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ASSESSMENTS OF THE NEEDS IN BIOTECHNOLOGY APPLICATIONS IN VIETNAM

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ABSTRACT

Development of biotechnology in Vietnam was launched with the first governmental decree in 1994. Legal frameworks in biotechnology policy appeared earlier in the Philippines in 1980, in Thailand in 1983 and in Indonesia in 1985. The results of country survey indicate that the Government of Vietnam has focused on developing physical and human capacity in the biotechnology sector. Now 23 research establishments involved in biotechnology research in Vietnam with an estimated number of 200 persons trained to work in biotechnology. The results of interviews with policy makers and managers in biotechnology and questionnaires distributed to the scientists indicate that the biotechnology sector is suffering not only from the shortage of funds but also from weaknesses in defining its mission in the Government development plan. And as a consequence the management of capital resources in biotechnology sector remains unclear and untransparent. Laws and regulations for biotechnology have not been effectively developed. While some countries have produced guidelines for research and field testing of GMOs, Vietnam has no comprehensive legal framework to address commercialization and consumer protection. Despite a build up of trained human resources in the last ten years, there is still shortage of human resources particularly in legal issues and safety aspects. Compared to the countries in the region, Vietnam is still at the embryonic stage and needs to dedicate more resources and expertise to the development process.

Key words: biosafety, biotechnology, GMO (genetically modified organism), risk assessment

INTRODUCTION

Biotechnology is a promising branch of science in the 21st century, offering great possibilities and new opportunities for improving human life in various ways. The use of biotechnology in different sectors such as agriculture, and health care has produced a growing number of genetically modified organisms (GMOs) and their products. In agriculture, it provides the advanced technology for increasing productivity gains to feed the world's population. Modern biotechnology can enhance agriculture productivity in developing countries by reducing poverty, improving security and nutrition, and promoting sustainable use of natural resources. Although the possibility for improving the crops through biotechnology is enormous, public corncern about the potential risks posed by genetically modified organisms should be taken into account.

Most developed countries have sophisticated legislation in place to ensure the safe transfer, handling, use, and disposal of GMOs and their products in order to protect environment and human health from the negative impacts of biotechnology in the implementation of biotechnology. While the developing countries, particular in least developed countries are still at the embryonic stages of formulation of the national policies, legal frameworks and building capacity. There will be a strong need for a careful assessment of the status of biotechnology development in these countries, and identification of the emerging challenges and constraints in response to the implementation of existing legislation, as well as other issues related to institutional, infrastructure, and human capacity development.

GLOBAL TREND IN BIOTECHNOLOGY DEVELOPMENT

The value of global market for GM products is worth approximately US$13 billion in 1998 and about 80 new biotechnology-based products are ready for commercialization (Persley and Doyle 1999). The great number of modern biotechnology application comes to health care, crop improvement and environmental protection. In agriculture, transgenic crops which were grown on 28 million hectares worldwide in 1998 are increasing up to 58.7 million hectares in 2002, with substantial growth rate of more than 10 per cent per year. There are almost 18 countries had adopted GM crops, mainly in USA, Argentina, Canada, China, South Africa and Australia. More than 25 per cent of global GM crop area is growing in developing countries. The proportion of transgenic crops grown in developing countries has increased consistently from 14 per cent in 1997 to 27 per cent in 2002 equivalent to 16 million hectares, particularly in Argentina, China and South Africa (CropBiotech Net 2003).

Globally, the dominant GM crops are soybean (62%), corn (21%), cotton (12%) and canola (5%). The most dominant trait planted is herbicide tolerance occupied 77%, followed by insect resistance (15%) and insect/herbicide tolerance (8%) (CropBiotech Net 2003). The rapid increase of adoption reflects the growing acceptance of transgenic crops by farmers using new technology in developed and developing countries. Recently, many developing countries recognize the potential benefits of biotechnology for alleviating poverty, ensuring food security, and enhancing product competitiveness. In view of this, many Asian countries have given high priority to biotechnology research and development in order to address the pressing challenges related to the country's needs.

APPLICATION OF BIOTECHNOLOGY IN VIETNAM

The economic growth in Vietnam is significantly contributed by agricultural sector. It contributes a remarkable increase of national product and stabilizes economy, society and politics for the country. In a national social economic strategy, Vietnam has identified biotechnology as an essential and prerequisite not only for increasing domestic needs, to meet new export market demands, but also conserving natural resources by developing improved and more sustainable agricultural systems.

According to the government decree No. 18/CP in 1994, the country's first priority for scientific research is given for biotechnology development for the period 1995-2010[1]. The government policy considers biotechnology as an essential and increasingly important pre-requisite to achieve national goals and objectives for food, feed and fiber production, health care and environmental protection. To facilitate and enhance the biotechnology development, the Ministry of Science, Technology and Environment (MOSTE) is the major player and responsible for establishment and implementation of "Capacity Development Program on Biotechnology". In coordination with MOSTE, Ministry of Agriculture and Rural Development, Ministry of Health, Ministry of Fisheries, Ministry of Forestry, Ministry of Industry established the biotechnology development programs in relation to their respective areas. To implement the decree, the National Committee for Science and MOSTE formulate the planning and investment for biotechnology development for the period one and five years from national budget and international funding and pass to the Prime Minister for approval.

In accordance with the government decree on the strategy of biotechnology development for the period 1995-2010, a National Commission on Biotechnology under MOSTE were formed in 1997. National Commission on Biotechnology consists of interdisciplinary team involved the Minister of MOSTE as a chairman, followed by different people from MARD, Ministry of Health, Ministry of Industry, Ministry of Fisheries, Ministry of Education and Training and National Center for Natural Science and Technology with a

[1] The first government decree on biotechnology development released on 11 March 1994, that could be retrieved on http://www.vietlaw.gov.vn/look_for/contain.asp?code=14120 (in Vietnamese)

mandate to assist the Prime Minister in the implementation of the national program on biotechnology. In coordination with other authorized ministries, the committee is responsible for evaluation and allocation of the funding for each project[2].

AGRICULTURE BIOTECHNOLOGY

In Vietnam, agriculture contributes a significant 25% to the GDP. Seventy percent of households involved in agricultural production. Crop cultivation is the major production branch

in agriculture, which accounts for 81.2% of the gross output of agriculture. Therefore, agriculture in Vietnam continues to play an important role in socio-economic development plan.

It contributes a significant increase of national product and stabilizes economy, society and politics for the country. Agricultural biotechnology application, therefore, is judged as a critical agenda for increasing crop production to meet domestic and export market demands and to conserve natural resources[3].

According to the government decree, for the period 1995-2010, the government has assigned biotechnology as first priority for scientific research. In this regard, four main research areas have been identified for the application of agriculture biotechnology:

- Developing micro propagation technology for economic important plants
- Application of biotechnology in breeding program to create varieties having higher yield, better quality and insect and disease resistance, focusing on rice, vegetables and root crops
- Promoting the use of biological measures in plant and animal protection, Biotechnology application for produding plant growth regulators and active compounds for livestock production and health protection.
- Research and development of biotechnology for post-harvest and food processing
- Development of biotechnology for environmental protection and reforestation

BIOTECHNOLOGY DEVELOPMENT FOR HUMAN HEALTH

- Research and development of biotechonology for pharmaceuticals such as technology for production of vaccines and recombinant vaccines, antibiotics
- Developing technology for production of biopharmaceutical products used for diagnostic kits and cures for the number of diseases and preventing nutrient deficiency in children.

BIOTECHNOLOGY DEVELOPMENT FOR ENVIRONMENTAL PROTECTION AND BIOLOGICAL RESOURCES

- Research and development of bioremediation of pollution in city and industrial areas, air and water pollution.
- Promoting technology for protection of ecosystems, particularly for reforestation and biodiversity, preventing gene erosion.

BIOTECHNOLOGY DEVELOPMENT FOR INDUSTRY

- Developing technology for production of acids, organic solvents
- Research and application of technology for mineral and fuel exploration

RESEARCH ACTIVITIES BY SECTORS

Research and development of biotechnology in Vietnam are largely undertaken by different public sectors. Ministry of Science and Technology is the major player and responsible for designing and managing the national strategy for S&T development on biotechnology. Other ministries such as Ministry of Agriculture and Rural Development, Ministry of Health, Ministry of Fisheries, and Ministry of Industry establish the biotechnology development programs related to their ministerial activities. The National Committee for Science working together with Ministry of Finance and

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2 http://www.vietlaw.gov.vn/look_for/contain.asp?code=4919(in Vietnamese)

3 Although its share in the GDP has been decreasing over the recent years, agriculture still represents an important economic sector in Vietnam. Vietnam has moved from a food importer to the world's third largest rice exporter and also emerged as the world-leading exporter of coffee, pepper and cashews. File: //D:\ VN% 20Database\ Agriculture % 20-product.htm

Ministry of Science, Technology and Environment set up a plan for investment and funding for biotechnology development, preparation of funding allocation for every year and 5-year basis and explore to obtain funding from international donor agencies and submit to the Prime Minister for approval.

There are totally 2 national institutes under National Center for Natural Science and Technology, 16 ministerial research institutions involving 9 institutes under MARD, 2 institutes under Ministry of Fisheries, 2 institutes under Ministry of Health and 1 institute under Ministry of Industry which are conducting the research and development projects of national biotechnology program (Table 1) on the following topics:

- Crop improvement
- Micro propagation of fruit and horticultural plants
- Microbial fertilizer
- Biological control of insect and diseases
- Veterinary vaccines
- Bioremediation
- Natural products and utilization

In addition, 7 universities have faculties or set up the centers or laboratories on biotechnology actively participating National Program on basic science research. The Ministry of Education and Training in coordination with MOSTE and other relevant ministries establishes in-house and overseas training programs on biotechnology at different levels for staffs working at the universities.

OBJECTIVES OF RESEARCH

- To review policy and institutional framework in Vietnam
- To analyse existing situation and emerging challenges in biotechnology development process in Vietnam
- To recommend appropriate policies or viable mechanisms for the implementation with regard to capacity building, and strengthened coordination within Vietnam and other ASEAN countries.

METHODOLOGY

As a part of assessment project, a country survey in Vietnam as case study to different public sectors involved in biotechnology development was carried out as follows:

- Three Ministries in Hanoi: Ministry of Natural Resources and Environment, Ministry of Science and Technology, and Ministry of Agriculture and Rural Development
- One National Agency in Hanoi: National Environmental Agency
- Six Research institutions: 4 in Hanoi (National Institute for Science & Technology, Policy & Strategy Studies, Institute of Biotechnology, Agricultural Genetics Institute, and National Institute of Agricultural Science) and 1 in Ho Chi Minh city (Institute of Tropical Biology and 1 in Can Tho city (Cuu Long Delta Rice Research Institute)
- Three centers/universities: Center of Biotechnology at Vietnam National University Hanoi; Biotechnology Department at University of Agriculture and Forestry in Ho chi Minh; and Biotechnology Research and Development Institute, Can Tho University in Can Tho city.

The trip has been made for the period of one week, from February 17-21, 2003. The major emphasis of the survey was aimed to the agricultural biotechnology and other issues related to the development and commercialization of GMOs. It is therefore the assessments in biotechnology were limited to the public sectors that cover research and development, transfer, handling, and use of GMOs and GMO-derived products. To have an overview structure of the institutional framework on biotechnology and to promote understanding the policy development and research strategies for implementing biotechnology activities at the governmental and institutional levels, the following issues were emphasized:

- Research and development strategy on biotechnology
- Current status of biosafety
- Human resources
- Infrastructure and Facilities
- Funding

As a part of study, a second set of questions was designed and sent to the research scientists who are working on biotechnology

in Vietnam. The survey was conducted by sending email to the 18 selected scientists working in institutes or universities in order to evaluating the situation of biotechnology research and development and their public concerns of specific applications of biotechnology(4).

NATIONAL DEVELOPMENT GOALS, RELEVANCE TO BIOTECHNOLOGY APPLICATION

One of the strategic goals of the 2001-2010 ten-year strategy [5] is to enhance the development of endogenous scientific and technological capacities to ensure applicability of modern technologies, and develop a number of fields, particularly information technology, biotechnology, new material and automation technologies. The major focussed areas have been identified for the biotechnology application in agriculture:

- To enhance the scientific and technological potential in agriculture, particularly biotechnology combined with information technology
- To pay attention to creating and cultivating plant and animal strains with high yield, quality and value
- To rapidly apply new technology to the production, harvesting, storage, processing, transportation and marketing of agro-products
- To apply clean technologies to the cultivation and processing of vegetables, fruits and foodstuffs
- To limit the use of hazardous chemicals in agriculture
- To establish a number of high-tech agricultural zones
- To reinforce the contingent of agriculture, forestry and fishery extension workers, raise their capacity, and promote their role.

In order to accomplishment the national development goals, the national strategy mentioned that it is necessary to strengthen the potential and renew the management mechanisms so that science and technology can really become a driving force for national development. For science and technology, The representative of Ministry of Science and Technology pointed out that there is a further need to concentrate on responding to demands of raising productivity and quality of products, business competitiveness and efficiency, environmental protection, and ensuring national defense and security; the information technology, biotechnology, new materials technology, and automation technology become the increasingly important areas of the development and application. The strategy is also to pay attention to importing new and modern technologies, adapt imported technologies, partially improve and ultimately create specifically Vietnamese technologies. The construction of two hi-tech centers in the neighborhood of Hanoi and Ho Chi Minh City, and a number of key laboratories of the region's advanced standard should be accomplished.

Development of education and training and science and technology is a critical factor for national development to meet the requirements in human resources. It is necessary to strengthen the potential and renew the management mechanisms so that science and technology can really become a driving force for national development. The Strategy for Socio-economic Development determined that natural sciences are to attempt to researching scientific grounds for developing key technological fields and exploiting natural resources, protecting the environment, forecasting natural disasters, and preventing and mitigating their consequences. Technological sciences are to concentrate on responding to the demands of raising productivity and quality of products, business competitiveness and efficiency, environmental protection, and ensuring national defense and

[4] As our data indicates, there are a limited number of scientists involved in the interview due to the problems of our limited timeframes as well as a deprived communication infrastructure in country survey. Many scientists/researchers might not have their email addresses, it is therefore difficult to getting involved them. Another striking challenge for the interview is their positive cooperation. Even though the questionnaire has been sent to 18 scientists, we received only 8 responses to the questions. This becomes the big hurdle in getting public involvement.

[5] Strategy for Socio-Economic Development 2001-2010. Presented by the Central Committee, Eighth Tenure, to the Ninth National Congress. http://www.vdic.org.vn/eng/pdf/socio_economic_dev.pdf

security; to attach importance to the development and application of information technology, biotechnology, new materials technology and automation technology.

In agriculture, over the past years, efforts have been made to increase in productivity, but production has not been met the market demands due to low quality or high production costs. One of the major constraints and challenges for the implementation of the agricultural plan is low level of science and technology capacity, productivity of many plant and animal species of Vietnam is generally low as compared with that of the region and the world. The Agriculture and Rural Development 5-year Plan (2001-2005) mentioned that to meet the urgent requirements on increasing of productivity, product quality and competitive capacity of agricultural sectors, in particular to reach the target of 33 million tones of rice production with 4-5 millions tones of rice for export, it should be necessary to build up a modern and sustainable agricultural sector, first priority is given to key fields like biotechnology, clean and safe agriculture. For the program on plant varieties and animal breeds, application of modern biology and biotechnology using hybrid technology should be implemented to select and create new varieties with high productivity and quality (MARD 2000).

EXISTING LEGAL FRAMEWORKS SUPPORTING BIOTECHNOLOGY DEVELOPMENT

The first national law supporting biotechnology development in Vietnam is the government decree No. 18/CP dated March 11, 1994 on the biotechnology development in Vietnam to the year 2010

According to the decree, the government has given priority for biotechnology research and development and determined the orientation for biotechnology development to 2010 focusing on the areas of agriculture, human health, environmental protection and biological resources, and industry, in particular the need for development of human resources and facilities and restructuring of research institutes on biotechnology in cooperation with other countries and international organizations. The Ministry of Education and Training, Ministry of Science and Technology together with other related ministries establish a strategic plan for different levels of relevant educational and training on biotechnology for staffs at the universities in country or overseas. Funding for biotechnology development will be obtained from different sources such as national budget, international funding from government- and non-government organizations, ODA resources and enterprises.

- Ministry of Agriculture and Rural Development, Ministry of Health, Ministry of Forestry, Ministry of Fishery, and Ministry of Industry establish the program on biotechnology development for their respective ministries
- Ministry of Science, Technology and Environment is responsible for establishment of program on scientific and technological development for biotechnology
- National Committee for Science works together with Ministry of Finance and MOSTE to establish the capital resources and investment plan for biotechnology development, national budget allocation for one and five-years and other international funding sources which will be passed through the Prime Minister for approval.

Decision No. 445/TTg by the Prime Minister dated March 20, 1997 on the establishment of National Committee on Biotechnology. The committee was established to assist the Prime Minister in implementation of the decree No. 18/CP on biotechnology development to 2010.

Decision of Prime Minister No. 02/1999/QD-TTG dated January 8, 1999 on the formation of the committee on Economical-Technological Biotechnology[6]. The committee is responsible for organizing and implementing the economic and technical program. The committee is collaborating with other agencies to evaluate and allocate funding for the projects based on the current rule, and at the same time monitoring and checking the implementation of the projects. The Ministry of Agriculture and Rural

[6] http://www.vietlaw.gov.vn/look_for/contain.asp?code=9315 (in Vietnamese)

Development is in charge of the Economical-Technological Biotechnology.

Decision of Prime Minister No. 98/2001/QD-TTG dated June 26, 2001 on development and investment for the establishment of the infrastructure for Hoa Lac hi-tech zone(7). The first hi-tech zone is built in Vietnam with an aim as the pilot for the process of hi-tech industrialization, and at the same time creating a hi-tech science and technology city. The zone will be established in two stages: first stage from 1998-2010 and second stage from 2010-2020. It is therefore, Hoa lac Hi-tech zone will play a very important role in the process of industrialization and modernization of Vietnam, and function as the driving force for the country to boost socio-economic development.

BIOSAFETY STATUS IN VIETNAM

In accordance with the precautionary approach in Principle 15 of the Rio Declaration on Environment and Development on the environmental protection, the objective of this Protocol is to contribute to ensuring an adequate level of protection in the field of safe transfer, handling and use of LMOs resulting from modern biotechnology that may have adverse effects on the conservation and sustainable use of biological diversity, taking into account risks to human health. The CPB specifically focuses on transboundary movement of all living modified organisms (LMOs), except for LMOs used as pharmaceuticals for human. In addition, the LMOs in transit or destined for contained uses are also excluded. In any case the protocol clearly provides for the right of an importing Party to subject all living modified organisms to risk assessment before taking a final decision on import.

According to the protocol, the countries need to designate a national focal point and competent national authorities to be responsible for performing the administrative functions. The needs of developing countries for capacity building in biosafety and biotechnology are clearly addressed in the protocol and all countries shall cooperate in the development and strengthening of human resources. For the purpose of implementation of this protocol, it is necessary to develop and strengthen the human resources and institutional capacities in biotechnology, in particular scientific and technical training in proper and safe management of biotechnology and in the use of risk assessment and risk management for biosafety, and the enhancement of technological and institutional capacities in biosafety. Many ASEAN countries are actively involved in biotechnology research and have made great efforts in investment in biotechnology, in particular agricultural biotechnology to enhance crop productivity, improve product quality, and better manage environmental resources. To boost up this new technology and benefit from it, it is critical to develop the national regulations that are in place to address the impacts of GMOs on human health and environment. Among the members in ASEAN, Vietnam has not yet signed or ratified the Cartagena Protocol on Biosafety and is still in a process of designing and developing safety regulation for GMOs.

As a country member of Convention on Biological Diversity (CBD) in 1993, Vietnam recognizes the need to concern about possible effects on the balance of the environment, in particular the regulation of import and export foods and commercialization of GMOs. Vietnam government is in process of establishment the biosafety regulations for GMOs and their products to ensure the safe research, management, production development, import, export and use of genetically modified organisms and their products. These regulations also address issues related to food safety.

In line with the Cartagena Protocol on Biosafety, Vietnam has formed a working group which involves National Environment Agency of MOSTE and other research insitutions such as: Institute of Biotechnology, Institute of Tropical Biology (under National Center for Natural Science and Technology), Agricultural Genetics Institute, Cuu Long Delta Rice Research Institute, Food Crop Research Institute, Vietnam Agricultural Science Institute (under MARD) acting as National Focal Points on Biosafety. The

[7] http://www.vietlaw.gov.vn/look_for/contain.asp?code=12574 (in Vietnamese)

working group has drafted the Biosafety Bill which is being approved by the Ministry of Science, Technology and Environment and the list of names and addresses of Vietnam National Focal Points on Biosafety given (Hien et al. 2002).

The main objectives of these regulations are established to ensure the safe research, management, production development, import, export and use of GMOs and their products. These regulations shall not only focus on the transboundary movement of GMOs in accordance with the Cartagena Protocol on Biosafety, but also provide the guidelines for the safe research activities in laboratory and testing in field trial. According to the draft Biosafety Regulations for GMOs and their products in Vietnam, a State Council on Biosafety is established by the Ministry of Science, Technology and Environment with the role of implementing biosafety policies. This ministry is responsible for overall coordination of biosafety regulations and development of guidelines and inspection. Other agencies involved in preparation and oversight of guidelines with respect to their specific areas such as the Ministry of Agriculture and Rural Development will implement the development of biosafety guidelines for agriculture. The Ministry of Industry will implement guidelines related to the food manufacturing industry. Ministry of Health will be responsible for foodstuff industry and food safety aspects; Ministry of Trade is coordinating with relevant ministries branches in permit of import, export of GMOs and their products (Figure 1).

In addition to that, the institutional biosafety guidelines for laboratories and research works have been prepared and implemented in few biotechnology research institutes such as Institute of Biotechnology, Institute of Tropical Biology but no any biosafety committees have been setting up at these institutions. The activities on biosafety at the institutional level involve training staffs on biosafety before working in specific research laboratories, organizing workshop on biosafety issues, and conducting research project on risk assessment. Vietnam is willing to comply with the international convention, i.e. Cartagena Protocol on Biosafety to the Convention on Biological Diversity, by taking necessary steps to formulate the appropriate legal such as the Draft Proposal of Biosafety Guidelines of Vietnam (MOSTE 1998) or the institutional biosafety guidelines for laboratories and research works (Hien et al. 2002), and to establish other administrative (National Focal Points, National Biosafety Committee) in accordance with the Cartagena Protocol.

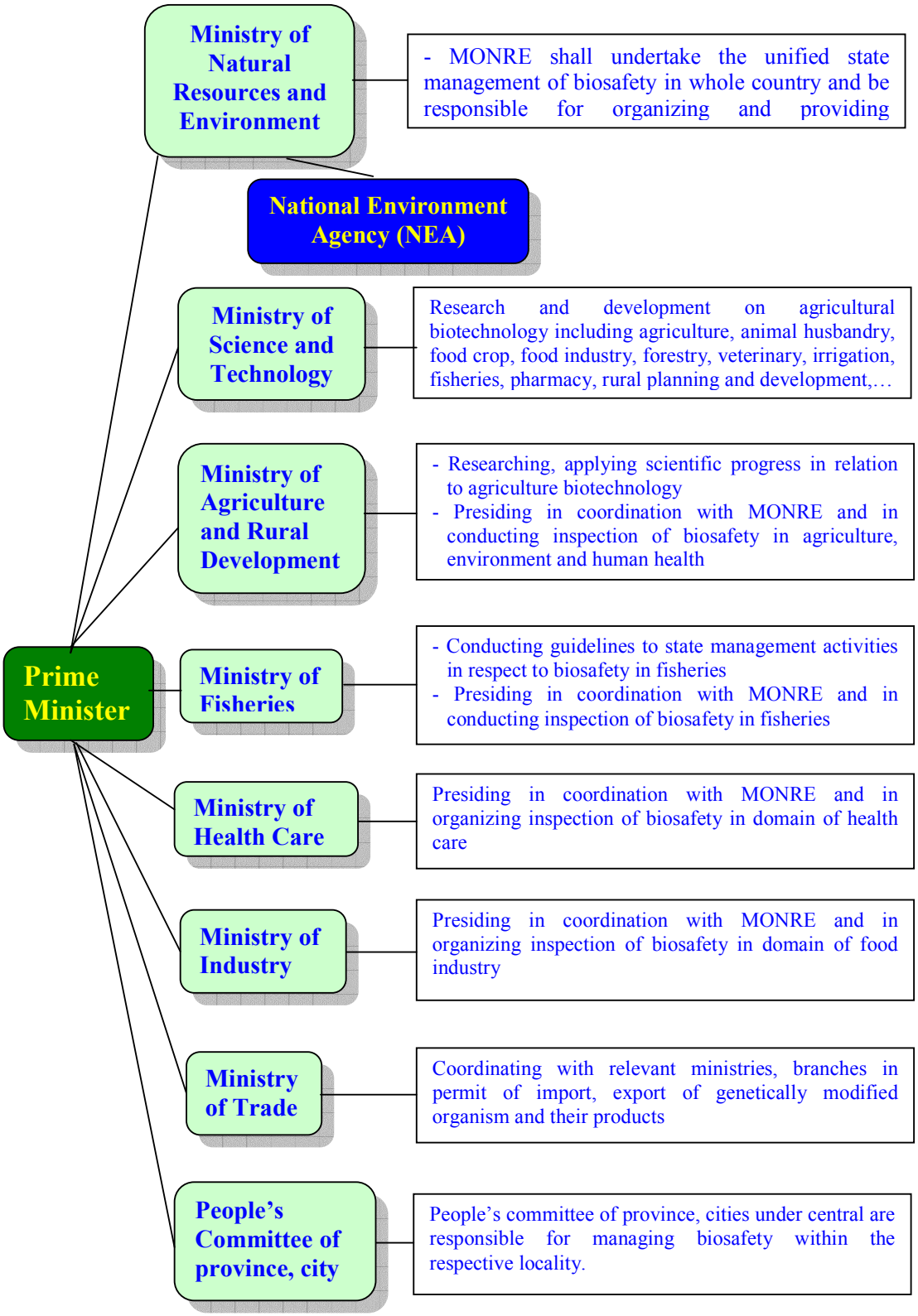

Figure 1: State management of biosafety in Vietnam

Table 1. Biotechnology Research and Development Institutions in Vietnam

Institution	Ministry	Location	Role	Function
1. Institute of Tropical Biology (ITB)	NCST	Ho Chi Minh	National research institute on biology and biotechnology	R&D
2. Institute of Biotechnology (IBT)	NCST	Ha Noi	National leading research institute on biotechnology	Fundamental, R&D and technique transfer
3. Food Crops Research Institute (FCRI)	MARD	Ha Noi	Breeding research on cereal crops, vegetables	Responsible for the Red River Delta areas
4. Vietnam Agricultural Science Institute	MARD	Ha Noi	Research and technical transfer on agricultural biotechnology	Fundamental, R&D and technique transfer
5. Forestry Science Institute of Vietnam (FSIV)	MARD	Ha Noi	Production relevant research	Research on forestry trees and products
6. Institute of Agricultural Genetics (IAG)	MARD	Ha Noi	Research and technical transfer on agricultural biotechnology	R&D on crop breeding and breeding sciences
7. Post-harvest Technology Institute (PHTI)	MARD	Ha Noi	Research and technical transfer on post harvest technology	R&D on storage and food processing technology
8. Cuu Long Delta Rice Research Institute (CLRRI)	MARD	Can Tho	Rice research for Cuu Long Delta areas	Crop breeding with the emphasis on rice biotechnology
9. National Institute of Plant Protection (NIPP)	MARD	Ha Noi	Research and technical transfer on crop plant protection	Breeding, agent testing, new agent development
10. Research Institute of Marine Products (MAF)	MOF	Hai Phong	Marine biotechnology	R&D and production relevant technologies
11. Research Institute for Aquaculture No. 1 (RIA.I)	MOF	Bac Ninh	Aquaculture research	Aquaculture research in fresh water areas
12. National Institute of Animal Husbandry (NIAH)	MARD	Ha Noi	Research and technical transfer on animal husbandry	R&D on animal breeding and animal feed technology
13. National Institute of Veterinary Medicine (NIVM)	MARD	Ha Noi	Research and technical transfer for animal protection	Vaccine and diagnostic kit development
14. Nha Trang Pasteur Institute (NTPI)	MOH	Nha Trang	Research on human vaccine and medicine microbiology	Human vaccine research and production, diagnostic kit for tropical diseases

15. National Institute of Hygiene and Epidemiology (NIHE)	MOH	Ha Noi	Research on epidemiology of tropical diseases, human vaccine	Development of diagnostic kits and human vaccines
16. Food Industry Research Institute (FIRI)	MOIN	Ha Noi	Research on food processing and industry	Enzymatic food processing
17. Hanoi National University (HNU)	MOET	Ha Noi	Education and research	Basic research and education
18. Polytechnical University of Hanoi (PUH)	MOET	Ha Noi	Education and research	Microbiology and food processing technology
19. National University of HCM City	MOET	Ho Chi Minh	Education and research	Plant micropropagation
20. Hanoi Agriculture University	MOET	Ha Noi	Education and research	Micropropagation and crop breeding
21. Can Tho University	MOET	Can Tho	Education and research	Agricultural biotechnology
22. Hanoi University of Medicine	MOET	Ha Noi	Education and research	Medicinal biotechnology
23. Medicinal and Pharmaceutical University of HCM City	MOET	Ho Chi Minh	Education and research	Medicinal biotechnology

NATIONAL ORGANIZATIONS AND ACTORS IN BIOTECHNOLOGY DEVELOPMENT

Biotechnology research and development in Vietnam are mainly financed and undertaken by the public sectors. The Ministry of Agriculture and Rural Development, Ministry of Health, Ministry of Forestry, Ministry of Fisheries, Ministry of Industry, National Center for Natural Science and Technology and many other ministerial institutions and centers are the major actors in biotechnology development. There are 23 research establishments involved in biotechnology research in Vietnam including 9 research institutions under the Ministry of Agriculture and Rural Development and 8 universities under the Ministry of Education and Training are actively participating in education and research program (Table 1).

In addition, several biotechnology centers have been formed and new courses on molecular biology and genetic engineering have been started within the many Universities. About 8 universities have faculties and laboratories on biotechnology and actively participating National Program on basic science research, some of them have contributed to development of human resources by offering undergraduate and postgraduate courses on biotechnology. For example, the number of students educated in biology/biotechnology at University of Natural Sciences increased from 350 in the year 1998 to 576 students in 2001 (Table 2) (Thuoc 2002). In this regard, the government has a plan 2000-2005 to invest 60 million USD to IBT and United Agricultural Laboratories and 20 million USD to strengthen eight training centers including Hanoi-Vietnam National University, Ho Chi Minh-Vietnam National University, Hanoi Technology University, HCM Technology University, Hanoi Agricultural University, 2.5 million USD for overseas training, 25 billion VND for R&D programs and 2 billion VND

for information and libraries (Nguyen 2000, Hien et al. 2002) (Table 3).

Table 2. Student's education in biology and biotechnology at University of Natural Sciences, HCMC

Year	Number of enrolled students		
	Biology	Biotechnology	Total
1998	350	-	350
1999	400	139	539
2000	339	233	572
2001	418	158	576

Source: Thuoc, 2002

Table 3. Funding for Biotechnology R&D in Vietnam

Activity	Budget (million USD)	Period	Institution
National key lab for gene technology	3	2001-2003	Institute of Biotechnology
Strengthening capacity	60	2000-2005	Institute of Biotechnology, United Agricultural Laboratories
Strengthening capacity	20	2000-2005	8 Training Centers
Overseas training	2.5	2000-2005	
Information and libraries	0.13	2000-2005	

Source: Nguyen 2000, Hien et al. 2002

HUMAN RESOURCES

Aside from expansion of funding for basic research, upgraded the infrastructures and facilities, the government is taking necessary step to build up potential capacity in biotechnology by increasing in number and quality of well-trained people, given more opportunities for overseas training. Many local universities have offered biotechnological courses for biology and agriculture students. Up to now there are more than 200 scientists involved in R&D biotechnology (Nguyen 2000), however to have enough biotech expertise, it is suggested that Vietnam must double training efforts in next few years (Uyen 2002).

Several numbers of scientists and researchers have been involved in the different field of biotechnology (Table 4), but a less number of training professionals who engage in risk assessment in Vietnam at this time. Also at moment, many scientists are still lack of opportunities to interact with other national and international research organizations. It also endeavors to establish biotechnology department at some Universities and pay more attention to invite foreign experts, professors to lecture for students and professional staffs in Vietnam.

Table 4. Biotechnology research institutes and number of staffs involved in biotechnology in Vietnam

Research Institutions involved in Biotechnology R&D	Field of application	No. of staff involved/Total	%
Institute of Biotechnology (NCST)	Animals, plants, microorganisms and basic genetic techniques	200/236	85
Institute of Tropical Biology (NCST)	Fundamental, R&D and technique transfer	35/110	32
Vietnam Agricultural Science Institute (MARD)	Fundamental, R&D and technique transfer	17/212	8
Institute of Agricultural Genetics (MARD)	R&D on crop breeding and breeding science	53/120	44
Cuu Long Delta Rice Research Institute (MARD)	Rice breeding based on MAS, gene cloning and gene transformation	15/125	12
Center of Biotechnology-Vietnam National University (MOET)	Basic research and education	15/107	14
Biotechnology Dept., University of Agriculture and Forestry (MOET)	Basic research and education	16/ ?	-
Biotechnology R&D Institute, Can Tho University (MOET)	Agricultural biotechnology, improved plant varieties and animal breeds	10/16	62

FUNDING

The potential benefits of biotechnology to agricultural production have drawn more attention to the various stakeholders such as the Government, policy makers and research scientists. The financial support for biotechnology investment has come from national and provincial sources. At the provincial level, several plant tissue culture laboratories have been established in many provinces to meet the requirements for quality, quantity, and productivity of vegetable crops (Nguyen, 2000).

The national budget for biotechnology research was very limited, but it is increasing considerably from year to year. In next five-year plan, Ministry of Science and Technology invests $US 14-15 millions for 5 national key laboratories in different fields of biotechnology with the funding amount of $US 4-5 millions (Binh and Sat 2002).

However, most of the institutions (87%) build the institutional research programs such as meeting, training or seminar on biotechnology and biosafety in order to promote the development of local expertise in procedures for risk management. To implement the Cartagena Protocol on Biosafety, 62% of the responders agreed that the country needs to develop legal biosafety frameworks to comply with the biosafety protocol requirements, and most of them (75%) agreed that the government should increase capital investment and improve facilities for biotechnological research (Table 5).

The government of Vietnam has assigned biotechnology as the highest priority in national policies, particularly the application of biotechnology in agriculture. As indicated, agriculture in Vietnam continues to play an important role in socio-economic development plan. It contributes a significant increase of national product and stabilizes economy, society and politics for the country. Vietnam Government policy considers agricultural biotechnology as an essential and increasingly important requirement to achieve national goals and objectives for food security, feed and fiber production, healthcare and

environmental protection. The application of agricultural biotechnology, therefore, is considered as a critical agenda for increasing crop production to meet domestic and export market demands and to conserve natural resources. For the period 1995-2010, the government has assigned biotechnology as first priority for scientific research. In this regard, four main research areas have been identified for the application of agriculture biotechnology (Hien et al. 2002):

- Developing micro propagation technology for economic important plants
- Application of biotechnology in breeding program to create varieties having higher yield, better quality and insect and disease resistance, focusing on rice, vegetables and root crops
- Promoting the use of biological measures in plant and animal protection
- Development of biotechnology for environmental protection and reforestation

Table 5. Scientists' Attitudes to Biotechnology-Related Issues

Question	Answer	Buu	Duc	Hop	Toan	Hien	Lang	Loc	Quynh
		1	2	3	4	5	6	7	8
1. What percentage of your time is devoted to research and what percentage to teaching?	Reseacrh	80%	80%	80%	50%	80%	80%	80%	100%
	Teaching	20%	20%	20%	50%	20%	20%	20%	
2. Do you identify research problems by yourself or is it provided to you?	By myself						+		
	By others								
	By myself & others	+	+	+	+	+	+	+	+
3. Is your research applied or is it basic and theoretical?	Applied	50%	50%	50%	50%	50%	50%	50%	50%
	Basic & theoretical	50%	50%	50%	20%		50%	50%	50%
4. Who are the recipients of your results and findings?	Government	+	+	+			+	+	
	Private sector	+			+		+	+	+
	Other researchers	+		+	+	+	+	+	+
5. How many joint projects	Number of joint projects	3	2	2	2	3	3	3	3
and with whom do you most have joint projects with?	Foreign partner	+	+	+			+	+	
	Other institutes	+			+		+	+	+
	Universities	+		+	+	+	+	+	+
6. How many research publications have you had in the past 5 years?	No. of publications	>3	3	>3	2	>3	>3	>3	>3
7. How many international meetings/conferences on biotechnology have you attended in the past 5 year?	No. of meeting attended	>3	3	3	0	>3	>3	>3	>3
8. Has your government provided appropriate financial support for the implementation of your research projects?	No								
	Not appropriate to national circumstances								
	Yes- to a limited extend	+	+	+	+	+	+	+	+

9. Has your institutions undertake measures to regulate, manage, or control the risk associated with the use of genetically modified products	No measures	+		+					
	Some measures in place				+	+		+	+
	Potential measures under establishment	+	+				+		
10. Has your institution organized expert meeting, workshop, seminar or training on biotechnology/biosafety in order to promote the development of local expertise in methodologies, techniques, and procedures for risk assessment?	No					+			
	Some programme in place	+	+	+	+		+	+	+
	Many programme in place								
11. How does your country comply with biosafety protocol requirements?	Develop biosafety policy in line with Cartagena Protocol				+	+			
	Develop legal framework for biosafety	+		+	+			+	+
	Training and implementation risk assessment						+		
	Human capacity development								+
12. What should your country do in order to take full advantage of development in biotechnology?	Increase capital investment for biotechnology research	+		+	+		+	+	+
	Improve research facilities, particularly applied research	+	+	+	+		+		+
	Implementation of biosafety protocol			+	+	+			

CHALLENGES AND CONSTRAINTS

In order to meet the national plan, the government needs to take necessary steps to establish the legal framework with regard to the conduct of both laboratory research and field trial of modern biotechnology products.

Few biotechnology research institutes, such as IBT has been prepared and implemented their institutional biosafety guidelines for laboratories and research works. However, as they mentioned, "the existing regulatory institution is not adequate for oversight of biotechnology products since there is no national legislation to address all aspects of biosafety issues so far". Even putting more strong effort on biotechnology research and development over last few years, no fund has not been yet provided for relevant scientific institutes or universities to conduct the research on the risk assessment of GMOs.

As compared to other countries in the regions, the biotechnology policy appeared earlier in the Philippines in 1980, in Thailand in 1983, and in Indonesia in 1985. The status of

biosafety regulations of ASEAN member countries revealed that few member countries involved Indonesia, Malaysia, Philippines, Singapore and Thailand had developed some guidelines for biotechnology research and development and field releases of GMOs. However, none of them had established a comprehensive legal framework to address commercialization and consumer's issues.

In Vietnam, the government of Vietnam is taking necessary steps to establish the institutional biosafety framework, and drafted the biosafety regulations has been formulated and submitted to the government for approval. It is realized that Vietnam is still need to put more efforts on the build up of appropriate policies which are more practicable to accelerate the development process in biotechnology.

Developing human resources has been paid more attention to biotechnology sector during the last ten years; it seems that the development of biosafety is impeded by the shortage of trained persons who are involved in developing and implementing legal issues and biosafety aspects, insufficient and poor infrastructures as well as lack of understanding of biosafety among stakeholders.

Vietnam has recently exhibited great efforts to the use of biotechnology as a tool to enhance agricultural and socioeconomic development, particularly focusing on the improvement of productivity and quality of basic crops such as rice, maize, root crops, soybean, sugarcane cotton, and fruit and vegetable crops. The government has set the budget priority in the field of agriculture not only to alleviate poverty and achieve food security in the future but also to increase the competitiveness of Vietnam products in global market.

Public awareness is one of the key factors in promoting the biotechnology development and considered an important issue for governmental agencies of the country. Most ASEAN countries do not have structured or organized public education programs on GMOs (Bhumiratana 2002). In Vietnam, even though most of the policy makers and researcher scientists which are still positively concern about agricultural biotechnology application being a potential market for biotechnology products. It is evident from the current study that the role of public awareness has not been implemented on the biotechnology development process in Vietnam, particularly for the commercial release and use of genetically modified products.

REFERENCES

Bhumiratana S. 2002. Report on Biosafety policy options and capacity building related to genetically modified organisms in the food processing industry of Asean. Retrieved 10 February 2003. http://binas.unido.org/binas/

Binh LT and LM Sat. 2002. Current status of biotechnology of Vietnam. Retrieved 11 November 2002. http://asean.kribb.re.kr/work/vetnam/vietnam.html

CropBiotechNet. 2003. Global status of GM crops. Retrieved 11 June 2003. http://www.isaaa.org/kc/Bin/gstats/index.htm

Dart PJ, IH Slamet-Loedin and E Sukara. 2002. Indonesia in G.J. Perley and L.R. Maclntyre, ed, *Agricultural Biotechnology: Country Case Studies-A Decade of Development*. Biotechnology in Agriculture Series No. 25. CABI Publications.

De la Cruz RE. 2001. *Agricultural Biotechnology: Country case studies-A decade of development* (Eds. G.J. Persley and L.R. Maclntyre). CAB International. 256 p.

Eiumpong C and S Sriwatanapongse. 2001. The development of biotechnology in Thailand. International Service for National Agricultural Research. Retrieved 9 June 2003. ftp://ftp.cgiar.org/isnar/ibs/papers/eiumpong.pdf

Hanephom S. 2002. Country paper: Lao PDR's paper on poverty and rural development. Planning Department of the Ministry of Agriculture and Forestry, Lao PDR. Retrieved 9 June 2003 http://www.worldbank.org/wbi/attackingpoverty/events/Asia_1002/lao_rural_paper.pdf

Hien LTT, LT Binh, NV Hai and LT Binh. 2002. Current status of biosafety in Vietnam. Retrieved 29 November 2002. http://www.rbp-iucn.lk/biosafety/CouStatus_Vietnam.htm

Jumroonpong B. 2001. Importation of Transgenic Plants and Field Testing in Thailand. Paper presented at South East Asian Workshop on Capacity Development for the Integrated Approaches to Biosafety of Genetically Modified Organisms (GMOs) on 6-8 November 2001. Jakarta, Indonesia.

MARD. 2000. (Ministry of Agriculture and Rural Development. 2000) *Agriculture and rural development 5-year plan (2001-2005)*

Moeljopawiro S. 1999. Managing biotechnology in AARD, Indonesia: priority, funding and implementation. In: J.I. Cohen. (Ed.) *Managing Agricultural Biotechnology-Addressing research program needs and policy implications*. CAB International. pp 66-76.

MOSTE, 1998. (Ministry of Science, Technology and Environment. 1998) *Draft Proposal on Biosafety Guidelines of Vietnam*. (in Vietnamese)

Nguyen T. V. 2000. Agricultural Biotechnology in Vietnam. Retrieved 29 November 2002. http://www.searca.org/~bic/resources/Proceedings/I%20%20Country%20Papers/Agbiotech%20in%20Vietnam.pdf

Osman MB, R Abdullah, V Pillai, UA Bakar, H Hashim, M Hashim and HM Daud. 2001. Status of Research and Development on Transgenic Plants in Malaysia. Paper presented at South East Asian Workshop on Capacity Development for the Integrated Approaches to Biosafety of Genetically Modified Organisms (GMOs) on 6-8 November 2001. Jakarta, Indonesia.

Persley G and JJ Doyle. 1999. Biotechnology for developing countries agriculture: Problems and opportunities. Focus 2, Brief 1 0f 10. IFPRI. Retrieved 27 February 2003. http://www.ifpri.org/2020/focus/focus02/focus02.pdf

Slamet-Loedin IH. 2002. Indonesia: Biosafety-Risk Assessment and Management. Retrieved 13 December 2002. http://www.rbp-iucn.lk/biosafety/CouStatus_Indonesia.htm

Tanticharoen M. 2000. Thailand: Biotechnology for farm products and agro-industries. Retrieved on 2 June 2003. http://www.cgiar.org/biotech/rep0100/Tanticha.pdf

Thuoc TL. 2002. Current issues on GMO and researches at the University of natural Sciences. Paper presented in the workshop on "Agricultural Biotechnology-Facts, Challenges and Future Directions" on 11 June, 2002. HCMC.

Uyen NV. 2002. Vietnam agricultural biotechnology – A critical review. http: // vietbiotech.com/ publish/ index.php/ article/ articleprint/86/-1/2/

SUMMARY IN VIETNAMESE

Đánh giá bước đầu việc ứng dụng công nghệ sinh học ở Việt Nam

Phát triển công nghệ sinh học (CNSH) ở Việt Nam được bắt đầu từ nghị định 18 của Chính phủ ban hành vào năm 1994. Chính sách phát triển CNSH đã có rất sớm ở Philippines (1980), Thái Lan (1983) và Indonesia (1985). Chính phủ Việt Nam đã nổ lực tập trung phát triển nguồn lực và cơ sở vật chất cho CNSH phát triển. Hiện nay, có 23 cơ sở nghiên cứu CNSH ở Việt Nam với trên 200 cán bộ được đào tạo chính qui. Thông qua kết qủa phỏng vấn các nhà quản lý các nhà làm chính sách, CNSH ở Việt Nam biểu hiện hai tính chất: (1) thiếu kinh phí đầu tư, (2) thiếu những kế hoạch thực hiện có tính khả thi cao. Do đó, việc quản lý nguồn vốn về CNSH vẫn còn nhiều vấn đề cần phải cải tiến. Hệ thống văn kiện pháp lý chưa phát triển kịp hiện trạng và yêu cầu của công nghệ sinh học phục vụ nông, sinh, y, môi trường, công nghiệp. Trong khi, nhiều quốc gia đã có những qui định hướng dẫn của nhà nước về trắc nghiệm ngoài đồng sản phẩm GMO, Việt Nam vẫn đang thiếu bộ khung pháp lý cần thiết cho nội dung như vậy, nhất là nội dung thương mại sản phẩm GM và bảo vệ người tiêu dùng. Tuy Việt Nam đã có những cố gắng rất lớn về đào tạo nguồn cán bộ về CNSH trong 10 năm qua, nhưng chúng ta vẫn còn thiếu rất lớn chuyên viên thạo nghề, nhất là lĩnh vực pháp luật và an toàn sinh học. So với các nước láng giềng, Việt Nam còn đang trong qúa trình khởi động bước đầu, cần phải hoàn thiện nhiều hơn nữa về nguồn lực và cơ sở vật chất trong qúa trình phát triển.