m ha
net rice land available for reprogramming from current 3.8m ha allocation.	1.1m ha.	0.7m ha.	1.5m ha.	2.0m ha.	1.6m ha	2.0m ha

Source: Centennial Model

Cambodia and Laos expand production and expand exports of lower quality rice. Vietnam should therefore be prepared to start upgrading the quality of rice produced in Vietnam, in order to be in a position to improve export quality along the same lines as Thailand has achieved. This will allow Vietnam to start targeting the higher quality /higher value rice market and safeguard export levels in the coming years. More details on the regional markets and future competition are in Chapter 5 of the "Overview Report" .

Conclusion: Production of rice is projected to remain fully sufficient to satisfy internal demand and for the most part provide some excess for export. Land dedicated to rice required to satisfy internal rice needs in Vietnam is less in 2040 compared with 2010 because: (i) yields/ha are expected to be higher in 2040 than in 2010; (ii) rice consumption is expected to be less per capita because of changed diets of a richer population; (iii) increased consumption from the small population increase expected between 2010 and 2040 is less that these factors. (i.e (i) and (ii)). Production quality needs to be improved to safeguard rice exports in the medium term.

Meat

Meat, with fish, is major source of Protein in the Vietnamese diet. As has been seen from the tables above pork is the major meat item consumed by Vietnamese with an estimated per capita consumption in 2012 of 18.3 kg/capita/year. Poultry comes second in preference and availability with 4.3 kg/capita/year. Beef is not currently so widely available and consumption is around 1.9kg/capita/year. Depending on income growth in the coming years, unlike rice for which consumption per capita is expected to fall as incomes rise the opposite is true of meat. Per capita consumption of Pork, Beef and Poultry is projected to rise by: 68%, 70% and 140% respectively by 2040 compared to 2010.

At present most meat that is consumed is produced locally. Vietnamese consumers generally stay away from (mainly imported) frozen meat products because of food safety concerns linked to the weakness of the national cold chain. There are a few imports of high grade products (mainly beef for the tourist industry), but meat is essentially still a local product in the markets. This however hides the fact that a significant amount of the animal feed used for animal production is imported. It is processed in local feedmills for use in the animal (and fisheries) industries. The simulations project that by 2040 there will be a major increase in the consumption of animal products under any scenario of future growth. The government will have to decide how best to handle the feed issue. Imports of feed and feed components could easily rise to $4–5 billion by 2040 unless there is more local production of raw materials for feed. Inadequate local production of animal products at competitive production costs could lead to pressure to import commodities at high cost to Vietnam.

Fish

Projections for an increase in consumption of fish products are much less than for meat products, partly because of the weak marketing chain for fish and the competition from exporters which raises local prices. Compared with the current per capita consumption of 17kg/capita/year only a small increase of 16% is projected by 2040 to 19.7 kg/capita/year. (18.3kg/capita/year in the low income growth scenario). Given the high growth in production there will be no problem for the Vietnamese industry and market to supply this increment by 2040.

Fruit and vegetables

Vietnamese farmers are used to producing these commodities and will have little difficulty supplying needs to the market as required.

Bottom Line: the main uncertainty for Vietnam regarding food security though 2040 is whether producers can supply sufficient meat to consumers to equal the demand and whether consumers will take a more favorable view of imported frozen meat.

Possible threats to agriculture production up to 2040

There are a number of possible threats to agricultural production which could affect food security and agriculture growth in Vietnam in the coming years or reduce Vietnam's capacity to contribute to regional food security, depending on the level of the threat. We have identified 16 potential threats to food security up to 2040. These threats underline the need for improved monitoring by the government of emerging threats to the sector and for support to the national research system to identify possible way of mitigating threats as they are identified. These 6 threats include:

1. external threats caused by factors beyond the direct control of Vietnam (such as global climate change);
2. threats to primary resources needed for agriculture and fisheries (such as water, land, and labor)
3. threats resulting from lack of investment
4. threats from inputs used for production
5. threats from outputs produced
6. threats from low profitability/incentives.

External threats

Impact of global climate change

Climate change is a potential concern for food security in the future as described in the main text, but there is still a lot of uncertainty about the timing and extent of changes which could affect food security in Vietnam by 2040. The three physical threats identified are (i) sea level rise causing loss of farm land through flooding and salinity incursion; (ii) temperature rise affecting seed potential; (iii) changes in rainfall intensity affecting yield potential. Specific impacts by 2040 are still not known but so far it appears that there is a low risk of major impacts on food production in Vietnam due to climate change before 2040. Most models predict major changes around 2050 and beyond. Current models suggest that sea level may increase is projected to increase by 28–33 cms by 2050. Mekong, the granary of Vietnam, could lose in some simulations as much as 590,000 ha of rice area[1]. With the combined yield impact, this could lead to a decline in rice production 2 to 7 M tons of rice per year if no adaptation is undertaken. However we emphasize the uncertainly that is still in estimates like this suggesting that is too early in 2012/13 to start launching major mitigation measures. Given the high cost of possible measures to prevent it makes sense to wait and measure ongoing impacts and establishing a more certain timing of the impact before allocating scarce national resources. Crop yields in Vietnam are expected to decline under a 1°C rise expected around 2050 as follows: for rice by 3.4–6.7% and other crops by 0.3 to 3.7%. Fishery sector will be impacted but not damaged. Increased habitat in the wet season will counter the reduction in the dry season and increased saline intrusion resulting perhaps in a small increase in overall production. In the plantation forestry sector average yields are expected to increase marginally but with increased variability across various districts. Livestock sector is likely to be confronted with more disease problems leading to a loss of productivity.

MONRE, MARD, and other agencies involved have been very careful in their assessments of CC impact. At this stage careful monitoring of developing impacts is the right course to follow as is already being done by government agencies involved. Precipitate action to build infrastructure to safeguard against CC could be very costly and very wasteful.

Impact of water diversions by upstream riparians reducing irrigation in Vietnam

The possibility of irrigation water shortages in the Mekong and Red River irrigation systems caused by development activities by upstream riparians on these important international rivers causing reduced food security has been assessed. The finding is that Vietnam is very likely to be affected by upstream diversions in the long term but on the

1 Current projections for rice production in 2040 are such that even if this unlikely reduction in rice land came about, local production of rice would still be far in excess of requirements.

basis of current information it is unlikely that Vietnam will be significantly affected by water shortages on the Mekong system from upstream developments up to 2040 but shortages will occur at some point probably starting around that date. The Red River flows seem less secure. Every effort should be made on both river systems to start using irrigation water as efficiently as possible to prepare for future limitations. In the meantime riparian use of the rivers' waters should be carefully monitored by Vietnam.

Impact of natural disasters (typically typhoons)

There will be damage from natural disasters, possibly of an increasing intensity because of climate change. However while these will be locally devastating for the people affected, Vietnam has many of the systems for relief in place and the impact at the national level is not expected to compromise food security up to 2040 given the high level of production already achieved. The main issue will be the level of emergency stocks that should be held in the country to deal with emergencies. These will have to be adjusted in the light of experience. For example national policy is now to use zoning controls as an instrument to try to minimize deaths and economic loss from natural disasters (flooding). This may subsequently permit a reduced holding of emergency stocks of food.

Threats to primary resources needed for agriculture and fisheries

Loss of fish breeding areas in Vietnam because of changes in flow patterns caused by upstream developments and flood control works which would reduce inland fish production in Vietnam is already occurring. The primary cause so far is flood control works on the river systems. More impacts are likely to occur in the lead up to 2040, and can be expected to reduce the catch of inland capture fisheries by a certain amount. This is not expected to have a major impact on national production, which is in the marine environment and protected aquaculture areas, but a more local effect. This would typically more affect food insecure families inland.

The occurrence of excessive pollution in water bodies from overuse and poor disposal of fertilizers, herbicides, pesticides and drugs used in agriculture and aquaculture, causing potential health risks and limiting the safe use of water sources for production. This is already occurring and already a concern. It requires a major and continuous campaign by local and central government to apply existing environmental legislation covering these inputs.

Demographic changes (population aging and migration) that reduce labor availability in rural areas to an extent that impacts food production. Demographic changes are already occurring but these are not yet a concern for food security. However urban migration will at some point reach a level where trained and experienced agricultural labor is more difficult to find. The aging of the rural population will also lead to farms being abandoned. However the loss of productivity can be limited by making land markets more flexible so that farmers who do not wish to continue farming can cede their land to others. This will reduce the number of farms and increase the efficiency of operations to allow higher labor productivity.

Loss of good farm land through urbanization/infrastructure/climate change impacts. Loss of farm land will certainly be a factor reducing farm production up to 2040. However since the excess of production over needs is now at a level that can liberate 1.5–2.0m ha of the best rice producing land without compromising rice security (see analysis above) the loss of good farm land is unlikely to impact food security for many years. The biggest impact is likely to be a reduction in the export surplus which would reduce Vietnam's ability to supply fellow ASEAN partners in rice should this become necessary. It will also affect the trade balance. However we note that current government policy at the central and provincial level is increasingly aiming at protecting high value agricultural land from expropriation for infrastructure and urbanization where this is possible and we expect that in time this will have an effect in limiting the loss of land. Overall we conclude that this land conversion issue will be of increasing concern approaching 2040 but in the near term it will have only a localized impact.

Threats resulting from lack of investment

The concern is mainly linked to the deteriorating irrigation systems in Vietnam which are key to the production of much of the rice and other food crops. Unless these schemes are upgraded they will gradually fall into decay and food security will be greatly affected. Investment is needed in water distribution and control systems and in operation and maintenance. On the other hand upgraded systems would permit more flexibility in cropping patterns and allow for increased productivity not only of rice but of other crops in rotation. Systems will also need adjusting to deal with changes expected in the land ownership distribution as farm sizes get bigger. (see Annex for technical details on irrigation.)

Another area of critical importance that will require increased investment is the inadequate research capacity available in Vietnam to address emerging technical and production problems in the more and more advanced food production systems being used in the country. This is also major concern for food security in the future. Vietnam has a high tech. agriculture and is a global actor in the international food markets but does not yet have the technical checks and balances in place to deal with technical imperfections developing in farming systems being used. Agriculture in Vietnam can be expected to become more and more high tech and a local research capacity of the highest standard will be required to support the farmers. Reforms have been started (see Chapter xx) but they will need strong government support to succeed, a change in the level of budgetary support to research, and a closer partnership with the private sector.

A third threat which can be partly resolved with new investment (by the private sector in this case) is the current inadequate development of the post-harvest value chain for agriculture and fishery products in the country. Currently Vietnamese farmers/investors get little benefit from adding value through the value chain beyond the production of basic raw commodities. Value is mainly added to Vietnamese production by others outside the country. Processed foods are for the most part imported. The development of the value chain within the country would provide added markets for Vietnamese farmers, and help safeguard food security in the country be ensuring a better sustainability of the sector.

- Three threats from poor quality inputs used for production
- Threats from smuggling into Vietnam of low quality or fake agro chemicals;
- Threats from smuggling into Vietnam of agro-chemicals which are prohibited by the Vietnamese authorities for health reasons;
- Threats from the sale of fake seeds and contaminated seeds.

There is a general area of concern, as the private sector takes a more important role in supporting farmers, that there is an increasing issue in Vietnam of “porous borders” and the movement of falsely labeled products from neighboring countries into the marketing chains used by farmers for purchase of seeds, fertilizers and pesticides. This must be a matter of great concern to the Vietnamese Authorities and to farmers who rely on quality branding for their purchases. Without action to prevent abuses the productivity and food safety in Vietnam could be seriously undermined and this would set back food security achievements. It is currently a growing problem in Vietnam, which has not yet reached epidemic proportions, but it is potentially very serious. In the coming period, Vietnam needs to take steps to prevent branding falsification and ensure that rules of origin (in this case of inputs) are properly followed.

Threats for/from outputs produced

Inability of Vietnamese producers to meet necessary food safety standards to the extent that consumers lose trust in national production and importers of Vietnamese products reject Vietnamese products. These are real concerns for food security in the years ahead. They will require (i) a determined effort by the central and provincial authorities to implement existing anti-pollution legislation and (ii) to introduce a modern food safety system supported by producers and retailers and buttressed by the national research

system. Inadequate food safety measures can completely undermine the food security situation of Vietnam in the coming years and greatly limit export potential and economic development in the rural areas. (For technical details see chapter xx).

Inadequate food quality causes consumers and importers to reject local production and favor imported items. This is already happening. Vietnam has already tended to "give in" to poorer quality production because the market has not yet pushed back on the quality of Vietnamese products. This is a dangerous development for Vietnam. Many Vietnamese farmers have tended to aim at the lower quality end of the market because this has provided them with a good market for their production. However Vietnamese consumers are becoming more demanding as incomes have been rising and there is a danger that in the future the market for lower quality production may be less open to Vietnam at the price Vietnamese farmers would expect. Over time farmers should move upmarket to secure the market. Vietnam will have to decide which end of the market they want to be. There is always the danger that new lower cost producers and exporters will take hold of the lower end market and reduce the opportunities for Vietnam.

Crop and animal diseases. Vietnam has been having increasing problems with crop and animal diseases affecting crop and animal/fisheries production and it is likely that these threats will become more prevalent in coming years as production becomes more intensive and possibly as a result of climatic change. This can affect production and food security (such as the culling of chickens for bird flu control) and other troective measures.

Threats from low profitability/incentives. An inadequate profitability from farming, partly as a result directed cropping patterns by government to less optimal cropping systems for national reasons that cause reduced farmer interest in the profession and hence reduced food production;

Farm budgets show that with current input and output prices there is little profit for farmers with small farms in intensive rice production but in many cases farmers could increase their income by changing cropping patterns with a higher productivity. More flexibility for farmers in cropping patterns would lead to more confidence in a farming future and more food security, or would encourage farmers to cede non viable farms others so that the land can be used productively.

A potential "quick win"? Dealing with post-harvest losses

The current weakness in harvest and post-harvest handling of paddy rice and maize in particular leads to substantial losses in productivity of these crops according to many surveys. Many observers believe that a concentrated effort to upgrade the infrastructure in the value chain could yield substantial benefits for farmers and post-harvest operators. This would reduce post-harvest losses and provide a "quick win" for Vietnamese agriculture.

Summary of proposed government strategies for realizing the 2040 vision

The optimistic vision of the agriculture and fisheries sectors in 2040 described above involving continued solid growth the sectors, and an upgrading of the rural areas and rural incomes through the widespread growth of commercial farming, is an achievable objective provided the government can take the necessary supporting measures, and farmers have the incentives to transform their production systems. Vietnamese farmers have already demonstrated their high capacity to adopt advanced agricultural technologies and Vietnamese businessmen has already demonstrated an excellent ability to market products on a world scale. The challenge is to ensure the sustainability of this performance and to allow this high income growth for farmers to maintain a reasonable balance between rural and urban incomes.

This transformation will require a continued restructuring of agriculture:

- Changes in the land policy. Commercial farmers will require farms of a size that is big enough to spread costs and have sufficient security of tenure to encourage their investment in their farms to increase the efficiency of their operations. Over time a broad

land consolidation program should be implemented to facilitate expanding farm areas taking advantage of continuing departures from the rural areas. The full and timely implementation of the government's ongoing Land Administration and Management program to upgrade the administration of land management can greatly facilitate this process.

- Border price transmission to farmers. The government should make every effort to ensure that prices available to farmers are not unduly distorted by government administrative actions.

- The growing disparity of income between rural and urban workers will result in farmers being more demanding on the profitability of farming, and less able to accept government directed cropping patterns. Over time, government should give farmers more freedom to choose their own cropping patterns particularly in those rice designated areas which are amenable to flexible cropping rotations. The Government should start moving away from a centrally planned directed approach to cropping towards a more market based approach.

- The aging of the population, the continuous flight of younger people from the rural areas, and the development of bigger farm sizes should lead to increased mechanization of farming activities to increase labor productivity. The Government research system should work with the private sector to test and demonstrate to farmers opportunities to make farming more profitable through increased mechanization.

- There will be a need to help develop support services for farmers for input delivery, sale of outputs and access to credit and technical information in an environment which can be expected to be much more private sector oriented than at present. Depending on the crop and the regions involved, this will likely involve support for the development of service cooperatives, outgrower models, large field coordination, technical support from agroprocessors etc. Several of these models are already being tested and the way forward can be designed to take advantage of this experience underway.

- Government should make efforts to facilitate the investment of the private sector in the value chain downstream of the farm, including the processing of farm produce and the development of a national cold chain, in order to maximize the market opportunities for farmers and the value added in Vietnam. Vietnam is currently very backward in this area.

- Government needs to rethink the investment policy in the rural areas particularly regarding support for irrigation schemes. Investment priorities in irrigation need to be determined on the basis of economic priority. This should lead to more support for rehabilitating and upgrading existing schemes by incorporating a better flexibility and water control in operation so that farmers can have a choice in cropping patterns based on market demand.

- To support the restructuring efforts Government needs to move decisively on food safety issues including for field crops, fish products and meat products. Current arrangements are clearly not working. Responsibility for food safety needs to be better coordinated and led by a high level in government. Inadequate action is this domain will severely set back the development and growth of the sector.

- Disease control. Government will need to continue to work on improving disease identification and control measures in the various sectors to avoid major setbacks in production and growth.

- A key factor for the continued high growth of the aquaculture subsector has been identified as being the development of marine aquaculture. The Government needs to ensure a strong effort by the

national research system to help resolve technical problems currently hindering this expansion.

- Agriculture/fisheries/livestock research. Improvements must be introduced in the national research system if this restructuring is to succeed. The current problems have already been well analyzed and the strategy must now be to implement identified reforms to improve relevance, efficiency, effectiveness, impact and sustainability of research. Reforms will require a reassessment of current funding levels for research which are low by regional standards.

- Climate Change impacts. The strategy must include the continued support for current efforts to monitor the evolving impact of climate change on Vietnamese agriculture to that mitigation measures can be introduced as needed to safeguard sector performance.

Chapter 10. Summary and Recommendations

Two scenarios were examined in detail during the study with the aid of the Centennial Model. The pessimistic scenario assumes an average GDP growth of 3.6%, with Vietnam lingering in the "middle income trap" and unable to break out into the higher growth patterns achieved in the past. Vietnam is assumed to follow the kind of restrained growth pattern prevalent in many other middle income countries after reaching middle income status. By 2040 around 50% of the population would have reached middle class status, about one half that in the optimistic scenario above. GDP/capita on a real exchange rate basis reaches only $3,000 by 2040 ($8,090 in PPP terms) less than one half of the optimistic scenario. The investment rate is 32% of GDP over the period but investment efficiency tracks current low efficiency levels such as those achieved by many SOE's. SOE's remain in control of a large part of the national economy and expansion of the private sector is crowded out by this SOE dominance in many key sectors. Nonperforming loans—many made to inefficient state-owned companies (by some estimates these account for 10% of the banking system) are allowed to linger. The scenario results in higher demand for rice (because lower incomes are associated with higher rice consumption), but lower demand for higher priced foods such as fish and meat. The nutritional status of the population under this scenario is poorer than in the optimistic scenario because of lower protein consumption.

Looking ahead to 2040, there are a number of concerns regarding the sustainability of the current satisfactory level of food security and measures need to be taken over time to address potential and emerging problems. To achieve major transformation of the sector and realize the vision outlined above will require appropriate policy actions on several fronts including the related policy, legal, institutions and programs, transformation of farming activities, logistics, agro-industries, marketing and societal practices and attitudes.

Experience in other countries suggests that over the coming years the agriculture sector in Vietnam will have to be restructured if the competitive edge is to be maintained as in the past. There are a number of emerging changes which make a restructuring advisable. Main areas where change will be needed are:

- Enabling business environment. Creation of a supportive policy and business environment including a level-playing field for all actors in the value chain, providing incentives to private sector and market forces to determine the use of land, choice of products and access to credit and market channels.

- Financial sector. Improving access to finance for the entire value chain including farm production, logistics services agents, processing and marketing. This will require a much stronger and vibrant market based banking sector and non-bank financial institutions as well as related infrastructure such as credit guarantee schemes, credit information system, credit and assets registry systems (both for movable and fixed assets), mobile banking, bankruptcy and mortgage foreclosure systems, etc.

- Infrastructure. Upgrading infrastructure and logistical value chain (especially in rural areas), including roads, transport, warehousing and storage, product handling systems, electric power, sea ports, ICT and other related systems.

- Income disparity. The growing disparity of income between rural and urban workers will result in farmers being more demanding on the profitability of farming, and less able to accept government directed cropping patterns. Over time, government should consider transforming farm production and practices by giving farmers more freedom to

choose their own cropping patterns. This will mean that the Government should move away from a centrally planned directed approach to cropping towards a more market based approach.

- Farm consolidation. Commercial farmers will require farms of a size that is big enough to spread costs and have sufficient security of tenure to encourage their investment in their farms to increase the efficiency of their operations. These factors should be taken into account in upcoming changes in the land policy to allow the consolidation of farm holdings and contract farming.

- Farm mechanization. The aging of the population and the continuous flight of younger people from the rural areas should lead to increased mechanization of farming activities to deal with labor shortages.

- Value addition. Providing incentives to increase the production and exports of higher value added processed products instead of primary products. This will include, inter alia, (i) creating stronger linkages and cooperation between producers, processors and distributors to accelerate introduction of modern technology and practices, better farm prices, and improving quality and yield; and (ii) improving Vietnam brands and reputation in the domestic as well as global markets thru trade promotion, brand building and advertising.

- Private sector. Government should make efforts to facilitate the investment of the private sector in the value chain downstream of the farm, including the processing of farm produce, in order to maximize the market opportunities for farmers and the value added in Vietnam. Vietnam is currently very backward in this area.

- Cooperatives. Looking ahead, farmers would benefit from a structure of support by grouping into private sector cooperatives to help with input and output purchase and sale, similar to successful cooperatives in the developed economies of Europe, Asia and North America.

- Irrigation. Government needs to rethink the investment policy in the rural areas particularly regarding support for irrigation schemes. Investment priorities in irrigation need to be determined on the basis of economic priority. This should lead to more support for rehabilitating and upgrading existing schemes by incorporating a better flexibility and water control in operation so that farmers can have a choice in cropping patterns based on market demand.

- Food safety. To support the restructuring efforts Government needs to move decisively on food safety issues. Current arrangements are clearly not working; consumers and importers are increasingly losing confidence in locally produced products because they fear contamination by chemicals or disease. Responsibility for food safety needs to be better coordinated and led by a high level in government. The food safety and market surveillance system and institutions require upgrading, the accreditation and certification systems need strengthening and advisory services to disseminate best practices should be upgraded. The solid performance of fisheries processing sector in terms of quality and food safety with international recognition could provide a good example to replicate in other agro-processing sectors.

- Research. Another area of support that is very important and currently inadequate for the future is agriculture/fisheries/livestock research. The key policy actions include the following: (i) improving the supply of technology and skilled workforce to enhance the use of modern technology and processing techniques. This will also involve reforming training, R&D and technology extension systems. The R&D resources will need to focus on the entire value chain including developing new seed varieties that are easier to transport and store resulting in lower post-harvest losses, as well as producing higher quality of raw materials. The R&D will need

to cover innovations in farm machinery, logistics supply chain, processing, as well as bio-safety, product hygiene and safety and environmental preservation. Since knowledge and technologies are increasingly available globally and at lower prices, earlier emphasis will need to be on technology adoption and innovation, while developing capacity to do own R&D in the long run.

- Value chains. Private sector (including foreign direct investment) should be enabled and encouraged to play a stronger role in the entire agriculture value chain. This will include increasing private sector involvement in farm production, input supply, distribution and trade, agro-processing, as well in R&D, innovation and extension. This will require forming strong public-private partnerships and treating private sector not just at par with but preferred option over the public sector.

- Governance. Public sector's role should be primarily to act as a facilitator and create an enabling business environment. There are some good examples of PPP already working in Vietnam such as Nestle in coffee, Monsanto in potato, Unilever in tea and Pepsi in fruit and vegetable.

Annex 1—Centennial Group Growth Model

Concepts Underlying the Macro Model and Scenarios[1]

Productivity Convergence

A wide body of research has shown that some growth differences between emerging market countries can be successfully modeled by dividing them into two groups: 'converging' countries with rapid growth and 'non-convergers' stuck in the middle income trap.

The 'convergence' idea is this: It has been observed that the convergers' incomes catch up to those of global best practice over time, and that convergers with lower incomes converge more quickly. Three main forces drive convergence: First, open economy forces yield convergent growth if poorer countries focus on their comparative and factor advantages and then trade with nations lacking those factors, e.g., cheap labor. This leads to more equal cross-country factor prices. Second, capital deepening boosts growth more in countries with lower ratios of capital to skilled labor (usually the poorer ones) due to the nature of diminishing returns.

The third force is productivity convergence. Here it is the TFP of convergers that catches up to that of best practice, with those further behind in TFP converging faster. This phenomenon reflects technology leap-frogging, technology transfers, shifting underemployed agriculture workers to efficient export-led manufacturing, transferring child laborers into schools, a steady increase in the average level of literacy, building roads to connect the unconnected to markets, and the diffusion of management and operational research from more advanced countries. It appears that countries can shortcut productivity-improvement processes by learning from economies that are already at the productivity frontier.

Middle Income Trap

However, as suggested by the records of many middle-income countries around the world, it is difficult (but possible) to avoid a stagnation in growth after a fast-growing economy reaches middle-income status. This stagnation has been termed the 'middle income trap' and results from an inability to make some difficult—yet critical—structural adjustments to the growing economy. Once the rural workers have been shifted, the labor-capital ratio approaches that of developed nations, educational attainment reaches higher levels, the old-age dependency ratio increases, everyone is connected by physical infrastructure, and productivity approaches best practice levels—so that importing foreign technology offers only small benefits—the strategies above no longer reap rewards. For example, moving from a BA to MA offers a smaller boost than moving from illiteracy to literacy.

The critical question in this context becomes the following: how have some countries managed to avoid the middle income trap?

Across the world, maintaining high growth after reaching middle-income status has required a change in approach, shifting focus from low-wage, export-led manufacturing to a knowledge-based society with strong domestic demand and a large middle class. Once a fast-growing country's citizens reach middle-income status, they will no longer accept wages low enough for low-wage manufacturing to be internationally competitive. The economy must become more dependent on innovation and differentiation, transitioning from input-driven growth to productivity-driven growth, but this cannot happen without developing advanced educa-

1 This subsection is taken from Kohli, Szyf, and Arnold (2012).

tional institutions, efficient financial systems to allocate resources, reliable public safety and pleasant living areas to attract mobile skilled workers and prevent a 'brain drain', skill-training programs and social safety nets, affordable housing, sufficient and wise investment, elimination of corruption and inappropriate regulations, and free information flows. If countries cannot change their economic strategies and move up the value chain, they find themselves stuck in the middle—between rich countries that have the legal and financial base to allow for economic growth through high-value innovations and poor countries that are globally competitive because labor and other input costs are low.

These concepts of convergence and the middle income trap drive the productivity component of the model and form the basis for our alternate growth scenarios for Indonesia, the Philippines, and Vietnam.

Estimating Future GDP[2]

To estimate the total GDP of each country through 2040, the model uses the following Cobb-Douglas function, with α equal to 2/3:

$$GDP = TFP \times L^{\alpha} \times K^{1-\alpha}$$

GDP figures are generated for three different measures: real GDP (constant 2010 dollars); PPP GDP (constant 2010 PPP dollars); and GDP at market exchange rates (explained in Section 1.4).

Our units to measure labor force are the number of workers economically active each year. Labor force growth stems from population growth and from changes in labor force participation rates. Labor force participation rates are projected separately, by gender, for seven age cohorts (15–19, 20–24, 25–29, 30–49, 50–59, 60–64, and 65+), using a separate auto-regression for each cohort. The labor force in each of the fourteen age-gender cohorts equals the number of individuals in that cohort times the participation rate for that cohort. Male rates are projected directly; female rates are derived by projecting the difference between male and female rates.

For the Philippines and Vietnam, population estimates are taken from the United Nations. For Indonesia, we have two different population scenarios: one from the UN, and the other from a country source.

Capital stock is projected by applying yearly investment and depreciation to each year's stock, beginning with an initial stock derived using the Caselli method. For each country, a quota is set so that its investment rate (over historical years and projected years combined) cannot remain above 30 percent (as a share of GDP) for more than 35 years. Once it reaches its quota, its rate linearly decreases to 30 percent over 10 years. And for countries with rates below 20 percent, the rate tapers up over time, reaching 20 percent in 2020.

Finally, TFP is estimated using the following equation:

$$TFPGrowth_{i,t} = DefaultRate + CB_{i,t} - FP_{i,t}$$

where i is the country, t is the year, DefaultRate represents the expansion of the global productivity frontier (1 percent), CB is the convergence boost benefiting 'converging' countries, and FP is the penalty suffered by fragile states (–1.8 percent).

The convergence boost is defined as follows:

$$CB_{i,t} = c_{i,t} \times BoostCoefficient \times ln\left(\frac{TFP_{USA,t-1}}{TFP_{i,t-1}}\right)$$

where i is the country, t is the year, BoostCoefficient is the convergence coefficient (0.0269), TFP is the total factor productivity, and c takes a value between 0 and 1 and identifies whether the country is treated as a converger (c=1), as a non-converger or fragile state (c=0), or as in an intermediate position (0<c<1), wherein the country is experiencing some, but not all, of the convergence boost.

For non–developing-ASEAN countries, the classification of whether the model treats them as convergers, non-converg-

2 Subsections 1.2, 1.4, and the middle of 1.5 are taken from or based on Kohli, Szyf, and Arnold (2012), where further details may be found, and Kohli (2011). Kohli, Harpaul Alberto. (2011). Model for Developing Global Growth Scenarios. In Harinder Kohli, Ashok Sharma & Anil Sood (Eds.), Asia 2050: Realizing the Asian Century. New Delhi: SAGE.

ers, or failed states may be found in Annex 1 of Kohli, Szyf, and Arnold (2012).

For developing ASEAN countries, their classification as convergers or non-convergers constitutes the most important difference between the optimistic and pessimistic scenarios.

The Macro Scenarios: Optimistic and pessimistic

In all cases, the differences between the scenarios consists in the values chosen for c in equation 3.5.1 (which affects productivity growth) and the investment rate. The precise definitions for each scenario for country are as follows:

Indonesia: In both scenarios, Indonesia starts out as a converger, continuing its overall success over the past two decades. In the optimistic scenario, this status remains unchanged through 2040, which corresponds to the c n Equation 3.5.1 remaining 1 for all years. But in the pessimistic scenario, beginning in 2017, it gradually begins to lose most of its convergent status, reaching a minimum c of 20 percent (meaning it is treated as in an intermediate position between convergence and non-convergence, in this case reaping just 20 percent of the convergence boost) in 2024 and continuing at that level through 2040.

As we also have two population scenarios, this yields four macro scenarios (identified in §1.8).

Table A1.1 provides the full details of Indoesnia's secario specifications. All other parameter values are as given earlier in this annex and Kohli, Szyf, and Arnold (2012), which is also the source of the investment rate given in the table.

Philippines: In both scenarios, the Philippines starts out as a non-converger. In the pessimistic scenario, it maintains this status through the end of the time period, and its investment rate gradually falls, reaching 15 percent in 2025 and through 2040. But in the optimistic case, it begins to experience increasing portions of the convergence boost beginning in 2014, reaching a c of 40 percent by 2022 and through 2040. In addition, in this optimistic case it enjoys the new-converger investment boost described in Kohli,

Table A1.1: Indonesia's scenario specifications

year	c (opt)	inv (opt)	c (pess)	inv (pess)
<=2016	1	25.45%	1	25.45%
2017	1	25.45%	0.97	25.45%
2018	1	25.45%	0.84	25.45%
2019	1	25.45%	0.72	25.45%
2020	1	25.45%	0.59	25.45%
2021	1	25.45%	0.47	25.45%
2022	1	25.45%	0.36	25.45%
2023	1	25.45%	0.25	25.45%
2024+	1	25.45%	0.2	25.45%

Source: These are the scenario definitions being presented in this section of this annex.

Szyf, and Arnold (2012),[3] rising to 24 percent by 2020 and then falling back down to a plateau of 20.12 percent by 2035. This investment boost is needed in order for the country to transition from being a non-converger to being a converger.

Table A1.2 provides the full details of the Philippines' scenario specifications. All other parameter values are as given

Table A1.2: Philippines' scenario specifications

year	c (opt)	inv (opt)	c (pess)	inv (pess)
2013	0	20.68%	0	20%
2014	0.35	21.71%	0	19.5%
2015	0.4	22.75%	0	19%
2016	0.45	23.79%	0	18.5%
2017	0.5	23.84%	0	18%
2018	0.6	23.89%	0	17.5%
2019	0.6	23.95%	0	17%
2020	0.6	24%	0	16.5%
2021	0.6	23.74%	0	16%
2022–2024	0.6	23.48%	0	15.5%
2025–2034	0.6	declines each year	0	15%
2035+	0.6	20.12%	0	15%

Source: These are the scenario definitions being presented in this section of this annex.

3 Kohli, Harpaul Alberto, Szyf, Y. Aaron, & Arnold, Drew. (2012). Construction and Analysis of a Global GDP Growth Model for 185 Countries through 2050. Global Journal of Emerging Market Economies, 4(2), 91–153.

earlier in this annex and Kohli, Szyf, and Arnold (2012), which is also the source of the optimistic scenario's investment rate, based on the invstment boost for newly converging countries.

Vietnam: Although Vietnam has traditionally been considered a converger, in the past few years its TFP growth has slowed. Therefore, in both scenarios, for 2014 Vietnam is made to benefit from only 70 percent of its convergence boost (a c of 70 percent). In the optimistic scenario, it gradually increases the share of its convergence boost it enjoys from 70 percent to 100 percent, regaining its fully convergent status in 2027. But in the pessimistic case, it gradually loses more and more of its convergence boost, reaching a thereafter-permanent low of a c of 20 percent in 2021. In addition, in the pessimistic case, its investment rate falls much faster than in the optimistic case (wherein it decreases after reaching the 35-year quota described above). As a point of comparison, in the optimistic scenario it does not fall to 35 percent until 2040 but in the pessimistic scenario it has already fallen to 35 percent by 2022.

Table A1.3 provides the full details of Vietnam's scenario specifications, except for the post-2027 investment rates, which equal the lower of 33.5% and the rate determined by the methodology in Kohli, Szyf, and Arnold (2012), which is also the source of the investment rate given for the optimistic scenario and pre-2020 for the pessimistic one.

Rest of Developing ASEAN: n the optimistic scenario, Cambodia, Malaysia, and Thailand are convergers throughout the entire time period; Laos and Myanmar begin as non-convergers but gradually begin converging, with an investment boost, in 2015 and 2017, respectively, according to the process detailed in Kohli, Szyf, and Arnold (2012).[4] In the pessimistic scenario, Malaysia (given its high income) remains a converger and Myanmar and Laos remain non-convergers throughout the time period; Cambodia and Thailand fall into the middle income trap according to the timetable explained in Kohli, Szyf, and Arnold (2012).[5]

Table A1.3: Vietnam's scenario specifications

year	c (opt)	inv (opt)	c (pess)	inv (pess)
2013	1	38.14%	1	38.14%
2014	0.7	38.14%	0.7	38.14%
2015	0.715	38.14%	0.63	38.14%
2016	0.72	38.14%	0.56	38.14%
2017	0.725	38.14%	0.5	38.14%
2018	0.7	38.14%	0.44	38.14%
2019	0.82	38.14%	0.38	38.14%
2020	0.83	38.14%	0.3	37%
2021	0.85	38.14%	0.2	36%
2022	0.85	38.14%	0.2	35%
2023	0.88	38.14%	0.2	34%
2024	0.9	38.14%	0.2	33.5%
2025	0.93	38.14%	0.2	33.5%
2026	0.99	38.14%	0.2	33.5%
2027–2036	1	38.14%	0.2	33.5%
2037	1	37.32%	0.2	33.5%
2038	1	36.51%	0.2	33.5%
2039	1	35.70%	0.2	33.5%
2040	1	34.88%	0.2	33.5%

Source: These are the scenario definitions being presented in this section of this annex.

GDP at Market Exchange Rates

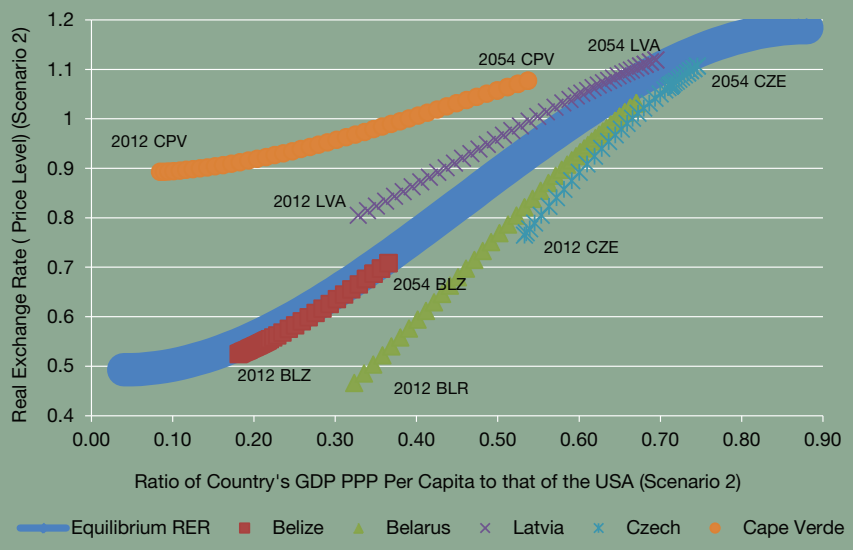
As countries grow richer, over time periods of 10 years or more, their real exchange rates (RERs) tend to appreciate. This gives them an even larger share of the global economy, increases their weight in trade, and increases the international purchasing power of their citizens. To capture this effect we generate a measure of GDP at market exchange rates, which serves as our proxy for nominal GDP.

For the historical observations we create the GDP at MER measure by taking away US inflation relative to 2010 from each country's nominal GDP and leaving in exchange rate differences. But for the future we project this indicator by inflating a country's estimated real GDP (at constant 2010 dollars) by its expected real exchange rate appreciation.

Our first step in estimating future RERs is to derive the following equation to establish a theoretical equilibrium relationship between a country's RER and its PPP income relative to that of the US:

4 Ibid.
5 Ibid.

FIGURE A1.1: EQUILIBRIUM RELATIONSHIP AND MOVEMENT OVER TIME



Source: Kohli, Szyf, and Arnold (2012)

$$RER_{i,t}^{EQ} = \frac{PPP_{i,t}}{e_{i,t}} = .498 - .255\left(\frac{GDPPC_{i,t}}{GDPPC_{US,t}}\right) + 3.23\left(\frac{GDPPC_{i,t}}{GDPPC_{US,t}}\right)^2 - 2.34\left(\frac{GDPPC_{i,t}}{GDPPC_{US,t}}\right)^3$$

where i represents the country, t the year, PPPi the country's PPP conversion factor relative to the US (US$=1), ei its exchange rate relative to that of the US, GDPPCi its GDP PPP per capita, and GDPPCUS the US's GDP PC. Then, using the following equation, each country's modeled exchange rate converges (see figure) towards the value that corresponds to its income in this equilibrium equation:

$$\ln(C_{i,t}) = \beta_1 \times \ln(C_{i,t-1}) + \beta_2 \times \ln(CappedGDPPC_{i,t}) + \beta_0 + \varepsilon_{i,t}$$

where RERi,t is the modeled value of country i's real exchange rate at time t and RERi,tEQ is the equilibrium RER of country i at time t predicted by the previous equation.

Figure A1.1from Kohli, Szyf, and Arnold[6] illustrates both the equilibrium relationship and the movement over time of example countries' rates.

MEASURES RELATED TO INCOME DISTRIBUTIONS

The final aspect of the macro model used in this study is estimates of income classes and median and percentile consumption. The first step in this process is to estimate per capita total consumption.

We calculate consumption in constant PPP international dollars (both for base year 2010 and base year 2005) as the GDP PPP PC times the share of GDP spent on consumption. To estimate the latter, we begin with the historical series of the ratio of consumption to GDP from the Penn World Table (Heston, Summers, & Aten, 2009).7 We then estimate future consumption using the following autoregression across all countries and years:

$$RER_{i,t} = RER_{i,t-1} + \left(1.184 - RER_{i,t-1}\right) \times \left(\frac{RER_{i,t}^{EQ} - RER_{i,t-1}^{EQ}}{1.184 - RER_{i,t-1}^{EQ}}\right)$$

where i is the country, t is the year, C is the share of GDP spent on consumption, CappedGDPPC is the minimum of $50,000 and the GDP PPP PC in constant 2010 PPP dollars, the βs are the coefficients, and ε is the error term.

6 Kohli, Harpaul Alberto, Szyf, Y. Aaron, & Arnold, Drew. (2012). Construction and Analysis of a Global GDP Growth Model for 185 Countries through 2050. Global Journal of Emerging Market Economies, 4(2), 91–153.

7 Heston, Alan, Summers, Robert, & Aten, Bettina. (2009). Penn World Table Version 6.3. Retrieved 8/10/2010, from Center for International Comparisons of Production, Income and Prices at the University of Pennsylvania.

To estimate the sizes of the lower, middle, and upper classes, the model calculates what share of the population is between certain income cutoffs (middle class is $10.80 to $100 of consumption a day using constant 2010 PPP dollars). As a country's total income increases, more people with small shares of the country's total will attain higher living standards. We use a type of income distribution curve called a GQ Lorenz curve (Kohli, Szyf, & Arnold, 2012). We calculate these shares using the following GQ-Lorenz-based headcount function (the share of the country's population below per capita income level z in a given year):

$$H(z) = -\frac{1}{2m}\left(n + r \times \frac{\left(b+\frac{2z}{\mu}\right)}{\sqrt{\left(b+\frac{2z}{\mu}\right)^2 - m}}\right)$$

where H(z) is the headcount index, μ is the country's mean consumption level per capita in 2010 PPP dollars, and the other letters are parameters that describe the shape of the income distribution (Kohli, Szyf, & Arnold, 2012), with values taken from Povcal (World Bank Development Research Group, 2011).[8]

For our food consumption model, we will also need to calculate percentile incomes, that is, what is the income (or consumption level) so that a given percentage of the population lives under that level. For percentile pct, the following equation identifies below which income level it is that pct% of the population lives:

$$\theta \times H(z) \times (1 - H(z)) \times \left(\frac{\gamma}{H(z)} - \frac{\delta}{(1-H(z))}\right) = 1 - \frac{z}{\mu}$$

where GDPPC is either the income or consumption level per capita, pct% is the percentage of the population, and the other terms are the same as in the previous equation.

The model also generates poverty measures for all ASEAN countries except Myanmar. However, the GQ Lorenz curve (and hence the headcount formula above) is not as accurate for extremely low incomes (Kohli, Szyf, & Arnold, 2012), and so we must use the Betz Lorenz curve. Using the Beta Lorenz, the poverty headcount ratio (what percent of the population lives below the poverty line) is the value of H(z) that makes the following equation true (Datt, 1998):[9]

$$\theta \times H(z) \times (1 - H(z)) \times \left(\frac{\gamma}{H(z)} - \frac{\delta}{(1-H(z))}\right) = 1 - \frac{z}{\mu}$$

where Θ, γ, and δ are the parameters that characterize the income distribution (with values taken from Povcal (2012)), z is the poverty line ($1.25 per day, measured in constant 2005 PPP dollars), and μ is the country's mean consumption level per capita in constant 2005 PPP dollars.

This headcount index tells us how many poor there are, but not how poor they are. A country with all the poor living just below the poverty line would get the same score as a country with the same rate of poverty but with most of the poor living on incomes below half the poverty level.

To estimate the magnitude of poverty, we use the poverty gap. This takes into account how far below the poverty line the average poor person is. More precisely, it measures what share of the society's resources would have to be transferred to the poor to eliminate poverty. The poverty gap equals

$$PG = H - \frac{\mu}{z} \times \left(H - \theta \times H^{\gamma} \times (1 - H)^{\delta}\right)$$

where z is the poverty line and H is the H(z) defined in the previous equation (Datt, 1998).

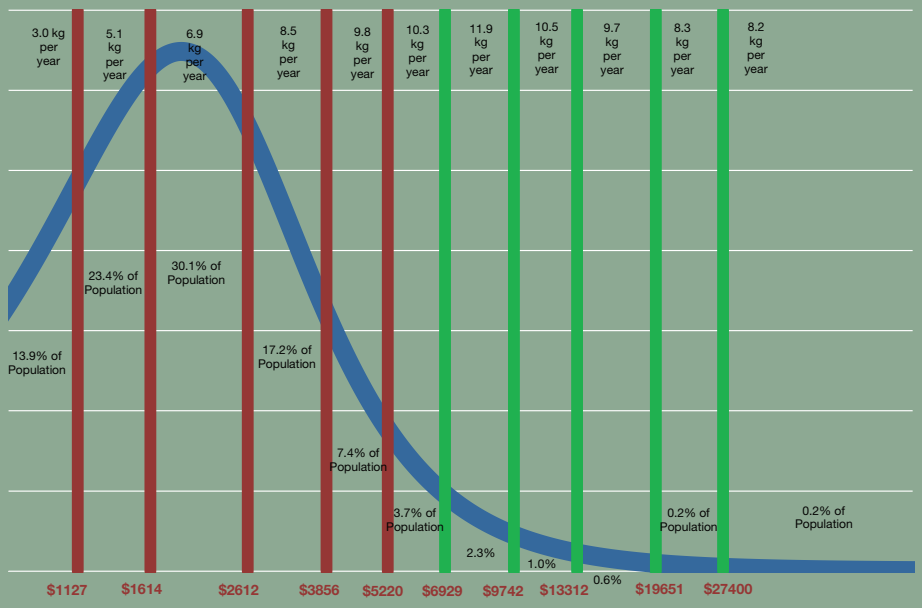
However, for the Philippines 2040 estimates, we do not use the above equations for the poverty gap and headcount because its Beta Lorenz curve is not valid (Povcal, 2012). Instead, we use the GQ-Lorenz headcount function above and the poverty gap equation given in Kohli, Szyf, and Arnold (2012).[10]

8 World Bank Development Research Group. (2011). PovcalNet. Retrieved 12/13/2010 http://go.worldbank.org/WE8P1I8250

9 Datt, Gaurav. (1998). Computational Tools for Poverty Measurement and Analysis. FCND Discussion Papers, 50. Retrieved from http://www.ifpri.org/publication/computational-tools-poverty-measurement-and-analysis

10 Kohli, Harpaul Alberto, Szyf, Y. Aaron, & Arnold, Drew. (2012). Construction and Analysis of a Global GDP Growth Model for 185 Countries through 2050. Global Journal of Emerging Market Economies, 4(2), 91–153.

FIGURE A1.2: POPULATION DISTRIBUTION BY INCOME (BLUE) AND EGG CONSUMPTION: INDONESIA 2010



Source: Centennial Model

FOOD CONSUMPTION MODEL

For each food commodity, future consumption is estimated as follows: a table is formed showing, for a set of 9 to 11 consumption income group cohorts, how much of that commodity the average member of each cohort eats. (This pattern already takes into account urban-rural differences.) For each year, the macro model computes what fraction of the population is in each cohort. The final per capita food consumption number equals the weighed average of how much each cohort consumes, weighed by each cohort's share of the total population. As the country grows richer, the number of people in each cohort changes, and so the country's average consumption changes, as illustrated in the following two charts for egg consumption in Indonesia.

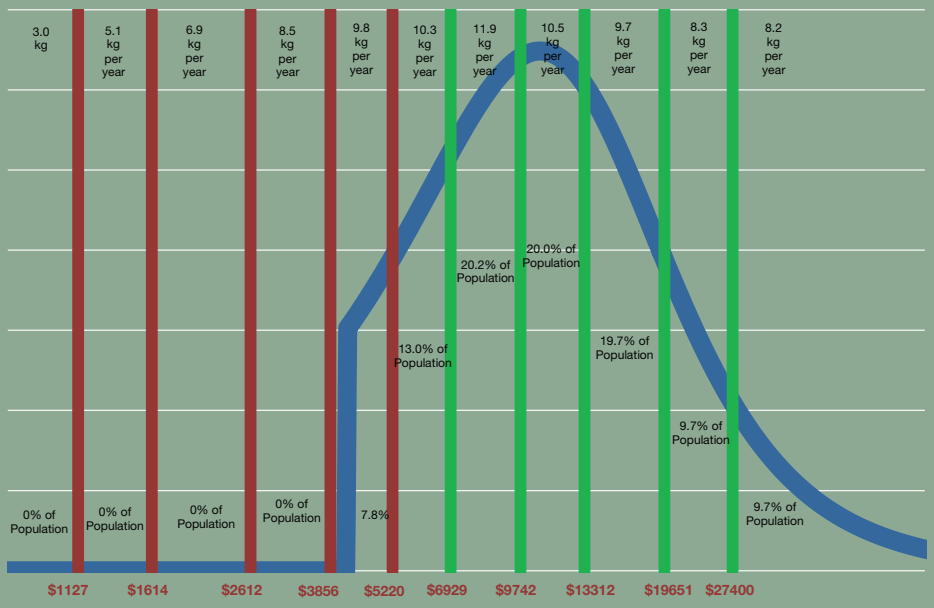
In each chart, the horizontal axis represents a person's consumption income per year, in 2010 PPP dollars (as we will see below, we use PPP because we will be extrapolating between different countries' experiences of how much food each eats, for which PPP is a better measure). The blue line represents a population density function: what the probability is that a random person in the country will have that level of consumption. (The vertical axis values are arbitrary and are not shown.) The higher the value of the blue line, the more people in the country have the consumption level indicated by the corresponding value of on the x axis.

The red and green lines demarcate the different cohorts we use, each cohort defined as a range of possible consumption levels. For example, the second cohort contains everyone with a consumption level between $1,127 and $1,614 a year. As will be explained below, the red lines indicate cohorts derived from the actual 2010 or 2006 historical household consumption data and green ones are constructed based on estimates of possible 2040 (optimistic scenario) outcomes.

For each cohort, at the top of the chart appears how many kilograms of eggs the average person in that cohort eats a week. For example, for the $1,127 to $1,614 cohort the value is 0.426 kg.

Finally, towards the bottom of the graph appears the percentage of the population in that cohort. This simply equals the area on the graph that is under the blue curve and between the upper and lower vertical lines demarcating the cohort (more precisely, this equals the integral of the blue curve between the two demarcating vertical lines). There-

Figure A1.3: Population distribution by income (blue) and egg consumption: Indonesia 2040 (opt.)



Source: Centennial Model

Table A1.4: Indonesian eggs

income range	< $1127	$1127–$1614	$1614–$2612	$2612–$3856	$3856–$5220	$5220 +
KG eggs/year	3.0	5.1	6.9	8.5	9.8	10.6
2010 population share	13.9%	23.4%	30.1%	17.2%	7.4%	8.0%
2040 (opt.) pop. share	0%	0%	0%	0%	7.8%	92.2%

Source: Centennial Model

Table A1.5: Singapore's eating habits

	1st quintile	2nd quintile	3rd quintile	4th quintile	5th quintile
	< $6353	$6353–$10417	$10417–$15470	$15470–$24271	$24271 +
KG eggs/year	4.9	5.6	5.0	4.6	3.9

Source: Singapore Household Expenditure Survey and Centennial Model (for quintiles)

fore, the $1,127 to $1,614 cohort contains 23.4 percent of Indonesia's 2010 population.

In the first chart, when we take a weighed average of each cohort's egg consumption, weighed by each cohort's share

Table A1.6: Inter-cohort ratios

cohort #	1	2	3	4	5	6	7	8	9	10 (& 11)
orig IDN cohort	<$1127	$1127–$1614	$1614–$2612	$2612–$3856	$3856–$5220	$5220+				
KG eggs/year	3.0	5.1	6.9	8.5	9.8	10.6				
SGP cohort						<$6353	$6353–$10417	$10417–$15470	$15470–$24271	$24271+
SGP eggs/yr						4.9	5.6	5.0	4.6	3.9
ratio of SGP quintile's KG eggs to previous quintile's							1.1= 5.6/4.9	0.9= 5.0/5.6	0.9= 4.6/5.0	0.8= 3.9/4.6
new IDN cohort	<$1127	$1127–$1614	$1614–$2612	$2612–$3856	$3856–$5220	$5220–$6929	$6929–$9742	$9742–$13312	$13312–$19651	$19651+
share of 2010 IDN population	Not relevant	Not relevant	Not relevant	Not relevant	Not relevant	3.7%	2.3%	1.0%	0.6%	0.4%
new KG eggs/yr value	3.0	5.1	6.9	8.5	9.8	10.3	11.9	10.5	9.7	8.3
new KG eggs/yr formula	3.0	5.1	6.9	8.5	9.8	x	x*1.1	x*1.1*.09	x*1.1*.09*0.9	x*1.1*.09*0.9*0.8

Source: SUSENAS (Indonesia), Singapore Household Expenditure Survey, and Centennial Model

of the population (the area under the curve), we reach an average of 6.7 kg per year.

But in the following graph, representing 2040's optimistic scenario, the average is 10.1 kg per year. The only difference between the two graphs is the income distribution. The cohort definitions (and corresponding vertical lines) and cohort quantities eaten are exactly the same. But as the blue curve moves right over time (indicating more prosperity), more of the population falls into the higher cohorts and less into the lower.

This model is therefore an application of the macro model to an estimate of the country's food eating patterns by consumption cohort. These patterns are determined as follows:

We begin with the historical household consumption surveys (broken down by consumption income cohort) collected for each country. (For fish in Indonesia and fish, meat, eggs, roots, vegetables, fruit, and corn in the Philippines, we make adjustments based on other country sources.) For Vietnam and the Philippines, the cohorts are given as quintiles. For Indonesia, a different percentile distribution is provided. For Indonesia we use the 2010 SUSENAS, for Vietnam the 2010 GSO household survey, and for the Philippines the 2006 household survey.

As our consumption model depends on having absolute dollar cutoffs for cohorts, not percentiles, we use the macro model to translate quintiles or other percentiles into dollar amounts. In our example of Indonesian eggs, that gives us the following pattern, with these cohort cutoffs drawn in dark red in the two graphs above. (As said, the green cutoffs above are not based on the historical data.)

But although this division into cohorts gives an acceptable level of detail to analyze 2010 eating habits, it does not provide a useful level of resolution for the 2040 optimistic scenario: there, 92% of people fall into the top red cohort. In other words, if we were to remove all the green lines from the graph above (all cohorts defined in the actual SUSENAS are drawn in red), our methodology would not be very useful. If we are to understand the national eating habits as the result of the population being distributed into a changing mix of the fixed cohorts (which also already reflect urban

and rural differences), not much change or information can be gleaned for 2040 if the top cutoff is $5,220.

However, our actual historical data for Indonesia does not report any cohort cutoffs above this. That is why the right half of the charts has only green lines, not red ones. If we are to have enough detail through our cohort demarcations to estimate future consumption, we will have to derive richer cohorts' eating habits from elsewhere, thus letting us decompose the richest SUSENAS cohort ($5,220+) into smaller cohorts.

We use comparator countries for this purpose. But because culture is different in other countries, we do not directly use our comparators' eating patterns. Instead, we use the following extrapolation procedure, again illustrated using Indonesia and eggs, for which we use a single comparator: Singapore.

Singapore's egg-eating habits for 2008 are:

As with the Philippines and Vietnam, the Singapore cohort data comes in the form of quintiles and not dollar ranges. We derive the dollar cutoffs via our macro model and its income distributions.

To use Singapore's data in order to estimate the behavior of Indonesia's richer cohorts for which we do not have Indonesian data, we create new richer Indonesian cohort demarcations by taking quintiles and deciles of the 2040 optimistic scenario and then construct the table below. (Note that to simplify the following explanation, we aggregate our 10th and 11th Indonesian cohorts into one)

In the below table, we very roughly line up the Singapore cohort cutoffs with our new Indonesian cohorts (the green lines in the charts above). If we were to directly apply the Singaporean eating habits to Indonesia—which we do not do, because of cultural differences—then we would take the Singaporean 5.6 value for our cohort 7. But as seen, we use a value of 11.9 instead.

To derive that, we take the ratio of many kilograms of eggs our approximate cohort 7 consumes in Singapore to how many our approximate cohort 6 consumes there, and then we multiply that by the actual kilograms of eggs consumed by Indonesia's cohort 6.

Likewise, to estimate Indonesia's cohort 9 egg consumption, we take Singapore's egg consumption ratio between cohorts 8 and 9 and then multiple Indonesia's cohort 8 egg consumption by that ratio.

Data permitting, for all countries and commodities, we employ this technique of applying the richer countries' inter-cohort ratios to our countries. As our comparators, we use Singapore and Japan, sometimes choosing one and sometimes taking their average.

One step is missing. We have established the relative values between cohorts 6, 7, 8, 9, and 10/11 based on this ratio-extrapolation method, but this does not give us the absolute values.

This is because we want our new eating pattern to be fully consistent with the real household survey table for 2010. What we have just done is decompose the richest cohort from the SUSENAS into subcohorts. We want the weighted average of our new sub-cohorts to equal the 10.6 SUSENAS value for the richest cohort.

For this we use the last line of the table. In it, the kg of eggs per year is expressed in terms of an unknown number x and the ratios derived from Singapore. We therefore search for the x that makes the weighed average of cohorts 6, 7, 8, 9, and 10/11 (weighed by the third-to-last row, which is the population shares) equal to the original 10.6 value of the original highest cohort, before we decomposed it into subcohorts. Once we have identified this x, our food eating pattern for Indonesian eggs is completed, with the relative values of the new subcohorts determined by the ratios between the Singaporean cohorts and with the absolute values chosen to be consistent with the original 2010 SUSENAS. Data permitting, we employ the same procedure for all countries and commodities.

Aggregate Agricultural Production Model

To estimate future aggregate agricultural production, we use the following function, based on Fuglie (2010b):[11]

$$AgProd = TFP \times Labor^{\alpha} \times QualAdjLand^{\beta} \times LivestK^{\gamma} \times MachK^{\delta} \times Fert^{\varepsilon}$$

where AgProd represents the total agricultural production, Labor the agricultural labor force, QuaAdjLand a measure of land area adjusted for quality, LivestK the livestock capital, MachK the machine capital, and Fert the fertilizer and chemicals. (Factor definitions are given in Fuglie (2010b).[12] The exponents α, β, γ, δ, and ε are the factor shares and together always sum to 1.

For our historical values of agricultural production, we multiply the country's GDP by the World Bank figure for agriculture's value added as a share of GDP.

Land

The quality-adjusted land measure we use is based on dividing land into 3 categories: Rain-fed land gets a weight of 1, irrigated land a weight of 2.993, and pasture land a weight of 0.094 (Fuglie, 2010b).[13] For our purposes, we ignore pasture land because its weight is so low. Land for tree crops is treated the same as rain-fed land (Fuglie, 2012).[14]

For Indonesia, we have one scenario for quality-adjusted land area change over time: a 0.50% average increase per year. For Vietnam we also have one scenario: a 0.27% decrease per year. For the Philippines, we have two scenarios: In the first, there is an increase of 0.47% per year; in the second, the increase is 0.65% per year. These rates are based on taking quality-adjusted sums of the initial and final land areas used in the country studies.

Livestock, Machine Capital, and Fertilizer

For all countries and scenarios, estimates for future growth rates for livestock capital, machine capital, and fertilizer are set equal to the average annual growth rates experienced from 1990 to 2006 derived from the data in Fuglie (2010a).[15]

Population

To estimate the future agricultural labor force, we use the following relation:

Labor=Population×Share of Population that is Rural×Ratio of Ag Workers to Rural Pop

For population we use our macro model's estimates; for the second term we use the UN urbanization estimates; and for the third term we use, for future years, the value of the agricultural-workers-to-rural-population ratio for the most recent year with actual data available. Therefore, the third term remains constant, the second term decreases over time, and the first term increases over time. The result is little net change in the agricultural labor force.

Factor Shares

The next component of the production equation is the factor shares. For years through 2013, we use the factor shares for Southeast Asia given in Fuglie (2010b).[16] As a country becomes more prosperous, though, the structure of its economy changes, and so the factor shares change. For example, in Fuglie (2010a),[17] the factor share for machine capital was usually about 0.01, and sometimes was even listed as 0. But in more developed countries, mechanization strongly boosts output. Therefore, as a country's income level rises, we set its factor shares' values to linearly change, converging to China's 1997 share values as its

11 Fuglie, Keith O. (2010b). Total Factor Productivity in the Global Agricultural Economy: Evidence from FAO data. In J. M. Alston, B. Babcock & P. G. Pardey (Eds.), The Shifting Patterns of Agricultural Production and Productivity Worldwide (pp. 63–95). Ames, Iowa: Midwest Agribusiness Trade and Research Information Center.
12 Ibid.
13 Ibid.
14 Fuglie, Keith O. (2012, August 13, 2012). [Conversation with Centennial Group].
15 Fuglie, Keith O. (2010a). Sources of Growth in Indonesian Agriculture. Journal of Productivity Analysis, 33, 225–240.
16 Fuglie, Keith O. (2010b). Total Factor Productivity in the Global Agricultural Economy: Evidence from FAO data. In J. M. Alston, B. Babcock & P. G. Pardey (Eds.), The Shifting Patterns of Agricultural Production and Productivity Worldwide (pp. 63–95). Ames, Iowa: Midwest Agribusiness Trade and Research Information Center.
17 Fuglie, Keith O. (2010a). Sources of Growth in Indonesian Agriculture. Journal of Productivity Analysis, 33, 225–240.

income approaches that of 1997 China, and, beyond that income level, converging towards the 2002 US values as its income approaches that of the 2002 United States.

TFP

The last component of the production model is the agricultural TFP growth rate. For each country macro scenario (GDP growth and population), we generate two agricultural TFP scenarios:

Vietnam and the Philippines: In the pessimistic agriculture scenarios, agricultural TFP growth is 2% per year. In the optimistic scenarios, it rises linearly to 3.22% in 2020, stays at that value for ten years, and then decreases linearly to 2.61% in 2040. (The 3.22% is that given in Fuglie and Evenson (2010) for China's most recent period.)

For Indonesia, yearly TFP growth is 3% in the pessimistic scenarios. In the optimistic scenarios, it rises linearly to 3.5% in 2020, stays at that value for ten years, and then decreases linearly to 3.25% in 2040.

Scenario Specifications

Table A1.7 shows how many variants each country has for each alterable component and in which section of this appendix those variants are defined:

Table A1.8 defines each scenario. See the previous table to locate where in this appendix the definition of each component appears.

Table A1.7: Scenario specifications

# alternatives for each component	GDP growth (§1.3)	population (§1.3)	agr. TFP (§1.7)	agr. land area (§1.7)	total # of scenarios for macro & consumption	total # of scenarios for production
Indonesia	2	2	2	1	4	8
Philippines	2	1	2	2	2	8
Vietnam	2	1	2	1	2	4

Source: This table is a re-statement and summary of the scenario specifications in this annex. Therefore, the source is the previous content in this annex.

Table A1.8: Scenario definitions

	Indonesia	Philippines	Vietnam
Scenario 1	High GDP Growth	High GDP Growth	High GDP Growth
	Low Population Growth	High Ag. TFP Growth	High Ag. TFP Growth
	High Ag. TFP Growth	Low Land Growth	
Scenario 2	Low GDP Growth	Low GDP Growth	Low GDP Growth
	Low Population Growth	High Ag. TFP Growth	High Ag. TFP Growth
	High Ag. TFP Growth	Low Land Growth	
Scenario 3	High GDP Growth	High GDP Growth	High GDP Growth
	Low Population Growth	Low Ag. TFP Growth	Low Ag. TFP Growth
	Low Ag. TFP Growth	Low Land Growth	
Scenario 4	Low GDP Growth	Low GDP Growth	Low GDP Growth
	Low Population Growth	Low Ag. TFP Growth	Low Ag. TFP Growth
	High Ag. TFP Growth	Low Land Growth	
Scenario 5	High GDP Growth	High GDP Growth	
	High Population Growth	High Ag. TFP Growth	
	High Ag. TFP Growth	High Land Growth	
Scenario 6	Low GDP Growth	Low GDP Growth	
	High Population Growth	High Ag. TFP Growth	
	High Ag. TFP Growth	High Land Growth	
Scenario 7	High GDP Growth	High GDP Growth	
	High Population Growth	Low Ag. TFP Growth	
	Low Ag. TFP Growth	High Land Growth	
Scenario 8	Low GDP Growth	Low GDP Growth	
	High Population Growth	Low Ag. TFP Growth	
	High Ag. TFP Growth	High Land Growth	

Source: This table is a re-statement and summary of the scenario specifications in this annex. Therefore, the source is the previous content in this annex.

Annex 2—Research

Agriculture research towards 2040

Research operational environment

The operational environment for agriculture research is one of the main reasons for a relatively weak agriculture research performance in Vietnam. While researchers will point to impressive increases in agriculture production, much of those increases can be attributed to policy changes such as "doi moi", increases in planted areas, rehabilitation of irrigation systems and increases in inputs, notably fertiliser. Research has contributed, especially in plant breeding programs, introduction of new breeds, diversification of crops and improved pest and disease management. In the fisheries sector impressive gains have been made through adaptation and development of intensive aquaculture systems and in the forestry the introduction of fast growing trees such as acacia, development of agro-forestry systems and intensification of bamboo production has given rise to a large (although highly over-capacity) pulp and paper industry. Almost all of the research gains have been achieved through adaptive rather than innovative research. It terms of research's contribution to agriculture GDP, a focus on adaptive research is also likely to provide the most significant gains in the foreseeable future. However future gains will be much more difficult to achieve as they will involve adapting advanced technology, largely developed and proven off-shore, to a continually changing Vietnamese agriculture structure. The ability of researchers and research institutions to do this is currently constrained by the existing research operational environment and major changes in the research operational environment are urgently required to enable research to deliver a substantial on-going contribution to the growth of the agriculture and rural development sector.

The operational environment for research is constrained by a number of major issues such as (i) low research funding; (ii) poor policy environment; and, (iii) structural issues that impact on research relevance, efficiency, effectiveness, impact and sustainability.

Many of the issues discussed below are beyond the control of the researchers themselves. They have proven to be very innovative in responding to their operational environment and many of active researchers express a personal opinion that the time for radical change is well overdue.

Policy environment

The policy environment is characterized by differing policies and strategies of key Ministries, the Ministry of Science & Technology (MOST) the Ministry of Agriculture and Rural Development (MARD) and the Ministry of Finance (MoF). The key policy and strategy issues are:

Ministry of Science and Technology. The driver for reform in delivery of science, technology and innovation is Decree 115/2005/ND-CP. This was promulgated in September 2005 and essentially is a strategy and policy designed to enable research organizations and institutions to become administratively and financially autonomous. Associated with this the main reform intended was science funding would be based on research projects (and by implication outputs) rather than research institutions. The view was that "uncompetitive" research institutions would not survive and would eventually close. Unfortunately Decree 115 did not ensure that science salaries could be incorporated into the cost of research and although Decision 96 resolved this issue salaries have continued to be paid by government and are not included in project costs. Decision 846 is about how to implement Decree 115 including the ability to develop output based contracts as a delivery modality. Decree 115

was intended to be fully operational by December 2009. It is not yet functional and even though the date for compliance has been extended a number of times and is now December 2013. Without major additional reform Decree 115 is unlikely to be effective in the foreseeable future.

The key strategy and policy document of the Ministry of Agriculture and Rural Development is Decision 36/2006/QD-BNN. This describes the management of science and technology within MARD. It identifies three major areas of funding: (i) MARD priority Research programs/projects, (ii) Special tasks (research project directed by the Minister; and, (iii) regular tasks (often associated with laboratory analyses etc.). It was intended that around 70% of funding would be in priority programs/projects and that regular tasks would be phased out over time and moved more to a user pays basis. Special Tasks have taken the form of a direct grant to research institutions. Revision of Decision 36 was commenced at the end of 2006 but as yet has not been approved.

The Ministry of Finance financial management regulations do not appear to align well with policies (existing or intended) of MOST or MARD. The key issues are salary, pricing of research delivery and expenditure accounting.

Salaries for scientists are very low. The consequence of this is that apart from a cohort of researchers who are rapidly approaching retirement and thus will receive the relatively attractive retirement benefits, the recruitment and retention of younger well qualified personnel is an on-going concern. There is a longer term intention to triple researcher salaries and currently there is an initial proposal to improve the basic research worker salary from VND540,000/month to VND 1 million/month. While this is a move in the right direction its impact on staffing issues is uncertain.

Pricing for delivery of research is based on Cost Norms defined by MoF. These cost norms are well out of date and do not relate to actual cost. This impacts the nature, scope and quality of research undertaken through a reduction in treatments and replicates and through that the quality of research. It also encourages on-station rather than on-farm research through savings on transport costs.

All research projects have to acquit all expenditure through provision of receipts which are required to exactly match the project budget. The nature of receipts are not well reconciled to the intended purpose of the expenditure (this led the Vice Minister of MARD to publically proclaim that his staff had checked the receipts for some water resources projects and concluded that researchers had eaten the project budget—i.e. receipts were for food!). The acquittal procedure cuts across the intention to delivery research on an outputs based contract approach. The acquittal process is an administrative nightmare and by law a research project cannot be considered complete until this process has been completed.

Research funding

There are three government sources of funding for agriculture research; (i) Ministry of Science and Technology (MOST); Ministry of Agriculture & Rural Development (MARD); and, (iii) Provincial Governments. MOST has recently announced the establishment of a VND 1000 billion innovation fund. As yet no funds have been allocated and MOST is currently determining the eligibility for access to the Innovation Funds and types of projects that are eligible. Provincial government funding has increased substantially over the last 5 years as a consequence of the Government of Vietnam's decentralization policies. Much of provincial government funding support is utilized at the technology transfer/extension end of the research spectrum, and in many instances research institutes' knowledge and skills have enabled them actively complete with National and Provincial Extension Centers to become preferred extension service providers.

Compared with other Asian countries Vietnam has for a long time been at the lower end of research funding on a percentage of GDP basis. The low levels of less than 0.1% in the early 1990s gradually improved to around 0.2% of GDP in the early 2000s The Asian Development Bank has provided considerable support for agriculture research (and technology transfer) since 2000 with the Agriculture Sector Development Program (ASDP) followed by the Agriculture Science & Technology (AST) Project providing loans totaling

US$90m. As one of the conditionalities of ASDP Vietnam has increased the funding for agriculture research by 11–12% per year, but this increase has barely kept pace with inflation and as the GDP has increased the percentage of GDP for research has been either static or marginally falling. Funding in 2012 is estimated to be marginally less than 0.2% of GDP. By contracts in 2002 the average of 10 Asian countries, excluding Vietnam, was approximately 0.45% of GDP.

In 2011 the total budget for agriculture research was VND646.9 trillion (US$31.5m). Of this VND526.2 Trillion (81%) was under MARD control and 19% under MOST management (around half of this is allocated to the biotechnology program and the other half contestable research projects).The allocation breakdown of the VND526.2t under MARD control is shown in Table A2.1.

Table A2.1: MARD research budget allocation by expenditure category

category	VND trillion	%	comment
personnel	191.3	36.4	salaries and superannuation
research projects	181.7	34.5	allocated to 7 broad research areas (see below)
special tasks	54.3	10.3	direct allocation to research institutes
regular tasks	98.9	18.8	regulatory activities, equipment, capacity building, international collaboration etc.
total	526.2	100	

The immediate intention of doubling and then tripling salary of researchers is likely to have major impacts on the availability of direct operational funds for research project delivery unless total research funding is substantially increased.

It is interesting to note the funding rations between each of the categories. In developed countries and other developing countries the ratio between personnel and direct research activity costs is around 65:35. In Vietnam it is close to 40:60. Funds allocated to research projects/programs by sub-sector (2012) are detailed in Table A2.2.

Efficiency: The key issue is whether research funds are used in a cost effective way. One measures used is whether the ratio between the cost of research overheads (Capital, Management and Administration) and the total cost of research program/project activities is maintained at an acceptable level. The background includes:

1. MARD has previously worked on a strategy and policy to improve the effectiveness and competitiveness of agricultural research and extension in Vietnam with the support of ADB. It was found that on a comparative basis the proportion of GDP allocated to agricultural research was much lower than other Asian countries. MARD also identified that there was a level of capital investment in research institutions which appeared high compared with the total cost of the research programs supported and promoted the rationalization/restructuring of this investment through a reduction or amalgamation of institutions, sub-institutions and centers and a refocusing of the research effort into priority programs.

2. Aiming at institutional rationalization, the Vietnamese response so far has been to establish 3 Research Academies which together with 11 other institutions make up the MARD controlled research system. These are (i) the Vietnamese Academy for Agriculture Research (VAAS) with a primary responsibility for crops and plant protection research; (ii) the Vietnam Academy of Water Resource Science; and the Vietnam Academy of Forest Science has 16 Institutes. There are 11 other institutions responsible to MARD including four fisheries institutes (Marine and Aquaculture.

The CARD Program supported by AusAID demonstrated an appropriate process for research prioritization including priorities for the Crops, Livestock, Fisheries, Forestry and Economics sub-sectors and for the agriculture sector as a whole (Crops v's Livestock v's Fisheries, v's Forestry). A

recommendation to MARD to use these priorities as a starting point was approved, but as yet has not been effectively implemented.

The 2012 budget allocations are little changed from the budget allocations over the 2006– 2011 period (Figure A2.1) although the small decreases in Crops/Plant Protection and small increases in Fisheries and Animal Husbandry & Veterinary reflect to a small extent the changed contribution of these categories to agriculture GDP over time.

Table A2.2: Research funding by sub-sector

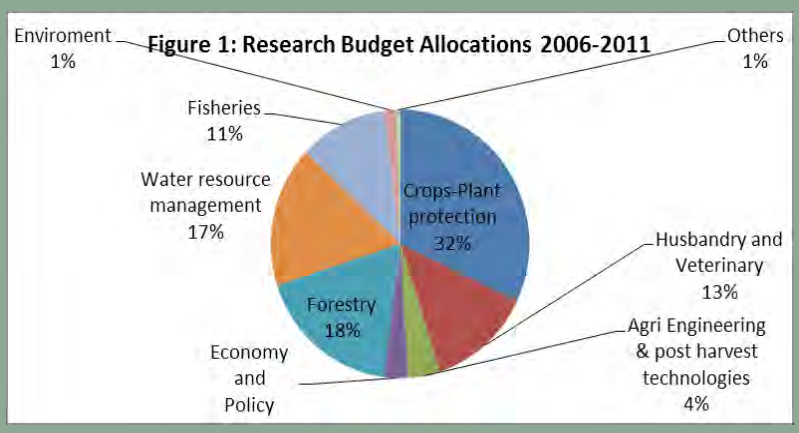
subsector	VND (million)	%
crops & plant protection	58570	30.8
animal husbandry & veterinary	27281	14.3
agriculture engineering/post harvest	8685	4.6
policy	7770	4.1
forestry	28800	15.1
water resources	27700	14.5
fisheries	28582	15.0
environment	3000	1.6
total	190388	100

Key issues are examined within the context of an evaluation of the overall performance of the National Agriculture Research System., covering (i) Relevance of current Research; (ii) Efficiency in the allocation of funds; and (iii) effectiveness.

An assessment of the current relevance of Vietnam's research work: The key issues impacting relevance include:

1. Supply driven research is less relevant than demand driven research. In general the research programs/projects are supply rather than demand driven. More demand driven research would increase the relevance of research efforts. It appears that most of the decisions on what to research are determined by the researchers themselves and this is likely to be the main reason for the supply driven emphasis. To improve research program design, a Science Council was established within MARD in 2006 to provide advice to the Minister on a research priority framework and recommendations for funding support for priority research programs/projects. The Science Council was supposed to have representation from the private sector, but apart from minor representation from State Owned Enterprises the Science Council has consisted of either active or retired agriculture scientists. Since its establishment the Science Council has met very infrequently and is now essentially non-operational. The MARD budget for research projects is to some extent contestable but the decisions on what research is supported is made by the scientists themselves and often there are conflicts of inter-

Figure A2.1: Research budget allocations 2006–2011



est between the decision makers and the potential research service providers.

2. Research topics need to be closer to the market: Unlike the situation in other successful rapidly developing countries, in Vietnam there is a low level of contribution/participation from the private sector in either developing the research agenda, funding research projects or in research delivery and reporting. The result is a disconnection between market requirements for research and the research delivered. Agriculture growth in Vietnam in the future is likely to be export led as basic food security is unlikely to be an issue in the foreseeable future. The research community has a relatively poor understanding of export market needs in terms of preferred varieties, differing requirements for different markets, food quality, safety and regulatory requirements of different markets. Research emphasis on harvest and post-harvest technology for value adding and improving shelf-life and an understanding of the dynamics of volume and continuity of supply that high value markets require is low compared with the research emphasis on production.

3. The research agenda is too driven by helping to meet output targets: Government of Vietnam agriculture targets are area and volume driven. Research programs and fund allocations are also closely related to targets rather than markets and the potential for research to provide significant impact. For rice Vietnam long term target is export of 5–6 million Metric Tonnes. Most of the export rice is of low quality and consequently low price. Food security is not an issue for Vietnam and there seems little point in further iterative research using conventional research techniques particularly as the volume of rice on the international market is likely to further increase (e.g. Myanmar is expected to export 1.5 million MT of rice in 2012).

4. Allocation of funds within sub-sectors: Within the Crops and Plant Protection Sub-sector a large proportion of the research capacity and funding is directed towards rice. Conventional rice research is considered mature both internationally and within Vietnam (see Box A2.1).

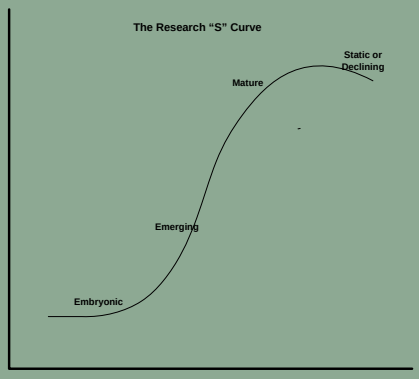
Efficiency: The key issue is whether research funds are used in a cost effective way. One measure used is whether the ratio between the cost of research overheads (Capital, Management and Administration) and the total cost of research program/project activities is maintained at an acceptable level. The background includes:

1. MARD has previously worked on a strategy and policy to improve the effectiveness and competitiveness of agricultural research and extension in Vietnam with the support of ADB. It was found that on a comparative basis the proportion of GDP allocated to agricultural research was much lower than other Asian countries. MARD also identified that there was a level of capital investment in research institutions which appeared high compared with the total cost of the research programs supported and promoted the rationalization/ restructuring of this investment through a reduction or amalgamation of institutions, sub-institutions and centers and a refocusing of the research effort into priority programs.

2. Aiming at institutional rationalization, the Vietnamese response so far has been to establish 3 Research Academies which together with 11 other institutions make up the MARD controlled research system. These are (i) the Vietnamese Academy for Agriculture Research (VAAS) with a primary responsibility for crops and plant protection research; (ii) the Vietnam Academy of Water Resource Science; and the Vietnam Academy of Forest Science has 16 Institutes. There are 11 other institutions responsible to MARD including four fisheries institutes (Marine and Aquaculture.

3. The CARD Program supported by AusAID demonstrated an appropriate process for research prioritisation including priorities for the Crops,

Box A2.1: Rice research in Vietnam—the potential for future gains?



Research resources in Vietnam since Doi Moi have heavily focused on improving the yields of rice production and the introduction of Integrated Pest Management for better and more sustainable management of pests and diseases. Certainly total rice production and rice yields have significantly increased. Some of these increases can be attributed to improved varieties but much of this increase could be attributed to the relatively high nitrogen inputs, improved irrigation and water management and improved but very dependent chemical control of pests and diseases.

The rate of increase in rice productivity has significantly slowed from around 3.5% per year to now 1% per year. This level of increase is expected to be maintained as a result small gains from research and increased adoption of improved agronomic and harvest and post-harvest practices. From a research perspective, given the results to date and the international research programs in

IRRI and other major rice producing countries the conventional rice research field could be considered mature (see the Research "S" curve). This means that the returns for further investment in traditional rice improvement programs are unlikely to provide cost-effective benefits. The challenge is to initiate another "S" curve through advanced scientific techniques possibly involving genetically modified organisms. There are three potential options (i) Hybrid Rice: The anticipated benefit from hybrid rice is 15–20% increase in yield. Vietnam researchers have tried to develop hybrid rice varieties since the mid-1990s with limited success. The yield increases have not matched those reported in other countries, notably China. The production of hybrid rice seed requires specific techniques for success and adoption of hybrid rice produced in Vietnam is low. In China almost 50% of the rice area utilises hybrid rice and some cross border purchase of Chinese hybrid seed is occurring. However the performance of these varieties in Vietnam has not delivered the same results reported in China and the rice quality is considered relatively low; (ii) GM rice to improve tolerance to pests and diseases. Vietnamese results claim a 40–50% increase in yield for corn for animal feed, but GM rice appears some way away and acceptance of GM rice for human consumption may be an issue in Vietnam and by importers of Vietnamese rice. (iii) C4 Rice. The anticipated benefit is an increase in yield of 40–50%. IRRI has a major internationally funded C4 Rice project and the science involves changing the cellular structure of leaves and hence the type of photosynthetic activity. It is unlikely that Vietnam would have the technical capacity and financial resources to do this on its own and the most likely successful strategy is to associate with the scientific expertise that is already involved in an international project. Once this breakthrough is made it is likely that there will be a new field of research which will investigate adaptation of C4 varieties to Vietnamese environments. For example C4 rice is expected to respond differently to nitrogen applications than existing varieties.

Livestock, Fisheries, Forestry and Economics subsectors and for the agriculture sector as a whole (Crops v's Livestock v's Fisheries, v's Forestry). A recommendation to MARD to use these priorities as a starting point was approved, but as yet has not been effectively implemented.

Effectiveness: Overall, the research program in Vietnam can be made much more effective. The main issues are:

1. Decree 115 has encouraged research institutions to be autonomous in terms of personnel and finance. Each institute and sub-institute has to focus on income generation in order to survive. This has led to a proliferation of non-research services,

such as production and sale of seeds of all kinds, development of nurseries for production and sale of planting material, fingerlings etc., and development of consultancy services—often extension services for provincial governments, production of machinery, and many other non-research activities. This increased non-research services activity is a strong disincentive for private sector delivery of similar services. It also tends to distract research institutes from their core function of research delivery.

2. Some institutions (e.g. Maize Research Institution—hybrid & GM seed production) have greater capacity to generate income than others and hence the institute well-being and ability to attract staff and deliver quality research programs varies widely between member institutions of an academy. The ability to generate non-research income tends to focus research investment into areas that are not necessarily high priority.

3. It has become accepted practice for bilateral support to agriculture research to include a salary supplement for Vietnamese research partners. Although in project budgets this support is often not explicit it is almost always there in one form or another. Often research institutes benefit by USD$80–100 per day for every day each of their staff are involved in project delivery. At the upper level the daily supplement is close to the researcher's monthly state salary. Not all the benefits go directly to the staff involved with a significant proportion being pooled to provide more equitable benefits to all staff. The result of donor salary support is that research institutes prefer to work in donor funded agriculture research and development projects, rather than MARD funded projects.

Impact: medium and declining. The reasons for this evaluation include:

1. Historical impact is considered by most commentators as being better than current and future impact. The reason is that most of the easy gains through research have been made. Future gains are more difficult and the research system has not had the investment required to further develop existing capacities and the new and different capacities required to address future research needs. For example the 2011 MARD research budget allocated only VND39 billion (USD$1.85m) for all research capacity development including equipment and research capacity development. As well as the university programs within Vietnam the research system has relied on scholarship programs from donors to provide the academic qualifications required for new staff. Although almost all foreign trained agriculture graduates return to Vietnam their retention within the research system for more than 5 years is an on-going issue.

2. There is an intention to move towards output based research contracts based on actual costs of research. This should improve research impact provided the beneficiaries and potential benefits are quantified. Within MOST there is a view that output based contracts with payments for defined deliverables will only work if the research is successful. The notion of success is that it provides substantial impact and unless that occurs the results will not be achieved and therefore output payments will not be appropriate. The concepts of a null hypothesis or alternate hypothesis appear not well understood as evidence that supports the null hypothesis (i.e. the treatments do not work) is considered as less important (and therefore a failure) than evidence that rejects the null hypothesis. The net result of this understanding is that researchers tend to submit project proposals that they know will be successful rather than test the boundaries of innovation. This approach significantly lowers impact.

3. High technology in agriculture is seen as the introduction of large scale farming systems where mechanization has replaced labor. From a Vietnamese research perspective almost all of this technology is readily imported as evidenced by the large

scale and often foreign owned large scale intensive commercial pig and poultry units and increasingly large dairy production systems. The question to ask is how can Vietnamese research improve the impact of these large scale mechanised farming systems?

4. Availability of salary supplementation through internationally supported projects gives rise to a concern that the research agenda can be driven by the donors. The absence of a clear research priority framework thus enabling donors to set their own agenda based on their own comparative advantage. Research institutes are more than willing to participate given the financial benefits associated, even if the research is considered to have relatively less priority and therefore potentially less impact.

5. On-farm research is a relatively minor component of research activity. This to some extent is understandable as costs are higher and researcher control is less sure. However the lack of on-farm research together with a need to improve the understanding of how to measure benefits at the farm level contributes to an inability to be able to demonstrate impact. The focus on research for yield increases without a sound understanding of input costs and output returns and mechanisms for improving profitability through cost reduction and impacts on farmer adoption rates. The rice "3 pluses and 3 minuses" program is a move in the right direction as rice farmers have again complained that rice farming is unprofitable with the current low export prices.

Sustainability: medium but under threat: The skeleton for a sustainable national agriculture research system is in place. However low levels of investment, a disconnect between research and the market for research outputs and outcomes, a closed research system, inability to recruit and retain competent researchers coupled with over-investment in land and buildings and high overhead costs has the potential to threaten sustainability. Options for the way forward should address sustainability.

Options for the way forward

Since the early 2000s the Vietnam Agriculture Research System has undergone some restructuring. There have also been attempts to undertake a process of reform. After more than 10 years of these processes there is little evidence that these changes have resulted in a substantial improvement in performance of the NARS. The time and effectiveness for iterative reform initiatives seems to be running out and perhaps now is the time to establish a new paradigm and develop policies and strategies that will lead to substantive change within a clearly defined timetable for implementation. Concepts that could be the subject of evaluation and application include:

Significantly increase research funding

To address the issues of a low percentage of GDP for research, low salaries, staff recruitment and retention and to increase the financial resources available to undertake research activity and capacity building, it is estimated that total research funding will need to more than triple by 2015 and maintain annual increases of 10% over and above inflation for the 2015–2040 period. Potential sources for this include:

1. Government funding: It is considered unlikely that government will meet this increase on its own, especially if research continues to have difficulty in demonstrating a sound return on government investment. Policies and strategies that enable government to leverage private sector funding support and options such as levies and interest bearing loans to research institutions for development of partnerships with the private sector could narrow the funding gap and encourage a closer collaboration with agro-industry.

2. Contribution from the private sector: Increasing agriculture's contribution to the national GDP is most likely to export driven. While the domestic market is large, food security is unlikely to be an issue in the foreseeable future. Domestic market

volume is therefore likely to be population driven. For agriculture exports government should evaluate the potential for levies on exports as a mechanism for significantly increasing private sector contribution to research and development (R&D). There may also be potential for some private sector contribution towards R&D where government agriculture priorities relate to import substitution. Tariffs may not be possible as Vietnam is a member of the WTO, but legislation to establishment research foundations with contributions from both government and the private sector may be an option (e.g. for the dairy industry, companies that import milk powder and reconstitute it may see opportunities for increasing domestic supply of milk and could be encouraged to contribute to R&D via a foundation).

3. Collaborative research programs: It is likely that the funding from this source will be relatively low, but Vietnam research organisations could encourage further investment by donors and international research organisations by changing their approach from a "seller of time" in collaborative research projects to an equal partner in terms of funding and scientific knowledge, skills and the integration of indigenous knowledge.

Address recruitment, retention and capacity building Issues

Research worker's salary is low and MOST has targeted a 3-fold increase over the next few years. This on its own is unlikely to fully address recruitment and retention issues. Most active scientists claim that to them the most important resource is adequate funding to plan and implement high quality research programs and projects. Their second priority appears to be the need for capacity building, both as individuals and for their institutional colleagues. Active scientists also state that development of a career pathway and promotion that enables them to stay actively involved in research delivery rather than having to become research managers is very important. Employment policies and strategies that address these issues are likely to significantly improve recruitment and retention rates. Strategies and policies to reduce research overhead costs and release savings for greater research activity should be developed.

Establish industry-based research and development foundations

The current disconnect between research and the marketplace needs urgent attention. As previously mentioned agriculture's contribution to GDP is likely to be driven by agricultural exports, and because of this concepts and policies such as levies on exports should be considered. The management of levies and their use for R&D will need careful analysis. One possibility is that Research and Development Foundations could be established on a commodity (or group of commodities) basis. For example there could be a Fisheries Foundation (involving marine capture and aquaculture) or these two arms of fisheries could have separate foundations. Similarly a Grains Foundation could be established for all grains (rice, maize, beans and pulses etc.), and other foundations that targeted fruit, vegetables and industrial crops etc. could be considered. Government could support the foundations by matching levies, for example on a dollar for dollar basis or for emerging industries government support could be greater than industry support. The structure, organization and management of these Foundations and the use of R&D funds would need to be carefully thought through and Foundation regulations and practices would need to be explicit and within the law. The Foundation would not necessarily deliver any R&D services, but would use its funds to contract service delivery from a range of service providers, including those in the public and private sectors. A commercial company model with a Chairperson and Board of Directors could be one appropriate model. Composition of the Board would of necessity have to reflect the industry, including exporters, marketing organizations, processors/value adding companies, producers and government agencies (research and extension service providers). There are models in other countries that could be evaluated for application in Vietnam and these should be carefully evaluated as to their appropriateness for Vietnam.

There are examples in other countries that may provide models suitable for adaptation in Vietnam. Australia has addressed private sector contribution through establishment of six commodity based Rural Development Corporations (RDC). RDCs are funded through levies on production matched by government funds varying from a public-private ratio of 50:50 to 70:30 depending on the size and stage of development of commodities. Australia has also introduced nine industry owned companies whose funding primarily comes from the private sector but has some access to government support. Both the RDCs and Industry companies heavily invest in agriculture research and industry development. These two interventions have had the impact of increasing private sector investment in agricultural research from less than 5% to more than 30%. In New Zealand government legislation allows for collection of levies based on exports. The decision to implement a levy is determined by agreement from producers. The funds generated are largely managed by the industries themselves. Several research partnerships between industry and government owned agencies, such as the development of the Dairy Research Corporation, which is a joint venture between AgResearch (a State Owned Research Organization and the NZ Dairy Board). There are similar agencies for other products such as kiwifruit, pip fruit, meat and fibers, etc. Some wholly levy funded organizations such as the Foundation for Arable Research have also been established. The contribution of the private sector to agriculture research has increased from 5–6% in the 1960s to over 30% in the early 2000s. In Kenya the Tea Research Foundation is supported by government legislation to enable levy funds collected at the manufacturing level, and potential at the green leaf production level to contribute to a stakeholder driven tea research program.

Prepare a research & development priority framework (to 2025)

Two aspects of R&D priorities that are not mutually exclusive and may slightly overlap at the product quality level could be considered: (i) R&D Foundation priorities. Once formed Foundations would need to develop an industry strategic plan. This plan should be comprehensive, but one aspect of it would involve development of R&D priorities. Priorities could primarily focus beyond the farm gate and if so feedback from the market should be a key driver. The R&D program priorities developed would address issues that will resolve export problems or capture promising export opportunities. Priorities may not be restricted to research but may also involve industry organization, production and industry structural issues. Specific technical advice could be contracted in to assist in establishing priorities and a contacting approach to R&D service delivery adopted. (ii) National R&D Priorities. The focus for these priorities should be public good R&D. Therefore National R&D priorities should be directed towards areas that will impact on potential beneficiaries that do not have the capability to pay for R&D services. In the medium term and probably longer relatively resource poor smallholders will contribute the majority of agriculture product. By implication National R&D priorities would target "pro-poor" R&D. Much of this research would be at the applied end of the research spectrum, and ideally involve low cost relatively low technology interventions including social research relating to community organization and integration into existing value chains. Delivery through regional research institutions should be encouraged.

Focus on "near market" research

It is strongly recommended that the majority of research funding supports "near market" research. This is research that is likely to provide significant benefits within a short time frame. It is research where if successful the direct application is highly relevant, has early application and is likely to address specific problems or opportunities. Research that will address market needs for variety, quality, taste, novelty, food safety, market access etc. would all quality as "near market". Other research that is likely to generate opportunities for high priced products, generate employment opportunities for specific markets (e.g. macadamia nuts?) could also quality as "near market" even though it will take some time before adequate production volumes can be delivered. This approach is most likely to deliver significant impact and through that encourage further investment in research. Some scientists consider this approach as an unattractive option as they would prefer to spend time developing

research capacity in high technology science applications. For scientific growth this is important but the potential for achieving these aspirations within the Vietnamese operational environment for research is limited and there may be better ways of improving capacities (see below).

Improve research innovation

The attitude that successful research only produces positive results tends to decrease innovation. One of the reasons for the current relatively low impact of research is that much of it repeats what is already known. Agriculture research is an international commodity and there is ready access to literature via the internet. English language may be a problem for older researchers but most of the younger well qualified researchers have obtained benefits from donor supported scholarships where English is the teaching language. Yet in spite of this, observation of many Vietnamese research projects over the last six years including some research and development projects funded by donors, demonstrates a relatively poor understanding of existing knowledge and experience and too many research and development proposals that repeat what is already known and proven. Examples of this include on-going trials into nitrogen fertilizer on rice, flushing sheep to improve ovulation rates and lambing percentages, feed requirements for large livestock (beef and dairy cattle) introduction of perennial legumes into forage programs, hybrid vegetable seed production etc. etc. Development of research proposal criteria that requires greater rigor in the preparation of research projects should include a comprehensive literature review, a sound understanding of indigenous knowledge and how the proposed project would advance knowledge and experience. This will require a major review of the format and content of research proposals

Seek collaborative role in major international basic science programs

Most major science breakthroughs are the result of large research investments from a range of sources and the assembly of the best scientific knowledge in international research programs. IRRI's leadership of the C4 rice program is a good example. History shows that the success rate of individual countries to deliver large scientific breakthroughs is limited. Vietnam could participate in these international programs, if it was prepared to provide financial support and with that an undertaking to include Vietnamese scientists in international research programs/projects. This should also significantly improve national research capacity and standing in the international science community. Policy changes would be required to enable research funds from government and if established foundation sources to contribute to large scale basic research programs managed by a range of international research agencies.

Implement open and contestable output-based research contracts awarded on price not cost

A major policy change that will facilitate implementation of output-based contracts is likely to significantly increase the quality and impact of research. Contracts allocated on price for high priority research projects will encourage competition based on quality and price and through that improve the cost-effectiveness of research. For this to succeed the Finance Law in relation to contract preparation will need to change so that the cost of research is based on market prices, not out-of-date and a low cost norm as it currently is. A review of finance law that delegates the legal responsibility for audit/acquittal to research institutions rather than finance departments within Ministries will also assist in the management of contracts. Attitude changes that accept that it is just as important to know what does not work as it is to know what does work will take time, but is an important step in developing deliverables and payment schedules for output contracts. Efficiencies in research delivery will also be encouraged as if the contract deliverables can be delivered for a cost lower than the contract price, the institution will benefit (i.e. the concept of profit is encouraged). Conversely institutions have the potential to lose money if research delivery efficiency is low or contract deliverables are unable to be met.

Change the role and skills of R&D funding agencies

In conjunction with other recommendations in this section, the structure and role of funding agencies will require modification. The role proposed for MARD's Science, Technology and Environment Department (STED) within Decision 36 (not signed) is that STED provides the secretariat, administration and science management services for a broadly representative Science Council (SC). The role of the SC is to ensure that research strategies and policies are developed, R&D priorities are established and decisions on funding for priority research programs/projects align with priorities. The Secretariat (STED) would be responsible for implementing the SC strategies and policies including initial screening and contracting technical evaluation of research proposals, development of outputs-based research contracts and monitoring and evaluation of research implementation. Unfortunately this model has not been tested as the approval of Decision 36 has been continually delayed. Significant improvement in research M&E skills will be a priority.

Establish an open market for research service delivery

Currently access to government research funds is limited to recognized Vietnamese research organizations. Almost all recognized research organizations are government research institutions and very little public funding is provided to private sector or international research agencies willing to undertake research in Vietnam. Potential impact from research investment is compromised though this approach and policy modification to establish an open market for research service providers in Vietnam is likely to significantly enhance return on investment. The use of GoV funds in collaborative research is especially important as it also delivers capacity improvements. Application of this recommendation will require more of a level playing field to encourage the development of private sector research agencies (see 11 below). The opening up of access to research funds is particularly important if R&D Foundations as suggested above are established. It is apparent that much of the MARD funded research targets "inside the farm gate", but in the future there will be increasing demand for "beyond the farm gate" research. Areas such as market intelligence, post-harvest handling and value adding, application of packaging technologies are examples of where government research agencies are relatively weak and where the private sector may be better suited to deliver. As earlier discussed use of GoV funds in large international projects will also provide opportunities for leverage.

Rationalize the capital investment in academies, institutes and centers

The current structure and level of government investment is a strong disincentive for private sector investment in research and the development of private sector research agencies. The exception to this is where large multi-national commercial companies do provide research that will make their commercial activities more competitive. For example large pig and poultry rearing companies and some companies involved in large scale dairy production and processing incorporate their own technology, such as breeds, concentrate feeds, animal remedies, management and animal housing and fit out equipment as a mechanism to maintain control of markets. The contribution of public research agencies to this form of research is negligible. Apart from this Government agencies receive most of their salary from government and land and buildings and most administration and management overheads and research equipment is provided by government through a direct grant from MARD to research institutes. Under Decree 115 (and subsequently Decision 96) salaries were to be included in the costs of research. This move is laudable but as yet has not been implemented. Some care also needs to be taken with this policy as international experience has shown that core research institute funding is necessary to enable research institutes to build and maintain capacity. If open and contestable output based contracts are implemented the ability of the private sector to compete will remain low as the only way they can recover overhead costs is to use a salary multiplier to recover overhead costs. This makes private research service delivery appear much more expensive that services provided by the public sector (although probably this is not true). One option for developing a more level play-

ing field is take account of the assets employed by government owned research institutions. For example if market rentals were required for land and buildings there would be a rapid reduction in the assets employed, more research would be undertaken on-farm rather than on station and the management structures and overhead costs associated with research delivery would be substantially reduced. The result would be improved efficiency.

Balance the location and connection of research institutions to farmers and farmer organizations

Up until 2008, almost 80% of the MARD research institutes were located in or near Hanoi. Since that time and with support of ASDP/AST, VASS has established four regional research institutes (Northern Mountains Agriculture and Forestry Science Institute [NOMAFSI]; Western Highlands Agro-Forestry Science Institute [WASI], Northern Central Agricultural Science Institute [ASISOV], Southern Coastal Agricultural Science Institute [ASINCV]). This is likely to improve the relevance of research in difference agro-ecological zones as the focus of the regional institutes is at the applied end of the research spectrum. Some difficulties in attracting and retaining suitably qualified staff in these regional institutes and delivery of supporting research services by VAAS member institutes such as Plant Protection and Plant Genetics has been experienced. The move to locate research service providers close to beneficiaries and to undertake more applied research is a step forward. There is room to further review the VAAS structure to continue this positive trend.

Central funding model

An objective assessment of the effectiveness of the science reform over the last seven years (2002–2012) would conclude that the degree of change has been disappointingly small. Decree 115 has not yet been fully implemented and Decision 36, although essentially completed in 2009, has not yet been approved and gazetted and appears to be in a state of on-going deferment. The Proposal for Reform of the Science and Technology Management Mechanism (issued with Decision 171/2004/QD-TTg September 2004 by the Prime Minister has not delivered significant change. The reasons for this are complex and include a lack of alignment between the policies and regulations of different Ministries. It is clear also that there is no incentive for change and little ability of key agencies such as MOST to encourage compliance. There is also a certain level of passive resistance from senior MARD research institution management against change.

It would be useful to undertake a feasibility study of the impact of channeling all agriculture research funding through a single agency. This could be MOST or some other suitable agency. As the experience over the last seven years demonstrates, policy without funds to ensure compliance has a much reduced chance of success. A move in this direction is a radical change. Care would be needed to ensure that the transition period was carefully managed, that research capacity could be strengthened and that core research competencies and resources, such as genetic biodiversity, public good regulatory functions and key analytical skills were not threatened.

Conclusion

This analysis of the agricultural research operational environment in Vietnam describes a less than flattering prognosis of the future sustainability of the Vietnamese agriculture research system. Apart from a comparatively low level of funding, there are major issues in relation to conflicting policies and regulations and structural issues that if resolved would significantly enhance the relevance, effectiveness, efficiency, impact and sustainability of the National Agriculture Research System. The conclusion drawn is that significantly increasing agriculture research funding on its own will not have a major impact on the quality and impact of agriculture research. It is argued that without major changes to policy and the ability to be able to implement those changes the sustainability of National Agriculture Research System appears uncertain. The difference between agriculture targets and the role and potential for agriculture research to be able to improve agriculture's contribution to GDP needs to be made. Procedures for development of research priorities

that emphasize the potential contribution of research to agriculture development would be a step in the right direction.

It is recommended that a major policy review is undertaken which would encompass the reasons for policy failure, develop options for resolving those issues, recommend perhaps radical policy and regulatory changes and determine the feasibility of implementation and compliance.

Annex 3—Fisheries and Aquaculture

Introduction

The fisheries and aquaculture sectors in Vietnam are complex and important contributors to the country's economy through the provision of essential animal protein key to nutrition, employment and foreign exchange earnings. The respective roles are derived from a history of traditional practices in fisheries as well as new innovations, particularly with regard to aquaculture now placing Vietnam in the third highest ranking position for aquaculture only behind China and India. The Government has recognized their respective importance and through the Prime Minister's Decision No. 1690/QD-TTg approved the "Strategy of Vietnam's Fisheries Development to 2020" that outlines a path forward to further extend development through modernization and the provision of high technical competence in achieving the defined goals. Among the goals are to have fisheries to contribute to 30–35% of the agriculture GDP with an annual growth rate of 8–10%, reaching 6.5–7 million tons (1.5 to 2 million tons over the 2011 level) with aquaculture accounting for 65–70% of total output. The annual target export is US$8–9 billion or US$2 to $3 million over the 2011 US$6 billion in exported fisheries products. In addition, it is projected that the number of people engaged in these sectors should rise from the current level of about 4.5 million to 5 million.

Over the past twenty years based on available statistics, major advancements have been made with regard to massive productivity increases in the two sectors with marine capture fisheries increasing over three times from 728,000 tons to about 2.0 million tons while aquaculture has increased by nearly 20 fold from 162,000 tons to about 3.1 million tons with a total yield from both sectors of 5.1 million tons in 2011. In land fisheries was reported to be about 200,000 tons, bring the total to about 5.3 million for 2011. In addition, reports indicate that another 200,000 tons is derived from inland capture fisheries which likely is significantly below actual production from inland fisheries resources. Exports factor large from this aquaculture and fisheries production, having risen to US$6 billion in 2011 up from about US$5 billion in 2010. The export volume represents about 25% of the total yield from the two sectors with the balance consumed domestically and contributing about 30% of the animal protein consumed in the country as compared to about 40% for Southeast Asia and 16% for the world. In addition it is estimated that rough 4.5 million people are directly or indirectly engaged in aquaculture and fisheries activities.

Fisheries and aquaculture development

Fisheries

Marine Fisheries. The total marine catch reported for 2011 was 2.0 million tons from Vietnam's roughly 1 million km^2 Exclusive Economic Zone (EEZ) along its 3,200 km coastline that extends from the border with China to the border with Cambodia. Vietnam's EEZ is roughly three times the land area of the country. An MPI/UC study reported that of the catch 15% is exported (high value including tunas), 20% is consumed fresh as food, 35% goes to animal/fish feed (smaller species including juveniles) and fish meal and 30% is used for fish sauce (mainly sardines) in 2009.

Regarding fisheries, the sea area is divided in two ways. The first concerns the estimates have been made of the standing stocks and maximum sustainable yields (MSY) as described for five distinct sea areas and listed in Table A3.1 that were recalculated in 2005. Therefore, since the total 2011 yield was reported at 2.0 million tons for the country, overall that yield is just under the estimated MSY which means that the standing stock is being fished near its estimated MSY of 2.15 million tons per year, though data is not

available on how the specified areas are impacted. However, due to the excessive fishing pressure in near-shore areas (roughly 80% of the estimated 130,000 fishing vessels with under 90 HP engine capacity in Vietnam fish within about 24 nautical miles (nm) of the shore which represent 25% of the EE), it is considered to be the more over-fished area.

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The second division of fishing areas is by vessel engine capacity. Under the 2010 Prime Minister Decree 123/2006/ND-CP, fishing is restricted to areas by fishing boat engine capacity. Within 1–6 nm, boats with engine capacities up to 20 HP are permitted to fish; between 6–24 nautical miles boats with engine capacities 20–90 HP are permitted; and, from 24 nm up to 350 nm, those above 90 HP are permitted to fish.

With regard to the level current effort, it has been increasing progressively especially over the past 20 years during which boat engine capacity has increased over 400 fold from about 17,000 HP to 8 million HP. During that period, the catch per unit HP has dropped from about 0.8 tons/HP/year to about 0.36 t/HP/year, though the production per vessel has also increased from about 9 to 22 tons/vessel/year. During this period, it has also been reported that generally the size and thus the value of the fish caught has also declined.

To reduce fishing pressure during critical breeding periods, the 2011 Prime Minister's Decision 89/2011/TT-BNNPTNT

TABLE A3.1: ESTIMATED MARINE FISH BIOMASS AND MAXIMUM SUSTAINABLE YIELD

sea zones	species group	standing biomass		MSY	
		tons	%	tons	%
Tonkin Gulf	small pelagic fishes	433,100	8.53	173,200	8.07
	demersal fishes	153,269	3.02	76,635	3.57
	total	586,639	11.55	249,835	11.63
Central Coast	small pelagic fishes	595,550	11.73	238,250	11.09
	demersal fishes	592,150	11.67	296,075	13.79
	total	1,187,700	23.40	534,325	24.88
South East	small pelagic fishes	770,800	15.19	308,300	14.36
	demersal fishes	304,850	6.01	152,425	7.10
	total	1,075,650	21.20	460,725	21.45
South West	small pelagic fishes	945,400	18.63	378,150	17.61
	demersal fishes	123,992	2.44	61,996	2.89
	total	1,069,392	21.07	440,146	20.50
Middle East Sea	big pelagic fishes	1,156,032	22.78	462,613	21.54
total	small pelagic fishes	2,744,850	54.08	1,097,900	51.13
	big pelagic fishes	1,156,032	22.78	462,413	21.53
	demersal fishes	1,174,261	23.14	587,131	27.34
	total	5,075,143	100.00	2,147,444	100.00

Source: University of Copenhagen and Vietnam Ministry of Planning and Investment, December 2010

Table A3.2: Breakdown of marine fishing vessels (2008)

capacity	number (000s)
non-mechanized	10
up to 20 HP	60
20 HP to 50 HP	25
50 HP to 90 HP	10
over 90 HP	25
total	130

has established closed fishing seasons in specific areas within the EEZ. In addition, the 2005 Prime Minister Decree 27 supports the establishment of marine and inland waters protected areas that are important breeding, nurturing and biodiversity conservation areas. These and several other decrees and decisions have been promulgated in reference to the statutes in Vietnam's 2003 Fisheries Law. Considering their recent enactment, in time their effectiveness will be realized and be important in sustaining fisheries in Vietnam to optimal economic levels.

With regard to establishing fishing effort levels, the Research Institute for Marine Fisheries has been charged by the government to via a 2011–2015 $8-million program to recalculate the standing biomass and maximum sustainable yield of fisheries in Vietnam. To complement that program, it would also be useful to calculate the maximum economic yield[1] (MEY) from fisheries which would be below the MSY in terms of volume.

The Government's plan at present is to limit the fish catch to the currently estimated MSY of about 2 million tons until a re-estimation of the above factors is completed. This will require controlling the issuance of fishing licenses for which at present there are no controls, meaning that essentially the fisheries in Vietnam are and will continue to be open access until measures are enacted to control fishing intensity.

The Government is also planning to increase the capacity for fishing boat monitoring and safety aspects under its MOBIMAR program that will allow observing fleet activities notification of fishers of pending storms. At present, about 7,000 vessels have been equipped according with another 3,000 planned to be included at a cost of about US$100/vessel.

Inland fisheries is perhaps the least understood sector in terms of yields as well as their relative importance to various stakeholder groups. Nearly all fish caught from inland capture fisheries are consumed domestically. The yield has been reported to be relatively stable at about 200,000 tons. However, this yield could possibly be established based on the traded fish only and not that caught for subsistence, household consumption. Detailed assessments conducted by the Tropical Biology Institute of Ho Chi Minh City show that the production from seasonally flooded 45,000-ha Omon-Xano area in Can Tho and An Giang Provinces in the Mekong Delta ranged from about 300–450 kg/ha/year which fluctuated mainly due to the differences in annual hydrology. Extrapolating that yield to the average 1.3 million ha flooded area in the Delta conservatively—assuming about 50% of the yield from the Omon-Xano area—shows a possible annual yield ranging from about 200,000 tons to nearly 300,000 tons per year, assuming a 50% production level overall than that recorded in the studied area. Therefore, the overall annual yield from inland capture fishes for the country is likely much larger than assumed.

Also, the importance of inland capture fisheries varies significantly among rural households. For those land holders who are also involved in agriculture or others whose income is derived mainly from day labor and other occupations, for those involved in inland fisheries, the fish catch likely is for subsistence, household consumption and possibly for supplemental income. There is another group whose main income is derived from more-or-less full time fishing with the majority of their catch sold for cash income.

1 The MEY is the fishing effort where the positive difference been the value of all opportunity costs—including labor, capital and operation—and revenue is maximized. For MSY, the level of harvest is based on the maximum sustainable yield regardless of economic and financial benefits. The MEY is usually below the MSY.

Aquaculture

Freshwater, brackish water and marine aquaculture is conducted in Vietnam for a total production in 2011 of 3.1 million tons as above noted. Roughly the yields from these three sub-sectors are about 82% from freshwater, 15% from brackish water and 3% from marine systems. About 70% of the total yield has been estimated to be from the Mekong Delta followed by 12% from the Red River Delta with small percentages from other regions of the country.

Freshwater aquaculture. The longest history is with freshwater aquaculture systems that also include integrated farming models where aquaculture is combines with animal husbandry and agriculture where the by-products of each are cycles as nutrients for the others. For those integrated systems, generally fish polyculture in ponds is conducted where species are stocked together to take advantage of available nutrients and feeds. Nevertheless, over the past decade, freshwater aquaculture has been dominated by the rise of Pangasius catfish whose production in monoculture grew from about 114,000 tons to the current level of about 1.2 million tons or a compounded increase of about 27% per year. Pangasius now represents about 40% of the total aquaculture value and is the highest foreign exchange earner, about 30% of total export sales for the country from fisheries and aquaculture at about US$2 billion in 2011. Associated particularly with the rapid expansion of Pangasius production has been major increase in water pollution of surface waters due to the discharge of water from regular exchanges.

Brackish water aquaculture. The farming of shrimp dominates brackish water aquaculture in Vietnam, particularly the indigenous Black Tiger Shrimp (Penaeus monodon) that represents about 60% of the brackish water yield followed by fish (25%), other shrimps (11%) and other crustaceans (14%). Although Black Tiger Shrimp represented 13% of the total aquaculture production in 2008, it represented 28% of the value that year. In comparison to Pangasius which represented about 50% of aquaculture yield, it equaled 40% of the total value that year. The relative value of shrimp aquaculture, though, is overshadowed by the disease risks from which pandemics can more seriously impact those cops in comparison to others. The Government's position, therefore, is not to expand shrimp aquaculture significantly from its current level, especially intensive farming due to the relatively higher financial and economic risks as compared to less intensive forms.

Marine aquaculture production is in its early stages of development and includes the culture of lobsters, grouper cobia, clams, seaweeds, barramundi and a number of other species. The expansion of marine aquaculture development has been slow. Nevertheless, the is enormous scope for its development, provided that sites are carefully selected to avoid or resolve conflicts with other uses of the sea area, carrying capacity limits are not exceeded and the investments can be targeted for areas that have acceptable risk to coastal storms. Toward developing an approach to rational coastal development, the Government is in the process of formulating and implementing integrated spatial management plans for near-shore areas. Three other important dimensions to marine aquaculture development are that it can be done in areas with poor soils for agriculture, provide alternative employment to fishing and use filter-feeding organisms such as clams, mussels and scallops and seaweeds that do not require feed and can actually improve water quality through the assimilation of excess nutrients into growth.

Fisheries processing

Vietnam's fisheries product processing industry is relatively modern producing diverse products, with some 570 industrial plants and thousands of manually operated units producing products with a value of around US$5 billion per year for domestic consumption and exports.

Since 1990, fisheries product processing industry has been upgraded with modern technology with high standards of food hygiene and safety. But the industry also faces shortage of raw materials both in quantity and quality. The number of plants that fully meet the standards to export to the US market were 534, China 518 and Korea 515, and EU/Switzerland/Norway 393. The industry has been modern-

Table A3.3: Fisheries products industrial units—2000–2010

	Unit	2000	2005	2006	2007	2008	2009	2010 (e)
no of Plants		225	439	470	490	544	568	570
capacity	1,000 ton	500	1,300	1,500	1,700	2,100	2,200	2,200
export	1,000 ton	300	634.5	821.7	942.4	1,240	1,216	1,300
export Value	US$ million	1,478	2,737	3,358	3,762	4,500	4,300	4,500

izing in order to comply with the requirements of importing countries and application of quality management systems such as HACCP, ISO, Cleaner Production, and Standard for Fisheries TCN. The organized industry is subjected to strict standards and inspection by the National Agriculture Forestry and Fisheries Quality Assurance Department (NAFIQUAD) and International Organizations which has helped enterprises in applying modern production process and in generating a large number of products of high quality for global markets. The enterprises can process nearly 1,000 different type of products most of them are tiger shrimp, white shrimp, catfish, tuna, and squid of all types. Although the share of added value products has been increasing,

Table A3.4: Number of export approved fisheries processing units

	markets	Feb 2012
1	USA 1/	534
2	EU/Switzerland/Norway	393
3	Japan	534
4	Korea	515
5	China	518
6	Canada	304
7	Brazil	79
8	Russia	34

1/ Units meeting Vietnam's national technical regulations requiring HAACP.
Source: NAFIQAD, Vietnam

about 50% are still primary products. The exports are mainly produced on foreign orders with lower added value, packaging and carry trademark of foreign companies. Vietnam is generally a supplier of raw materials for foreign processors for processing into their value added products.

Current challenges facing fisheries and aquaculture

With rapid rate of development of fisheries and aquaculture over the past couple of decades in Vietnam, this expansion in production has not gone without problems that threaten the sustainability of marine fisheries and aquaculture developments. Inland fisheries is threatened as well but more do to exogenous factors that have an impact particularly on floodplain hydrology that have a direct effect on inland fisheries productivity. Some of these factors are influenced and will be further affected by climate change. Moreover, to a large degree, indications are that many related activities have reached near to maximum production levels. The 2003 Fisheries Law and pertinent supporting Prime Minister's decisions and decrees are relatively new—most within the past couple of years—are in the early stages of their being implemented.

Fisheries

Marine fisheries has approached or exceeded the maximum MSY and most definitely the MEY in most if not all fishing grounds largely due to the progressive increase in fishing pressure due not only to an increase in the number of vessels but also the increase in the engine capacity of vessels. Although there is no specific data quantifying evidence of fishing down the food chain from high quality and higher valued species, what has been witnessed is an average reduction in the size of the various species fished. Also, particularly for inshore fisheries, observations indicate that

among the smaller fishes caught, there are many juveniles of larger sized species.

Profit margin. Generally, the profit margin for fishers is difficult to generalize; however, reported information in 2010 shows that it is quite narrow for two of the major fisheries in Vietnam. For tuna which is caught offshore, the margin is very narrow due to the relatively high operating cost or about 3% of the revenue or about VND400 per kilogram with a sale price of VND14,000/kg. For anchovies that are caught in near-shore waters, the profit margin varies depending on the landed quality that is used for export, direct domestic consumption and fish sauce. The profit margin for export quality is about 77% (VND15,400) and about 54% for direct domestic consumption (VND5,400) with average price around VND20,000/kg for the former and VND10,000/kg for the latter. Anchovies used for fish sauce can essential be considered by catch that is separated from the above two sources and sold at about VND4,500/kg which if it were the only fish landed by the vessels would result is a net loss of about VND80/kg. The surveyed production cost per kg of anchovy caught is VND4,578 all inclusive with the off-loaded value and use determined by the quality of the catch when it reaches port and which of the harvest are suitable for the various demands. Clearly, the better on-board, post-harvest quality the higher the benefit will be per fishing trip, if market demand remains the same with the greater portion of high valued anchovies.

The reported unit cost per kilogram landed is VND4,578/kg for anchovies and VND13,592/kg for tuna of which all (variable cost per trip, labor, depreciation and maintenance and interest) are higher for tuna while the revenue per unit is also lower for tuna. It has been reported that on-board, post-harvest quality control capacity is substandard for many vessels that could be a contributing factor to the price of tuna obtained by the fishers.

What is interesting in comparing these data is that the off-shore yield is less profitable than the near-shore yield, though priority has been given to expanding off-shore fishing and reducing near-shore fishing.

- Post-harvest needs. Although on-shore processing needs are well met by the seafood processing industry, onboard equipment on fishing vessels often is in adequate with regard to effectively preserving the catch. Reports indicate that only about 30% of the fish caught remain in the highest or export quality condition. There is a need for fishing boats to improve that capacity. Regarding processing, all fish processing factory's staffs are knowledgeable in the various international seafood processing standards, errors have occurred with shipments contaminated with prohibited chemicals, pathogens, other filth and antibiotics which results in rejections by the importing countries. For antibiotics and other drugs, the main source of these is at the production end, particularly for aquaculture products. Although these occurrences are relatively infrequent considering the overall export volume, they do impact the national reputation for seafood products, result in revenue losses and can lead to embargoes of all seafood products from a country as has been witnessed for shrimp exports, in particular, for some producing countries from time-to-time. In the south central part of the country which is the main area for tuna harvests, the on-shore wholesale marketing facilities are poorly developed and need to be improved to assure better quality of caught tuna. Through the development of wholesale systems, competitive pricing is can also result that can lead to greater revenues for the fishers. On the domestic side, the aquatic product marketing systems is relatively poorly developed, particularly from the standpoint of quality assurance. In addition, managing the harvest on-board and via market points on shore have resulted in a loss of quality and thus revenue for the fishers.

- Implementation of laws and regulations and their enforcement. As indicated, the 2003 Fisheries law has only been effect for about 9 years with supporting Prime Minister Decrees and Decisions having been issued since then. These are at present being implemented; however, to bring a

Table A3.5: Planned change in number of marine fishing vessels (2008–2015)

capacity	2008	2015	change (%)
non-mechanized	10	0	-100%
up to 20 HP	60	24	-60%
20 HP to 50 HP	25	16	-36%
50 HP to 90 HP	10	16	+60%
above 90 HP	25	24	-4%
total	130	80	

Source: 2010 MPI and CU Report

complex sector such as marine fisheries into compliance is a major task. The complexity is further compounded by proposed adjustments to the fleet in terms of the number and capacity of different groupings of fishing vessels, especially since there are no controls at present on limiting the licensing of fishing vessel numbers or capacity. The reported plan, which is presently under reconsideration by the Directorate, to achieve by 2015 can be found in Table A3.3.

- Implementation of laws and regulations and their enforcement. As indicated, the 2003 Fisheries law has only been effect for about 9 years with supporting Prime Minister Decrees and Decisions having been issued since then. These are at present being implemented; however, to bring a complex sector such as marine fisheries into compliance is a major task. The complexity is further compounded by proposed adjustments to the fleet in terms of the number and capacity of different groupings of fishing vessels, especially since there are no controls at present on limiting the licensing of fishing vessel numbers or capacity. The reported plan, which is presently under reconsideration by the Directorate, to achieve by 2015 can be found in Table A3.3.

- Subsidies. 2008 represented the last year when subsidies were provided to the marine fishing industry and those were for fuel. That year there was a spike in oil prices that threatened the livelihood of those involved in marine fisheries, in particular, due to the narrow profit margin from fishing. As a result of the subsidies, unlicensed fishing vessels registered in order to take advantage of the subsidy which provided the Government with a better tally of the mechanized fishing fleet overall. Prior to that in the late 1990s and early 2000s subsidies were provided for fishing boat construction that has been attributed to contributing the excessively high fishing pressure on available resources. Most vessels that benefited from those subsidies were default on loan repayments.

- Inland fisheries continues to be the least understood and quantified fishery in the country. This fishery is one that is highly important in providing not only relatively low-cost, high-quality animal protein to the rural population particularly in floodplain areas of the country from which the major portion of the inland catch is estimated to be derived such as the major deltas via subsistence fishing but also provides but also provides supplemental or the main source of income to many in those areas. Floodplain fisheries are also under threat due to flood control projects that that limit the flooded area to assure an additional agricultural crop, particularly rice, but also due to upstream hydropower and irrigation dam projects that reduce the flow to the delta areas, particularly in the Mekong region.

Aquaculture poses the greatest promise for expanded aquatic product production in Vietnam, though is facing a number of major challenges that will need to be met as the sector increases it yields for decades to come.

- Seed. The aquaculture seed needs in Vietnam are highly diverse due to the wise range of species including crustaceans, mollusks, finfish, seaweeds, holothurians, etc. The type and number of species also increases every year as the sector continues to diversify. The main challenges with regard to seed include purity of strains and inadvertent or intentional hybridization, lack of family selective

breeding capabilities for the wide range of cultured species and supply and organized national distribution. Regarding distribution and supply, most emphasis is placed on those species that can best meet the export targets and less upon those mainly consumed domestically. An effort to selectively breed Pangasius catfish has been initiated by the Aquaculture Research Institute No. 2 that follows on the work done on Genetically Improved Farmed Tilapia (GIFT), initiated in the Philippines, for which selective breeding has improved growth rate, feed conversion efficiency and disease resistance. There is also interest in Vietnam to domesticate other commercially important indigenous species. The GIFT program has also been taken up in Vietnam.

- Feed. For finfish and crustacean aquaculture, in particular, feed represents a high percentage of the operating cost. In the case of the Pangasius catfish which the is species of highest aquaculture production in Vietnam (about 35%), the cost of feed is approximately 90% of the operating cost with a profit margin of less than 3% of gross revenue. With a feed price increase of roughly 0.33%, the financial viability of the production of this species will be lost as would be the case in a similarly small drop in unit revenue. At present, the catfish industry, which is segmented with seed and feed producers, growers and processors for the most part operating independently, has been particularly hard on the growers' profitability which has a clear impact on the whole value chain. As a result, many processors were reported to have suspended operations due to lack of raw material from growers. For semi-intensive and intensive shrimp farming, feed represents roughly 68% of the production costs; but, more importantly the production profit per kg of shrimp is about VND46,000 versus VND550/kg for catfish. Similar feed cost issues affect nearly all finfish (marine, brackish and freshwater); however, the impact is somewhat less for those integrated fish farming systems where combinations of indigenous and exotic species in polyculture are able to derive their nutrition from the by-products of animal husbandry and agriculture as fertilizers and feeds, respectively, as well as from farm raised forage by some fish species. Obviously, bivalve and seaweed aquaculture require no feeds but do need an environment in which plankton and nutrients are adequate for efficient growth.

- Disease. Most forms of aquaculture are threatened by disease. Except for shrimp aquaculture, prophylactic measures are generally well understood. For all species of shrimp, disease pandemics strike from time-to-time and can be devastating throughout a country and in some instances a region, mainly due to shrimp in general having a primitive immune system. Attempts have been made to breed specific pathogen resistant shrimp (SPR) without success. Alternatively, specific pathogen shrimp have been reproduced for farming purposes; however, these are still susceptible to diseases introduced via other pathways—e.g., water exchange, bird landings, feed, etc. Disease control chemicals such as antibiotics and other medicines can help to control and arrest disease, but residues of these drugs can accumulate in the organisms, if not properly administered, resulting in tainted flesh for human consumption. This factor significantly reduces the marketability of the product; and, if detected, can result in enormous losses to the producer and processor.

Coastal zone planning and management. In Vietnam, there is tremendous scope for the expansion of marine aquaculture. To complement this, a planning process needs to be put in place for the use of coastal waters. The Ministry of Natural Resources and Environment's (MONRE) Vietnam Administration of Seas and Islands (VASI) was established in 2008 to develop, among its tasks, integrated spatial planning (ISP) of coastal areas. These plans will be developed through a cooperative process among the pertinent ministries and coastal province departments. This planning is critical to assure all coastal needs are met so as to resolve conflicts and potential infringements among the

various uses—e.g., urban, transport, energy, aquaculture, tourism, critical habitat protection, etc. There is some experience with this kind of planning in Vietnam, but it's in its early stages. A recently approved project with International Development Association project entitled "Coastal Resources for Sustainable Development Project (CRSDP)" to start in December 2012 includes an ISP component, and it will be implemented in eight provinces—Thanh Hoa, Nge An, Ha Tinh, Khanh Hoa, Phu Yen, Binh Dinh, Soc Trang and Bac Lieu. The experience from this operation will provide important groundwork and lessons for further or concurrent development in other coastal provinces.

Environmental management. One of the major challenges with all forms of aquaculture concern their impact on the environment and the environment's impact of the aquaculture itself including water quality from their own emissions. Water quality is the key environmental factor. For freshwater Pangasius catfish culture, poor pond water quality with regard to oxygen and nitrogen concentrations is not a significant concern in that the fish is an "air breather." For all other species, those factors must be kept within acceptable limits to assure efficient growth and survival. The effluent from the catfish ponds as well as from other ponds such as those on shrimp farms has an adverse impact on the local environment. For shrimp farms, often the water supply and drainage systems are either common or allow cross-contamination due to poor engineering. These and other aspects need to be carefully managed and or remedied. Also, for marine or inland finfish cage culture, carrying capacity factors with regard to effluent loading on the culture environment need to be carefully calculated and monitored. A guide to aquaculture management was prepared in 2006 that goes through the full range of environmental management factors that pertain to aquaculture in Vietnam (www.aqua.stir.ac.uk/public/GISAP/pdfs/Guidelines_Vietnam.pdf).

Different forms and situations of aquaculture development can interfere with other economic activities which could in some cases reduce the overall net economic benefit from the aquaculture development. In other cases there will be only minimum losses, if any, caused to other activities. These factors are discussed in the Box A3.1.

Future direction and government priorities

The Directorate of fisheries has prepared a Strategy for Vietnam's Fisheries Development to 2020 (Prime Minister Decision No. 1990/QD-TTg dated September 2010) that outlines the Government's key priority development areas for the fisheries and aquaculture sectors in all regions of the country. Based on a projected growth rate of 8–10% per year, the plan aims to raise export value to US$8–9 billion with a production level of 6.5 to 7 million tons of which 65–70% would be from aquaculture. The aquaculture target would thus essential leave the capture fisheries level at about the current 2.2 million tons/year so the main emphasis on increased yields into the future is expected to be largely be derived from aquaculture or an increase of about 125% by 2020. It is projected that much of that yield will be derived from expansion of marine aquaculture, especially with the development of coastal integrated spatial management plans that will secure areas for development. Nevertheless, as with the rapid expansion in Pangasius production, there might likely be other species or groups of species that have until now received little attention that would develop quickly to meet the domestic and global market demand. Those could be derived from the Government's interest in domesticating more promising indigenous species for aquaculture. In addition to this expansion in yields particularly from aquaculture, the Government plans to modernize and improve the overall efficiency of the sectors overall with regard to (1) fishing boat design and safety; (2) improving and in some instances consolidating value chains, supply channels, diseases control and environmental management within the full range of aquaculture options; (3) increase training of workers, restructuring and in some instances relocating fishing villages, strengthening fisheries inspection capacity; (4) improving management through co-management options partnering fishers and local communities; (5) developing the research capacity and transfer of findings from it; (6) supporting market chains with improved analytical capacity of market demand trends, including that of importing countries. Prime Minister Decrees and Decisions, as noted above, are also being issued in support of the 2003 Fisheries Law to assist in assuring sustainability

Box A3.1: Aquaculture and pareto efficiency

In planning for future development and the needs to support that development, it is critical to minimize or best to eliminate options that adversely take away from or retard growth in other related sectors. Aquaculture development offers options where such losses can be avoided while its development and productivity is expanded. It can also be developed where losses to other sectors can result. For the latter as an example, if aquaculture is developed and supplants agricultural land in the process (e.g., construction of fish ponds where land crops are grown), there would be a loss to agricultural productivity that would be a clear opportunity cost. Or, if the demand for feed for aquaculture increases the general cost and availability of feed for animal husbandry, the profit margin would be reduced for those relying on the same feedstuffs. Similar impacts on water availability and quality would also adversely affect the economy dependent on those resources.

For Vietnam, there are opportunities in freshwater, brackish water and marine aquaculture where the Pareto efficiency would be high.

For freshwater aquaculture, integrated rice-fish culture has been demonstrated to produce two crops in the same space at the same time. Other benefits include reduced need for pesticides due to the fish consuming some insect pests and larvae. They derive their feed from residual nutrients in the paddy. About 10% of the paddy area is required for a fish sanctuary, commonly a trench along one side of the paddy and in some instances a deeper sump is also included. These areas serve as sanctuaries for fish when pesticide use is deemed necessary. Water levels are lowered: the fish migrate to the deeper areas: pesticide is used: and after about 48 hours when the pesticide has degraded, the fields are re-flooded. Evaluations have also shown that rice yields are not compromised due to the use of the area for fish habitat and actually have been found to be moderately increased by 3–4% or by 225 kg/ha/crop. Fish yields with stocking and no feeding are in the range of 550 kg/ha/year from documented experience in China. The fish derive their nutrition from residues in the fields. The culture of freshwater prawns has also been conducted in rice fields in the Mekong Delta but most often as an alternate crop.

For brackish water aquaculture, coastal areas which lack water for rice cultivation in the dry season can be used for shrimp aquaculture during that period. Fields can be flooded with sea water and stocked with low density shrimp seed with expected yields without feeding of about 250 kg/ha/season. Salt water intrusion into the soil is limited to about 1 cm which is flushed out with the first rains of the wet season when the shrimp crop is harvested. This form of shrimp culture is also characterized by low input, relatively low output and thus low risk.

For marine aquaculture, areas of the sea where critical habitats and other competing uses are absent, except possibly for fishing can be suitable for aquaculture development. In this regard, although fishers would be excluded from fishing these areas, coastal waters throughout the country have been overfished; and the water and benthic habitat beneath these areas would essentially be protected from fishing and be a sanctuary for fish breeding and growth in particular. Also, by using the sea area, only small land areas are required for landing and service needs points and possibly some for hatchery development. Moreover, integrated marine aquaculture systems can be implemented where wastes from marine fish or lobster culture in cages can be combined with suspended seaweed and bivalve culture that would utilize the wastes from feeding the cage reared species. Sea cucumbers can also be stocked beneath the cages that can derive their nutrition from the settles wastes from the cages. Through this integration when proportioned properly environmental impacts can be minimized. Alternatively, depending on water quality and nutrient levels, seaweed and/or bivalves can be cultured separately or together. Marine clams have also been seeded and successfully grown in coastal mudflat areas in southern Vietnam.

and environmental protection of full exploitation of the potential of the fisheries and aquaculture sectors.

To achieve the above objectives the Government estimated that the investment required to complete the plan would be US$2.87 billion over the 10-year period to 2020.

In looking ahead to 2040, assuming the targets for 2020 are achieved and the rate of aquaculture production increase continues, the total fisheries yield would be about 10 million tons—8 million tons from aquaculture, a 2.7 fold increase over the 2011 yield. This is a simplistic linear estimate with most of the increase potentially coming from marine aquaculture due to its present underdevelopment. With an estimated 40% of total production from fisheries exported extrapolated to 2040, the domestically consumed portion would rise from three million tons in 2011 to six million tons in 2040. The production of domestically consumed

aquatic products would increase from the 2011 of 35 kg/capita from 90 million people to 59 kg/capita for the estimated 108 million people in 2040[2]. Whether the domestic demand will keep pace with this rise is uncertain; however, if not, there likely will be international demand which means a larger portion would be exported. The potential of this expansion in aquaculture production will thus also be a major source of rural employment particularly in coastal areas with regard to the entire material supply sector as well as the value chain.

Recommendations toward sustainable food security to 2040

There are a number of specific remedies and constructive actions that can assist with sustaining benefits from the fisheries and aquaculture sub-sectors and expanding yields from the latter, and some will require a progressive effort over the next three decades at least to achieve more reliable performance. The following recommendations focus specifically on those long-term interventions:

- Fisheries monitoring. A fisheries monitoring system is in place; however, it needs to be strengthened with an audit system built-in to assure the accuracy of the statistics provided, particularly at the data collection points at the provincial level. A strong system is necessary as catch limits are determined and set. For inland fisheries, data collection should be sure to include that which is consumed by the catchers/households directly, for it could be and often is more than what is traded and most often the only data collected. In addition, the existing MOBIMAR program needs to be expanded to cover all motorized fishing vessels, including communication capability, to be able to know where boats are fishing and whether they are fishing in prohibited areas or at prohibited times and to be able to advise of coastal storms. Of the current 120,000 mechanized vessels fishing the marine environment, the current program has adequate resources for 10,000 vessels.

- Integrated marine spatial planning in the coastal zone and co-management. These aspects concern the management, exploitation and habitat conservation via a co-management planning effort among all stakeholders—government and private sector. Through additional efforts to those presently being conducted by the Government, conflicts over resource use can be minimized and optimal benefits should be more achievable as part of an overall fisheries and coastal management strategy.

Capture fisheries

- Marine capture fisheries. Inshore fisheries are considered to be highly overfished resulting in diminishing returns. These areas are predominately fished by about 10,000 non-mechanized and roughly 60,000 low horsepower (>20 HP) vessels. A critical factor is to reduce the fishing through providing alternative livelihood opportunities to fishers who are interested while concurrently providing education and vocational training to younger generations prior to their entering into the fishing business. Similarly, for offshore fisheries, efforts should be taken to reduce the fishing pressure and to properly management and exploit the stock so that endemic populations are allowed to develop for sustained, optimal economic benefit. The Government to reduce the mechanized fishing fleet significantly with specific number still being formulated. Use of appropriate gear that will help to sustain and properly exploit the fish catch while minimizing by-catch—especially juveniles—would also need to be further applied in the country. Also, the Government has also begun an initiative to develop a fisheries co-management program that creates a cooperative arrangement between government officers and the fishers themselves in sustaining a productive fishery.

2 This does not take into account replacement by other animal protein from other in-country animal husbandry sources or from imports.

- Floodplain and river risheries are often overlooked with regard to its importance to rural nutrition and livelihood, especially for landless fishing households. It is impacted by flood control projects and upstream interventions such as hydropower and irrigation dam projects that result in loss of aquatic habitat for fish growth—resident populations in canals and migratory species from rivers. The tradeoff between losses to fisheries (as well as fertility from less silt deposited), particularly with regard to flood control, need to be evaluated.

- Aquaculture. The main technical issues facing aquaculture are seed quality, disease control, feed supply and formulation, environmental impact management and technology transfer. For seed quality, family selective breeding programs can be expanded upon with emphasis on indigenous species and means to control escapes of these genetically modified organisms or producing sterile seed for grow-out. Also, in some areas of the country, seed (fry and fingerlings) for aquaculture are not available or not in sufficient quantities. The seed supply system needs to be strengthened through better coordination. One option would be for the Vietnam Fisheries Association (VINAFIS) to assist producers with connections to seed suppliers, particularly for favored species in the north such as tilapia that are in short supply and could benefit from hatcheries in the warmer climes of the south. Effluent and sludge management for reuse is a particular challenge to preclude environmental impacts due to the discharge of this pollution. Research needs to be done on how to best manage and reuse these nutrient by-products most likely via application to agriculture. Also, many aquaculture operations will need adjustments to their infrastructure, particularly as it relates to water supply and drainage systems. For feed, development of lower cost formulations can help with profitability for organisms that require feeds versus filter feeders or aquatic plants. Greater capacity for environmental monitoring, mainly water quality, needs to be made available as does disease monitoring. At present, the National Fisheries Quality Assurance and Veterinary Directorate (NAFIQAVED) assists with disease identification and control issues. In addition, it appears that more vertically integrated farming systems where all input, production, processing and marketing are done in a coordinated way so as to assure maximum benefits may prove to be more sustainable. How these would best be formulated needs further consideration and model development through participation of the involved stakeholders. The models may vary by species and farming system.

Marine aquaculture is the least developed form in the country, producing about 70,000 to 80,000 tons in 2011 or 2.4% of the total from aquaculture that year. Though considering the potential, there is considerable scope for its expansion, particularly via integrated marine aquaculture where filter feeding bivalve mollusks and seaweeds are cultured in close proximity to fish or lobster cage culture to enable feed wastes to be controlled through assimilation. In areas where water fertility is adequate, bivalve mollusks and/or seaweeds can be grown deriving their nutrition from the fertile waters. A system of water tenure would need to be further developed for interested households or companies. Expansion should be done in an incremental manner with water quality monitoring. Marine aquaculture can also created areas protected from fishing allowing habitats for fisheries regeneration that would also contribute to restoring the marine catch.

Brackish water aquaculture mainly involves shrimp farming (indigenous Penaeus monodon and exotic Penaeus vannamei from the central eastern Pacific) reached about 400,000 tons in 2011. It is not anticipated that the current area or overall annual yields will increase very quickly due to risks of disease. In the Mekong Delta, in particular, where most shrimp aquaculture is conducted, the sense is that farmers are more interested in improved extensive systems—mainly through supplemental stocking of post larvae—where risks are minimized and can be conducted in rice fields during the dry season when there is insufficient water for rice production along the coast in areas where

saltwater intrusion is seasonally feasible. Shrimp reared in these systems derive most of their feed via the natural food chain that derives its nutrition from rice cultivation residues that breakdown in the flooded fields after harvest. Means to control disease—such as the development of specific pathogen free post-larvae and secure production—will take many years to resolve fully before further intensification can be realized.

Freshwater aquaculture takes many forms that include pond, pen and cage culture of single species as well as fish polycultures that fully utilize he nutrient niches in the ponds. For pond aquaculture, integrated fishing farming with animal husbandry and agriculture where the wastes of each activities become nutrient for others is practiced in Vietnam as is rice/fish-or-freshwater prawn farming. Further expansion of these forms can help diversify food production structured to meet market demand. For integrated systems, greater resilience is feasible as markets fluctuate. Providing extension and training to farmers for broader application will require a long-term effort. For systems where fish or prawns are integrated into paddy fields, the yield of rice is little affected while pests can be controlled in part by the aquaculture and fertilizer use is also reduced.

- Post-harvest and marketing. Post-harvest capacities for better quality assurance generally need to be strengthened with regard to aquatic products, especially facilities on-onboard offshore fishing vessels. On-shore needs also need to be assessed. Considering the quantity of seafood exported from Vietnam, market channels are well established; however, analytical capacity in forecasting changes in international markets could help to prevent shocks as is the current case with striped catfish sales that were reported to have suddenly weakened in Europe due to the economic downturn there. Also, most aquatic product processing, is very simple and mainly concerns cleaning and freezing. Greater value added processing to generate higher returns and profits is also needed to be introduced.

- Governance and enforcement. The government is in the process of enacting its 2003 Fisheries Law and releasing the decrees and circulars related to its enactment. Many of the new regulations will require major changes in fishing behavior—such as the recently issued circular on closed fishing seasons in various parts if the EEZ for various species and another on devolving near-shore fishing to the provincial level to name a couple with another on fisheries co-management in preparation—will take some time to familiarize the fishing community with the restrictions and to develop the means to enforce them. Support will be needed to the sector for many years to complete for formulation of all regulations related to the law and to enforce their adoption. As critical dimension to achieving this objective, fisheries co-management that directly involves fishers, fishing communities and local governments will be required to effectively improve fisheries management. Support for co-management is included under the CRSDP for initial efforts in establishing this approach in the above noted eight coastal provinces.

- Research, with some needs noted above, will need to be pursued to assure that adequate knowledge is available to strengthen fisheries and aquaculture in Vietnam. The research will involve a number of technical matters as they relate to advancing improvements in the operation of aquaculture, disease control, seed quality, feed formulation, environmental management, etc. as well as on social issues that pertain to changing behavior and providing incentives to bring fisheries to being more sustainably managed.

The Directorate of Fisheries under MARD has recognized the importance of taking action to improve the overall management of the sectors over the long-term along the lines of the recommendations noted above and is taking actions within its capacity to issue regulations and invest in the needs to address the challenges.

Annex 4—Climate Change

Summary and conclusion

Climate change is already underway in Vietnam and it is projected that average surface temperature will rise by 0.8–1.3°C by 2050, total rainfall will increase by 5–10% by the end of the century, with 20% larger variations between wet and dry seasons. Sea level is projected to increase by 28–33 cms by 2050. Global supplies of food are not likely to be threatened by modest temperature rise of 1°C because of positive yield response in the higher latitudes. Crop yields in Vietnam are expected to decline under a 1°C rise expected around 2050: for rice by 3.4–6.7% and other crops by 0.3 to 3.7%. Mekong, the granary of Vietnam, could lose in some simulations as much as 590,000 ha of rice area and combined with the yield impact, this could lead to a decline in rice production 2 to 7 M tons of rice per year if no adaptation is undertaken. Fishery sector will be impacted but not damaged. Increased habitat in the wet season will counter the reduction in the dry season and increased saline intrusion resulting perhaps in a small increase in overall production. In the plantation forestry sector average yields are expected to increase marginally but with increased variability across various districts. Livestock sector is likely to be confronted with more disease problems leading to a loss of productivity.

Overall impact of CC on agriculture sector is likely to be quite modest with a 1°C rise. A productivity increase of 10–13% over next 30–40 years would fully compensate for all foreseen yield and area loss effects. Changes underway in diet preferences away from rice and towards poultry, fruits and vegetables will further dilute the impact of these changes.

Vietnam agriculture has been continuously adapting to past climate change and has now produced a significant exportable surplus of rice. Vietnam agriculture is poised to reach a new high level of performance and to increase farm incomes. Among key policy actions needed would be steps to soften the informal quota system that applies for rice production, shifting to higher quality rice, and encouraging crop diversification to higher value added crops in response to consumer demand. These actions supported by farm level adaptation will effectively counter all anticipated CC impacts on agricultural production to 2040–2050.

Autonomous response actions are well known and contribute to the growth of the sector, whether there is CC or not. In the crop sector these include delays in winter-spring rice planting in Red River delta, switching to drought resistant crops such as cassava and maize and in the Central region, changing to heat and salinity tolerant varieties in the Red River Delta, expanding a fish/rice rotation in the Mekong and improved water management systems. In the fishery sector, upgrading of ponds and changes in water/salinity management practices and use of new salinity tolerant species are needed. In the plantation forestry sector, shifting production from unfavorable to favorable areas and changing varieties will be needed.

Soft—policy and institutional—planned adaptation measures options are many. Government can enhance farmers' ability to plan the growing season based on detailed and timely information about temperature and rainfall and the knowledge to use this information. Strengthened agricultural research and extension will play a crucial role in adaptation to CC, since new varieties tolerant to salinity, flooding and draught, and new practices to reduce waste, increase efficiency and reduce emissions will be needed to be developed, tested and disseminated. Among these soft measures would be the introduction of water charges and delivery of effective veterinary services. Provision of strengthened veterinary services to counter increased threat of livestock disease would be needed.

Table A4.1

CC threat	likelihood	severity	immediacy
GMT rise 1 C by 2050	high	low	high
GMT rise 2 C by 2050	medium	medium	high
change in ratio of high/low season rain by 20% by 2050	high	high	low
GSL rise 0f 40 cm by 2100	medium	medium	low
GSL rise of 1 m by 2100	low	high	low
GSST increase by 1 C by 2050	medium	medium	low
extreme events increase by 50% by 2050	low	high	low

Hard planned adaptations—involving public expenditures—to expand irrigation and especially to build new sea dykes or coastal embankments need to be implemented after considerable site and threat specific due diligence, given their huge costs, the large uncertainty in predictions and slow pace of sea level rise. The first priority would be improve the utilization of existing irrigation infrastructure, which is little better than 60–70%. Potential for expanding irrigation is nearly exhausted in the Red River delta, where the emphasis is on rehabilitation and upgrading, and constrained by flooding and saline intrusion in the Mekong. Irrigation expansion in the Mountainous regions is prohibitively expensive. Potential to expand irrigation in the Central region is estimated to be about 700,000 ha by 2050. Restoration of mangrove forests as a natural barrier to flooding and storm surges forms part of a planned response in coastal areas, perhaps in the form of "green" dykes, of which as much as 6000 kms may have to be raised or built to protect against sea level rise to 2100, if it and when happens.

Estimates of financial costs of adaptation are indicative upper ranges only. To generate the estimated 10–13% productivity increase in the crop sector, investment costs have been roughly estimated to be $6.3 Bn. In the fishery sector costs are estimated to be $150M annually. No estimates are available for the cost of enhanced veterinary services to counter increased livestock disease. Estimated cost of strengthening and adding about 2000 km of sea dykes, embankment and associated mangroves, although it is not certain that all these would be needed by 2050, is roughly about $2.2 Bn.

With high social vulnerability household food insecurity can persist despite national food self sufficiency. The lowest 20% of households will face inequitable risks and damages and see disproportionate decline in real standards of living when the combined impact of lower yields, cost of autonomous response measures and increased variability of food retail prices hit them. In the mountainous regions of the NW and Central High lands where poverty rates are high, large segments of the population in these regions could feel more food insecure with CC. Without irrigation, which is costly to build in these regions, productivity is low. Their resilience is best enhanced through income augmentation by facilitating diversification to higher value crops. In addition, prompt actions are needed to compensate for unexpected loss due to CC events. Vietnam has begun piloting an index based crop insurance program aimed at the poorer segments.

A decision framework to guide the process of developing an optimal response strategy would require judgments about the urgency, severity and probability of climate threats being averted and cost of likely damage and adaptation and scope for recovery of costs from beneficiaries and social impact. Vietnam is piloting a methodology to make such choices, the first results from which should be available in 2012.

With virtually no progress on global GHG reductions since Kyoto, the world may well be on way to a 4–7°C warming by 2100 when the food situation could become really unmanageable. The totality of climate actions underway will not hold the world to a 2 degree C rise by 2100. While the Koyoto commitments called for a reduction of GHGs by 5.2% below 1990 level by 2012, emissions globally have increased by 36% to date. Even the softer Copenhagen 2009 agreements which would have limited global emissions to 44 Gtons CO_2e by 2020 are already showing a slippage of 5 Gtons. With a 3°C or higher rise, even in the higher latitude regions, all major crops are projected to

show decline in yields of 16–29%. In the lower latitudes, yield declines are of the order of 20–40%.

The fate of Vietnam agriculture in the period 2050–2100 rests squarely on what the world does now to control green house gas emissions since Vietnam itself contributes very little (1.1%) to global GHG emissions and there are long lags in the green house gas system. While low GHG technologies are known or even being piloted in rice irrigation, livestock management as well as in fisheries, all taken together and implemented successfully, will at best reduce the GHG contribution of Vietnam agriculture by roughly 20% of the sector's emissions. However, with reforestation planned to achieve 47% tree cover by 2020 and by arresting land use changes in primary forests, Vietnam could make a meaningful contribution to sequestering carbon.

Vietnam is steadily building its institutional architecture to deal with CC since 2009 and legislation, institutions and programs in all key sectors—10 ministries and 35 departments—are being systematically set up. This phase of will be complete by 2013. Similar structures and process are to be replicated at various tiers of local government but some selectivity in roles and responsibilities between various tiers is called for. Local Governments will have a primary role in implementation of adaptation measures and this is a critical need to be addressed. Community empowerment and engagement is fundamental to the adaptation process to help ensure full awareness of CC and how it unfolds, as well as rapid learning and dissemination of lessons to others. The NGO community is deeply involved in this sphere. There is scope to enhance the systematic engagement of the scientific community which is spread out over 15 institutes.

Primary conclusions of this study are that Vietnam needs to accelerate the uptake of well known and currently practiced autonomous adaptation measures by farmers, to fully counter the impact on yields and land available for agriculture due to climate change projected to 2050. High cost public expenditures to build dykes and embankments to deal with slow, long term and uncertain threats of sea level rise need to be undertaken with due caution, and appropriate phasing. Negative social impacts on the poorer segments of the population need to be countered with diversification to higher value crops and promotion of non farm income opportunities, including appropriate payments for eco services provided by them and through crop and livestock insurance. Vietnam's institutional capacity to manage climate change can be further strengthened through continued improvement in its resource allocation framework for climate expenditures and through integrated management of its coastal zones and further enhance regional collaboration among with riparian states of the Mekong delta to focus on impact of climate change on water availability.

Climate change in Vietnam

Climate change is already underway in Vietnam. Global Mean Temperature (GMT) has risen by 0.74°C over the last hundred years since 1906, and is expected to rise by 1oC by around 2050. In Vietnam, surface temperature has increased by 0.5–0.7°C since 1958, with winter temperatures and those in the Northern zone rising faster than summer and in the Southern zone. Global Mean Precipitation (GMP) has over the past 100 years shown an increasing trend in higher latitudes and decreasing trend in the tropics with more heavy rainfall events. Overall rainfall is projected to decrease in the sub-tropics with more intensive rainfall. In Vietnam, over the last 9 decades, rainfall patterns have not been consistent but over the last 50 years, on average across the country, rainfall has decreased by about 2% and number of cold fronts affecting Vietnam have remarkably, while anomalous events, such as a cold surge lasting 38 days in 2008, have increased. Global Sea Level (GSL) has risen by about 1.3–2.3 mm/yr over the period 1961–2003, but this has accelerated to 2.4–3.8 mm/yr over the last decade of that period. GSL is projected to rise by 0.18–0.6 M by 2100. In Vietnam, sea level rise has been at the rate of 3mm/yr during the period 1993 to 2008 with considerably variability. Globally, extreme weather events such as cyclones and typhoons are projected to increase with higher sea levels and higher sea surface temperatures. In recent years there were more typhoons with higher intensity affecting Vietnam with a typhoon track that has shown a tendency to move southward (1/).

Vietnam is one of the five countries most affected by climate change. Changes in climate are projected to impact up to 10 M people, up to 5% of agriculture land, and up to 30% of wetlands of Vietnam. Overall costs of climate change (CC) could reach 10% of Vietnam GDP by 2100 (2/). Vietnam has developed its own Empirical Downscaling Model to permit projections at local level which are not possible with the Global Circulation Models. Of the 32 scenarios developed by IPCC, Vietnam has focused on three alternative emission scenarios. For planning purposes, Vietnam is projecting that temperature will rise by 0.8–1.3°C by 2050 (1.6–2.8°C by 2100). Total rainfall is expected on average to increase by 5–10% by the end of the century, with 20% larger variations between wet and dry seasons and considerable regional variations under which the South Vietnam could become much drier. Sea level is projected to increase by 28–33 cms by 2050 (and 65–100 cm. over the next century) (1/).

Global supplies of food are not likely to be threatened by modest temperature rise of 1°C, given the longer growing season anticipated in the higher latitudes. In these regions, yields of all major cereal crops as well as pastures are projected to rise as temperatures rise up to 1°C and, except for maize, continue to do so up to a temperature rise of 3°C. In the low tropics, even a 1°C rise is likely to impact yields of major crops and livestock and sea level rise will the impact land available for agriculture in the major deltas (3/).

Impact of CC on Vietnam agriculture and food security

Crop yields in Vietnam are expected to decline due to these climate threats by 2050: for rice (by 3.4–6.7%), maize (by 0.3–1.1%) cassava (by 0.6–2.6%), sugarcane (by 1.4–3.7%), coffee (by 0.1–0.4%) and vegetables (by 0.9–3.1%) (4/). Mekong delta will likely see increased flooding in the upper reaches of the delta and flooding and saline intrusion seaward of the Highway 1 embankment. While to 2030, the area inundated above 0.5 m or affected by salinity would be about 280,000 ha, much of it in the coastal belt already suffering decline in paddy yields, but by 2050 some simulations project that 590,000 ha of rice area could be lost in Mekong alone. Overall, with the combined effect of yield decline and area decline could lead a decline in Vietnam rice production by 2–7 M tons per year by 2050 (4/) which could lead to reduced rice exports, if yields are not improved further through adaptation.

Fishery sector will be impacted but not damaged. Growth of fishery sector has contributed to the recent diversification of Vietnam agriculture. Aqua culture will certainly be challenged by CC as ponds are threatened by erosion and controlling salinity becomes more challenging as dry season fresh water flows are reduced and saline intrusion increases. Mekong Delta accounts for more than 70% of production. While increased flooding will increase habitat in the wet season there will be a reduction in dry season habitat and increased saline intrusion: these together would challenge current cat fish and shrimp farming operations, without necessarily a loss or perhaps even an increase in overall production, still requiring a major adaptation response (4/).

Plantation forestry sector characterized by short duration rotations will feel the combined effect of rainfall variations and longer growing season. Average yields are expected to increase marginally but show a marked increase the variability across various districts, with a possible decrease in the Mekong delta (4/).

Livestock sector is likely to be confronted with more disease problems. In tropical areas, especially the humid ones where thermoregulation through transpiration or panting is not very effective, high temperatures stress leads to hormonal imbalances, which suppresses fertility. In the case of poultry, high temperatures lead to weak eggshells, a higher percentage of deformed eggs and increased mortality. Many animal diseases are transmitted by vectors which due to higher temperatures reproduce more rapidly and persist longer and might extend their habitat into erstwhile areas free from the vector. No estimates are available of the possible loss of productivity in beef, pork and poultry production, but effective veterinary health care and better nutrition would be needed to counter these effects.

Overall impact of CC on agriculture sector is likely to be quite modest to 2050. The sector has been growing at an annual rate of 3.7% since 2000. It is roughly estimated that a productivity increase of 10–13% over next 30–40 years would fully compensate for all foreseen effects of CC (4/). These impacts may be further diluted given that these projected trends are broadly in harmony with the changes underway in diet preferences. Consumers are showing a reduced demand for rice and a shift towards poultry, fruits and vegetables. Restructuring of the rapidly growing economy away from agriculture which now contributes 20% of the GDP and employs 50% of the population, and creation of non-farm employment under the "new" rural development strategy, and increased absorption of surplus labor from agriculture by other sectors, should also make the adaptation somewhat less onerous, though there will be regional challenges.

Adaptation needs of Vietnam agriculture

Vietnam agriculture has been continuously adapting to past climate change and has not only achieved food self-sufficiency but also produced a consistent and significant exportable surplus of rice, making it the 2nd largest exporter of rice. Vietnam has also seen an increase in production of livestock and other food items. Vietnam is at the point where it can move its agriculture sector to a new high level of performance, driven by domestic and external market demand and in the process increase the sector value-added and farm incomes. Among key policy actions to help further boost Vietnam agriculture would be steps to soften the informal quota system that still exists for rice production and encouraging production of rice of higher quality, and crop diversification to higher value added crops as demanded by the domestic market. These actions will add to the resilience and incomes of Vietnam's farmers and prepare them to deal with the increased variability and risks due to CC. Such policy actions supported by farm level adaptation measures already known to farmers or being piloted by researchers, will effectively counter all anticipated CC impacts on agricultural production to 2050.

Adaptation measures can be autonomous or planned which in turn can be "soft" or "hard". Autonomous measures are those which market participants—individual farmers or firms—can take by themselves in response to new market signals, with modest support from the state. Planned measures are actions that the state takes to ensure a robust response, when the scale of action is beyond the individual, due to scale, urgency, costs, or public goods nature or other externality of benefits. Among the planned measures are soft measures, such as policy or institutional changes or better information or risk management programs which do not involve major public investment. Hard measures are those actions which call for major outlays of public resources over and for a long term.

Autonomous response actions are well known and are almost all are "no regrets" since they are good for the sector, with or without further CC. In the crop sector these include (i) delays in winter-spring rice planting in Red River delta to avoid the cold weather in the winter and in the process increasing yields; (ii) switching to drought resistant crops such as cassava, maize and ground nut in the Central region; (iii), changing to heat and salinity tolerant varieties, sometime replacing modern with local varieties, in the Red River Delta; (iv) expanding the fish/rice rotation in the Mekong to take advantage of the flood season; and (v) improved water management systems to avoid saline water and increase efficiency of water use through alternate wet and dry irrigation techniques. Autonomous adaptation measures in the fishery sector would include upgrading of ponds and changes in water/salinity management practices and breeding programs to introduce salinity tolerant species. In the livestock sector, adaptation will require the delivery of effective veterinary services to deal with increased incidence of vector borne disease. In the plantation forestry sector autonomous adaptation will naturally be in the form of shifting production from unfavorable to favorable areas and changing varieties as new rotations come up.

Planned adaptation measures will also be selectively needed, both "soft" (i.e. policy and institutional) and "hard" (i.e. public investment) to support autonomous adaptation. Among the soft measures, Government can enhance farm-

ers' ability to plan the growing season based on detailed and timely information about temperature and rainfall and the knowledge to use this information. This is being done in Indonesia, through Climate Schools (12/). Strengthened agricultural research and extension will play a crucial role in adaptation to CC, since new varieties tolerant to salinity, flooding and draught, and new practices to reduce waste, increase efficiency and reduce emissions will be needed to be developed, tested and disseminated. Among these soft measures would be transfer of the management of the smaller irrigation systems to farmer associations, the re-introduction of water charges, which used to exist in the past, first on an area basis and then with metering devices, on a volume basis.

"Hard" planned adaptation measures especially building coastal or river protection against sea level rise need to be implemented with site and threat specific due diligence, given the large uncertainty in predictions, huge cots and slow pace of CC. The first priority would need to be improve the utilization of existing irrigation infrastructure, which is little better than 60–70%. The projected change in rainfall patterns and increased wet to dry season variability and overall higher intensity call for increased storage of fresh water for use in the dry season as well as for flood protection. Potential for expanding irrigation is nearly exhausted in the Red River delta where the priority is on rehabilitation and upgrading for better water control. Expansion of irrigation is constrained by flooding and saline intrusion in the Mekong. Irrigation expansion in the Mountainous regions is prohibitively expensive though for social protection grounds, there may be arguments to implement these. Potential to expand irrigation in a cost effective way is mainly in the Central region and is estimated in the long run to be as much as 700,000, but only 50% is foreseen for rice, with the rest for maize and coffee (4/). Some extent of climate proofing through design changes would be needed to protect against possible increase in extreme events which tend to concentrate in this region of Vietnam.

Restoration of mangrove forests as a natural barrier to flooding and storm surges could form part of a planned response in coastal areas. About 200,000 ha is currently listed as mangrove area, but much has been lost to aquaculture. Restored mangroves in North Vietnam (costing about $600–800/ha) have reduced a 4 m surge in 2005 to a 0.5 meter wave (5/). In Red River Delta, a 100m wide protective swath of mangrove in front of a conventional earthen sea dyke is predicted to increase the life time of the dyke from 5 to 50 years (4/). In addition to natural protection and providing the local community with livelihoods, mangroves sequester nearly 1000 tons of CO_2e per ha. (6/). Vietnam's plans to strengthen/build dykes and embankments now include on the concept of "green" dykes, with mangroves offering protection to the dyke.

To protect against sea level rise of 70 cm anticipated by 2100, may require Vietnam to raise, strengthen or build new ring embankments including river dykes. Up to 2700 km of sea and estuary dykes may need upgraded design to increase heights by 1–2 M; and 3300 km of ring embankments may need to be raised by 0.5 M in the Mekong. These structures cost from $0.6M to 1.6M/km/m height (5/). One estimate for the incremental area in the Mekong Delta expected to experience occasional flood inundation exceeding 0.5 meters could be some 261,000 hectares. By 2050, some simulations suggest that these numbers could be as high as 590,000 ha (1/). While these estimates of potential rice area inundation due sea level rise of 70 cm projected for 2100, present obvious threats, it would be prudent in view of the huge costs involved, that decisions about building new dykes or embankments be made taking into account the slow pace of sea level rise and the considerable uncertainty over the longer term.

Mekong Delta is one of the three deltas most vulnerable to climate change, other two being the Ganges and Nile (2/). 90% of Vietnam Mekong Delta freshwater comes from other countries. While the impact of CC on the composition of agriculture/fishery sector of Mekong will inevitably require continued adaptation, a bigger impact on Vietnam's Mekong delta will come from what happens in the upper riparian states.

Vietnam Mekong Delta, Climate Change and Food Security

Mekong Delta's value has been enhanced over the last two centuries by improvement in flood management through 10,000 km of canals and multiple flood control structures. It now produces nearly half of Vietnamese rice and nearly 70% of all its fish.

With liberalization, production pattern has changed over time: paddy cropping intensity has increased from about 1.3 in 1980 to an average of 2.1 crops per year in 2010. As sea level has risen and salinity has crept in, the coastal parts of Mekong have shifted to aqua culture and the fresh water zone in the upper reaches of the delta has shifted to horticulture and mixed agriculture production. Paddy productivity is generally high, up to 6.5 tons/ha in the winter-spring season and 4.7 tons/ha in the autumn-winter season. Farmer incomes have not generally matched the overall growth of agriculture in Mekong, due to sharp drop in farm gate prices of paddy at harvest. Only 14% of farmers with holdings more than 2 ha are judged to be able to earn a reasonable return from rice production (7/). Most small and even middle size farmers sell most of their paddy, buying back rice often greater than their paddy sales later in the season. Household welfare and food security is as much affected by the high retail price of rice during the dry season as by the low farm-gate price of paddy at harvest and by opportunities for non-farm employment.

Climate change will affect the hydrology of Mekong through changed patterns of precipitation in the basin and the delta, snow melt and rising sea levels. Increased monthly flows of 16% in the peak season and decreased flows by 26% in the lean season are projected in the delta and somewhat higher levels in the basin by 2050. Increased flooding would positively affect fishery yields, countered somewhat by loss of habitat in the dry season. Even a modest sea level rise of 20 cm will move the water contour lines 25km towards the sea in the flooding season and inland movement of water during the dry season would significantly affect species composition of fish and land suitable for rice (5/). By one estimation, up to 590,000 ha of former rice area could be lost (4/).

Production impacts of these changes are likely to be reduced yield of rice, loss of rice area, expansion of fishery in a rice rotation, somewhat increased production of fish and horticulture produce: trends generally in line with changing internal market due to changes in dietary patterns. Adaptation is a continuous process in the Mekong delta and farmers would continue to adapt, changing crops and increasing fishery and aqua culture. In terms of national food security, climate change projected to 2050 with ongoing continuous adaptation would have little impact: it would not affect the domestic availability of food (7/).

Agriculture of the Mekong delta would be impacted by changes in the Mekong river basin by users upstream of Vietnam. Nearly 90% of the freshwater in the Vietnam Mekong delta comes from other countries in the river basin. Construction of dams, deforestation, changes in snow melt and in water use in the upper riparian countries will critically affect the future course of agriculture in the delta, far more than the impact of climate change to 2050.

4 costs of CC adaptation

Estimates of financial costs of adaptation vary widely and are indicative upper ranges only. For Vietnam agriculture, to generate the estimated 13% productivity increase in the crop sector needed to offset the projected impact of CC to 2050, investment costs have been roughly estimated to be $6.3 Bn in 2009 prices (4/), excluding costs of embankments to protect against possible sea level rise. In the fishery sector costs to counter CC impacts are estimated to be $150M annually from 2010 to 2050 (4/). No estimates are available for the cost of enhanced veterinary services to counter increased livestock disease. Estimated cost of needed strengthening/building of about 6000 km of sea dykes or embankments and associated mangroves, should all of these be needed when the time comes, is roughly about $6.0 Bn assuming that the average increase in height is 1 m. No estimates are available of costs of autonomous measures which are absorbed by market participants. One study focusing on four countries of SE Asia (Vietnam, Indonesia, Philippines and Thailand) concluded that the costs

would be about 0.2% of GDP to 2020, mainly for R and D and construction of dykes (5/).

With high social vulnerability, household food insecurity can persist despite national food self sufficiency. The lowest 20% of households will face inequitable risks and damages and disproportionate decline in real standards of living when the combined effect impact of lower yields, cost of autonomous response measures and increased variability of food retail prices hits them. Most poor households are net buyers of food and depend upon non farm incomes for survival. While urban poverty is quite low (1.5%) rates of rural poverty average about 27%. In 60% of Vietnam's districts the poverty rate is said to be above 50%, especially in the mountainous regions of the NW and Central High lands which are rated as highly socially "sensitive" to CC (4/). Despite the country having achieve food self-sufficiency, large segments of the population in these regions could feel more food insecure with CC due to their poverty. Enhancing the resilience of poverty affected people and improving their food security is best achieved through income augmentation by facilitating diversification to higher value crops and by generating non-farm incomes opportunities. Social safety nets which are not location dependent would be needed in case CC leads to relocation. In addition, prompt actions are needed to compensate for unexpected loss of crops and livestock due to CC events. Vietnam has begun piloting an index based crop insurance program aimed at the poorer segments, which if successful, could provide the kind of safety net needed by the most vulnerable segments to cope with the additional risks generated by climate change (5/).

Vietnam: pilot crop insurance

A pilot program launched in December 2011 aims to offer protection against risks of natural disasters and disease both likely to increase with climate change, with a special focus on poor households. The program is an example of Public Private Partnership. It is run by joint sector insurance companies, and is voluntary. The established premium is subsidized by the state on a progressive scale, 100% subsidy for the "poor" and 20% for the best off and for agricultural enterprises. Insurance cover is offered for paddy, livestock and fishery. In case of paddy, the program aims to avoid the complexity associated with ascertaining individual loss. It is index based. Natural disaster conditions and extent of loss are established by a committee of county officials based on area wide surveys. Livestock and fishery coverage is based on assessment of individual loss. Payments of subsidies are handled directly by Ministry of Finance with the insurance company and loss coverage payments are handled directly by insurance company with the insured party.

In its first 6 months of operation, in 8 of Vietnam's 63 provinces, 54,000 households have signed up, 49,000 being eligible for 100% subsidy; these early contracts cover 63,000 ha of rice, 80,000 livestock, 620,000 poultry and 59 ha of fishery. Premium paid per household by the State averages about $25. Events triggering payments have yet to occur, except in fishery where the first claims of 2 Bn VND are being processed. It is too early to evaluate but it is an important initiative in the tool box to deal with weather related vulnerability faced by smaller farmers which is likely to be aggravated by climate change

Optimizing planned adaptation responses, avoiding potential waste

Planned adaptation responses can be costly and, given the uncertainties involved in long term CC, potentially wasteful. They call for a careful analysis of options and timing of the planned response explicitly taking into account the severity, probability and immediacy of various CC impacts and combining this analysis with knowledge about adaptation costs and distribution of benefits. For example, current judgments about probability of various threats can be summarized as follows:

To prioritize among all possible actions among various sectors to respond CC would require additional data about:

1. Estimates of cost of likely damage and cost of adaptation;

2. Judgments about the scope for recovery of costs from beneficiaries;

3. Target beneficiaries and social impact.

A decision framework to develop an optimal menu of responses is needed. Under such a framework, the decision makers would examine each proposed adaptation action, its costs, benefits, beneficiaries and social impact and consider whether autonomous actions by market participants (individual farmers or firms) or planned adaptation, soft or hard, by the state are needed. An overall framework could deal with impacts

1. whose severity, probabilities and immediacy are all high, and there is little scope for recovery of costs from beneficiaries, by acting quickly through public expenditures in the most cost effective

2. with high probability which beneficiaries can absorb the costs against benefits to be received, by promoting promote autonomous actions by beneficiaries to minimize public costs and spread the burden of adaptation;

3. with low probability and immediacy, by pursuing soft measures and a sequential decisions approach to buy time for gathering more information;

4. which will produce similar results with "soft" options or reduce the need for "hard" direct public expenditure, by putting emphasis on the former to minimize public expenditures.

Vietnam is currently testing out a methodology to choose among the wide range of climate change actions in different sectors. The process involves (9/):

1. Local Governments/Sector Ministries make proposals using a common framework;

2. One nodal ministry—MONRE—prioritizes these using established criteria;

3. Ministry of Plan Implementation and Ministry of Finance recommend proposals for financial allocation decisions by the PM.

The criteria based system uses a 100 points score, giving 24 points to two factors: designated priority sector and region and another 76 points for five factors: urgency, effectiveness, multi-purpose/integration, feasibility and sustainability. The issue of what to classify as CC expenditure is real, since many adaptation options are of the "no regrets" type, good for the sector with or without CC. The possibility of supporting with public expenditures, actions which could be autonomous or pushing hard measures when soft ones would work as well, also exists. So far out of the 200 projects presented, 20 projects were put on a short list and 10 are being given serious consideration for funding. Nearly all selected projects are for adaptation and mostly involve dykes and embankments. The full results from the application of this system should be available in 2012 but it is clear that the demand of CC expenditures will far outstrip supply. There will be a need not only for serious prioritization but also knowledge sharing to ensure that projects which are presented deal with the more serious systemic threats given the decentralized nature of the project generation process.

Climate change and food security beyond 2050

With virtually no progress to reduce Green House Gas (GHG) emissions since Kyoto, the world may well be on way to a 4–7°C warming by 2100. The totality of climate actions now underway will not hold the world to 2°C rise by 2100. While the Kyoto commitments called for a reduction of GHGs by 5.2% below 1990 level by 2012, emissions globally have increased by 36% to date. Even the softer Copenhagen 2009 agreements which would have limited global emissions to 44 Gtons CO_2e by 2020 are already showing a slippage of 5 Gtons (13/). In the energy sector, which accounts for 26% of global GHG emissions, half of the new coal plants which have come up in the last decade do not meet latest efficiency standards and none pursues carbon capture. Pace of improving energy efficiency of buildings, a win-win proposition, has been tardy worldwide. The one bright spot is renewable power—solar, hydro, wind and geothermal—which has been growing at 27% annually and keeping pace with aspirations. In the transport sector, which accounts for 13% of GHG emissions, vehicle efficiency has been growing at just 1.7% annually, compared to a need of

2.7%. (11/). In the forestry sector, which accounts for 17% of global emissions largely from reduction in tree cover, despite pilot efforts to promote reforestation and stop deforestation for example in Indonesia, overall trends are not encouraging. In the agriculture sector, including livestock, which accounts for 14% of GHG emissions, there has been very virtually no attention to mitigation.

With a 3°C or higher rise, prospects for food production become unfavorable even in the high latitude regions and disastrous in the low latitudes. In the higher latitude regions, all major crops including pasture are projected to show decline in yields of 16–29%. In the lower latitudes, yield declines of the order of 20–40%. Even if an allowance is made for not yet fully researched carbon fertilization effect, and for increased prevalence of pest and disease as temperatures rise and increased loss of agricultural land to sea level rise are projected (3/ and 10/), the situation once temperature rise exceeds 3°C looks quite unmanageable.

The fate of Vietnam agriculture in the period beyond 2050 rests squarely on what the world does now to control GHG emissions. Vietnam itself contributes very little (1.1%) to global GHG emissions and there are long lags in the greenhouse gas system where what happens to climate after 2050 depends upon what is happening on GHG emissions now. Vietnam's agriculture sector accounts for nearly half of its total GHG emissions. Low GHG green technologies are known or even being piloted in rice irrigation, livestock management as well as in fisheries. However, all taken together and implemented successfully will at best reduce the contribution of Vietnam agriculture by roughly 20–30% of the sector's emissions. By contrast, there is a significant potential for carbon sequestration of as much as 700M tons CO_2e, as Vietnam increases its tree cover to 47% by 2020, by restoring forest cover to an additional 2.6M ha, arresting land use changes in primary forests and strengthening its system of paying farmers to keep forests intact (8/).

Promoting low GHG agriculture

In rice cultivation, an alternate wet and dry (AWD) system of irrigation, with a few variations, can significantly reduce emissions of methane (which is 21 times more potent than CO_2) by 25–35%, without a decline in yields, reduced water use by 22% and an improvement in incomes. It is projected that 50 % of Vietnam's irrigated rice production could be under AWD system by 2020 as systems are upgraded to allow better control of water. Improved nitrogen fertilizer application techniques are a win-win proposition, because some of them can help reduce by 4–16% emissions of NO2 which is 300 times more potent GHG than CO_2, while raising yields by 17–25% and also reducing the cost of fertilizer waste. Changes in livestock feeding techniques to ensure that animals produce as efficiently—this would require that animal feeds should be balanced to achieve the highest digestion and utilization and animals should be of the best genetic composition—can produce modest gains in farmer income as well as in emissions. Processing of cattle, pig and poultry manure and farm waste through bio-digesters, in which Vietnam is a recognized leader, significantly eliminates emissions of methane while providing household energy and liquid nutrients to use in farming. This program could be extended. The collective impact of full implementation of all these green growth technologies could amount to about 20–30% of the sector's projected GHG emissions even though this would be less than 0.1% of global GHG emissions. In terms of carbon sequestration, the potential is greater: planned reforestation on 2.6 M ha by 2020, could permanently take out 700M tons of CO_2e from the atmosphere and better management of 13 M ha could sequester another 700 M CO_2e of carbon. While Vietnam's pursuit of a low GHG growth in agriculture would make only a very modest contribution to global GHG reduction, the focus clearly needs to be on its forests (8/).

Institutional capacity to manage CC

Vietnam is steadily building its institutional architecture to deal with CC. It launched its National Target program for CC in 2009 and a donor supported program for CC, which focuses on strategic, policy and institutional issues. Legislation, institutions and action programs in all key sectors—10 ministries and 35 departments are part of the program—are being systematically set up and decision mechanism to prioritize actions and fund them are being put into place.

This phase of establishing the basic architecture would be complete by 2013, as the financial mechanism including incentives to sector's to participate and a system to monitor and evaluate each sector's Policy Actions, are fully established. Where skills are lacking they are being filled through donor financed Technical Assistance under which national staff are being trained. Vietnam's scientific skills in the new and emerging domain of climate change are spread out over 15 technical institutes and an assessment of the needed strengthening of this technical base, is needed. In the meanwhile more systematically tapping this base, through the creation of recognized working groups and more formal engagement with the national as well as the IPCC led international system of planning and monitoring CC actions, can help further build Vietnam's technical capacity in this area.

Similar structures and process are to be replicated at various tiers of local government where the capacity to do so, and even the universal need to do so, may not be as great. Some selectivity in roles and responsibilities between various tiers of government is called for. Primary implementation role for adaptation measures falls on local governments, and international NGOs are actively assisting them till adequate capacity is built at the local level. This is a critical need to be addressed.

Community empowerment and engagement is fundamental to the adaptation process which requires good understanding and flexible response capacity to changing demands. Full awareness of CC and how it is likely to unfold, as well as the prompt adoption of measures and rapid learning and dissemination of lessons to others are critically needed and is best achieved through an engaged local community working with local government. The community can also offer an invaluable and prompt safety net, back stopping government efforts, in case of adverse developments. Indonesia's experience with Climate Schools (12/) has been positive for building awareness and capacity for rapid adaptation.

Conclusions

In summary, this study recommends that Vietnam needs to:

1. Accelerate the uptake of well known and currently practiced autonomous adaptation measures by farmers, to fully counter the impact of climate change projected to 2050, on yields and land available for agriculture;

2. Exercise due caution and careful phasing when considering high cost public expenditures to build dykes and embankments to deal with slow, long term and uncertain threats of sea level rise;

3. Manage the potential negative social impacts on the poorer segments of the population through promoting diversification to higher value crops and promotion of non farm income opportunities, including appropriate payments for eco services provided by them and through crop and livestock insurance.

4. Further strengthen its institutional capacity to manage climate change through continued improvement in its unique resource allocation framework for climate expenditures and through integrated management of its coastal zones; and,

5. Continue efforts to further enhance regional collaboration among with riparian states of the Mekong delta to focus on impacts of climate change on water availability.

Sources

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Annex 5—Agro-processing

The current status

In Vietnam, some 69% of population and 90% of the poor live in rural areas. This includes 13.2 million households of which some 9.5 million households are engaged in farming, forestry, and fishery and aquaculture. The agricultural sector plays an important role in Vietnam's economic and social development accounting for 20.6% of nation's GDP (24.5% in 2000) and almost 60% of employment is attributed to agriculture. Within the agriculture sector, the share of fishery and aquaculture increased from 16.2% in 2000 to 21% in 2010, cultivation decreased from 61.8% to 56.4% and livestock production increased from 15.2% to 18.7% in the same period (MARD 2012)[1]. The sector is also a major source of country's exports totaling US$19.1 billion in 2010. In 2009, top agricultural exports included: rice US$2,895 million, coffee US$2,112 million, cashew nuts US$846 million, rubber natural dry US$448 million, pepper US$348 million, fruits and vegetables US$261 million, and tea US$147 million (FAO 2012).

The structure of the rural economy remains mostly agriculture-based (agricultural production accounts for up to 65%), while non-agricultural activities, manufacturing industries and handicrafts make up a quite small share. The productivity, quality and competitiveness of Vietnam's many agricultural products are low. Farm size is small scale and fragmented and the absence of land ownership and marketability remains a serious issue. Although some contract farming has started, farmers lack a culture of honoring contracts and enforcement mechanisms are weak and socially not acceptable. Most farms use manual labor with low level of mechanization and follow traditional farm practices. Access to credit and modern knowledge is limited and skilled labor is generally in short supply. Intensive farming with the overuse of fertilizers, pesticides and growth stimulants as well as flows of wastes from livestock and aquaculture activities (and from concentrated and specialized areas for intensive farming of cotton, grapes, vegetables, etc.) lead to residues of dangerous and hazardous substances in agricultural products, and increased the resistance and mutation of pests.

Policy and business environment

Investment climate in Vietnam is not conducive for private sector development and for attracting FDI in the agriculture production and processing sector. This situation is particularly bad in rural areas. In addition to the poor infrastructure and a lack of credit and skilled workforce, the policy and legal systems and institutions are weak and policy making and implementation is problematic. The central planning and socialist ideology still permeates the government system reducing incentives for entrepreneurship and creativity. Occasionally, there is confusion and inconsistency between national policies and those at the provincial and local levels. While many policies are sound, they are not fully enforced due to the weak institutional capacity and financial resources or lack of determination, leading to poor monitoring and oversight. The government management apparatus and procedures are cumbersome and ineffective, division of responsibility and coordination among various ministries and agencies is weak even in multi-sector activities (e.g. in dealing with food safety issues, or environmental protection and natural resources management). The coordination between central agencies and local governments is also inefficient in many areas such as epidemic prevention and control, etc.

1 Ministry of Agriculture and Rural Development (MARD) Paper—Restructuring Agricultural Sector—Towards Greater Added Value and Sustainable Development, February 2012.

Dominance of state-owned enterprises

The state-owned enterprises (SOEs) play a leading role in many aspects of agriculture production, processing and marketing (e.g. fertilizer 99%, fruit and vegetable processing 50%, refined sugar 37%). The SOEs own and absorb a far greater share of the country's assets (land) and factors (domestic credit) than their share in the national output. They benefit from privileged position including access to land, raw materials, finance and marketing rights. At the same time, a majority of such SOEs do not have modern plant facilities, and operating and corporate governance systems. They operate inefficiently and/or are under financial pressure, which in turn put strains on the government budget and on the banking sector. The special privileges extended to SOEs make it more difficult for the private sector to participate in certain key areas of the economy, thus inhibiting competition and associated productivity and efficiency gains. (WB 2012)[2]

State-owned commercial banks (SOCBs) dominate the banking system (about half of the system), the largest accounting for nearly one sixth of the system. Both their capital base and loan portfolio quality are weak. The two state-owned banks (Vietnam Bank for Agriculture and Rural Development—Agribank, and Vietnam Bank of Social Policy—VBSP) dominate credit to the rural sector accounting for almost 90% of the rural credit in Vietnam. The government has a number of programs to provide subsidized credit for agriculture and rural development thru these banks. (WB 2012) Agribank is the biggest commercial bank with assets of US$27.9 billion, 2,340 branches and transaction offices and 40,000 staff. Loans to agriculture and rural sector accounted 68% of its total outstanding portfolio; lending to coffee industry 1.9%, food industry 3.2%, fishery 4.6%, livestock and poultry 10.2%. VBSP primarily on providing micro-finance to the small households and individuals. VBSP also has extensive nation-wide outreach. Most of its lending programs are subsidized by the government. With total assets of US$5.5 billion and US$5.1 billion in loans outstanding to some 6.8 million active borrowers, the bank claims to meet almost of 50% of the loan demand for its target group. (VBARD & VBSP 2012)

Land rights and infrastructure

Land is the most important asset in Vietnam as land use rights generally allow use of land for a specific purpose, such as for residential use, manufacturing, mining or agriculture. Maintaining control over the land while transferring the right of use from one sector to another is an important means of creating and transferring wealth in Vietnam. State agencies and SOEs enjoy an advantage over private companies and individuals in gaining control over land. However, even these entities do not have clearly specified property rights to the land. This causes problems in using land optimally as well as a source of collateral for borrowing from the banking sector.

The quality of infrastructure, especially in rural areas, is poor. Though access to electricity is widespread, power cuts are frequent in certain parts of the country. Other aspects of infrastructure, especially those related to irrigation and drainage, drying yards, transport and logistical services, storage and processing such as warehouses, cold storages, sea ports, ICT, etc., are underdeveloped. Access to roads in rural areas is an ongoing problem, especially in rainy season when road deterioration is quite common. Many fishing harbors and berths are overloaded and degraded. Under monsoon climate, agro-products deteriorate easily if not dried or processed soon after harvesting. This results in lower yields of finished products, as well as deterioration in color, flavor, taste, texture and overall product quality. Post-harvest losses remain high both in terms of quantity and quality. For example, high post harvest losses of 13–16% in rice are due to small scale, fragmented rice production leading to poor harvesting, drying, milling and storage system; poor paddy quality for milling and storage. All these factors lead to low quality and competitiveness of many agro-products, especially rice, vegetables and livestock products, as well as hinder the development of the agro-processing industry.

2 World Bank Vietnam Development 2012.

State of agro-processing industry

Vietnam's agro-processing industry is quite small and its value added contribution is limited. According to some estimates (World Bank staff), food and beverage manufacturing as % of primary agriculture value added in Vietnam is only 20% compared to 85% in Thailand, 96% in Chile and 120% in Mexico. Product quality in general is not high, and goods produced are monotonous with lower competitiveness, value, and export prices. Most agricultural products (coffee, cashew nuts, rubber, fruits and vegetables, seafood) are still exported as semi-processed or preliminarily processed, with low value added, and without reputed brand name and modern packaging. For example, coffee kernel (Robusta) which is highly appreciated, only 17% export of this reaches Grade 1, and tea processing accounts for only 55%, vegetables 10%, meat export 1% of the total amount of each agricultural product (MARD 2010).[3]

There are over 5,000 industrial processing units in operation, including over 2,000 agricultural processing, 570 seafood processing and 2,500 forest product processing facilities. During 2000–2010 period, total capacity of the manufacturing facilities has increased: rubber production capacity increased from 294,000 to 800,000 tons of dry latex/year, sugarcane from 73,700 to 106,750 tons of sugarcane/day, cashew nuts from 220,000 to 800,000 tons of raw materials/year, and animal feed capacity from 2.9 to 12 million tons. Many enterprises have been investing in modern technology and equipment, processing of products with high added value, applying technical regulations, standards (ISO, HACCP) and gradually improving their quality and competitiveness. More and more processing companies are exporting products to USA, EU, Japan, South Korea, typically as rice, coffee, cashew nuts, pepper, rubber, seafood. (MARD 2010)

A majority of agro-processing plants is located in remote and underdeveloped areas that have contributed to improving economic wellbeing of rural society engaging directly about 1.5 million workers, and tens of millions of labor for production of materials and services, contributing greatly to poverty alleviation in rural areas. But there are so many households and small and medium scale agro-processing enterprises with outdated technology and primitive processes and unskilled labor. Application of standards, technical specifications, quality and food safety aspects are not high on their agenda. Access to credit, especially to small facilities remains a serious constraint with SOEs having a preferential treatment from the government agencies and banking sector. The supply of raw materials for agro-processing industry is unstable and generally of low quality with high risk of poor hygiene and food safety thereby requiring large imports for many commodities (e.g., fruit and vegetables, cashew, milk, sugar). (MARD 2010)

Knowledge and skilled workforce

Vietnam has comprehensive networks of scientific and agricultural research and development institutions (RDIs) and universities. But barring a few major institutional networks, most RDIs are weak and lack capacity to do relevant applied research and technology transfer. Actual R&D outputs from the system are not commensurate with the needs of Vietnam's economy. The R&D system has not been able to bring about any major breakthroughs for improving the productivity, quality and added value of agro-products. Some institutions have developed new R&D and technologies, but technology transfer and knowledge application process are weak and cumbersome. In most cases, new technologies developed do not reach the intended beneficiaries. Therefore, technologies have not created a good impact yet, for example, on rice harvesting and milling, tea plantation, mulberry silk raising, vegetable growing, fruits or livestock products, etc. Further, extension network is rather weak at the grass-root level, and there are not enough technicians for the transfer of techniques and technology to the farming and agro-processing community.

Despite a plentiful labor force, the human resources, especially qualified personnel for production and business management are in short supply. The industry generally faces a shortage of skilled and trained workers and in recent years, the number of people choosing to study agriculture, forestry

3 Ministry of Agriculture and Rural Development (MARD) 2010 Paper, The Development of Agro-Forestry and Fisheries Processing Industry Until 2020.

TABLE A5.1: RELATIVE REJECTION RATE FOR IMPORTS TO THE EU AND THE US FOR VIETNAM, 2002–2008

European Union					United States				
total	fish and fishery products	fruit and vegetables	nuts and seeds	herbs and spices	total	fish and fishery products	fruit and vegetables	nuts and seeds	herbs and spices
high	high	high	low	medium	medium	medium	medium	low	low

Source: UNIDO—Meeting Standards, Winning Markets—Trade Standards Compliance Report 2010

and fishery subjects has been decreasing. The share of trained rural workers is quite low (15.5% in 2010), while the competitive advantage of cheap labor is decreasing. This leads to low productivity and poor quality of agro-products that do not meet the requirements of domestic and foreign consumers.

FOOD QUALITY AND SAFETY

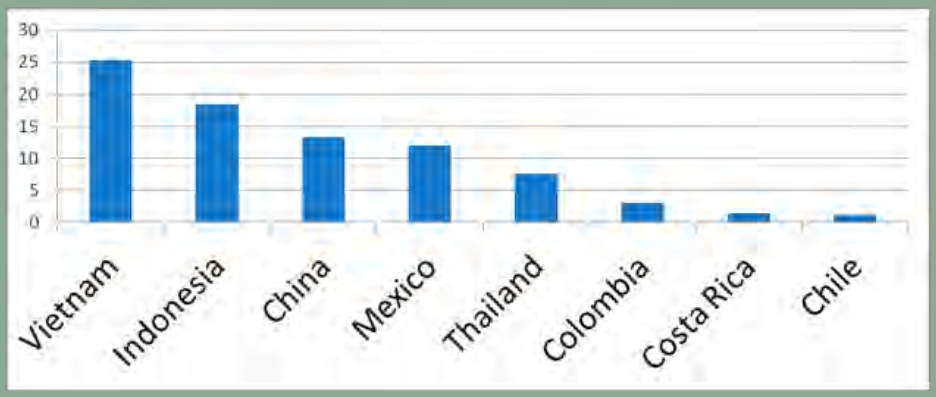
The management of food hygiene and safety, monitoring systems is weak and at times overlapping between different agencies and ministries. In general, the system lacks adequate capacity and resources to operate an effective food safety and market surveillance system. The National Agro Forestry and Fisheries Quality Assurance Department (NAFIQAD) of MARD is state governing body for quality and safety of agricultural, forestry, fishery and salt products. NAFIQAD is a professional organization with 6 ISO/TECH 17025 accredited labs and 63 local competent authorities. But it does not have adequate capacity (staff, skills and budget) to carry out its responsibilities effectively in a fast growing sector. (NAFIQAD)

In Vietnam's agro-processing industry, food safety and hygiene issues are quite prevalent. The agro-processing plants do not associate closely with the raw materials producers, thus do not provide support and guidance to farmers in accessing advanced technology and knowledge on best practices. Poor handling practices, overuse of fertilizers and pesticides, injecting impurities in raw materials, misuse of antibiotics, and banned chemicals in the post-harvest product preservation continues to pose high risk to food supply. Further, the waste treatment facilities and environmental protection is inadequate.

For example, frequency of occurrence of food poisoning is 750–800 times of that of advanced countries (WHO 2007) and the ratio of suspension case on Vietnam's food at Japan's custom of import is increasing year by year (JICA 2012). Currently, Vietnam cannot export honey to the EU market due to residue issues. Incidents such as the use of formaldehyde to improve the shelf-life of rice noodles and concerns over "toxic" soy sauce, have further undermined confidence and done little to reassure buyers at home and abroad of food quality. Recent official studies also found high levels of lead, copper and E coli in vegetables grown in "safe zones" in Northern provinces, attributed to excessive use of fertilizer, pesticides and improperly composted manure. Also there are ongoing concerns about increasing concentrations on carcinogenic dioxins in the food chain, related to Agent Orange herbicide spraying during the US-Vietnam war.

The above situation notwithstanding, the conditions in the seafood sector are better, which is a strictly regulated export sector. In Vietnam, in 2011, all 534 industrial scale units met mandatory requirement of HAACP certification compared to 80 units in 1990. According to the 2010 UNIDO Trade Standards Compliance report, in both the EU and the US markets, Vietnam, Indonesia, China, India and Thailand are amongst the countries with the greatest number of rejections of fish and fishery products during 2002–2008 period, collectively accounting for over 45% of total Rejections. For Vietnam, prominent causes for EU rejections include microbiological contaminants and veterinary drug residues. For Vietnamese fish and fishery products, the labeling and unregistered process/manufacturer reasons were high on the list of US rejections. Frequently these determinations

Figure A5.1: Food product rejections on imports by the USA (# per million in trade; 2006–2008)



Source: Dr. Nguyen Do Anh Tuan, Center for Agricultural Policy IPSARD—Vietnam's Agriculture: Performance, Problems and Perspectives based on data from UNIDO—Meeting Standards, Winning Markets- Trade Standards Compliance Report 2010.

were accompanied by other aspects of non-compliance, notably filthy/unsanitary and microbiological contamination.

Some sector specific highlights[4]

Vietnam's agro, forestry and fisheries processing sector includes 12 major commodities—paddy rice, coffee, rubber, tea, cashew, sugarcane, fruit and vegetable, pepper, animal feed, meat, seafood and wood.

Rice. The rice processing industry has mostly old facilities and outdated equipment. Currently, almost 2/3rd of paddy is being threshed by households and 10,000 small threshing private facilities for domestic consumption. There are some 10,000 dryers with drying capacity of only 20% of the paddy rice production. A majority of rice storage facilities (of around 3 million tons total) are not in good condition. Poor drying and storage not only affects quality but also reduces rice yield—bad grain rate, broken grain, humidity, impurities, etc. Losses due to poor drying and storage conditions are rather high (about 10–12%) and processing wastage rate is also high (3–4%). As a result, Vietnam's export rice prices are usually lower than the same types of Thailand rice.

Tea. Vietnam exports large volume of tea, but mostly in raw, low quality and low prices. Only about 20% of tea production is processed by large plants equipped with modern technology ensuring technical standards, but 40% of processing plants are patchy and do not meet technical standards of tea processing.

Coffee. Vietnam is the second largest coffee exporter in the world but value added is low (mainly exporting core coffee) and does not have stable brand name reputation on the world market. The quality of export core coffee is low and not commensurate with its inherent potential. Some 70–80% of coffee originated from Vietnam does not meet the classification criteria of the LIFFE market.

Rubber. The Rubber processing industry focuses mainly on primary processing for export and products processing of rubber accounts for only about 15% of rubber production. Currently, there are some 144 latex processing units with total capacity of 977,370 tons of dry latex/year. But many plants have outdated facilities not complying with modern procedures leading to primary processed rubber with lower and uneven quality adversely affecting reputation of the industry as well as brand name of Vietnam.

Fruit and vegetable. The fruit and vegetable processing industry suffers from the unstable and shortage of quality raw materials due to small and fragmented production and seasonal factors. Raw materials collection, sorting, selection and preservation are mainly carried out manually with post-harvest losses of up to 20–25%. There are over large 60 fruit and vegetable processing plants (total capacity of 300,000 tons/year), of which state-owned enterprises

4 This section uses data from a 2010 MARD Paper, The Development of Agro-Forestry and Fisheries Processing Industry Until 2020.

(SOEs) account for 50% of total capacity. In addition, there are tens of thousands of small-scale processing establishments such as longan and litchi drying, cucumber pickle, and fruit and vegetable processing. Processed products are of lower value added with canned products accounting for around 50% of total. Majority of plants do not operate according to international standards (ISO, HACCP and GMP) resulting in lower quality (and occasionally unsafe) products.

Pepper. Vietnam has become the leading pepper exporter in the world exporting nearly 95% of its supply with domestic consumption of around 5%. Vietnam's pepper is processed as three main products: black pepper (80–85%), white pepper (15–20%) and red pepper (only processed in small scale). There are 17 pepper processing plants with relatively advanced machines and equipment with a total capacity 60,000 tons/year, of which 10 plants with fairly modern technologies and steam handled pepper meet standards stipulated by ASTA, ESA and Japan. Pre-export products are inspected and supervised strictly on each shipment by international and domestic bodies to ensure quality required by exporters.

Cashew. In 2008, with export of 167,000 tons (US$920 million), Vietnam became the largest cashew exporter of the world with core cashew being one of its major export agro-products. Currently, there are some 210 cashew processing plants (total capacity of 800,000 tons of raw cashew nut/year), mostly small units using manual labor and outsourcing peeling work to outsiders with a higher risk of food safety. The shortage of raw materials is the biggest challenge of these plants. Due to poorer economic performance compared to other crops, in the last few years cashew nut area has decreased with expected raw cashew production of 400,000 tons. The enterprises have to import a large quantity of raw cashew nut (40% or 350,000 tons in 2010) from African countries, Cambodia, etc. The cashew processing industry also does not have good linkage with cashew growers to improve access to advanced technology to enhance cashew yield and improve quality, necessary to increase the economic efficiency and competitiveness of cashew cultivation with other crops.

Sugar. Currently, 41 sugar plants are operating (total capacity of 106,750 tons of sugarcane/day) in Vietnam but these plants regularly face shortage of raw material. In recent years, Vietnam has been importing sugar to meet domestic consumption demand.

Meat. The state of meat processing industry, including from raw material supply, slaughtering to processing, storage and handling, is not good. The share of processed meat is low—about 20–25% of total meat production. Most of the meat products (98%) are produced for domestic consumption. Currently, there are 28 meat-processing plants of industrial scale and some 17,129 slaughterhouses of cattle and poultry, of which 94% are small abattoirs. Only 45% of the 434 cattle slaughterhouses are licensed by veterinary agencies, and many others operate under unhygienic conditions. Animal husbandry industry is small and scattered and the control of food safety, inspection, disease prevention and use of veterinary drugs is not sufficient. During manual processing, plants often use various additives and fillers, including prohibited chemicals. As a result, the quality of meat products is poor and often unsafe.

Table A5.2: Fisheries products industrial units—2000–2010

	unit	2000	2005	2006	2007	2008	2009	2010 (e)
no of Plants		225	439	470	490	544	568	570
capacity	1,000 ton	500	1,300	1,500	1,700	2,100	2,200	2,200
export	1,000 ton	300	634.5	821.7	942.4	1,240	1,216	1,300
export Value	US$ million	1,478	2,737	3,358	3,762	4,500	4,300	4,500

Source: MARD 2010.

Table A5.3: No of export approved fisheries processing units

	markets	Feb 2012
1	USA 1/	534
2	EU/Switzerland/Norway	393
3	Japan	534
4	Korea	515
5	China	518
6	Canada	304
7	Brazil	79
8	Russia	34

1/ Units meeting Vietnam's national technical regulations requiring HAACP.
Source: NAFIQAD, Vietnam

Fisheries. Vietnam's fisheries product processing industry is relatively modern producing diverse products, with some 570 industrial plants and thousands of manually operated units producing products with a value of around US$5 billion per year for domestic consumption and exports.

Since 1990, fisheries product processing industry has been upgraded with modern technology with high standards of food hygiene and safety. But the industry also faces shortage of raw materials both in quantity and quality. The number of plants that fully meet the standards to export to the US market were 534, China 518 and Korea 515, and EU 393. The industry has been modernizing in order to comply with the requirements of importing countries and application of quality management systems such as HACCP, ISO, Cleaner Production, and Standard for Fisheries TCN. The organized industry is subjected to strict standards and inspection by NAFIQUAD and International Organizations which has helped enterprises in applying modern production process and in generating a large number of products of high quality for global markets. The enterprises can process nearly 1,000 different type of products most of them are tiger shrimp, white shrimp, catfish, tuna, and squid of all types. Although the share of added value products has been increasing, about 50% are still primary products. The exports are mainly produced on foreign orders with lower added value, packaging and carry trademark of foreign companies. Vietnam is generally a supplier of raw materials for foreign processors for processing into their value added products.

Animal feed. The animal feed production mainly for chickens and pigs is concentrated in SOEs. Although, Vietnam is an agricultural country, it imports a large amount (over 3 million tons/year or almost 40% of total needs). By 2010, there were 225 animal feed processing plants—184 domestic plants with capacity of 35%, and 43 plants with 100% foreign capital or joint venture with capacity of 65%. Most plants are equipped with advanced technology—this area has attracted the largest FDI in the agriculture sector. But this industry also faces shortage of raw materials including corn, soybeans and fish meal—corn account for 35–40%, soybeans 20% and fish meal 10%; quantity of imported materials is large, soybeans are imported 100%, and domestic fishmeal production is only 200–300,000 tons. (MARD 2010)

Table A5.4: Proportion of animal feed mills with official standard certificates

	domestic feed mills	foreign feed mills
% of feed mills with standard quality	70.5%	82.4%

Source: Dr. Nguyen Do Anh Tuan, Center for Agricultural Policy, IPSARD- Vietnam's Agriculture: Performance, Problems and Perspectives, 2011.

Way forward—agro-processing sector 2040

As mentioned earlier, for Vietnam, the agriculture sector will continue to be an indispensable part of its economy contributing a significant share of the GDP, export revenues and supplying food to consumers as well as providing livelihood to a significant section of population. Domestic food demand will continue to increase as a consequence of the economic growth, urbanization and rise in incomes and living standards. Rising disposable incomes and changing consumption patterns will lead to an increase in demand for more and higher quality food and horticultural products.

This will fuel higher emphasis on processed and packaged foods, and on modern distribution channels. The retail sector will become increasingly relevant and sophisticated and will require higher standards from food producers and manufacturers. Consequently, policy makers will increasingly emphasize food quality and productivity.

Vision for agro-processing sector

Evolving domestic, regional and global markets will offer new opportunities for Vietnam's agro-processing industry and farming community. These will complement opportunities in export markets and substitution from imports. The role of agro-processing will become increasingly important in improving farm productivity, reducing post-harvest losses, producing quality processed and packaged foods, enhancing food safety as well as food security. The agro-processing sector will also become a major factor for enhancing farmer incomes, creating non-farm employment and improving the quality life for rural as well as urban populations.

The long term vision for Vietnam's agro-processing sector should be an industry that is modern and globally competitive capable of producing high value added products of quality and safety standards that meet international standards and global market requirements. For this vision to become a reality, in the coming decades, Vietnam's agro-processing sector will need to become large, modern and efficient for generating a significant source of export revenues and for meeting the food needs of increasingly affluent and urbanizing society as well as for creating jobs and improving farm productivity. This will require a major transformation of the agro-processing industry including the related policy, institutions and programs, cultivation, logistics, industrial, marketing and societal practices and attitudes.

Major threats

Some of the major threats to achieving the goal of creating a large and modern agro-processing industry include poor policy and business environment including continuing emphasis on central planning, weak institutions, lack of predictability and transparency in policy design and implementation, small and fragmented farm holdings, weak land ownership and property rights, poor infrastructure, unstable and poor quality of raw materials supply, dominance of unviable small units with outdated technology and processes and preference for SOEs at the cost of private sector and FDI, poor access to credit and technology, weak quality and safety enforcement system, restrictions on open markets, etc.

Major policy actions

To achieve major transformation of the agro-processing sector it will require appropriate policy actions on several fronts including the related policy, legal, institutions and programs, cultivation, logistics, industrial, marketing and societal practices and attitudes.

The key policy actions include the following;

- Creation of a supportive policy and business environment including a level-playing field for all actors in the value chain providing incentives to private sector and market forces to determine the use of land, choice of products and access to credit and market channels. The country will need to build strong institutions, align investment priorities with wider economic strategies and create strong public-private partnerships (PPP).

- Improving access to finance for the entire value chain including farm production, logistics services agents, processing and marketing. This will require a much stronger and vibrant market based banking sector and non-bank financial institutions as well as related infrastructure such as credit guarantee schemes, credit information system, credit and assets registry systems (both for movable and fixed assets), mobile banking, bankruptcy and mortgage foreclosure systems, etc.

- Upgrading infrastructure and logistical value chain (especially in rural areas), including roads, transport, warehousing and storage, product handling

Box A5.1: Potential of Vietnam's agro-products

According to FAO reports, currently in the world, there are 63 countries growing tea and 162 countries consume tea. Consumers' demand for tea in the world each year increases by 2.8%. Particularly for the developed countries, consumption level increased from 3 to 4.5% annually. It is equivalent to an increased demand for tea in the world of 77,000 to 100,000 tons every year, equal to the export volume of Vietnam's tea annually. With such demand, the world and domestic tea markets could provide favorable conditions for the development of Vietnam's tea industry which will need to focus on improving productivity, quality and production efficiency.

Total amount of coffee in the world during 2003-2009 increased from 112.9 to 132 million bags, the average annual growth rate is of 2.5% and it is forecasted that the growth rate will be maintained in the near future. Besides the growth in consumption, the market will increasingly demand higher quality, especially good hygiene and food safety. As Vietnam becomes industrialized country, the domestic demand for coffee should also increase. With the advantage of the largest production of coffee, especially Robusta coffee, Vietnam's coffee industry should have a good potential.

With the trend of using the environmentally friendly products in the world, the demand for natural rubber is likely to gradually increase. Vietnam should develop rubber production areas along with build processing facilities and manufacture higher value added diversified products.

Fruit and Vegetables are widely used, especially in periods of social economic development, clean fruit and vegetables are an indispensable food for humans and also help for limiting diseases. Every year, the world needs some 600 million tons of vegetables and 500 million tons of fruit. With such large volumes, Vietnam fruit and vegetables should good potential in the domestic and world markets. Therefore, the fruit and vegetable processing industry needs to develop both in terms of volume and quality.

Pepper has become an indispensable part of the spice in the world's food. Vietnam has emerged as the largest producer and exporter of pepper in the world. The pepper processing industry will need to focus on investment in improving the quality and structure of products by increasing the proportion of white pepper, crushed pepper powder to enhance the added value.

Vietnam's cashew nut kernels currently are exported to some 83 countries around the world. In the long run, cashew nut kernels remain popular in developed countries. The potential of its market is large, both in domestic market and in exports.

Meat is an important food in the social life of mankind. Overall, the demand for meat in the world market requires increasingly both the higher quality and quantity. Every year, Vietnam produces about 3 million tons; it is very small in comparison with the total needs of the world. However, meat consumption in developed countries is increasing; besides, the food needs of China will have increased opportunities for expanding market for Vietnam meat. At the same time, livestock production is shifting from developed countries into developing countries, from the western countries to Asia Pacific countries. Asia is likely to become the largest livestock production and consumption areas. Therefore, market for Vietnam livestock products should have a good potential.

Source: Ministry of Agriculture and Rural Development- Development of Agro-Forestry and Fisheries Processing Industry Until 2020, Draft Proposal 2010.

systems, electric power, sea ports, ICT and other related systems.

- Transforming farm production and practices that are capable of providing stable and reliable supply of quality raw materials to the agro-processing sector. This will need to include consolidation of farm holdings, promotion of contract farming, use of modern technology and farming practices, etc. Further, in a market economy, full property rights will need to be conferred to the owners with the freedom to sell, transfer and mortgage land assets. Vietnam will need to undertake land reforms by allowing more flexibility with land-use planning and letting buyers covert land use after paying an appropriate fee to the state, and by creating a market for trading land use rights among the existing users.

- Providing incentives to increase the production and exports of higher value added processed products instead of primary products. This will include, inter alia, (i) creating stronger linkages and cooperation between producers, processors and distributors to accelerate introduction of modern technology and practices, better farm prices, and improving quality and yield; and (ii) improving Vietnam brands and reputation in the domestic as well as global markets thru trade promotion, brand building and advertising.

- Upgrading of technology, equipment and operating and management practices of the cultivation, post harvest handling and processing industry. This will also need consolidation and closure of many household and small processing units as they cannot afford to upgrade their facilities. For example the rice sector will need to upgrade technology and processes to modernize harvesting, drying, milling, transport and storage systems to reduce post harvest losses and improve the quality of rice. Such investment could have high returns. For example, if post harvest and processing losses in rice could be reduced by half it could generate as much as 3 million tons of rice, an amount about equal to the quantity of rice exported by Vietnam. (The Nghe An Province has already achieved post harvest losses in rice to a level of 9%).

- Upgrading the food safety and market surveillance system and institutions including related metrology, standards, testing and quality (MSTQ) system, accreditation and certification systems, and advisory services to disseminate best practices. The solid performance of fisheries processing sector in terms of quality and food safety with international recognition could provide a good example to replicate in other agro-processing sectors.

- Improving the supply of technology and skilled workforce to enhance the use of modern technology and processing techniques. This will also involve reforming training, R&D and technology extension systems. The R&D resources will need to focus on the entire value chain including developing new seed varieties that are easier to transport and store resulting in lower post harvest losses, as well as producing higher quality of raw materials. The R&D will need to cover innovations in farm machinery, logistics supply chain, processing, as well as bio-safety, product hygiene and safety and environmental preservation. Since knowledge and technologies are increasingly available globally and at lower prices, earlier emphasis will need to be on technology adoption and innovation, while developing capacity to do own R&D in the long run.

- Enabling and encouraging private sector (including FDI) to play a stronger role in the entire agriculture value chain. This will include increasing private sector involvement in farm production, input supply, distribution and trade, agro-processing, as well in R&D, innovation and extension. This will require forming strong public-private partnerships and treating private sector not just at par with but preferred option over the public sector. The role of public sector should be primarily to act as a facilitator and create an enabling business environment. There are some good examples of PPP already working in Vietnam such as Nestle in coffee, Monsanto in potato, Unilever in tea and Pepsi in fruit and vegetable.

Annex 6—Livestock

Background

Historically, livestock in Vietnam[1] was kept by farmers for self-sufficiency. Around 2000, faced with increasing urbanization and consumer demand for more diverse products in an expanding economy, the government of Vietnam started supporting a major growth of investment in the livestock sector. At this time some major direct foreign investments were also made in feed milling and livestock operations. Overall there was a major growth in livestock production from 2000–2010, from a combination of increasing animal numbers and productivity increase due to better feed and genetics. Nevertheless imports of livestock products and support for livestock development still grew fast during this period. Between 2000 and 2005, in response to increasing domestic demand by consumers, dairy imports increased in value from 307 million to 715 million USD. As animal production increased so did the need for animal feeds and thus the import of animal feed. From 2000–2010 animal feed imports grew in value from 597 million USD to 2160 million USD.

The growth in the livestock herds took place for the most part in the backyards of people in settlements, where in the past only a small number of animals for self-sufficiency were kept. Unfortunately, the close proximity of animal-animals and animal- humans with the usually poor biosecurity increased the risk of disease transmission and made control of diseases difficult. This has been a factor leading to major disease occurrences in Vietnam's livestock sector. It was in this period that HPAI[2] first occurred in Vietnam and became endemic, as did FMD[3] and CSF[4]. It also caused negative environmental effects.

The current government support programs for livestock development are now geared towards "sustainable agriculture", in which climate change mitigation, food security for Vietnam and ASEAN, modernization of agriculture, good quality and safe products without negative effects on the environment are the key development drivers. The government wants to increase the share of livestock in the agricultural GDP to 40% by 2020, in a manner consistent with these environmental objectives. The GDP share has already gone up from 17% in 1995 to 25–28% in 2011. However livestock development in Vietnam is more challenging than in some neighboring countries where livestock is already an export commodity. For example compared with Thailand: land prices in Vietnam are typically 10 times the price of land in Thailand and in Vietnam the average family has access to 0.3–0.5 ha, whereas in Thailand this is 6 ha/family. The high livestock and people densities in Vietnam make it more difficult to control and eradicate animal diseases and in recent years the sector has been consistently plagued by disease problems requiring herd culling and restricting growth.

The following sections of the report describe the current status and future prospects of each of the main types of livestock and the associated livestock products that are important in Vietnam covering:

- poultry, poultry meat and egg production;
- pigs and pig meat production;
- ruminants including beef cattle, dairy cattle, buffalo, goats and sheep.
- The report then takes a look at key current issues affecting the sector overall.

1 The major livestock that are important in Vietnam are: pigs, poultry and cattle. Major products for consumption are: meat, dairy products and eggs.
2 Highly Pathogenic Avian Influenza
3 Foot and Mouth Disease
4 Classical Swine Fever

TABLE A6.1

Year	1995	2000	2005	2008	2010	2011
poultry *10^6	108.0	147.1	160.0	176.0	218.2	232.7

Source: MARD

POULTRY

Introduction

The Vietnam poultry sector started to develop beyond backyard poultry in the eighties and nineties when state farms started expanding Leghorn, Fayoum, RIR and locally developed breeds. These farms supported nearby smallholders with chicks and feed. Only at the turn of the century did direct foreign investment came in, and with it the commercial "brands" of chicken. This was also the period that the outgrowers' model was developed, whereby an integrator would supply chicks, feed, vaccines and drugs and take the birds for slaughter at the end of the cycle. The remaining state farms still play a role in the production of DOCs[5], maintaining the existing poultry lines and working with the smallholder poultry sector, for which they play an important role, considering that this sector still produces 70% of all poultry meat. The scale of production overall has increased and small poultry farms are now considered the farms with less than 1000, semi-commercial farms between 1000 and 10.000 and above 10.000 commercial and corporate.

POULTRY: CONSUMPTION AND CONSUMER PREFERENCES

At the moment broilers form 30% of the poultry meat consumed. The sector foresees that this will slowly increase to 40% in 2020 and maybe 50% in 2040. Consumers have a strong preference for a light whole carcass, which is sold fresh to them. There is hardly a market for portions and ready to cook products and people buy their poultry requirements on the wet market. With the advent of HPAI the live bird markets have been moved out of town, but middlemen will deliver slaughtered animals to salespoints, restaurants and to private individuals. Because of this preference for fresh/hot meat it is high risk to invest in a poultry slaughterhouse and the companies who did run a loss on such installations. Also the corporate poultry producers use agents/ middlemen to sell their birds on the live bird markets/ wet markets. Based on the experience in other countries, it would need a change in consumer behavior, whereby people purchase more ready to cook and portioned parts, for poultry slaughterhouses to become profitable. The increasing urbanization and consumption of fast food will trigger the change. Some large supermarket chains have installed meat-packaging plants to further process the carcasses for their shop. The provincial governments have been asked to set up public-private partnership based slaughterhouses, but the interest to use these is only limited.

The Vietnamese are, just like the Chinese, lovers of duck meat. Most duck meat is produced in a fairly extensive way with foraging on rice fields as part of the live cycle of such animals. Although the government is trying hard to change the duck husbandry system to indoor keeping because of the role the ducks and other waterfowls play in the transmission of HPAI this has not as yet been very successful. Such a move would probably change the flavor, taste and texture of the animals, which would again require customer adaptation.

There is a 10% of domestic consumption importation of chicken thighs/legs and wings. In 2011 110.000 ton and in 2012 90.000 ton. There is also import of culled layers from China and South Korea. This quantity serves the poorer part of the population, which would otherwise not be able to afford poultry meat. The sector feels that it has a price depressing effect. It could also be said that it keeps the poultry sector aware of the fact that their product is more expensive than poultry meat on the world market and that without government installed quota and import tariff the

5 Day Old Chicks

Table A6.2

year	1995	2000	2005	2008	2010	2012	2015	2020
poultry meat products 10^3 ton	197	287	322	448	621	390	584	800
maize needed 10^3 ton [8]	227	331	372	517	717	450	674	923

Source: MARD

market could be flooded, although the preference for fresh product protects the market for local producers.

Poultry meat

Poultry production has grown very rapidly in Vietnam since 2000 and MARD envisages a further doubling of production by 2020. At present some 37% of all poultry meat comes from the corporations and the linked commercial outgrowing companies with the balance from smallholders. Consumer preference lies however still with the traditional birds, which is expressed in the price per kg live weight: at the time of this study white broilers cost 30.000/kg live, whereas local birds sold for more than three times that price at 100.000/kg live. Live local chickens and rabbits, which are grass fed typically fetch 100.000/kg live and 130.000/kg carcass weight.

Table A6.2 gives an overview of historic and projected amount of chicken meat production through 2020 and the calculated quantity of maize required to produce this.

When doing the planning for the poultry production in 2007 for the Livestock Development Strategy 2020 it is obvious that the real rate of growth could not be foreseen, so that there is in 2010 already more production than what was predicted for 2012. The growth in 2003 till 2007 was hampered by outbreaks of HPAI and the consecutive culling and restrictions. Taking an average consumption of 7.1 kg/person/year and a population of 87.375 million with a production of 621 million kg for 2010 a self-sufficiency of 101% can be calculated. There is an additional reported import of 99 million kg legs and wings and 50.000 live broilers coming into Vietnam per day from South China (between 20 and 35 million kg carcass weight on annual basis), which would mean a self-sufficiency of around 120%. This is just to illustrate how difficult it is to come to reliable figures when a large part of the sector is informal and there are undocumented imports. In Northern Vietnam the level of integrated production is less than in the south. North Vietnamese producers are hindered by at the moment around 50.000 live birds coming from Southern China into Vietnam each day6. This has downward impact on the local market and is of concern to Vietnamese producers.

Egg production

Vietnam at the moment has about 7.000.000 hens with an average production per bird of 200 eggs, which is a low production rate in an industry where 300 is a common target. There is only one company with GPS7 with brown egg layers. There is strong health awareness in Vietnam for certain issues and eggs are still associated with cholesterol and heart diseases. Per capita consumption is currently 80 eggs/year and consumption seems to be constant. Besides the international commercial layers there is a whole range of local layer breeds, remaining from the state farming poultry past. These are kept on government farms and still provide chicks to farmers. The poultry producers' association did import cocks from China to promote crossbreeding. Only 20% of all the chickens get fed commercial concentrate, which would explain the 200 eggs/hen housed per year: this is an average figure for both the commercial and the household sectors.

6 Information from a large operator in the poultry sector
7 Grand Parent Stock

TABLE A6.3

year	1995	2000	2005	2008	2010	2012	2015	2020
billion eggs	2.8	3.7	3.9	4.9	6.3	7.2	8.8	14
10^3 ton maize[9]	192.5	254.4	268.1	336.9	433.1	495	605	962.5

Of the total egg production and consumption 60–70% comes from commercially kept layers and 25% of the total egg production is duck eggs. Half of all the commercially produced eggs end up in the processing industry. There is a good market for spent hens, which makes the laying sector more competitive. There seems to be however a large influx of spent hens from China and Korea, where they are worth less than in Vietnam.

The following egg production was achieved and is envisaged in the Livestock Development Strategy up till 2020 as from 2012, with a corresponding maize consumption based on the assumption of 80% lay, 110gr/day feed consumption and 50% maize in layers' mash[8] (Table A6.3).

Poultry: future developments

Vietnam has different kinds of poultry sectors covering both traditional and hi-tech systems. Government attention in planning seems to be solidly on the industrial poultry production in closed housing with commercial feeds. There is a stronger consumer preference for the more traditional products than for those produced by the commercial breeds and production systems. This generates possibilities for those farmers, who do not have the means to enter the industrialized production processes. From a pro-poor, pro-rural development and pro-rural employment perspective it is necessary to also develop models for the poultry production based on traditional systems when planning for the future of the sector, whereby increased biosecurity and food safety are paramount to a successful development of such models in the future. Products from this segment of the poultry industry will have to be distinguishable, in quality and taste, packaging and presentation and the places where these are sold. Separate value chains will have to be developed for the more traditional high value poultry products, produced by smallholders and the industrial lower priced poultry products. It could be foreseen that the first (traditional) value chains feed into wet markets, small retail outlets and specialty restaurants, and the second value chains in supermarkets, food processing industry and fast food chains for example.

Farmers involved in the more traditional forms of poultry farming will have to organize themselves to make the development of niche-market poultry value chains possible. The government breeding farms as suppliers of chicks of preference for this farming sector could play a role in promoting such developments and bringing farmers in contact with market organizations in towns. In this way farmers can build up a closer contact with the markets and produce according to market requirements and demand a better price for their products.

At the moment it seems that even with all the regulations and decrees the government finds it hard to control the middlemen and even the large poultry corporations to comply with the existing food safety and biosecurity measures. Live birds can be found in every city, to be slaughtered under uncontrolled conditions and the private sector is reluctant to invest in modern poultry slaughter facilities, as they will not be used like the ones present. It will require a concerted effort of the whole sector, in which the poultry producers' association should play a role, to develop codes of conduct to improve on the situation.

8 Both calculations for maize equivalents consumed leave out the maize consumption of grandparent and parent stock and in the case of layers consumption up to point of lay.

Table A6.4

year	1995	2000	2005	2008	2010	2011	2012	2015	2020
pigs (million)	16.3	20.2	27.4	26.7	27.4	27.1	28.5	32.9	34.8

Source: MARD and Livestock Development Strategy

Table A6.5

year	1995	2000	2005	2008	2010	2011	2012	2015	2020
10^3 ton pork	1007	1409	2288	2806	3036	3099	2840	2768	3495
10^3 t maize	1359	1902	3089	3788	4098	4184	3834	3737	4718

Many small-scale poultry producers would like to improve their operations and invest in becoming VIET-GAHP[9] compliant, but lack the finance to do so. It is likely that the rapidly expanding corporate poultry production will bypass these small-holders and opt for the construction of their own broiler sheds, further undermining the profitability of the smaller size poultry farms due to diminishing margins per animal. An accessible rural (micro) finance system, probably even linked into the outgrower schemes as guarantor, would assist more farmers to upgrade their poultry farming practices to comply with food safety and biosecurity requirements and to become interesting for the poultry corporations to become an outgrower.

The envisaged growth in total poultry meat and egg production will not be matched with increased local production of feed ingredients and the gap between what feed is locally available and required will grow. It is therefore important to increase the efficiency of production: an increase in the number of eggs per layer (from 200 to e.g. 300 per year) will already mean a large reduction in the amount of feed needed to produce one egg of 33%. The widespread use of antibiotics in feed will have to be replaced with better hygiene, management and the judicious use of probiotics.

Pig production

Introduction

Pigs are the most important provider of meat in Vietnam. The government's aim is to diminish its share in the overall by raising the beef and chicken meat shares. The number of pigs in Vietnam has increased at a fast rate during the last 15 years and so has the genetic composition. Abortion blue/PRRS has slowed down the increase in numbers over the last 5–6 years. Table A6.4 gives an overview of the pig numbers for 1995 till 2011 from statistics and 2012 till 2020 from the livestock development strategy:

Besides the increasing number there has been an increasing share of modern genetics, so that the total biomass of these pigs is increasing faster than one would expect on the basis of only the animal numbers.

This number of animals corresponds to a reported and predicted pork production as follows, again with maize equivalents calculated at a feed conversion of 2.25 and 60% maize in the feed (Table A6.5):

The traditional Vietnamese pig sector has, besides the increase in numbers, gone through other major changes. First of all the traditional pig with 40kg slaughter weight and 45% lean meat has been crossed extensively with commercial pig 'breeds' with a slaughter weight of 80–85 kg

9 Vietnam Good Animal Husbandry Practices

and lean meat 50–54%. This crossing has made that pigs in Vietnam are now of a wide variety in type and slaughter weight, which makes industrial slaughter, grouping and processing difficult. The feed conversion has improved dramatically with the improved genetics and higher % lean meat and the use of commercial feed has taken off. The more than 3 million households keeping pigs are however now at the maximum of what is feasible on their home plots without aggravating the environmental and animal disease problems. The next developmental steps will have to be specialization in either breeding piglets or fattening pigs. With the need to increase farm size to remain competitive the government will have to make land available for groups of pig producers to construct their pig farms away from the population centers. This will require land and capital, which are both scarce.

In the future the role of the private sector in the pig sector development will increase when the integrators start producing larger numbers of fattening weaners for farmers to rear till slaughter weight. It will also remove the need for farmers to produce their own piglets. The government built slaughterhouses are currently hardly been used. The integrators' slaughterhouses will be the start of value addition through processing and will slowly but surely replace the current often unsanitary slaughter procedures with controlled slaughter and deeper processing of the carcasses.

The pig sector is battling with PRRS and occasional Foot and Mouth Disease outbreaks, which both cost the farmers dearly. It also makes that even if Vietnam would like to export pork this will be impossible. The only way to at some stage to make export possible would be through the creation of disease-free zones. It is the question whether the average Vietnamese pig farmer would be part of that or purely an undertaking for the large corporations.

Pork consumption and consumer preferences

Also with pork the Vietnamese consumers prefer fresh/hot meat. Much meat is deboned and cut up in the urban areas after middlemen have delivered carcasses to the salesmen and women in the early morning. It is remarkable how little red meat can be found in supermarkets for the simple reason that customer's preference is for meat from wet markets or from these small-scale butchers they have known for a long time and trust. Although the government tries to interest the private sector in investing in agricultural infrastructure through concessional rates for land, land clearance, financial support for treating waste and land rental the private sector does not respond with investments in slaughterhouses as it knows that chilled meat from an abattoir is not what the consumers want.

Pork production and trade

Currently 30% of all pork comes from the corporate sector and commercial producers, linked to the corporations as out growers. There are however tremendous increases foreseen in the number of sows kept by the corporations: in the next 5 years the two main players want to increase their number of sows from 12–13.000 to 50.000 and from 180.000 to 300.000. The aim would be to produce 20kg weaning piglets, which then will go to out growers to be fattened. With 24 piglets weaned per sow per year in commercial farms and 0.30 sow replacement this would mean 8.295.000 weaners, a quarter of the total number of pigs expected in 2020.[10]

The Thai transnational company "CP" is the most important player with 10% of the current total pork market of 27 million pigs. It has its own high quality genetic material, which produces the type of pig CP needs for its processing plant. These pigs with a high lean meat percentage usually fetch a 2–3000 VDN/kg premium price. The challenge lies in expanding the market share for processed pork products through changed consumer behavior for this additional money to be recuperated from the market. Also here the fast food chains and supermarkets selling processed pork products will play an important role.

10 A problem with the government statistics, especially with poultry and pigs is that the animal numbers given probably refer to the annual census in October: with broilers there can be 5 cycles per year, with pigs with 20 kg weaning piglets 3.

Pigs: future developments

Given the biosecurity and environmental risks it is likely that the projected growth in the number of pigs is only possible when there will be construction of new farms away from people, with good biosecurity. Ideally these farms would be specialized in either breeding or fattening. However the level of investments required would be extremely high and most probably it is only the 12% of the 3.418.000 pig farmers that are expected to be in business in 2040 who can afford to take this path. To push for more pigs in the existing farms, which are largely within the settlements, will only aggravate the biosecurity and environmental problems.

There is also a need to make the sector more efficient through better performance: As written in the Livestock Development Strategy the sow herd accounts for more than 16% of the herd and only 10.2% was exotic in 2006. Average slaughter weights can be improved. With better management and technology weaned piglets per sow could be increased from current 20 kg to 25–26 kg. Also growth rate can increase and feed conversion decrease. In this way the cost price per kg pork will be reduced and make Vietnam more competitive on the international market and less attractive for dumping and smuggling practices.

There is need to look into the composition of feed: to what extent would replacing some of the maize with broken rice and or tapioca reduce the dependency on the international grain market and reduce the cost price? How and when can the standard addition of antibiotics be stopped? Would that need a government directive and sanctions or first improve the management and husbandry conditions to avoid a drop in production? The advent of MRSA[11] has made the European pig industry painfully aware of their responsibility towards human health. In Vietnam the situation is not different.

With an increase in the quantity of "modern" lean meat there will be an increasing market segment looking for the more traditional pork products. Not everybody wants lean meat. To distinguish this traditional pork product beyond the visual aspects there is need for the establishment of special value chains with branding, Standard Operational Procedures (SOPs) and guarantees for such more traditional products, including outlets in towns. It is quite normal to have 2 systems for food safety assurance: one for export and large-scale producers and one for the smaller ones. Vietnam could develop such a system for small producers, small slaughterhouses, transport and retail outlets with minimum conditions and some tracking and tracing, whereas the system to be developed for potential export will need to have complete tracking and tracing and certified HACCP[12] systems at all levels of production, processing and trade.

The traditional pig breeds might be under threat from uncontrolled crossing. It is not certain whether the special value chains will be best operated with the traditional pigs or crossbreeds. There is a task for the government and the sector to maintain viable populations of the traditional pig breeds in Vietnam. The indigenous breeds, such as Muong Khuong, Co, Meo, Tap Na, and Mong Cai, show great genetic variation and could be important for future crossbreeding programs with western pig breeds.

Ruminants

Introduction

Ruminants play an important role in the farming system, but a changing one. Where buffaloes and cattle were mainly used for animal traction with some low quality meat production at the end of their lives, now there is increasingly a population of animals that are exclusively kept for beef and/or milk as their traction role is diminishing. Buffaloes in particular are efficient converters of poor quality roughages such as rice straw with some strategic supplement into carabeef and milk. Goats and sheep were meat for the family and community and a cash reserve, but are with increasing numbers now commercialized in the urban markets. With the importation of dairy and meat breeds and crossbreeding programs this role is changing into a more intensively held animal exclusively for marketing or milk production. The intensification in the crop cultivation has led to

11 Methicillin Resistant Staphylococcus Aureus

12 Hazard Analysis Critical Control Points

TABLE A6.6

year	1995	2000	2005	2008	2010	2011	2012	2015	2020
dairy cows (1000)	18.7	35.0	104.1	107.9	128.4	142.7	155.0	263,3	500
fresh milk 1000 ton	20.9	51.4	197.8	262.2	306.7	345.4	350	500	1012

less fallow land and shorter fallow periods thus less grazing time on crop land, which have only partly been compensated for by increased availability of crop residues due to the difference in feed quality between grazing with selection and crop residues stall-fed.

The major health challenge for ruminants is Foot and Mouth Disease (FMD), which is endemic. The government funds vaccination programs against this disease. There are occasional outbreaks of anthrax, against which farmers would be wise to vaccinate at their own expense as it invariably leads to dead animals and in the worse case of people eating the meat of diseased animals people suffering from anthrax.

DAIRY

The dairy sector in Vietnam is probably the most remarkable of the livestock sectors in terms of its growth and technological developments. Started on state farms with Cuban TA and the Laisind cows (Yellow Vietnamese cross Red Sindhi or Sahiwal with a yield of around 800–900 kg[13] Milk) the breeds now used are Holstein pure or crossed with Sahiwal or Red Sindhi. The following table (Table A6.6) gives the current and expected number of dairy cows.

Also here it seems that the 2012 actual production will be more than the one predicted in 2012. The government is actively supporting the dairy sector with promotion of AI, heifer breeding on government farms, research and extension on better forages and forage conservation, the formation of farmers' associations/cooperatives. Milk prices have however been low since the Chinese melamine scandal as consumers prefer imported product and are wary of the local dairy products. It is another indicator that consumer trust in the sector is of great importance. Together with the high feed prices and high interest rates it is still surprising that the last 10 years the dairy production on average has been growing at 10%/year, considering the proximity of some of the most competitive dairy exporting countries in the world. The production of forage in fields is now taking over from grazing and cutting grass along roads and canals. It is estimated that 1 ha can produce the fodder required for 30 cows, besides purchased fodder and feed. Anybody with less than 10 cows is already considered a small cattle farmer, 10 to 30 a medium and over 30 a large cattle farmer. The average milk yield is now between 4.500 and 5.000 liter/lactation. The milk price is between 12.000 and 13.000 Dong. There are some extreme size dairy investments ongoing, which depend upon foreign TA[14] for their management. Such large units with 10.000 and more animals pose a risk for the environment if no drastic measures are taken, the local markets for fodder, feed and dairy and for e.g. all the bull calves, which have to find interested parties to fatten them (unless they will be slaughtered as bobby veal, which is wasteful). There are as yet no farmers specialized in fattening all these bull calves and the Vietnamese level of management skills to run such farms is not as yet there. Usually the cost structure of such large farms with imported cattle is so high that the only way to be profitable is to try to export into more lucrative markets. Examples of this practice can be found in Indonesia supplying the Singapore dairy market.

The government is strongly promoting the foreign investors in dairy processing to collaborate with and support emerging dairy farmers. There is a maximum to the amount of milk powder companies can import linked to the intake of farmers' milk. The former state farms/processing plants

13 http://aciar.gov.au/files/node/2229/exploring_approaches_to_research_in_the_animal_sci_19985.pdf

14 http://israel21c.org/environment/milking-israels-dairy-expertise-in-vietnam/

have been changed to joint stock companies. At the moment there are 4 major dairy companies operational in Vietnam (Moc Chau, Vinamilk in collaboration with Nestlé, Dutch Lady and Fonterra. All of these run collection schemes and manage a number of dairy plants.

The main issues with dairy are still the milk quality in terms of hygiene and food safety. The Somatic Cell Counts are usually high and over 60% of cows suffer from sub-clinical mastitis. There is widespread and heavy use of antibiotics, exactly because of the often poor hygienic conditions under which cattle is being kept and the resulting poor udder health. A payment schedule with a bonus for high quality milk is usually a quicker way to improve the milk quality than issuing decrees and regulations. Milk processors should agree on a countrywide principle for payment according to quality in chemical (fat and protein %, absence of antibiotics and other residues), physical (alcohol test for stability and pH) and bacteriological terms (bacteria and SCC).

Dairy: Future developments

There is a potential issue of the instability of marketing arrangements for dairy products produced by private farmers. Two large dairy plants that were 100% state owned have recently had 49% of their shareholding shifted to private non-farmer shareholders but the most successful dairy undertakings in the world are farmers' cooperatives. It is remarkable that both Fonterra and Dutch Lady in Vietnam are commercial companies owned by farmers' cooperatives in their home countries but in Vietnam they operate as purely commercial companies and transferring dividend to the home cooperative. None of the benefits of a cooperative are available to farmers. In a cooperative structure farmers feel more responsibility for what happens in the factory, share in the profits, the cooperative can fairly easily mobilize money through members' certification (withholding part of the milk money e.g.) and the cooperative can render services to its members. Commercial companies can undercut marketing arrangements for farmers if markets change. Nestlé is an example of how commercial companies can drop their activities after some time, leaving farmers without a market for their milk (although in the case of Vietnam Nestlé struck a deal with one of the other companies to continue with the collection scheme). It would be timely to start the discussion now with the milk producers about the possibilities of them forming a dairy cooperative, which in the long run can take over the activities of what are now joint stock companies with the state still as major shareholder and even discuss with the Dutch and New Zealand mother cooperatives about the possibility to convert the commercial undertakings into "sister" cooperatives.

Vietnam is currently very reliant on Holstein cattle for current production and future expansion. Although it is the highest yielding breed in the world with an enormous gene pool to select from there are other breeds, which under specific conditions like Vietnam's hot and humid conditions might be a better choice (e.g. Jersey) or in mountainous areas when animals have to walk to pastures (Brown Swiss). Upgrading local breeds with continuous crossing with Holsteins leads to diminishing heterosis and increasing sensitivity of the animals to mistakes or shortcomings in the management. The inclusion of some Zebu blood in the Holstein dairy animals gives increased heterosis and resistance: a crisscross breeding scheme using alternatingly a Holstein and a Sahiwal or Red Sindhi bull will give a more resilient dairy cow, better adapted to the humid tropical conditions than a pure Holstein, especially for the smallholder,

Table A6.7

year	1995	2000	2005	2008	2010	2011	2012	2015	2020
million head	3.6	4.1	5.5	6.3	5.9	5.4	6.5	9.5	12.5
1000 ton beef	118	140	202	298	363	375	180	294	388

TABLE A6.8

av. carcass weight(kg)		1995	2000	2005	2008	2010	2011	2012	2015	2020
annual extraction %	10%	328	200	240	324	370	452	191	237	252
	15%	219	133	160	216	247	301	128	158	168
	20%	164	100	120	162	185	226	96	119	126

although it must be said that the Vietnamese dairy industry has developed remarkable skills in keeping Holsteins in the humid tropics.

BEEF

Beef makes up only 8% of the total meat consumption. The government wants to push it up to 10–12% of total consumption, which over time will also increase so a big increase in the overall quantity of beef required to and increase the share and increase the absolute amount because of population growth and income growth. The following table (Table A6.7) gives an overview of reported beef animals and production, till 2011 actual and 2012, 2015 and 2020 from the livestock development strategy:

It can be seen that again the growth in numbers and beef production in the period 2007–2011 was faster than the strategists did foresee. However: these data have to be taken very carefully. In 2020 it is expected that 3% of animals will be slaughtered under veterinary control. That means that currently far less than 3% of the animals are slaughtered under veterinary control. It means that it is very difficult for official statistics to be gathered as most animals are slaughtered in the backyard and then transported by middlemen to the wet markets. The following calculations show what this means in terms of carcass weight, with 3 assumptions for extraction rate: there is unexplainable variation over the years, showing that there is a poor relationship between the animal inventory and the amount of beef produced. For this calculation the buffaloes have been added to the cattle numbers (Table A6.8):

The government proposes large-scale crossbreeding with beef breeds, such as Limousin and Brahman. The suggested doubling in animal numbers up till 2020 raises the question what these animals will feed on: it is likely that the pig and poultry sector take already most industrial byproducts, which leaves all the cattle with grazing and maybe some supplementation. Animals are kept near the houses, are often tethered. The Brahman and Sahiwal do not seem to be such a good choice for crossing animals of the household sector because of their temparement: they belong in a ranching situation, not in a cut and carry household farming system. Therefore it would be better to change the structure of the beef production, whereby households with their traditional animals produce crossbred calves, which are sent as weaners into feedlots. A market for weaners would be built up with the construction of such feedlots and specialists can fatten animals. In this way the breeding cow population remains more adapted to the prevailing farming system and the animals in the feedlot will also be uniform with maximum heterosis. A nucleus-breeding program to improve the traditional yellow Vietnamese breed for a number of characteristics such as its fertility and growth rate would assist small farmers to gain more from their cattle.

TABLE A6.9

year	1995	2000	2005	2008	2010	2011
buffaloes (million)	2.9	2.9	2.9	2.9	2.9	2.7

TABLE A6.10

year	1995	2000	2005	2008	2010	2011
no of goat + sheep (million)	0.551	0.543	1.314	1.484	1.428	1.197

BUFFALOES

The buffaloes are losing their traditional role as draught animal with the advent of mechanization. This is reflected also in the declining number of buffaloes in the rice growing areas and only a moderate increase in the northern mountains over the last years (Table A6.9):

Many consumers still associate buffalo meat with tough meat, as in the past animals were slaughtered after their working life as old animals. The image of carabeef will have to be improved. The superior capacity of the buffalo to utilize low value roughages and its resilience are important assets to keep the buffalo in the farming systems. Swamp buffaloes have less milk than water buffaloes. Vietnam could consider the possibility to cross the buffaloes in for milk production suitable areas with Murrahs. The Philippines has built up the experience over the last 20–25 years. It requires the development of special value chains to capture the higher value of buffalo milk. As the milk production of buffaloes is about half the one of cattle the double producer price for milk is necessary to make buffalo milk production a viable option.

SMALL RUMINANTS

The number of small ruminants has increased considerably over the last 15 years as the following table shows (Table A6.10).

The husbandry system is changing from grazing to semi- or totally confined and cut and carry feeding systems. This will also create the possibility to start goat production outside the mountainous areas, where most goat and sheep are now being kept. Milk production with goat is on the increase through crossing with dairy breeds. Goats and sheep in Vietnam are kept by the poorer farmers and will also in future remain in that domain. They are therefore an excellent proposition for resource poor rural farmers and as such the government development programs should be geared towards developing low-cost housing with bamboo and promoting farmers goat breeding groups, who collaborate with breeding, selection and management (superior breeding billies from selection within the group's animals or from outside, joint marketing and purchase of additional feed).

EVOLUTION OF CONSUMPTION OF LIVESTOCK PRODUCTS.

Consumption of livestock products in Vietnam is currently only 60–65% of the world level consumption and 40–45% of consumption in the west. There is a major expectation of a growth in consumption in the coming years. Important determinants for the consumption of products of animal origin are the size of the middle-class and the rate of urbanization. The consumption of meat has a high elasticity with expendable income. The middle-class segment of the population will increase up till 2040. The degree of urbanization plays a role in the type of products consumed: people in urban areas have access to supermarkets and fast food restaurants. In 2010 30% of the population lived in the urban areas and from 2010 till 2015 an annual increase in the urban population of 3% was foreseen[15]. The "supermarketization" started late in Vietnam in comparison to the surrounding countries due to a ban on Direct Foreign Investment in the retail industry till 2009. In the early 2000s this development started also in Vietnam and its neighbor China, with the supermarkets now holding a 5–20% share of the overall food retail. These developments have put challenges to the primary production to give guarantees about quality and product safety to consumers, who so far would prefer to see the animal they are going to eat killed in front of them or who will only buy from a trader they trust. For this reason

15 http://www.indexmundi.com/vietnam/urbanization.html, accessed 26–7-2012

TABLE A6.11

maize 1000 ton	1995	2000	2005	2008	2010	2012	2015	2020
for broiler	227	331	372	517	717	450	674	923
for eggs	192.5	254.4	268.1	336.9	433.1	495	605	962.5
for pork	1,359	1,902	3,089	3,788	4,098	3,834	3,737	4,718
total	1,778.5	2,487.4	3,729.1	4,641.9	5,248.1	4,779	5,016	6,603.5
ha required (*1000) to produce the required quantity of maize with various yields/ha								
if 4 ton/ha	444,625	621,850	932,275	1,160,475	1,312,025	1,194,750	1,254,000	1,650,875
if 6 ton/ha	296,417	414,567	621,517	773,650	874,683	796,500	836,000	1,100,583
if 8 ton/ha	222,313	310,925	466,138	580,238	656,013	597,375	627,000	825,438

overall consumer preference is for fresh meat and it will take time to accustom consumers to accept chilled, frozen or further produced products. These changes will most probably have to be triggered in the youth and with the fast food culture.

FEED MILLING

Good quality balanced feed is the driver for a profitable livestock sector, it being 70% of overall production costs. Vietnam is highly insufficient in animal feed: of the 11.5 million tons used in 2011, around 9 million tons was imported. The local maize production of around 3.5–4 million tons occupies some with 1 million ha providing a yield of around 4t/ha. Given the excess production of rice for export there is scope to increase the area under maize at the expense of the area under rice to offset imports of maize if price levels provide that opportunity. A problem with the maize is that in the principal areas for maize production (e.g. Son la) the harvesting time coincides with the rainy season, which makes it necessary to mechanically dry the maize. It will require careful selection of hybrid maize varieties with growing length up to maturity, which would fit in the crop rotation and preferably mature before the onset of the rains. In the following table the earlier theoretical maize requirements for egg, poultry meat and pork production are added up. With 3 levels of maize production/ha year the number of hectares required if all maize were to be produced in country is calculated. The assumption is 1 crop per year.

Another option to increase the locally produced share of animal feed is to expand cassava production which currently yields 11–12 ton in its growing cycle, which is longer than maize. Also sorghums in the drier areas could be tried in case rainfall is too little for a guaranteed maize crop. Both cassava and sorghum need more extensive processing than maize, which basically only needs drying and milling. With the programs of rural industry development and SME support funds such processing facilities should be possible to develop.

Most soya required is imported from India and Argentina and like with maize also the soya prices are going up, mainly due to China's insatiable demand for soya. Especially India, with a quickly expanding poultry industry itself would require more soya for its own use. Therefore Vietnam will have to look for alternative sources of protein of comparable quality. The dairy sector imports some dried lucerne as additional feed to locally produced forage, but could as well produce leguminous hay in country if land in the higher altitudes were available. With the ever-increasing grain and soya prices the profitability of the livestock sector is under severe pressure, as the market prices seem to lag behind the production costs. The answer for the future for the conventional livestock sector is to increase the productivity through increased use of genetically superior animals and improved management, to increase the scale of production and to reduce labor costs through increased mechanization.

Out of the 233 feed mills in the country 70 are members of the national feed millers association. These members

represent 7 million ton of the total feed produced. The 4 major foreign investors in the feed sector produce 60–65% of the total and the local companies 35–40% of the total. It is foreseen that the number of feed milling companies will go down in future as the smaller plants cannot play the international commodity markets as effectively as the larger companies. There are currently 46 foreign feed mills, 11 joint ventures and 176 local mills.

Industry representatives foresee that the livestock population will double between now and 2020, extrapolating the current growth rate and that the amount of commercial feed used might increase with a factor 3, because more farmers are going to feed with commercial feed. Currently only 30–40% of all animals receive commercial feed. Especially with high grain prices farmers would be better off to grow their own maize and mix it with a commercial concentrate: reduced transport costs and buying of someone else's maize in the complete feed.

There are good regulations and quality standards for animal feed as issued by the department for veterinary services and the MARD. Only the larger feed mills are able to test and monitor their product quality. Most feed mills work with sales agents, who get paid commission to convince more farmers to use that company's commercial feed. Farmers are quite capable of comparing the technical results from different feeds and farmers 'potential voting with their feet' is maybe an even stronger incentive to produce feed with the right composition and good quality than the ministerial decrees and regulations. The addition of antibiotics to stock feed is still common practice and leaving it out with the current sanitary situation on the farms and with the disease pressure would give a severe dent in the production. Research on replacement with probiotics is ongoing, but as long as there is no ban on the use of antibiotics in the feed the industry will not make the change. Especially the foreign large companies have the full knowledge of modern feed milling, what additives to use and how to make best use of certain probiotics Food safety would be better assured if the government would establish a specific time frame for banning the sale of medicated feed as a routine commodity.

Issues

Current issues for the sector are mainly focused on animal health and food safety concerns and the effect on the environment of many of the traditional systems of livestock development. There are no easy solutions to the current problems being faced of this rapidly growing sector.

Animal health

Vietnam needs to continue to make progress on animal health issues. The World Organization for Animal Health (OIE) in its Terrestrial Animal Health Code has recommendations on how this world animal health standard setting body sees the ideal veterinary services. This is with a Chief Veterinary Officer (CVO) with if not the same status as a minister then at least the authorization to talk to the various ministers involved in the livestock sector (Industry and Trade, Public Health) and a single line of command all the way down to the veterinarians operating at village level. Unfortunately in many countries decentralizations have eroded this line of command. In Vietnam there is an additional particularity in that the People's Steering Committee on the advice of the government veterinarians will or will not declare the outbreak of a disease. Also the reports from the provincial veterinary services to the central level veterinary department are scrutinized by the Steering Committee. For Vietnam to build up an efficient and effective veterinary services there is need for up to date veterinary legislation, on which the politicians can shed their light to agree with the underlying principles of how the veterinary services operates; the outcome of the veterinarians' work process should however not be influenced by politicians without the required technical knowledge and experience in the field of animal diseases.

An example is HPAI: it has changed the way in which the veterinary services operate in many countries of the world, as it did in Vietnam. It has led to better equipped diagnostic laboratories, a description of the various production systems, and studies into the value chains and the hot spots for transmission. However, if it is politically not acceptable to impose strict movement rules and cull animals, if opera-

tional budgets are not sufficient to purchase the necessary equipment and consumables and contract/pay the required people for the field work then the investments will not resolve the problem. Therefore operational budgets of the veterinary services should assure their mobility, their communication and testing capacity.

With the current structure of the livestock sector and consumer preference for fresh/hot meat and the low degree of slaughter under veterinary supervision it is difficult to put the measures in place with which the spread of diseases can be effectively controlled. Some 97 per cent of Viet Nam's 30,000 slaughterhouses are operating without the necessary paperwork, veterinary inspection and in residential areas rather than in abattoirs away from the build-up areas according to the Department of Animal Health.

The increased modernization of livestock keeping (e.g. no longer mixing ducks and chickens on the same farm, closed instead of open housing in poultry, specialization of pig farmers in breeders and fatteners) will create the conditions in the future with which it might be possible to control many livestock diseases better. For the time being due to the presence of HPAI, FMD, PRRS etc. it is impossible for the corporate companies to get export licenses, whereas there are lucrative regional and further away markets for pork (China, Singapore, which banned pigs in 2005 because of H1N1, wrongly called pig flu, Hong Kong) and poultry meat (Europe, Africa). However to be able to export from a country either the country has to be free of these diseases or be divided in compartments, whereby some of those are disease free, after which there might be issued an export permit. Vietnam therefore has to make choices how to organize its veterinary services, whether it goes for a country-wide approach or starts to create disease free zones, from which the corporate agriculture sector can start to build up export based livestock production.

Food safety

Currently ensuring food safety from on farm production up to consumption is split between MARD for production, Industry and Commerce for processing, storage and packaging and Ministry of Health for the effect of the products of animal origin on the consumers. There are as anywhere questions about the competence of each party in different segments of the value chain, areas that are undercovered and in general this system does not lead to sufficient assurance on the food safety control systems. In the European Union specialized agencies have been set up in all member states, in which the control and inspection functions of these three ministries have been brought together in one agency, usually with its director at ministerial level. This means that the 3 ministries can continue to fulfill their core tasks and don't need to be a judge over their own work: especially in crises or serious shortcomings in the normal technical functioning of a ministry its control and inspection department might be tempted or even told to cover up. Vietnam has too many technical issues in all three sectors to be addressed to expect the ministries to be able to also make fair and unbiased judgment on its systems, procedures and processes. Vietnam has an increasing number of incidents of non-conformity with food safety standards and needs to take bold action to remedy this: the formation of a national food safety council with far stretching authority, also towards the ministries involved, is a step to be taken. A new law on Food Safety was gazetted on the 4th of July 2011. MARD is only mentioned in 1 article, whereas most food safety infringements are usually related to products of animal origin. Such a law should refer to the existing veterinary legislation to spell out what is expected from the veterinary services in terms of their contribution towards food safety assurance.

Current ideas are to try to address deteriorating animal health and food safety problems through the introduction of a series of Good Animal Husbandry Practices (Viet GAHP[16]) designed address the specific conditions of livestock development in Vietnam. For example development (herd expansion) is to be mainly limited to take place in locations, which are distant from human centers where animals can optimally produce, where the environment is saved through the application of measures to process the waste and biosecurity can be maintained. The government also aims at

16 http://www.thucphamantoanviet.vn/a-aproducers-and-traders/b-pork-chicken/a-quality-assurance-systems/pork-poultry-vietgahp/1200_-_pork_-_sops_for_on_farm_-_pork_production_-_version_2.pdf

farmers associating to create larger units and economics of scale. For all of these developments to take place considerable investments are required which the average livestock farmer does not possess and which the state budget can also not pay for. New private sector investment in commercial livestock farms therefore seen as a possible way forward.

Besides the government's role in food safety assurance the private sector will also have to start taking responsibility for its own products and production methods, whereby the government does the control on the control. Such self-control systems, HACCP will only work when all the perquisite programs (Good practices in agriculture, hygiene, manufacturing, veterinary practice: GAP, GHP, GMP, GVP) have been implemented and complied with to reduce the number of critical control points. Sector professional bodies can and should help its members to improve on their production methods and work according to good practices: in most cases it leads to more streamlined production systems with reduced wastage and pays back for its initial costs. The step to HACCP is then a small one, which would bring Vietnam on par with advanced international players.

Declining profit margins in the sector

The rapid increases achieved in livestock production have come at a price to the environment and there are continued concerns with non-compliance with food safety requirements. In addition, recent years have seen stagnating producer prices and increasing costs for livestock farmers leading to decreasing profit margins per animal. Livestock farmers are being increasingly forced to increase their numbers of animals if they want to stay in business and improve on their management. Calculations from the CARD project[17] showed that a smallholder in 2008 would need at least 8 sows to have a profitable pig breeding enterprise; this number is bound to have increased during the last 4 years with the vast increases in stock feed and other prices.

The government has an active policy to promote private investment in agriculture. In 2010 Decree 61 set out a SME policy, which for particular branches would give tax relief and government support in case it engages in advanced technologies in the agricultural sector. Livestock farmers are being encouraged to take advantage of the provisions of this new policy to help them expand operations to more profitably sized units.

Challenges for the Vietnamese livestock sector: the declining number of traditional farms

There is wide gap between the ideal models of the future and the traditional production model. It is one thing to set up pilot model pig farms in each province, far from the population, with a progressive farmer, treating the waste water, complying with the 17 aspects of VIET-GAHP, it is another thing to assist the current 3.418.000 farmers keeping pigs to modernize their farms. The technical and financial challenges are such that sector representatives estimate is that in 2040 only around 10–12% of these farmers will still be pig farmers. In the other livestock sectors similar issues exist. The wave of the future will be the corporate farming sector, which is so far quite underdeveloped in Vietnam. Current estimates are that less than 5% of the aggregate livestock production comes from the corporate farming sector. It is to be expected that in the years to 2040 this share will increase to somewhere between 30 and 50% as already happened in other countries in the region, where these developments started earlier than in Vietnam.

Consumer behavior and choice: Vietnamese consumers have strong preferences

Consumers in Vietnam will form an important driver for the production sector to achieve food security. It was found that both income and price elasticities of fresh fruit and vegetables expenditure from supermarkets were much higher than those from traditional retailers. Also in the case of meat consumers are prepared to pay higher prices for meat products from supermarkets. It might be caused by a quality difference, but most likely to food safety concerns of the increasingly affluent urban Vietnamese consumers. Therefore consumer preferences are a strong reminder to the sector to give meaningful guarantees to the consumers

17 "For the Cause of Agriculture and Rural Development in Vietnam", pers comm. Mr. Keith Milligan, former Technical Coordinator of CARD

about product quality and safety: the ongoing depressed milk consumption and choice for local products after the melamine scandal in China proves how difficult it is to regain lost trust.

Vietnam is considered an "early supermarket penetration" country, part of the 'third wave'. This means that there is tremendous interest from foreign investors to become part of this growth. Modern retail channels, be it supermarkets or fast-food chains, will play a major role in future growth and will determine increasingly what type of a product is required. Also in Vietnam the working middleclass needs convenience and cannot afford to trek every day to the wet markets to purchase its meat, fruit and vegetables. Also the better-informed consumers realize that street vending and wet markets do not have the conditions to deliver a hygienic product. There are currently 636 supermarkets, 120 commercial centers and over 1000 convenience stores according to the Ministry of Industry and Trade. This still does not seem to fulfill the demand. Local retail will need to receive some protection from the foreign investors by the government to create a level playing ground: the might of the established internationally operating retailers is too big for them to compete. Local retail is important to conserve a place for the local products on the shelves and in the consumption pattern of especially the urban consumers.

Environment and animal welfare

The number of livestock in the settlements has reached levels under which the environment suffers. Major investments are made to promote biogas, but these reach only a fraction of all farmers and the effluent still has to be disposed off in a responsible manner. Moving livestock production away from the people is a laudable move, but due to land and money restrictions not possible for all. Simple slurry and manure storage structures have to be designed, whereby composting with the now often burned rice straw would produce a tradable soil improvement commodity: compost. The technology to process manure and straw, even using worms such as Californian tiger worms to speed up the process has to be developed, extended and promoted.

The continuous maize production on the sloping lands in the North is leading to erosion, in some places already severe erosion. Most of these areas are inhabited by ethnic minorities. The maize cultivation should be strongly embedded in a farming system of ruminant production, whereby the soil on the slopes if not through terracing then at least through grass strips is stabilized and farmers can use maize stover and cut grass from the anti-erosion strips to feed their livestock. Through these interventions the increase in numbers of ruminants through the close combination and integration with crop production is feasible. Strategic low-cost supplementation with a urea-molasses-minerals mix should improve the efficiency of the animals to utilize these high fiber diets. With proper veterinary services, doing the right vaccinations to prevent animal diseases and the construction of livestock markets, where slaughter animals or weaners can be sold to urban traders and feed lot operators both the environment and the ethnic people in the north will have a robust and environmentally sustainable livestock production system.

Animal welfare is low on the list of priorities. Nevertheless many consumers are besides looking at product quality and safety starting to look into how their food was produced. Especially animal transport on motorbikes is something, which over time should be faced out. To anticipate future demands of consumers it would be good for the veterinary services to appoint an animal welfare officer, who keeps in touch with the international developments in this field, develops SOPs for animal transport and slaughter and eventually for animal housing and husbandry. Often with simple changes and interventions animal welfare can be improved drastically. If the demand for such changes is made by the consumers there is even an economic reason to comply with such demands. For the moment it seems to be too early to force changes through legislation, as too many laws are now already not enforced and adding another one will not be effective.

Helping traditional livestock farmers

Vietnam has managed to make major changes to its livestock sector, whereby tremendous increases in animal

numbers and productivity have been achieved. The drive to modernization has paid off in terms of self-sufficiency through increased production. There is however still a large number of livestock farmers, which due to age, lack of land and finance or simply because they are not interested who will continue to depend upon the old way livestock keeping. With their children being educated and most probably opting for a life outside agriculture they form a large group of "last generation" livestock farmers. This group should not be forgotten in all the strategies. Their strong point is the type of product they produce, for which a premium price can be gotten when it is brought in the right form to the market. This forms the best chance for this group to secure their livelihood through livestock production. Certain measures will have to be taken to achieve this.

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