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Joint Research for 2021 KAPEX with Cambodia

Policy Capacity for Developing Livestock Vaccine in Cambodia

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National Animal Health and Production Research Institute(NAHPRI)

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List of Abbreviations

ACIAR	Australian Center for International Agriculture Research
ADB	Asian Development Bank
AGDP	Agriculture Gross Domestic Product
AI	Avian influenza
AMR	Antimicrobial resistance
ASDP	Agriculture Sector Strategy Development Plan
ASEAN	Association of South-East Asian Nations
ASF	African swine fever
AFSC	American Friends Service Committees
CASDP	Cambodia Agriculture Sector Diversification Project
CJ	CheilJedang Feed
CP	Charoen Pokphand
CSDG	Cambodia Sustainable Development Goals
CSF	Classical swine fever
CSO	Civil Society Organisations
DAHP	Department of Animal Health and Production
FAO	Food and Agriculture Organisation
FDI	Foreign direct investment
FMD	Foot and mouth disease
GAHP	Good animal husbandry practice
GDAHP	General Directorate of Animal Health and Production
GDP	Gross Domestic Product
HPAI	Highly pathogenic avian influenza
HS	Hemorrhagic septicemia
JICA	Japan International Cooperation Agency
LSD	Lumpy skin disease
MAFF	Ministry of Agriculture, Forestry and Fisheries

MAFRA	Ministry of Agriculture, Food and Rural Affairs
KRC	Korea Rural Community Corporation
KREI	Korea Rural Economic Institute
LASED III	Land Allocation for Social and Economic Development Project
LDC	Least developed countries
LSD	Lumpy skin disease
MAFF	Ministry of Agriculture, Forestry and Fisheries
MARD	Ministry of Agriculture and Rural Development
MOE	Ministry of Environment
MOH	Ministry of Health
NAHPRI	National Animal Health and Production Research Institute
NCVD	National Center for Veterinary Diagnosis
ND	Newcastle disease
NSDP	National Strategy Development Plan
ODA	Official Development Assistance
OIE	World Organisation for Animal Health
PAHPO	Provincial Animal Health and Production Office
PCP	Progress control pathway
PDAFF	Provincial Department of Agriculture, Forestry and Fisheries
PRRS	Porcine reproductive and respiratory syndrome
RS	Rectangular Strategy
SDG	Sustainable development goals
TAD	Transboundary animal diseases
TWG	Technical working group
VAHW	Village animal health workers
WB	World Bank
WHO	World Health Organisation

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1 Joint Research Outline

1.1. Joint Research Background and Purpose

Located in Southeast Asia, Cambodia is recognized as an agricultural country where approximately 45% of the population engages in agricultural activities (MAFF, 2018). In addition to crop cultivation, Livestock is currently making a substantial contribution to the national economy and agricultural sector which provides the draft power for cultivation and serves as a major source of cash income and capital accumulation for farming households.

In the last 5 years, all types of livestock increased significantly from 42.18 million heads in 2016 to 54 million heads in 2020. In 2020, the population of livestock was 53.90 million heads including 2.85 million cattle, 424 thousand buffaloes, 2.52 million pigs, 48.06 million poultry, 3 thousand equine, 1.72 thousand sheep, 30.3 thousand goats, 51 elephants, 17.2

thousand macaques, and 311 rabbits. Compared to 2019, the overall growth rate was 17.6%; including cattle increased by 2.5%, pig 15.1%, poultry 19.0%, sheep 166.2%, goat 9.2%, elephant 183.3%, macaque 21.1%, and 68.1% rabbit growth, while buffaloes decreased by 5.3% and equine decreased by 21.8%.

〈Table 1〉 Statistics of livestock nationwide from 2016–2020

no	Species	Animal statistic in the last 5 years (2016–2020)					Comparison 2019/2020
		2016	2017	2018	2019	2020	
1	Cattle	2,920,314	2,971,722	2,928,534	2,779,762	2,848,576	2.5%
2	Buffaloes	523,514	508,656	500,995	447,385	423,825	-5.3%
3	Draught	1,051,625	935,239	836,301	717,902	648,729	-9.6%
4	Swine	2,970,624	3,074,283	2,747,855	2,185,924	2,516,679	15.1%
5	Poultry	35,733,761	36,244,939	38,166,751	40,395,453	48,062,169	19.0%
6	Horse	5,674	5,137	4,296	3,801	2,971	21.8%
7	Sheep	467	461	459	648	1,725	166.2%
8	Goat	28,977	28,907	26,447	27,740	30,281	9.2%
9	Elephant	63	63	58	18	51	183.3%
10	Macaques	-	-	-	14,228	17,229	21.1%
11	Rabbit	-	-	-	185	311	68.1%
Total		42,183,394	42,834,168	44,375,395	45,855,143	53,903,817	17.6%

Recent figure from a report shows that the total population of cattle in Cambodia was 2.85 million in 2020 (GDAHP, 2020). However, a decline of 4.97% of the total livestock number was observed from 2016-2020, indicating an increasing use of agricultural machinery (GDAHP, 2020). It is noticed that most of the production types are still in forms of small scale or backyard husbandry, while the General Department of Animal Health and Production (GDAHP) has been working to upgrade them into medium or large-scale commercial cattle farms.

There are many constraints pertaining to livestock production. Cattle, buffalo, pig, sheep and goat, and poultry populations are severe affected by endemic parasitic and infectious diseases, with resultant high sickness and mortality rates. Poor nutrition and management are undoubtedly an additional factor contributing to susceptibility to pathogens. livestock diseases are a significant threat to livestock keepers and have major economic implications through losses from outbreaks and costs resulting from measures taken to prevent or control disease (Otte, 2004). They have significant economic, trade and/or food security importance for a number of countries, and can easily spread to other countries and reach epidemic proportions and their control requires cooperation between several countries (FAO, 2006). Foot and mouth disease (FMD), hemorrhagic septicemia (HS), black leg, lumpy skin disease (LSD), classical swine fever (CSF), porcine reproductive and respiratory syndromes (PRRS), African swine fever (ASF), Newcastle disease (ND), avian influenza (AI) and duck hepatitis are endemic and a serious problem in Cambodia. Although the prevalence and distribution of the diseases are poorly documented, the disease has the potential to cause significant disruption to the use of cattle and buffalo for draft power and can cause severe losses to pigs and poultry. Losses can include reduced production and productivity and can include both financial losses as well as psychological effects on farmers. Furthermore, a reduction in productivity results in less food which has a significant impact on the livelihood of people in rural settings.

Among livestock diseases, HS is one of the most challenges for farmers. The disease is caused by a certain bacteria strain of Pasteurella multocida. It is the most epidemic infectious disease that has huge economic loss. The

outbreaks usually occur during rainy season (OIE, 2012), lasting annually from May to October in Cambodian climate conditions although there are some annual HS vaccination campaigns and interventions by the GDAHP.

Reducing the impact of livestock diseases is important for rural communities and is part of the Cambodian Government's policy to improve livestock production and reduce the morbidity and mortality of livestock. In Cambodia, the Government has provided infrastructure and services to prevent and combat livestock diseases. However, intervention focuses on prioritized infectious diseases that significantly constrain the production of livestock. The main constraint to disease control is the low level of Government veterinary capability. For example, control systems are not in place to provide for rapid reporting and investigation of disease, the ability of field staff to undertake basic control procedures such as isolation of infected animals and control of livestock movement is very limited, and central capabilities for epidemiological and economic analysis of animal diseases are weak. Experience has shown that the provision of disease control services by a government can create a dependency among farmers and discourage their adoption of disease management approaches through which they can address the problems themselves (Otte, 2004). Although much effort and input has been made to control the diseases, very little has been achieved due to the fact that there were no appropriate control strategies in place. Moreover, vaccination has sometime not managed effectively by relevant entities, and there is no restrict veterinary regulation concerning the improper use of vaccines and its consequences. It is also sometimes not performed by authorized veterinarian or village animal health workers (VAHW). In some cases, the

vaccine is not stored properly, and the deliveries could take long time. In addition, farmers also opt to treat their animals rather than prevent the disease or ignore the vaccination campaigns.

From 1986-2001, Department of Animal Health and Production (DAHP), which was a former name of GDAHP, had capacity to produce HS vaccine. However, the production has ceased since then due to lacking budgets from donor, American Friends Service Committees (AFSC). Nowadays, the vaccine has been imported 100% from neighboring country to complete the national demands.

The HS vaccine is mostly used more than any other vaccines, but there is shortage in supplies. It not often managed with effectiveness by relevant entities, and there is no restrict vet regulation concerning the improper use of vaccines and its consequences. It is also sometimes not performed by authorized veterinarian or village animal health workers (VAHWs). In some cases, the vaccine is not stored properly, and the deliveries could take long time. In addition, farmers also opt to treat their animals rather than prevent the disease or ignore the vaccination campaigns.

The GDAHP has encouraged local production of veterinary vaccines. In the organization's strategic framework, it has set a target to vaccinate 800,000 heads of cattle and buffalo in 2020 and up to 1,350,000 heads in 2023 against HS. According to the GDAHP's report for 2019, the number of cattle and buffalo vaccinated against HS was about 700,000 heads.

However, the effectiveness of vaccine remains questionable and required investigation. There is also no report on the bacteria serotypes presented in Cambodia. Thus, the information and data obtained from this research is necessary for the potential HS vaccine production in the future.

The overall objective of the joint research is to reduce morbidity and mortality of livestock diseases contributing to food security, food safety and profitable trade, with the following **specific objectives**:

- To find out the demands and uses of vaccine in fields;
- To identify the current existing policy on livestock vaccine and vaccination;
- To identify factors affecting vaccination program; and
- To generate scientific basis and policy recommendations to establish vaccine production and distribution contributing to livestock production improvement.

1.2. Joint Research Contents

1.2.1. Subject of Research

- Collection and analysis of existing data on the current situations of the topic;
- Review and analysis of the existing government policies and strategies including laws and regulations;
- Review of related international cooperation projects/programs related to the topic;
- Conduct field surveys to gather data and information;

- Formulation of practical policy recommendations for investing in livestock vaccine production and disseminating quality vaccines in Cambodia; and
- Preparation of a written proposal that may be submitted to the related governmental organizations for the future cooperation project/program.

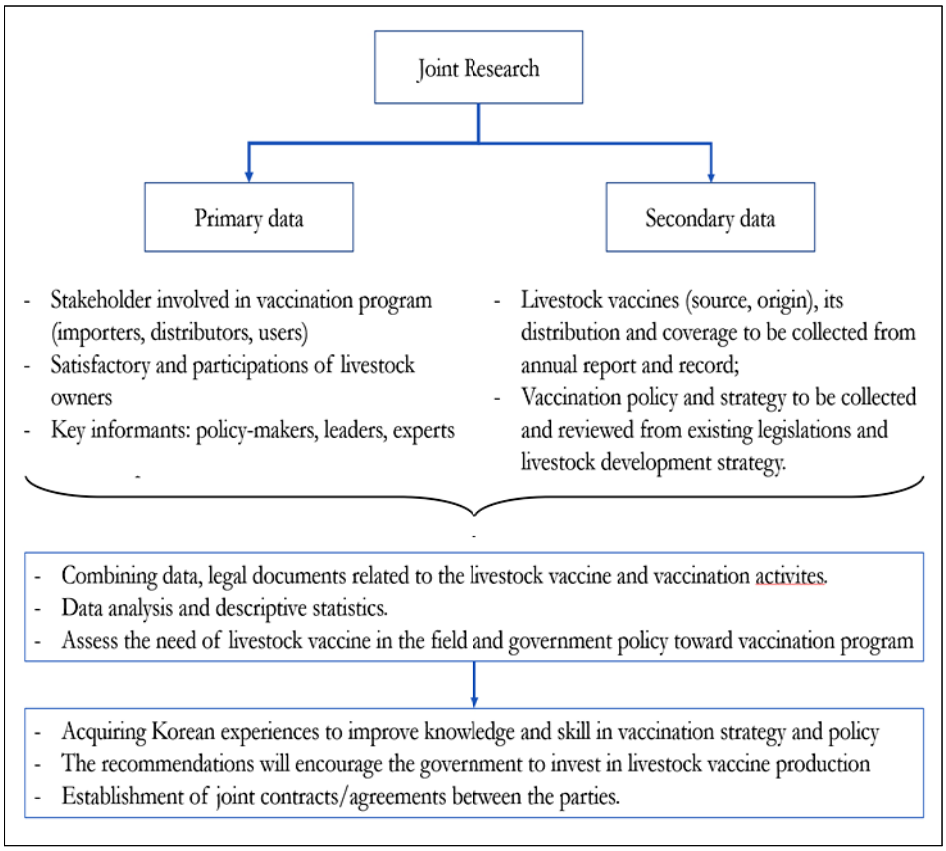
1.2.2. Research question

- What is the current existing policy in livestock vaccination, and vaccine production?
- What are factors affecting vaccination program?
- What is the scientific basis and policy recommendations to establish vaccine production and distribution contributing to livestock production improvement?

1.2.3. Methodology

The study is designed into desk review to gather information on current livestock vaccines that are available at the markets and vaccination program; and the research to collect more information on the vaccine availability, the level of satisfactory and participation in vaccination program, policy and strategy supporting vaccination program and livestock vaccine production.

〈Figure 1〉 Study Methodology Matrix



1.2.4. Research Teams

The GDAHP is the lead agency for this joint research in Cambodia, where NAHPRI has been assigned and responsible for the field implementation. The names and positions of both Cambodian and Korean teams who are working to facilitate and provide support to the joint research are shown in below Tables.

〈Table 2〉 NAHPRI Team

Name	Title	Position
Tum Sothyra	Dr	Director, NAHPRI
Bun Chan	Dr	Deputy Director, NAHPRI
Chhim Vutha	Mr	Chief, Epidemiology and Information Analysis Office
Krean Sokhom	Mr	Vice Chief, Epidemiology and Information Analysis Office
Koeut Dina	Mr	Vice Chief, Epidemiology and Information Analysis Office

〈Table 3〉 National Consultants

Name	Title	Position
Cheat Sophal	Dr	Director,
Ith Manay	Dr	Head of Department of Veterinary Medicine

〈Table 4〉 Korean Team

Name	Title	Position
Hyojung Lee	Dr	Team Manager, KREI
Duk Huh	Dr	Research Director, KREI
Heeseong Lee	Mr	Researcher, KREI
Dongseob Tark	Dr	Professor, Jeonbuk National University

1.2.5. Data collection

Secondary data will be collected from the annual report of the General Directorate of Animal Health and Production (GDAHP). Information on livestock vaccine including the source, type, supplier and distribution will be collected from official reports, and legal documents of GDAHP and MAFF, while vaccination usage will be collected from the Provincial Office of Animal Health and Production.

Primary data will be collected through structured questionnaires from all

stakeholders (Table 5) involved in vaccination program. Five sets of questionnaires for different stakeholders including policy-makers, veterinary drug importers and/or distributors, service providers (district officers and VAHWs), and end-users (cattle farmers) were developed, trialed and revised. The questionnaires covered the aspects of livestock vaccination program and policy, importation and distribution of veterinary medicinal products and vaccines, application of and demand for livestock vaccines in livestock production.

〈Table 5〉 List of stakeholders to be interviewed

No	Key informants	Information to be collected
1	Smallholders	Level of satisfactory and participation in vaccination
2	Semi-commercial producers	Source and cost of vaccine used annually, availability
3	Commercial producers	Source and cost of vaccine used annually, availability
4	Village animal health worker	Types of vaccines used and accessed, customers, challenges
5	Private animal health	Types of vaccines used and accessed, customers, challenges
6	Public animal health	Types of vaccines used and accessed, customers, challenges
7	Importers	Sources, target customers, awareness strategy
8	Distributors	Products sold, target customers, awareness strategy
9	Local drug stores	Products sold, target customers, awareness strategy
10	Ministry of Agriculture, Forestry and Fisheries (General Directorate of Animal Health and Production, Department of International Cooperation)	Legal/institutional issues, international cooperation
11	Department of Agriculture, Forestry and Fisheries (Animal Health and Production Office, Agriculture Extension Office)	Legal/ institutional/ social/ cultural issues Farmer extension program on vaccination

1.2.6. Data Analysis and Interpretation

Qualitative research is a scientific method of observation to gather non-numerical data. This type of research "refers to the meanings, concepts, definitions, characteristics, metaphors, symbols, and description of things" and not to their "counts or measures"; analyzing stakeholders in the vaccination program including the livestock owners, vaccinators, policy makers and veterinary product suppliers.

Five sets of questionnaires were developed and administered to get primary data. Statistical method including univariate analysis will be used to analyze factors and correlation of variables. A descriptive statistic such as frequency, percentage, mean, minimum and maximum were used to analyze quantitative data.

1.3. Joint Research Results

Data on vaccine importation and distribution were collected from the GDAHP, while policy and legislative documents were collected from relevant institutions. Information related to vaccine and vaccination in the field setting was gathered through questionnaire interview. The survey was conducted in five provinces namely Battambang, Kampong Chhnang, Kampong Thom, Phnom Penh, Prey Veng, and Takeo provinces. There was a total of 235 people met and interviewed including 30 government officers (5 central, 5 provincial and 20 district), 55 VAHWs, 26 veterinary drug

pharmacies/selling points, 4 veterinary product companies, and 129 farmers.

1.3.1. Animal Health Services

Animal health services in Cambodia are provided by the GDAHP, which comprises three technical departments (Animal Production, Animal Health and Veterinary Public Health, and Technical Extension and Legislation), an administrative and financial department, and the National Animal Health and Production Research Institute.

The budget for the national veterinary services has been steadily increasing, particularly since the formation of the GDAHP in 2016. Notwithstanding this improved financial support from the central government, the funds available to the veterinary services remain inadequate to provide basic disease surveillance, to support effective disease prevention and control, and even for repairs and maintenance of buildings, equipment. and vehicles. International donors continue to be a key resource supporting the delivery of animal health services in Cambodia with a strong focus on TADs, particularly the HPAI and FMD. The management of resources and operations is limited by the lack of a direct chain of command of GDAHP over the POAHP which are managed directly by the constitutionally separated provincial agricultural departments.

At the central level, there is a total of 293 staff of whom 87 are women. The educational background of these staff includes: doctoral degree 7, master's degree 63, bachelor degree 152, and 71 administrative and ancillary staff. A further 872 veterinarians work in decentralized services in the provinces and districts.

Most veterinary services, however, are carried out by about 12,500 active village animal health workers (VAHW) of whom less than 10% are women, who are the backbone of livestock health, and detection and reporting of disease. The goal of the GDAHP is to have at least one VAHW in each village.

An important role for the VAHWs is to contribute to government disease control programs by reporting disease outbreaks, especially FMD to the District Office of Animal Health and Production. VAHWs should also assist in diagnostic investigations and participate in national vaccination campaigns, particularly against HS and FMD. VAHWs are recognized as an important local resource, enabling persons with some skills in animal health, albeit with limited training and support, to assist smallholder farmers. A new bylaw is in preparation for revising the procedure on the selection, training, sustainable management, and duties of VAHWs.

There are several private veterinarians in Cambodia, usually in private companion animal practice in the major cities or working for large integrated production companies. The number of private veterinarians could not be established due to the absence of a Veterinary Statutory Body (Veterinary Council) mandated to keep registers and develop competencies and professional standards of all veterinarians working in the public and private sector in the country. The veterinary association remains in an embryonic stage and is also unable to provide details of all private veterinarians.

1.3.2. Disease Control Program

Livestock production system in Cambodia still relies on smallholder family farming. This includes the majority of cattle, buffalo and small ruminant (predominantly goat) production and a lesser majority of poultry production (68.7%). Only pig production has shifted from family farming to commercial farming as a consequence of increased use of artificial insemination and market volatility from intensive importation of pigs for local slaughter.

Transboundary animal diseases (TAD) and emerging diseases adversely affect livestock production and livelihoods from livestock. In 2019, GDAHP reported the country's first ASF outbreak in five provinces of the country. FMD and HS are endemic in Cambodia. The prevention and control of TADs remain a challenge in Cambodia. Weak field animal health services and a limited budget for the promotion of awareness and behavior change is exacerbated by an inadequate budget for operations, including the lack of supply of sufficient vaccines and a robust cold chain. Stronger veterinary services are needed to protect livelihoods that are reliant on livestock production and to enable the livestock subsector to achieve its potential for socioeconomic growth. The animal health service must efficiently prevent, detect and control diseases that can adversely affect domestic and regional markets, demonstrating to importing countries that national veterinary risk management systems are effective. This is urgently required to enable Cambodia to advancement on the OIE-led FMD Progressive Control Pathway (FMD PCP). Bylaws on the procedure for issuing licenses, veterinary certificates, and technical standards for

animals and animal products movement are all steps towards better control of both endemic diseases and particularly TADs.

Vaccination and improved biosecurity are key control methods for TADs and other infectious diseases in cattle, pigs and poultry in Cambodia, with immunization generally an effective method of protecting individuals and communities. The absence of biosecurity greatly increases risks of TADs epidemics, compromising animal health and the safety of livestock trade. Moreover, smallholder farmers opt to treat their animals rather than prevent the disease or ignore the vaccination campaigns. This may due to the misconception of farmer on the efficacy of vaccination, one injection can protect all diseases. Furthermore, after vaccination about 3% of cattle developed post vaccination effects, swelling at the injection site.

1.3.3. Vaccination Program

Annually the Provincial Animal Health and Production Office (PAHPO) received vaccines from the GDAHP. Of the vaccines received HS vaccine is the highest (93%), followed by FMD (5%) and Blackleg (2%). Once received, the PAHPO dispatches the vaccines to district officers to vaccinate farmers' cattle in villages in early rainy season commonly and at the end of rainy season. The vaccination program conducts under the district officer's authority, and usually involved VAHWs.

The highest number of vaccinations, as reported by GDAHP, is 2 million animals vaccinated annually against HS, with about 100,000 cattle vaccinated annually against FMD. These figures reflect budget challenges

and not disease importance, as this vaccination is conducted at a nominal fee to VAHWs from farmers, with the vaccine provided free of charge. In 2017 and 2018, when the FMD vaccine was provided by donors through the regional OIE office, about 300,000 cattle and buffalo were vaccinated. TADs can severely constrain livestock export, particularly when used as a non-tariff trade barrier by importing countries.

The VAHWs generally assist and participate in vaccinations during the vaccination campaigns once or twice a year. In average, a VAHW vaccinates 446 cows against HS, and to less extent FMD. VAHWs play an important role in treating and vaccinating animals in their village. Most of their incomes derive from treatment of sick animals, and very little from vaccinations.

Cattle vaccine is not readily available in the markets, especially HS vaccine. The vaccines imported by the GDAHP are not enough to vaccinate cattle in the country. The findings from this survey showed that HS vaccination rate in Cambodia is below 50%, where in general cannot develop protective herd immunity, thus cannot prevent the disease occurrences in country.

This may pose problems for harnessing livestock rearing as a driver of economic growth. Small-scale, family-based livestock husbandry operations are not readily transitioned to expansion on a scale that contributes to development of regional trade and export industries.

1.3.4. Cold Chain

Successful vaccination campaigns require proper manufacture/import, storage, transportation, and handling of vaccines by vaccine suppliers or handlers in both the private and public sectors. Implementing successful vaccination campaigns remains a major challenge in Cambodia due to the limited knowledge of vaccine retailers and wholesalers on veterinary vaccine handling and cold storage management practices. The uptake of vaccination by smallholder farmers is discouraged if vaccine integrity is damaged by a poor cold chain with failure of provision of the expected protection. Licensing of vaccine retailers or wholesalers is an important option to consider, enabling auditing of commercial vaccine cold chain conditions, presumably by government officers. In the interim, vaccine distributors should be offered training to improve cold chain standards.

Vaccine cold storage management and handling practices at some veterinary drug stores were not met the required temperature range, with temperatures below the minimum or above the maximum. All the veterinary pharmacy/shop owners interviewed did not monitor the temperature of their fridges, and a wide range of veterinary products are kept in the fridge. This was similar to the findings observed through a study conducted in Pursat, Kampong Cham and Phnom Penh, where daily refrigerator temperature recording was not practiced in any of the veterinary drugstores.

1.3.5. Import and Distribution of Veterinary Products and Vaccines

Cambodia does not produce any livestock vaccines. All available livestock vaccines in the market are imported from various sources by both government and private companies. Poultry and pig vaccines are imported by private companies, while cattle vaccines are imported by the government institution (GDAHP).

There are fifteen private veterinary drug companies registered as drug importers with a total of 685 products, including 526 veterinary drugs and 159 vaccines. The volume of vaccines for cattle/buffalo, pig and poultry, imported respectively by the GDAHP and private companies between 2017 to 2020 is provided in below tables.

〈Table 6〉 Vaccine importation by GDAHP between 2017 and 2020

State	Vaccine	Product of	Animal	Year (doses)			
				2017	2018	2019	2020
GDAHP	FMD	France	Cattle/ buffalo	90,000	90,000	90,000	37,600
GDAHP	FMD	India	Cattle/ buffalo	0	0	0	70,000
GDAHP	FMD	France (OIE)	Cattle/ buffalo	297,700	298,900	0	0
GDAHP	HS	Vietnam	Cattle/ buffalo	1,800,000	2,000,000	2,000,000	1,000,000
GDAHP	HS	India	Cattle/ buffalo	0	0	0	750,000
GDAHP	Blackleg	USA	Cattle/ buffalo	35,000	51,000	25,000	25,000
GDAHP	FMD-trivalent	Vietnam	Pig	1,500	600	500	600
GDAHP	Classical Swine fever	Vietnam	Pig	1,500	600	500	600
GDAHP	Salmonellosis	Vietnam	Pig	1,500	600	500	600
GDAHP	Aujeszky's disease -live	Korea	Pig	1,500	600	500	500
GDAHP	Pasteurella	Vietnam	Pig	1,500	600	500	600

〈Table 7〉 Vaccine importation by private sector during 2017–2020[1)]

Private	Vaccine	Product of	Animal	Year			
				2017	2018	2019	2020
BKP	FMD	India	Cattle/ buffalo	12,000	60,000	0	60,000
Medivet	FMD	India	Cattle/ buffalo	30,000	80,000	80,000	100,000
BKP	HS	India	Cattle/ buffalo	5,000	5,000	10,000	10,000
Medivet	HS	India	Cattle/ buffalo	0	0	5,000	30,000
BKP	Blackleg	India	Cattle/ buffalo	5,000	5,000	7,000	6,000
Medivet	Blackleg	India	Cattle/ buffalo	0	0	0	5,000
BKP	Mixed all		Pig	425,000	345,000	435,000	627,000
Medivet	Swine Fever	Korea	Pig	400,000	400,000	400,000	400,000
Medivet	Swine Fever	France	Pig	100,000	100,000	100,000	100,000
Medivet	Respiratory for piglet	France	Pig	200,000	200,000	200,000	200,000
Medivet		Spain	Pig	100,000	100,000	100,000	100,000
Medivet	Aujeszky's Disease, Porcine Parvovirus, Swine Erysipelas	Spain	Pig	100,000	100,000	100,000	100,000
Medivet	Salmonellosis	Spain	Pig	200,000	200,000	200,000	200,000
Medivet	HS	Spain	Pig	150,000	150,000	150,000	150,000
PhalHeng	Hog Cholera	Korea	Pig	0	0	0	40,000
Medivet	Aujeszky's Disease	France	Pig	400,000	400000	400,000	400,000
Medivet	Aujeszky's Disease	Spain	Pig	200,000	200,000	200,000	200,000
PhalHeng	Aujeszky's Disease	Korea	Pig	0	0	0	100,000
BKP	Mixed all		Poultry	5,900,000	6,940,000	7,690,000	7,683,000
Medivet	Newcastle	Spain	Poultry	2,000,000	2,000,000	2,000,000	2,000,000
Medivet	Newcastle	India	Poultry	200,000	200,000	200,000	200,000

1) Department of Administration, Planning, Finance and Cooperation, GDAHP.

Private	Vaccine	Product of	Animal	Year			
				2017	2018	2019	2020
Medivet	Newcastle	Italy	Poultry	500,000	500,000	500,000	500,000
PhalHeng	Newcastle	Korea	Poultry	0	0	0	1,000,000
Medivet	Infectious Bronchitis	Spain	Poultry	500,000	500,000	500,000	500,000
Medivet	Infectious Bronchitis	Italy	Poultry	500,000	500,000	500,000	500,000
Medivet	Egg Drop Syndrome-76, Newcastle, Bronchitis	Spain	Poultry	300,000	300,000	300,000	300,000
Medivet	Gumboro Disease	Spain	Poultry	1,000,000	1,000,000	1,000,000	1,000,000
Medivet	Gumboro Disease	India	Poultry	100,000	100,000	100,000	100,000
PhalHeng	Gumboro Disease	Korea	Poultry	0	0	0	1,000,000
Medivet	Cholera	Taiwan	Poultry	500,000	500,000	500,000	500,000
Medivet	Fowl Pox	Spain	Poultry	1,000,000	1,000,000	1,000,000	1,000,000
Medivet	Fowl Pox	India	Poultry	500,000	500,000	500,000	500,000
Medivet	Fowl Pox	Italy	Poultry	500,000	500,000	500,000	500,000

Other companies such as CP, Betagro, M pig, CJ import veterinary products and vaccines for their breeding farms. The imported products are strictly used only in their production lines including contracted farms. NAVETCO on the other hand, imports and distributes solely Vietnamese drugs and vaccines.

Between 2017 and 2020, the GDAHP imported and used about 2 million doses of vaccines for large ruminants per year, including 1,887,500 doses of HS vaccine, 94,400 doses of FMD, and 34,000 doses of blackleg (Clostridium chauvoei) and one thousand vaccine doses against pig diseases. It is noted that only part of the total cattle population is vaccination, assuming that the figures are correct. These types of vaccines

together with vaccines for poultry diseases were also imported by the private sector each year.

The veterinary product companies import drugs, vaccines and medicinal products from different sources, and in accordance to the market needs. The imported products are distributed to local veterinary pharmacies or sale points through their sale-agents. Besides, these sale-agents sometimes also deal directly with smallholder farmers to sell medicines or vaccines, mostly for ducks, chickens and pig producers. They also provide advice to farmers on how to use a particular medicine or vaccine.

The demands for veterinary drugs and vaccines vary depending on the users. Smallholder producers prefer cheaper products while the commercial or semi-commercial or small-commercial producers look for higher quality products.

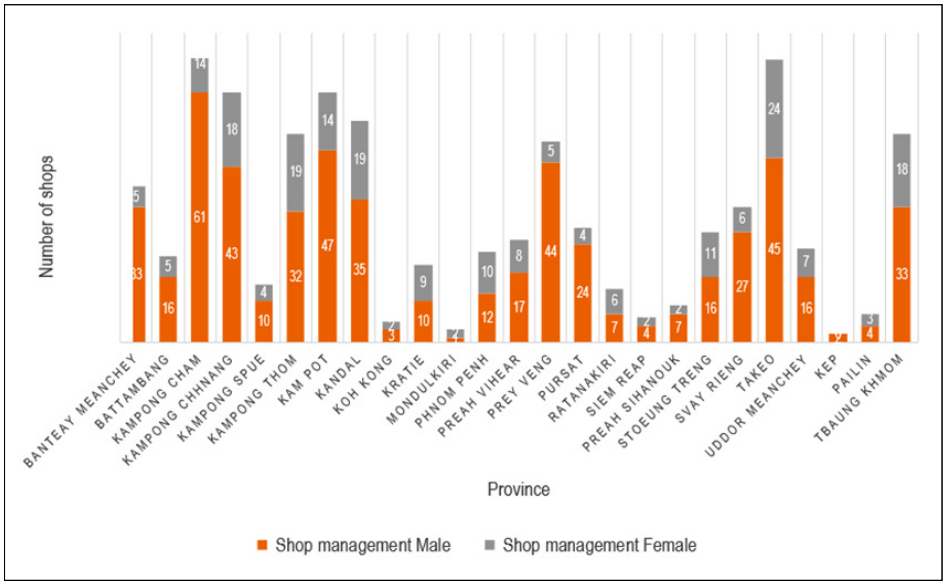
1.3.6. Distribution of Veterinary Pharmacies/Shops

There are 780 veterinary medicine sales points exist in 141 districts of Cambodia (on average 5 veterinary pharmacies per district), where one-third of these pharmacies are managed by women. Forty percent of the pharmacies also sell vaccines, which require a functional cold chain, however, as studies have shown the cold chain management does not meet requirements, and flaws in vaccination campaigns (e.g., level of immunity in vaccinated animals) are surely related to the poor cold chain management. Table 4 shows the number of veterinary pharmacies in each province disaggregated by-products sold, type of operation (retail or wholesale), and gender of the shop manager.

〈Table 8〉 Veterinary pharmacies disaggregated by province, type of trade (retail, wholesale), and sex of management

No	Provinces	Total district	Total drug shops	Shop management		Product sales		Type of trade		
				Male	Female	Drug	Vaccine	Retail only	Whole sale only	Both
1	Banteay Meanchey	6	38	33	5	38	8	31	0	7
2	Battambang	9	21	16	5	21	12	10	0	11
3	Kampong Cham	9	75	61	14	75	23	57	0	18
4	Kampong Chhnang	7	61	43	18	61	20	41	0	20
5	Kampong Speu	3	14	10	4	14	7	7	0	7
6	Kampong Thom	9	51	32	19	51	20	32	0	19
7	Kampot	8	61	47	14	61	19	44	0	17
8	Kandal	9	54	35	19	54	21	33	0	21
9	Koh Kong	2	5	3	2	5	4	1	0	4
10	Kratie	6	19	10	9	19	10	9	0	10
11	Mondulkiri	2	3	1	2	3	0	3	0	0
12	Phnom Penh	8	22	12	10	22	22	0	0	22
13	Preah Vihear	6	25	17	8	25	5	20	0	5
14	Prey Veng	11	49	44	5	49	15	34	0	15
15	Pursat	5	28	24	4	28	8	20	0	8
16	Ratanakiri	4	13	7	6	13	6	7	0	6
17	Siem Reap	1	6	4	2	6	4	0	0	6
18	Preah Sihanouk	2	9	7	2	9	4	5	0	4
19	Steung Treng	1	27	16	11	27	9	18	0	9
20	Svay Reing	8	33	27	6	33	24	9	0	24
21	Takeo	7	69	45	24	69	32	37	0	32
22	Uddor Meanchey	5	23	16	7	23	8	16	0	7
23	Kep	2	2	2	0	2	2	0	0	2
24	Pailin	2	7	4	3	7	3	4	0	3
25	Tbong Khmoum	9	51	33	18	51	19	32	0	19
Total		141	766	549	217	766	305	470	0	296
Percentage				72%	28%	100%	40%	61%	0%	39%

〈**Figure 2**〉 Veterinary Drug and Vaccine Shops in Cambodia (2020)[2)]



1.3.7. Smallholder Livestock Producers

Farmers have an average of 2-3 cattle, 10 chickens with some chicks, and some people also raise a few ducks. Animal disease outbreaks are the most challenge in smallholder production system, where perceptions on vaccination very in both poorer and wealthier farmers interviewed. Most farmers showed their willingness to participate in vaccination program, if it is free, they do not have to pay for vaccinations. Some farmers believe that vaccination is cheaper than the costs of treating a sick animal; and that vaccine provided by governmental authorities are of high quality. Others did not consider vaccination to be the first choice in preventing

2) Department of Administration, Planning, Finance and Cooperation, GDAHP.

their animals from being infected. Furthermore, when prompted about pigs and poultry vaccination most farmers feel reluctant to response, and majority are not ready to vaccinate their pigs or poultry.

In general, only about 70% of cattle were vaccinated against HS. Unvaccinated cattle were due to untamed, pregnancy and fattening conditions. The vaccination rate in pigs and poultry, on the other hand is relatively low. Livestock vaccines used by smallholder farmers are Newcastle disease, fowl cholera, fowl pox, swine salmonellosis, classical swine fever, swine pasteurellosis and FMD. The finding is similar to the study by the People in Need (PIN), where the vaccination rate in cattle is about 72%, pigs 46% and poultry 12% (PIN, 2013).

Smallholder farmers know and are able to contact VAHW when needed. They received animal health services such as vaccination, treatment and deworming from VAHWs, however those who selected to participate with the government or non-government organization programs were more prone to treat their animals themselves. The semi-commercial and commercial producers employ technical staff to provide animal health services at the farms or through the animal health staff from the company, in case of the contract farms.

1.3.8. Vaccination Policy

Vaccination protects the welfare of farm animals by either prevention or reduction of disease risk. This improves the welfare and production of animals from reduced losses from illness. Healthy livestock provide the

bulk of healthy animal-sourced foods, with vaccination and biosecurity safeguarding our food security system. It is an understandable desire of the GDAHP to ensure the protection of livestock against the most common epizootic diseases through locally produced vaccines. The justification is not only to reduce foreign currency outflows for the purchase of those vaccines but also the reliability of the supply chain. Recent COVID-19 restrictions have shown vaccine supply may be compromised when international flight routes are closed or during periods of high demand for the same vaccine.

The government organize vaccination program for large ruminants (cattle and buffalo) annually for smallholder cattle farmers across the country against HS, black leg and FMD. Black leg vaccination organizes in the high-risk areas where the disease commonly occurred. FMD vaccine, on the other hand, use commonly for emergency vaccination program due to limited government resource.

The first veterinary vaccines in Cambodia were produced in 1953 by the Institute Pasteur in Phnom Penh, but soon afterward the Institute withdraw from veterinary and human vaccine production towards human biology and pathology. During the period from 1986-2001, Department of Animal Health and Production (DAHP), which was a former name of GDAHP, had capacity to produce 700,000 dose of HS vaccine. In 2002, MAFF planned to re-establish a vaccine institute to cover Cambodia requirements for the livestock sector. Unfortunately, the donor withdrew since then due to lacking budgets from donor, the American Friends Service Committees (AFSC). In response to this challenge, GDAHP has listed the establishment of a vaccine production unit as one of the top priority projects to be funded through the ADB Greater Mekong Subregion Cross-border Livestock

Health and Value Chains Improvement Project. GDAHP has proposed the following actions under planned ADB project:

○ Establishment of veterinary vaccine center to produce vaccines for large ruminants, pigs and poultry, and vaccine distribution in Cambodia, with the aim to manage and reduce the importation of vaccines that could be produced in the country.

- Establishing a National Veterinary Vaccine Center to produce vaccines for large ruminants, pigs, and poultry, located at an appropriate location in Phnom Penh on land identified and provided by GDAHP;
- Training of appropriate technical staff selected in a gender-responsive manner by the GDAHP, in vaccine production at recommended vaccine production institutions in the region, as soon as funding for the center has been approved, to ensure that the production can start as soon as the premises are handed over;
- Initial consultations should occur with international organizations providing vaccines (e.g., OIE) and veterinary vaccine producers supplying vaccines in SEA to procure all important and required equipment for vaccine production;
- The institute will require the development of animal houses for the testing of vaccines, considering sterility, immunogenicity and/or challenge testing, with potentially, testing of imported vaccines if biosecurity requirements are met;
- Acquire accreditation as an ASEAN Animal Vaccine Testing Laboratory to ensure that all domestically produced vaccines meet the required international manufacturing standards;

- Provision of appropriate cold chain equipment from importers/ vaccine producers to the final users e.g., VAHWs;
- Training of VAHWs in the correct use of the different vaccines (storage, dilution, sites of injection, etc.)
- Post-vaccination surveillance (sampling system and tracing);
- Sample testing (post-vaccination antibody diagnosis) through upgraded laboratories with ISO17025:2017 certification and upgrading of equipment to carry out required tests;
- Quality testing laboratory for vaccines (imported but also domestically produced vaccines).

If success, Cambodia will have some capacity to produce livestock vaccine locally, in particular the HS vaccine. GDAHP also envisages to expand the production to cover other livestock species, and if possible, heat tolerant Newcastle disease vaccine and others will be developed and produced. In addition, the current joint research project on Policy Capacity for Developing Livestock Vaccine in Cambodia has offered support to the GDAHP for accessing livestock vaccine production and policy, and disease control programs.

1.3.9. Conclusion and Recommendations

The findings from this study suggested that the disease control program is weak which may need to strengthen and review. Furthermore, the

current vaccination program does not produce enough herd immunity to protect cattle and buffalo from potential outbreaks of common endemic diseases due to low vaccination coverage. Cambodia does not have capacity to produce livestock vaccine, all available vaccines are imported from various sources by both government and private companies. In order to produce livestock vaccine/s Cambodia need to have capacity for livestock vaccine research and development which can be achieved through a bilateral or multilateral collaboration.

Since the Republic of Korea, has advanced technology in livestock development a collaboration with Korean institutions on livestock vaccine research and development should be explored through the ODA program.

2 Cambodia's Policies and Agricultural Status Analysis

2.1. Consistency with Sustainable Development Goals (SDGs)

The Kingdom of Cambodia is situated in the southern portion of the Indochina peninsula in Southeast Asia, with extensive land borders with Thailand to the west (817km), Laos to the northeast (555km), and Vietnam to the east (1,158km). The Gulf of Thailand forms Cambodia's southern border with a coastline of 443km. Cambodia is divided into 25 provinces, including the capital. The provinces are subdivided into 159 districts and 26 municipalities.

Provisional results from Cambodia's 2019 census,[3] released in August 2019, show a total population of 15.29 million people. The provisional

[3] Open Development Cambodia. 2015. Population and censuses. 3 August. https://opendevelopmentcambodia.net/topics/population-and-censuses/

figures indicate 7.42 million men and 7.87 million women. 78 percent of the population live in rural areas.

Cambodia's Human Development Index (HDI) value for 2019 is 0.594, which put the country in the medium human development category positioning it at 144 out of 189 countries and territories. The poverty rate in 2014 was 13.5 percent compared to 47.8 percent in 2007 with about 90 percent of the poor living in the countryside. In Cambodia, 37.2 percent of the population (6.0 million people) are multidimensionally poor while an additional 21.1 percent are classified as vulnerable to multidimensional poverty (3.4 million people).[4)]

Cambodia has achieved strong socio-economic progress over the last twenty years. Its economy has grown steadily to become a lower Middle-Income Country in 2015 and the government aspires to achieve upper-middle income status by 2030. Overall, Cambodian GDP growth has averaged about 7.7% between 1998 and 2019. This growth has been driven by a combination of expanding tourism, manufacturing, especially garment production, and construction which, together, accounted for more than 70 percent of the country's growth in 2019 and almost 40 percent of paid employment. Remittances from labor migrating to regional countries also contributed to growth. Cambodia's growth has been pro-poor. The percentage of Cambodians living under the national poverty line fell from 47.8% in 2007 to 13.5% in 2014, according to official estimates. The Gini coefficient declined to 0.30 in 2014 from 0.34 in 2009. Cambodia has made significant progress in attaining the Millennium Development Goals. Since 1990, the country has more than halved extreme

4) Cambodia Human Development Index 2020. UNDP

poverty and maternal mortality, achieved nearly universal primary education enrollment, and made significant progress in combating HIV/AIDS. Poverty reduction was particularly dramatic during the 2007-9 period, when poverty declined by 25 percentage points and 3.3 million people escaped poverty, thanks in large part to an expansion of cultivated area and high international food prices which benefited both farmers and agriculture workers.

Growth has also been driven by the country's rich and diverse natural capital, which supports the livelihoods of millions of Cambodians. Agriculture, which depends heavily on natural resources and ecosystem services, contributed to 30 percent of gross domestic product (GDP) in 2015. More than five million people depend on agriculture and fisheries to supplement their income and support their food security, and 88 percent of the population still relies on traditional biomass for cooking. Cambodians are also the largest consumers of freshwater fish per capita, with fish and other aquatic resources contributing 37 percent of total protein. Tourism, another engine of economic growth, is also becoming increasingly dependent on natural resources and environment.

Going forward, Cambodia may not be able to rely on the same factors that drove strong growth and poverty reduction over the past two decades. In the case of agriculture, the outlook for commodity prices is not positive, and Cambodia's scope for further gains in cultivated area is more limited nowadays, especially considering the need for environmental sustainability. Risks posed by the degradation of natural resources could affect economic sustainability. It is crucial to maintain and develop natural resources while strengthening climate resilience. Low prices for

agricultural commodities prices along with rising salaries will require improvements in productivity in order to remain competitive. Given the continued importance of the agricultural sector to growth and poverty reduction, Cambodia will need to foster a gradual transformation of the sector through intensification, diversification, and value addition. The public sector could facilitate expanded irrigation, knowledge and technology adoption in collaboration with the private sector, and strategies of quality differentiation by enhancing systems for managing quality and food safety and introducing an overall coherent approach to "brand" Cambodian food and agriculture.

In September 2015, the Royal Government came together with all the United Nations (UN) member states at the annual session of the General assembly to endorse the expanded and more ambitious agenda set out by the Sustainable Development Goals (SDGs) 2016-2030. The Royal Government has sought again to adapt these global goals to the national context and craft a fully localized set of targets - the Cambodia SDGs, or CSDGs – which will feed into national and sectoral development planning processes, and this document sets out the CSDG framework as a primary input to the National Strategic Development Plan 2019-2023. The framework has been developed through a series of preparations, which have included the Rapid Impact Assessment (RIA) mapping of SDG priorities to national goals; the United Nations Statistics Division (UNSD) assessment of indicators and data sources; and a round of consultations with government's line ministries and various technical working groups.

The RGC has built a solid foundation to support its ongoing development but faces many interlocking challenges, particularly as it further transitions

as a low middle-income country. The CSDGs will contribute and provide an invaluable guide to policymaking and a comprehensive means of measuring performance. The government will continue to do the deeply reform in order to improve efficiency and effectiveness and to harness the contribution from other stakeholders, including private sector, civil society organisations (CSO) and development partners.

〈Figure 3〉 Cambodia Sustainable Development Goals

Underpinned by the Vision 2050, the CSDGs are fully embedded in the Government's long-term agenda to deliver a prosperous, socially cohesive, educationally advanced, and culturally vibrant Cambodia, without poverty, and one where all Cambodians live in harmony.

The CSDG Framework has four specific objectives:

- Presentation of the national goals, targets, and indicators based on Cambodia's priorities;
- Identification of the agencies responsible for oversight and conducting activities to achieve the targets and monitoring schedules;

- Identification of data sources for each indicator, and the data cycle, with provision of working definitions and methods for calculating indicators;
- Presentation of pathways towards achievement of targets, setting (2015) national baselines, setting annual (or cycle-based) target values, and the implementation at sub-national level.

2.1.1. Trade Trend

In recent years, Cambodia has experienced significant developments not only in political and security but also in economic and social aspects. Such environments of political stability, peace, and safety are the prerequisites for Cambodia to make use of its socio-economic potentials.

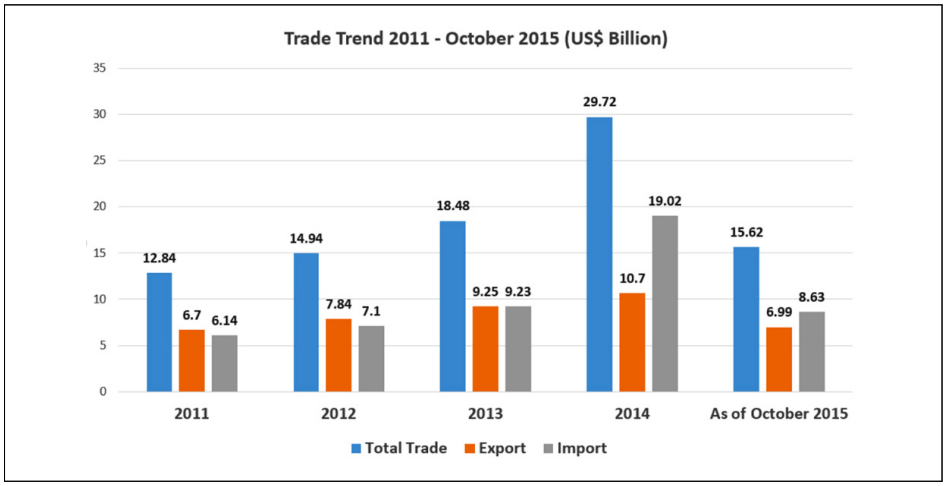
Cambodia achieved steady macroeconomic stability and considerable economic progress including annual average economic growth of 8.4% in the period of 1994-2006 and from 1999 to 2006 the economy was growing at an annual average rate of 9%.

The garment industry in Cambodia has been expanding rapidly and as a result textiles account for more than 70% of total exports. Cambodia's other exports include footwear, natural rubber, rice and fish products. Cambodia mainly imports petroleum products, fabrics, vehicles, wholesale yarn, cigarettes, electrical communications equipment and medicine. Cambodia's main trading partners are the United States, Hong Kong, China, Singapore, Canada and Viet Nam.[5)]

The trade volume from 2012 to 2014 shown an upward trend with a sharp

increase from US$ 14.89 billion in 2012 to US$ 29.72 billion in 2014 marking an increase of 99.60%.[6] Besides, the total trade volume in the first eight months of 2021 remains positive despite the global economic fallout from the Covid-19 pandemic, reaching $25,610 million in the January-August period, up 7.9 percent compared with the same period last year.

〈Figure 4〉 Trade Trend from 2011 to 2015



Agriculture is a best prospect industry sector for the country. The primary agricultural commodity is rice. Other major crops include cassava, maize, mung bean, and soybean. As a matter of policy, the Cambodian government encourages investment in agriculture, diversification of agricultural products, and investment in improved irrigation and water control. The sector accounted for approximately 23.5 percent of GDP in

5) Cambodia Balance of Trade. https://tradingeconomics.com/cambodia/balance-of-trade

6) Trade trend. http://www.cambodiainvestment.gov.kh/why-invest-in-cambodia/investment-enviroment/trade-trend.html

2018. The Cambodian government set a goal of exporting one million tons of milled rice by 2015. However, the actual import could not reach the plan as shown in below table.

〈Table 9〉 Cambodia Rice Production and Exports[7)]

Rice Production and Exports	2015	2016	2017	2018	2019
Total paddy rice surplus for export	4,649,702	5,110,000	5,560,000	5,772,760	5,992,125
Total rice surplus for export	2,975,809	3,270,400	3,560,000	3,752,294	3,954,918
Total export of milled rice	538,396	542,144	635,679	626,225	650,000

The government of Cambodia's Industrial Development Policy 2015-2025, launched in 2015, included the goals of reducing logistics and electricity costs in food processing. There is significant potential to expand the production and processing of high yield varieties of rice, cassava, sugarcane, and other crops. Several investment projects in mango and vegetables are underway.

Higher quality seeds, fertilizers, and other agricultural inputs and new technology – such as spraying machines, pest identification drones, cold storage systems, and other equipment and training –would greatly benefit the agriculture sector, which is only slowly becoming modernized. The presence of an increasing number of plantations also creates opportunities for the establishment of processing plants to add value to basic products for export and domestic consumption. With Cambodia trying to diversify its export market, food safety technology has been in great demand. With limited application of the Sanitary and Phyto-Sanitary (SPS) measure, a

7) Country Commercial Guide, Cambodia – Agriculture. https://www.trade.gov/country-commercial-guides/cambodia-agriculture

significant number of Cambodian products continue to be excluded from export markets due to poor hygiene in handling or other contaminations.

2.1.2. Agriculture Sector Overview

While the agriculture sector contributed about a quarter to annual GDP, it was the source of 36.4 percent (or 3.1 million jobs) of all jobs in 2016. 46.3 percent (or 3 million people) of rural population still rely on agriculture for employment. Employment creation supplied by the agriculture sector grew at 2.8 percent during 2007-11, driven by agricultural development boosted by rising agriculture commodity prices and cultivated land expansion.[8] In 2009, the agriculture sector managed to absorb a large number of laid off factory workers caused by the collapse of the industry sector as the garment and footwear sector faltered during the 2008/09 Global Financial Crisis. Owing to accelerated structural transformation, Cambodia has recently experienced a sharp decline in the share of the employed population working in agriculture. During 2011-15, employment creation by the agriculture sector shrank by 5.8 percent a year caused by drought and depressed agricultural commodity prices. Agriculture continues to depend heavily on natural resources and ecosystem services.

The country experienced exceptionally rapid agricultural growth during the period of 2004 – 2012. This largely resulted in an impressive reduction

8) 2018 Job diagnostic study, the World Bank

of poverty in terms of Cambodia's recent history. During this period, national paddy production more than doubled, while that for a range of feed and industrial crops grew many folds, albeit from an initially small base. Production of livestock/poultry and fisheries also grew significantly, although with a high degree of year-to-year variation. Both area expansion and improved productivity contributed to this rapid and relatively broad-based growth. As mentioned above, between 2008 and 2012, high international commodity prices incentivized farmers and others to expand their planted area, increase their use of improved technologies and invest in the sector. An open trade and investment policy, including allowing the export of un-milled paddy and other raw materials, enabled the quick transfer of international prices to farmers (and farm laborers).

Since 2013, however, Cambodia's agricultural value added has experienced very little growth, raising concerns about the sector's underlying strength and competitiveness and its ability to provide remunerative livelihoods going forward. External shocks, including a large drop in agricultural commodity prices that started in 2012 and extreme weather events in 2013 through 2015, played an important role in slowing progress in the sector. This has led to emerging questions about the underlying sustainability and quality of the earlier growth. After all, the rapid agricultural growth, which was partly driven by the expansion of cultivated areas and practice of monoculture cropping at the early stage of agricultural development, had unfortunately also contributed to deforestation and soil degradation. Initial challenges facing the management of national resources have resulted in depletion of some important aquatic resources including overfishing.

In spite of this, the growing trade of high quality, branded fragrant rice has been a remarkable achievement. Guided by the 2010 rice export policy,[9] promoted in part by the "Everything But Arms" initiative, part of EU generalized system preference, and underpinned by rising private investments in agriculture and agricultural processing with total domestic credits (provided by banks) alone going to the agriculture sector rising to US$1.7 billion in 2017 from US$ 220 million in 2010, milled rice exports have grown tenfold, increasing to 0.53 million metric tons (US$ 310 million in rice exports value) in 2017 from a mere 51,000 metric tons in 2010. This rapid increase has demonstrated that investment in rice production and processing is gradually transforming the sector from subsistence to commercialization, benefitting a significant number of farmers.

2.1.3. Livestock Overview

Livestock production has also seen remarkable development during the past 10 years, despite some existing challenges. Generally, livestock production by both farmer households and commercial farms has seen average growth of 5 percent per annum. Cattle production has decreased by 2.45 percent and buffalo production by 4.8 percent, while pig production has increased by 0.27 percent and poultry production (chickens and ducks) by 6.55 percent, in terms of annual average growth. Animal production among farmer households and commercial farms

9) The Policy on the Promotion of Paddy Rice Production and Export of Milled Rice targeted 1 million tons of milled rice exports by 2015.

increased from 28 million heads in 2011 to 42 million heads in 2020 (from US$1,458 million to US$1,827 million). It is noteworthy that cattle production among farmer households has decreased by an average of 2.47 percent per annum (3.41 million heads in 2011 to 2.84 million head in 2020) owing to a lack of labor in rural areas caused by migration, a decreasing tendency to use animals (cattle and buffalos) as a tractive force and an expanding trend towards using tractors and machinery services to replace the missing labor force.

Pig production by farmer households is still not yet noticeably developed (increasing from 2.2 million heads in 2011 to 3 million heads in 2017 and decreasing to 2.52 million heads in 2020). The slow growth in pig production is the result of high costs of production, which make it hard to compete with neighboring countries, as well as animal diseases (African Swine Fever and other diseases). Regarding poultry production, there has been remarkable progress in both farmer households and commercial farming, with an increase from 23.7 million heads in 2011 to 48.1 million heads in 2020 (or from US$109 million to US$404 million).

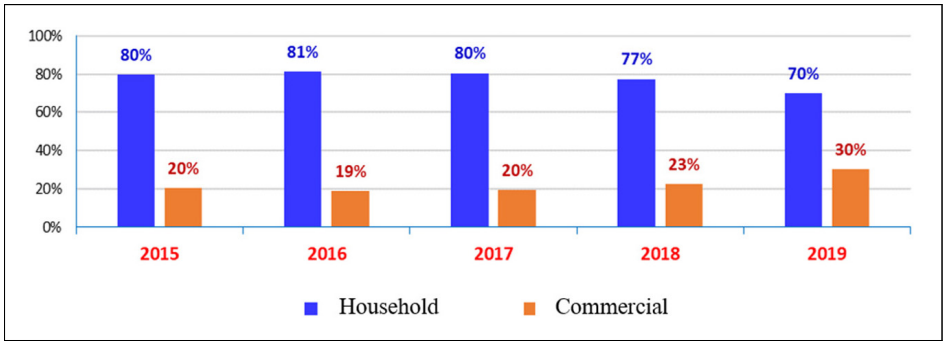
〈Table 10〉 Livestock population (smallholder and commercial) 2011–2020

Description	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020
Cattle (million heads)	3.41	3.38	3.43	3.05	2.91	2.92	2.97	2.92	2.77	2.84
Buffalo (thousand heads)	689.9	657.0	619.1	541.8	506.2	523.5	508.6	500.9	447.3	420.0
Pig (million heads)	2.26	2.46	2.43	2.73	2.77	2.97	3.07	2.74	2.18	2.52
Poultry (million heads)	23.7	27.0	27.6	31.5	34.5	35.7	36.1	38.1	40.4	48.1

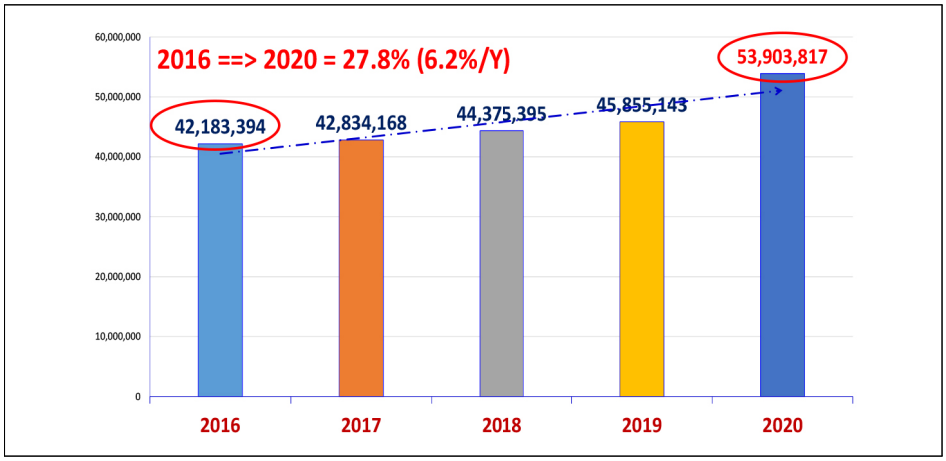
2.1.3.1. Livestock production types

The share in animal-raising taken up by farmer households has decreased over the past five years, going from 80 percent in 2015 to 70 percent in 2019. The share of animal-raising carried out by commercial farms, on the other hand had increased to 30 percent in 2019.

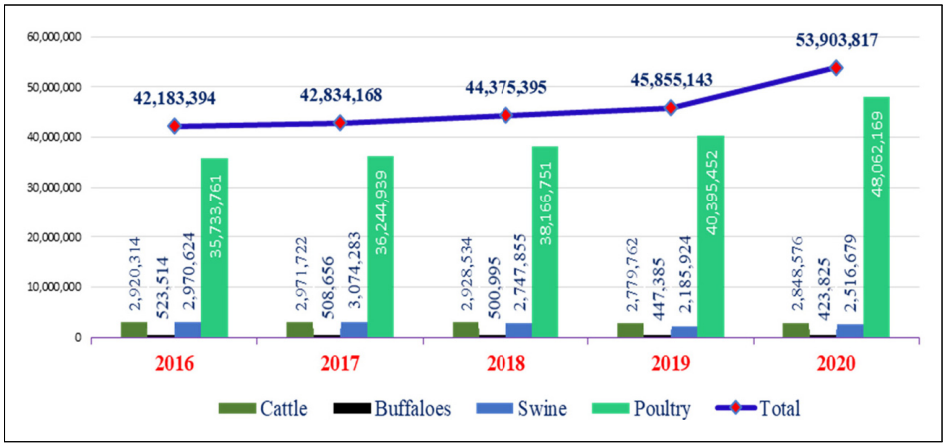
〈Figure 5〉 Change in the share in animal husbandry by households and commercial farms (2015–2019)



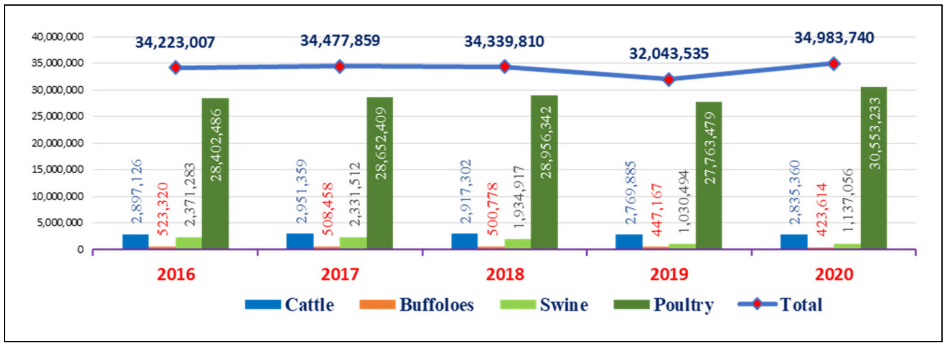
〈Figure 6〉 Nationwide animal production (2016–2020)



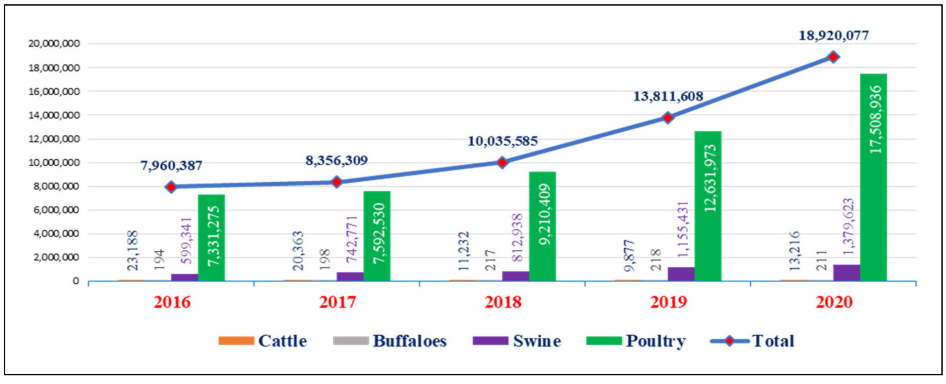
〈Figure 7〉 Nationwide animal production by species (2016–2020)



〈Figure 8〉 Smallholder livestock production (2016–2020)



〈Figure 9〉 Commercial livestock production (2016–2020)



2.1.3.2. Meat Consumption in Cambodia

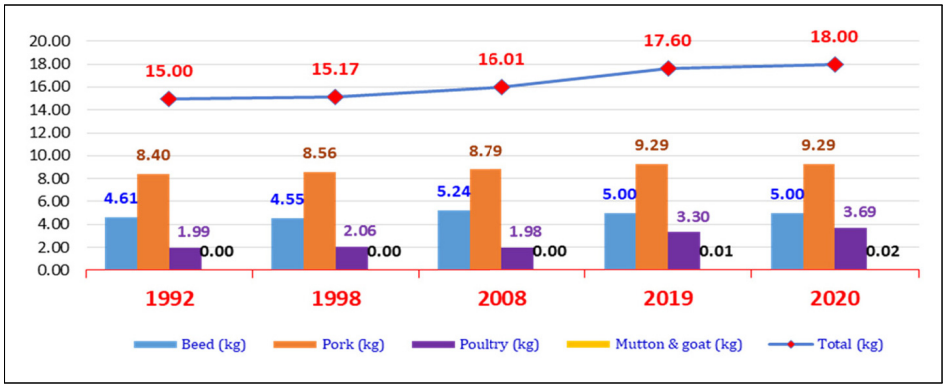
Cambodia is capable of producing 239,000 tons of meat or 82 percent of overall local market demand, which is about 290,000 tons per year (18 percent is made up of imported meat). Artificial hybridization techniques for cattle and pigs are being promoted and disseminated to farmers to boost production but are still not sufficiently developed.

In the last five-year, demand for meat consumption in the country had increased remarkedly from 276,000 tons in 2016 to 301,000 tons in 2020. In 2020, the demand for meat was 301,000 tons of this beef 84,000 tons, pork 276,000 tons, poultry 62,000 tons, mutton and other meat 334 tons. Domestic livestock production has the capacity to contribute around 256,000 tons (85%) including beef 90,000 tons (815,000 heads), pork 10,000 tons (2,179,000 heads), poultry 58,000 tons (48,128,000 heads). To fulfill the need, the remaining amount has been imported from neighboring countries including 1,680,000 live pigs, 5,110,000 chickens, 105,000 ducks, 4,100 sheep and goats and mixed meat (4,930 tons (pork, mutton, poultry, geese, quail, beef, and meat products).

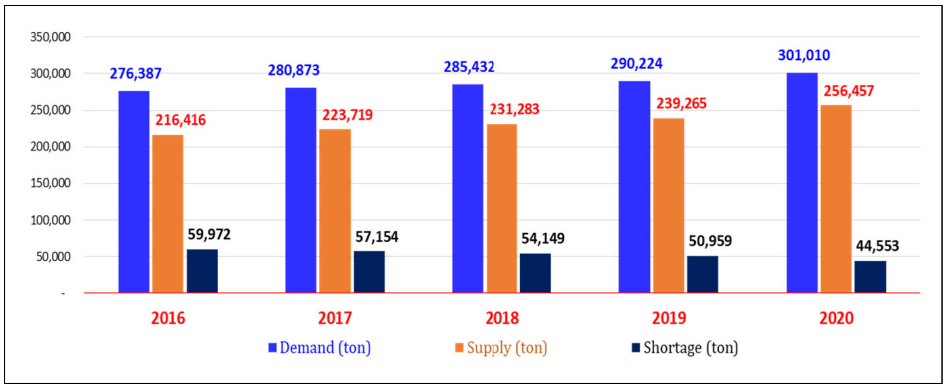
〈Table 11〉 Meat demand, supply and import in 2020

Species	Demand		Supply		Surplus/ deficit	
	Ton	Head	Ton	Head	Ton	Head
Cattle	83, 614	760,000	89,598	815,000	5,984	54,000
Pig	155,355	3,107,000	108,953	2,179,000	−46,401	−928,000
Poultry	61,707	51,423,000	57,754	48,128,000	−3,953	−3,294,000
Sheep, goat and others	334	33,000	152	15,000	−182	−18,000
Total	301,010		256,457		−44,553	

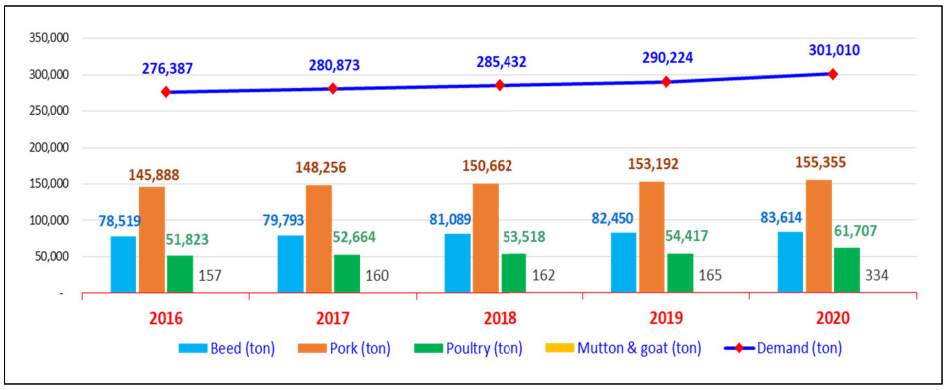
〈Figure 10〉 Per capita meat consumption of Cambodia



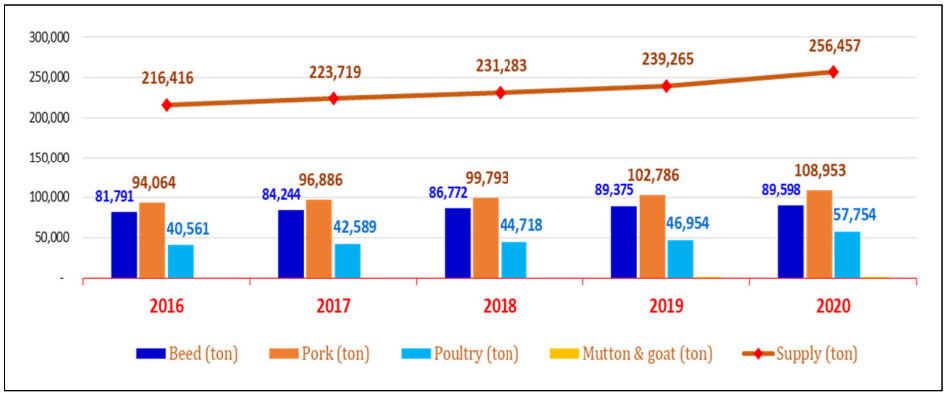
〈Figure 11〉 Meat demand, supply and shortage (2016–2020)



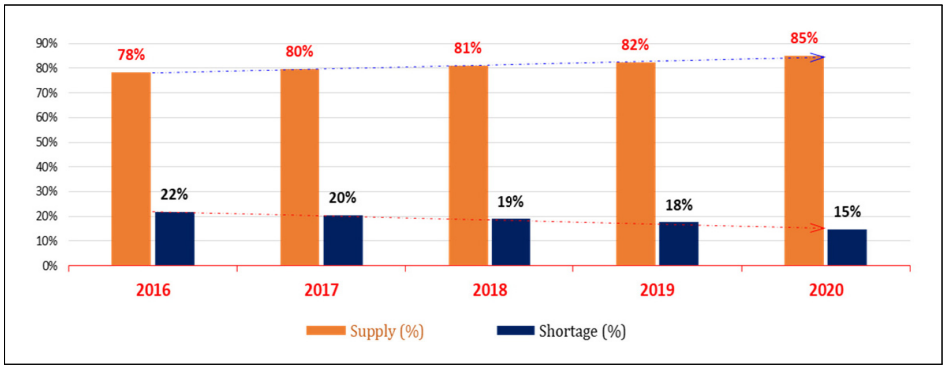
〈Figure 12〉 Meat demand by species (2016–2020)



〈Figure 13〉 Meat supply by species (2016–2020)



〈Figure 14〉 Rate of meat supply and shortage (2016–2020)



〈Table 12〉 Livestock production by sector (1st Semester statistic of 2021)

Livestock	Sector	Measure	Target				Total
			Battambang	Kampong Speu	Svay Rieng	Tboung Khmum	
Cattle (head)	Smallholder	Population	190,882	265,315	232,167	122,200	810,564
		%	98.8%	99.6%	99.4%	99.5%	99.3%
	Commercial farm	Small scale	1,340	630	817	200	2,987
		Medium scale	950	505	490	400	2,345
		Large scale	0	0	0	0	0
		Amount	2,290	1,135	1,307	600	5,332
		%	1.2%	0.4%	0.6%	0.5%	0.7%

Livestock	Sector	Measure	Target				Total
			Battambang	Kampong Speu	Svay Rieng	Tboung Khmum	
Pig (head)	Smallholder	Population	32,737	16,004	85,433	27,000	161,174
		%	64.7%	3.6%	92.3%	35.2%	24.5%
	Commercial farm	Small scale	2,214	111,459	0	6,600	120,273
		Medium scale	15,101	161,997	0	18,200	195,298
		Large scale	584	149,800	7,100	24,800	182,284
		Amount	17,899	423,256	7,100	49,600	497,855
		%	35.3%	96.4%	7.7%	64.8%	75.5%
Poultry (head)	Smallholder	Population	1,540,074	1,528,524	2,085,909	1,331,420	6,485,927
		%	72.5%	34.8%	99.7%	53.3%	58.4%
	Commercial farm	Small scale	241,105	2,422,450	6,750	1,165,000	3,835,305
		Medium scale	122,400	193,250	0	0	315,650
		Large scale	221,000	244,000	0	0	465,000
		Amount	584,505	2,859,700	6,750	1,165,000	4,615,955
		%	27.5%	65.2%	0.3%	46.7%	41.6%

2.1.3.3. Exportation of animals and animal products

Cambodia has capacity to export live cattle and buffalo, pig, chicken, monkey, meat, animal products, animal feed, and milk. During the past five-year Cambodia exported 90,000 cattle and buffalo, 42,500 breeding pigs (sow, boar and piglet), 56,000 day-old-chicks, 109,000 monkeys, 87 tons of beef, 12,000 tons of condensed milk, 7,500 tons of dog food, 112.80 tons of duck down/goose down, and 7,700 tons of cattle hide. In 2020, Cambodia exported 9,700 cattle and buffalo, 200 breeding pigs, 24,000 monkey, 2,276 tons of dog food, 2.80 tons of duck down/goose down, and 1,554 tons of cattle hide.

〈Table 13〉 Number of animals, meat, animal products and animal feed 2016–2020

Animals and animal products	Unit	2016	2017	2018	2019	2020	Total
Cattle and buffalo	Head	6,235	11,240	6,786	56,218	9,742	90,221
Breeding sow, boar	Head	1,250	1,140	505	200	200	3,295
Piglets	Head	34,200	–	5,000	–	–	39,200
Macabre monkey	Head	51,530	6,934	10,472	16,196	23,770	108,902
Chicks	Head	56,000	–	–	–	–	56,000
Beef	Ton	68	7	12	–	–	87
Condensed milk	Ton	–	451	7,558	3,984	–	11,993
Dog feed	Ton	1,370	1,365	1,494	1,011	2,276	7,516
Duck down/ goose down	Ton	50	28	24	8	2.80	112.80
Cattle hide	Ton	1,483	1,972	1,275	1,440	1,554	7,724

2.1.3.4. Animal Feed

The management and implementation of the animal feed program as well as nutritional and productive grass dissemination to farmers are surprisingly developed. Currently, there are 1,980 grass plots and animal feed demonstration farms over 2,307 hectares of land.

Currently, Cambodia has 21 companies and enterprises (CP Cambodia, Agri-Master, Green Feed, Betagro, New Hope, East Hope, CJ, Sanagro, M's Pig ACMC, CKYE, Bright Agri Star, World Vet, Kandoldom Animal Feed, ANT feed, Deheus TMH, Vattanak Animal Health, Feed Bro KH, PWR, Noble Taste Food, I Tao Pet Supply, and Lodi Pet Products) that manufacture animal feed with a capacity to produce about 2.27 million tons of feed per annum. However, they are only able to run at about 56 % of their capacity for various reasons, including deficiencies of local raw materials. Compensating for these deficiencies, was the importation in

2021 of about 322,000 tons of ready-to-use feed and 679,000 tons of raw material for commercial feed production.

In addition to local production capacity, there are a number of companies importing animal feed, raw materials and substantial additives for consumption and local animal feed production. In 2020, Cambodia imported 203,000 tons of animal feed, 254,000 tons of raw materials, 14,000 tons of substantial additives, 2,470 tons of animal medicine, 45 tons of animal vaccines and 75 tons of veterinary equipment and tools.

2.1.3.5. Animal Disease Control

Animal infectious diseases/ zoonotic diseases are still the main problem for causing animal sick and death as well as impact to the household and national economic losses. Currently in 2019 and 2020, African Swine Fever, Highly Pathogenic Avian Influenza, Rabies, Foot and Mouth Disease, Hemorrhagic Septicemia, Newcastle Diseases, Classical Swine Fever and Lumpy Skin Disease occurred in several provinces.

Village animal health workers (VAHWs) serve as a frontline providing local animal health services in rural communities in Cambodia. The contribution and involvement of VAHWs in disease prevention programs are obvious particularly in vaccination programs in the communities, with all vaccines delivered through the government-subsidized program. However, weaknesses in the VAHW system has been identified, particularly in contributing to disease control. Thus, the animal health authorities require more effective policies to strengthen the current VAHW system, improving their services delivery; their retention; their development of

more sustainable roles and the prolonged gender inequity. With the limited availability of government-subsidized vaccination, extension programs engaged VAHWs and farmers in seeking privately funded and delivered vaccination that incorporates appropriate vaccines of high quality, delivered from a robust cold chain, is suggested. This strategy would assist VAHWs to contribute to the provision of private livestock vaccination services that are likely essential for sustainable animal disease prevention and control.

The inspection of animal movement is being strengthened through stronger cooperation with the concerned authorities in implementing the required conditions for the import, export and movement of animals/ animal products. Also, M&E to prevent animal infectious diseases (especially newly emerging disease such as African swine fever and lumpy skin disease) and management of the reporting and information system at national and international level are being reinforced, as are biosafety measures and the emergency response to animal infectious diseases.

Trafficking in wild fauna can significantly impact human health, national security and economic development. Despite the travel restrictions and other social-distancing measures enacted by the government to manage the COVID-19 pandemic, there is likely to be little pause in wildlife trafficking; in many cases, poaching is likely to increase and illegal wildlife traded in a clandestine way exposes human beings to the transmission of new viruses and other pathogens. Wild animals would not pass on these pathogens to humans if didn't bring them to markets and shops.

It can be concluded that achievements in this sub-sector have not yet been sufficient, and stronger efforts are still required. Lack of labor in rural

areas has led to the progressive diminishment of farmer household animal-raising, while animal production through both small- and large-scale commercial farming has progressed notably. This means that local producer protection through an import quota on animals/meats remains necessary. The private sector has formed a livestock raisers association but still needs support from the government, including a reduction in the cost of electricity for animal production and a VAT exemption on animal-raising in order to increase marketability. The cost of electricity in Cambodia is higher than in neighboring countries, with impacts on both livestock production under commercial farming and investors in animal feed; this is thus a priority issue. It is also true that Cambodia still imports a great deal of animal feed, medicine and vaccines, which increases the cost of production.

2.1.4. Key Challenges

Cambodian SMEs, including many of those involved in agro-processing, have limited knowledge about and access to modern inputs and equipment, and limited knowledge about and/or capacity to implement modern processing techniques that would respond to increasing market and quality demands at home and abroad. SMEs and agro-processing firms face high costs of firm formalization, operation and financing. Access to finance is also found to be the fourth- most-severe obstacle for firm operation in Cambodia, according to the World Bank Group 2016 Enterprise Survey. Cambodia recently experienced rapid financial deepening, facilitating improved access to finance. However, though

declining, interest rates remain relatively high, resulting in the high cost of financing.

Market access remains an infrastructure challenge. With road connectivity between Cambodia's main cities having considerably improved in the last decade, access to and from remote rural communities remain a challenge for their inhabitants. Farm to market roads ("agriculture roads") are in many places non-existent or in poor condition, not allowing access to production sites or making access and the transport of in particular bulk agricultural commodities often prohibitively expensive. This also constrains aggregation efforts by trader and middlemen, further aggravating the marketing problems for poor rural smallholders. The situation is compounded by the limited existence of well-organized rural and urban markets where products could be controlled, graded and distinctively priced according to individual qualities. Therefore, farmers' access to markets remains to be further improved, while cutting transportation and storage (and export) costs.[10] Still, there remain large differences between low farm gate prices and high retail prices of agricultural products; this prevents local farmers from gaining more from their production.

Access to Finance for Agriculture remains constrained. Cambodia's financial sector has maintained a strong growth for the past 4 years, at the average credit growth rate of 20% per annum from 2014 to 2017. Lending to agriculture by commercial banks and micro-finance institutions (MFIs) reached US$ 3,878 million equivalent in 2017, accounting for 18.6 percent

10) See Cambodia Economic Update, October 2017, making the most of Cambodian rice sector.

of the total lending (banks + MFIs), against the agriculture sector's contribution to the country's GDP of 30 percent. Agricultural lending has also increased over the past years, however, at a lower rate than lending to other sectors: at the end of 2017, agricultural lending represented only 13.7 percent of the total lending by the commercial banks (compared to 15.06 percent in 2016), and 25 percent of the MFI total lending, against 37 percent at the end of 2014. The perceived riskiness of the agriculture sector, as well as the shortages of long-term funding in the financial sector constrain access of the agriculture sector participants to finance.

On-demand irrigation and adequate water management is essential for successful crop diversification and competitiveness improvements. Though overall Cambodia can be classed as having abundant water resources, its availability is highly variable both temporally and spatially. Even during the wet season, there can be long dry spells and supplementary irrigation will be required to avoid crop moisture deficits between rainfall events. Irrigation is essential during the dry season for crop production. Most existing irrigation schemes have been developed for rice cultivation. The crops that will be targeted under this project require much better water control and management than rice. Irrigation schemes will have to be adapted for diversified cropping and different irrigation methods will have to be introduced, depending on the cop. There are also ample opportunities to develop small schemes for a variety of irrigation methods, either using surface or groundwater that can be abstracted through solar pumping.

Over an extended period, public support for Cambodian agriculture has, appropriately, been focused on meeting the country's food security needs,

with scarce attention to commercial agriculture, or at least the commercialization of smallholder-based production systems and value chains. While the 2014-18 Agricultural Strategic Development Plan (ASDP) lays out a vision for a more diversified and competitive agricultural sector, in practice, many of the instruments of public support, including agricultural research, extension, and bulk irrigation water delivery have been motivated by goals to increase the planted area and yields of rice, financed by a majority of public (including donor-financed) expenditure. Agricultural productivity and commercialization are affected by policy and regulatory constraints, particularly laws and regulations that shape the country's agribusiness enabling environment. A recent global study (Enabling the Business of Agriculture 2017) highlights important constraints in Cambodia's regulatory framework, as it relates to variety registration, seed quality control, fertilizer registration and import, tractor testing and standards, truck licensing, a plant protection framework and an electronic money and warehouse receipt system, limiting private sector investment and inclusiveness along the agricultural supply chain. Logistics and export costs are high compared to most countries in the region due to burdensome procedures and informal payments that many agribusinesses have to pay to speed up the process of obtaining required licenses, permits or certificates for operating, importing and exporting. In addition, there is a shortage of technical laboratories to undertake the necessary independent testing that is required to support the sector; for example, pesticide residue levels and steam sterilization of mangoes that would help facilitate exports.

Reductions in poverty and food insecurity have outpaced improvements

in child undernutrition in Cambodia. At a national level, Cambodia achieved food security in the late 1990s and is now self-sufficient in rice. Thus, the prevalence of undernourishment declined from over 30 percent in 1992 to 16 percent in 2014 (FAO 2015). The country has seen an increase in the quantity and diversity of calories available. Over time, the proportion of calories available from rice has declined from 78 percent of total calories available per person per day in 1992 to 63 percent in 2011, though rice continues to account for the dominant share of available energy. Additional calories are available from fish, sugars, oils, and pulses, but there has been a per capita decline or stagnation in supply of vegetables, fruits, and non-seafood animal source foods. The availability and affordability of a diverse, nutritious diet remains a concern despite improvements in the national food security situation. Recent analysis found insufficient availability of other nutrient-rich fruits, vegetables, and animal source proteins in Cambodia.[11] Cambodia has the lowest per capita fruit and vegetable consumption,[12] with only 105.79 grams of vegetables and 70.15 grams of fruit available per capita per day in Southeast Asian countries. Also, in 2011 Cambodians relied on fish for roughly 70% of protein[13] intake and 8% of calorie intake. In the period

11) National estimates of dietary diversity are an indicator of food security and an important underlying determinant of nutritional status. Percent dietary energy from non-staples, an indicator of dietary quality, was a potent contributor to stunting reduction in developing countries over the period 1970–2010 (Smith and Haddad 2014).

12) Keats S, Wiggins S. 2014. Future diets: implications for agriculture and food prices. London: Overseas Development Institute.

13) Dietary protein is necessary to meet physiologic requirements and maintain the structural and functional integrity of human cells and tissues. Animal proteins are particularly high quality and are an important source of iron, zinc, a number of other micronutrients.

1990-2011, per capita animal-source protein availability in Cambodia rose proportionately faster than total per capita protein supply. Though total protein supply exceeds neighboring Thailand (59 g/capita/day), only 28.5 percent of available protein in Cambodia is of animal origin, compared to 39 percent in Thailand.

Malnutrition is remaining a persistent human development challenge in Cambodia. Child stunting (low height-for-age), which negatively affects children in achieving cognitive potential, is as high as 32 percent in 2014. More importantly, children in the bottom quintile are twice as likely to be stunted compared to children in wealthiest quintile. Stunting is a physical manifestation of chronic undernutrition and is caused most proximately by low nutrient intake and high burden of disease. A recent study found that economic loss due to child stunting amounted to US$130 million per year.

2.1.5. Government Reform Agenda Responding to Challenges

The country's Industrial Development Policy (IDP) was prepared to contribute directly to achieve the objectives of the Rectangular Strategy Phase III and proposes the launch of a new growth strategy, including for the rural economy and the agriculture sector, that responds to the structural transformation of the domestic economy and the changing regional and global economic architecture. Specifically, IDP targets processed agriculture product exports as a share of total exports to increase from 8 percent in 2015 to 10 percent and 12 percent in 2020 and 2025, respectively. In addition, it highlights the role of the industrial sector

to enhance the performance of core economic sectors, including agriculture, which will further contribute to boosting economic growth. The IDP identifies four key strategies of mobilizing foreign and domestic investment; developing and modernizing small and medium enterprises (SMEs); improving regulatory environments to strengthen competitiveness; and coordinating policies for supporting services. Specifically mentioned is the strengthening of the agro-processing industry and the role that SMEs can play and the creation of Special Economic Zones and industrial parks. MAFF/DAI has prepared its own strategic plan complementary to the IDP.

Going forward, it is important to not only expand the range of commodities produced in Cambodia but to diversify beyond crop production, extending agriculture processing to rubber, cassava, cashew nuts and pepper which are currently exported as raw materials to neighboring countries where the value addition and commercialization is done. It is also crucial to promote domestic production and processing to meet a growing demand by households and by the rapidly expanding tourism sector for animal products, fruits and vegetables, and processed food that currently has been serviced primarily by imports. The sector will need to rely upon productivity gains, through intensification, diversification and value addition, and seek to differentiate itself from the region's commodity giants.[14] That differentiation can be qualitative, with an

[14] Unlike in the past, Cambodia's agriculture cannot draw upon an untapped land frontier (except at the expense of protected areas). Given the volatility of international agricultural commodity prices, the sector cannot rely upon a return to exceptionally high international commodity prices to fuel agricultural growth. It is unlikely to prosper, both in the near and longer terms, as a low-cost bulk supplier of undifferentiated commodities, owing primarily to the limits of economies of scale Cambodia can offer.

emphasis on higher quality foods and raw materials, sustainably produced and with due credible assurances. With urbanization and income growth, significant shifts in domestic dietary, food expenditure, and food shopping/eating patterns can continue to be expected, providing new opportunities for well-organized farmers and agro-food entrepreneurs in food distribution, logistics, etc. Continued growth in the tourism sector will also increase 'local' demand for higher value foods, providing further opportunities for Cambodian farmers and firms.

In an attempt to include and promote farmer groups in the development of the agriculture sector, the Ministry of Agriculture, Forestry and Fisheries (MAFF) formulated the Royal Decree on the establishment and functioning of Agricultural Cooperatives (ACs) in 2001 and formulated the ACs Law in 2013 to promote ACs in Cambodia. The Department of Agricultural Cooperative Promotion (DACP) was established in May 2014, under the leadership of the General Directorate of Agriculture. Since then, the numbers of ACs have increased significantly to almost 1,000 ACs in 2017. Around 100,000 families are currently organized in cooperatives. However, capacities of producer groups and cooperatives are still low. Despite the promotion of ACs through MAFF and development partners i.e. JICA, ADB, FAO, IFAD, AFD and NGOs, internal management of the cooperatives remains mostly weak. Their major involvement is through credit and savings activities, with ACs having jointly accumulated a total of about US$10millions.

Further improving the productivity of (labor, land, water) resources devoted to rice remains essential, and there is scope for Cambodia to continue advancing in its exports of high quality, branded rice. Yet, the

aspirations which Cambodia has for its agro-food system need to extend beyond rice. It should embrace the elements of RICE - that is, an agro-food system which is increasingly resilient (R), inclusive (I), competitive (C), and environmentally sensitive (E). It is therefore important to ensure that in many locations a more diversified cropping (or crop/fish/aquaculture) mix or a shift toward other patterns of specialization could yield higher incomes for farmers, more remunerative employment, improved local nutrition, and greater opportunities for value addition.

Looking ahead, it is crucial to reorient the agricultural sector to diversify, add value, externally reposition itself, and increase the competitiveness of small farms and firms. This requires a body of knowledge, technologies, skills, infrastructure, institutions, management systems and commercial relationships which differ from those required for addressing food security needs or supplying low cost, generic raw materials. There are examples of innovation and production diversification occurring in selected government and development partner/NGO-supported projects/sub-programs where some such new knowledge, relationships, etc. are emerging. However, this is not yet being institutionalized or being applied on a scale that would lead to tangible impact at the sectoral level.

2.1.6. Other Complementary Activities in the Sector

Diversification of production and value chains is a direct and indirect objective in a number of donors funded projects and programs with an agricultural and rural development focus. There are a number of other

government-funded and donor-supported interventions with similar or related objectives in the sector. The main and most relevant projects, for which learning and/or exploitation of synergies would be explored include (i) Boosting Agriculture Production, a government funded project aiming at increasing and improving agriculture production; (ii) Accelerating Inclusive Markets for Smallholders (AIMS) supported by IFAD and ADB, supporting selected value chains with an objective to increase returns for smallholders, including poorer farmers and youth, through efficient public sector investment; (iii) Agriculture Services Program for Innovation, Resilience and Extension (ASPIRE), supported by IFAD, promoting a coherent agriculture sector policy and demand and service-oriented extension models; (iv) Cambodia Agricultural Value Chain Program (CAVAC), supported by Australian AID, aiming to increase the productivity and incomes of small farmers and trade in milled rice and other crops by strengthening market systems and investing in irrigation infrastructure; (v) Improving Irrigated Agriculture, supported by ADB, an upcoming project aiming at improving MoWRAM's capacity to deliver irrigation services to farmers; (v) ASEAN Sustainable Agrifood Systems (ASEAN-SAS) implemented by the German Agency for International Development (GIZ), a regional program promoting sustainable, organic (certified) agriculture and food production and marketing systems.

The project would also learn from and work with smaller and larger initiatives supported by private sector and NGOs in the anticipated project regions; (vi) World Bank supported projects for which cooperation or convergence are anticipated would include the ongoing Land Allocation for Social and Economic Development (LASED II) project, providing

support to beneficiaries of the Government's Social Land Concession Program and the planned Cambodia nutrition project. The Project would also be in line with the strategies and interventions proposed as part of the Advisory Services and Analytics (ASA) for the preparation of the Agriculture Sector Master Plan 2030 and the Agriculture Sector Development Strategy 2019-2024; and (vii) ROK have focused on cooperation in rural areas development such as infrastructure construction, water resource development, and expansion of Saemaul Undong projects through the ROK-Cambodia Joint Economic Commission. Since 2018, two sides also discussed ways to cooperate in areas such as support for strengthening industrial capacity, improvement of connectivity in four key areas (transport infrastructure construction, urban development projects, water resource development, power generation), finance, investment, agricultural trade, and labor, and so forth.

2.2. National Development Strategies and Policies

The National Strategic Development Plan (NSDP) is the overarching policy instrument of the Royal Government of Cambodia (RGC). First developed in 2006-2010, it has brought together all key government policies, including economic development, education, health, agriculture, land planning, and environment policies and many others. It is the RGC's blueprint for poverty reduction in Cambodia for the future.

The RGC has endeavored to implement the Rectangular Strategy

Phase-III and accomplished with the proud achievement in the past. In this sixth mandate, The Royal Government of Cambodia sets out the Rectangular Strategy Phase-IV and the National Strategic Development Plan 2019-2023 to strengthen necessary pre-condition and support environment to the deep reform of Cambodia aiming to fully achieve sustainable development goal, particularly, to achieve the Vision of Cambodia becoming as a high-medium level income country in 2030 and high-income country in 2050. The Rectangular Strategy Phase-IV focuses strongly on enhancing productivity and competitiveness, reforming and economic diversification in high value-added activities.

Building on these deeper trends, the RGC has identified a series of opportunities and challenges, for Cambodia, classifying the issues which are highly relevant in the formulation of the NSDP 2019-2023:

Capitalizing on and maintaining growth momentum in the Cambodian economy (flourishing domestic business activity and investment, and high and rising FDI flows, on the back of bullish demand and trade) by addressing productivity and competitiveness bottlenecks. This has many dimensions, including: building human resources and skills; diversifying the economy; boosting value added in industry and service sectors; enabling adoption and adaptation of new (Industry 4.0) technologies, and a specific focus on productivity in rural areas (encompassing farm and non-farm production).

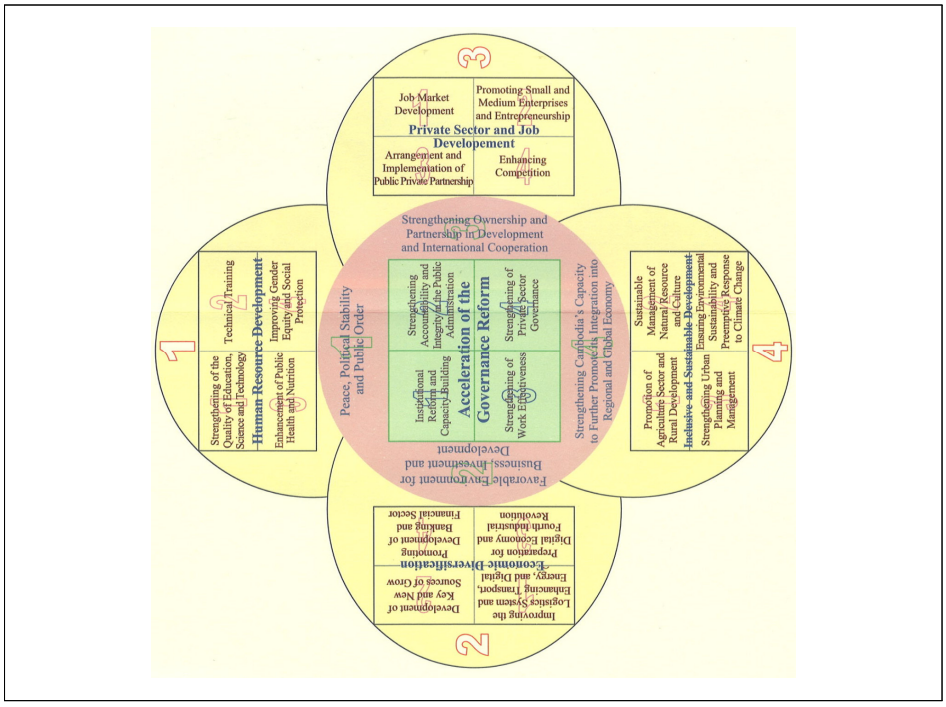
Making full use of Cambodia's locational advantages within southeast Asia, and its proximity to the centre of gravity of global trade by exploiting trade liberalization opportunities (including the ASEAN integration and the LDC trade preferences) to absorb investment and expand export markets.

But equally, to guard against regional and global economy uncertainties, including trade shocks, and lay the groundwork for tackling the eventual loss of the LDC Special and Differential Measures by preparing early for gradation.

Improve the functionality the financial sector, including easing the supply/ reducing the cost of credit, so relieving a key constraint for enterprises of all sizes. This includes development of the domestic insurance and securities markets, improving the quality of the financial intermediation, boosting domestic savings and curtailing household debt. Noting that with the loss of concessional loans, domestic savings and a more efficient capital market are essential to maintaining investment and growth levels. This also has connections with the progressive longer term de-dollarization of the economy, and the issuance of Riel-denominated commercial and state financing instruments.

Reap the full benefits of the demographic dividend and low dependency ratio, to build social security and healthcare systems. This is a route to reducing personal and economy-wide vulnerabilities and risk-aversion, and in turn boosting productivity and economic growth.

〈Figure 15〉 Rectangular Strategy Phase IV



- Maintain peace, political stability and the social order, heading off external and internal challenges – first by reforming public security and judicial services, to deliver the trust of the general the public. Additionally, ensuring political and administrative accountabilities via renewed de-concentration and devolution, and wider public/ civil service reforms.
- Address environment weaknesses which have been inherent to the past economic model and protect the natural resource endowment by nudging/ incentivizing greener production and consumption. In parallel, also meet Cambodia's commitments to climate change action, including de-carbonization of the economy and alongside measures.

Agriculture sector remains one of the lead sectors which contribute to the national economic growth, and also contribute to growth of the national product and income obtaining from agricultural product exportation. The agriculture sector provides job employment and income to people who living in rural area and occupied by agriculture. Stated in the CSDG, Cambodia will double the agricultural productivity and incomes of small-scale food producers by 2030, in particular women, indigenous peoples, family farmers, pastoralists and fishers, including through secure and equal access to land, other productive resources and inputs, knowledge, financial services, markets and opportunities for value addition and non-farm employment.

2.3. Cambodia's Policies and Strategies in Agricultural Sector

In the 4th Rectangular of the Rectangular Strategy Phase-IV, the RGC has mainly focused on (1) Promotion of agricultural and rural development; (2) Strengthening sustainable management of natural and cultural resources; (3) Strengthening management of urbanization; and (4) Ensuring environment sustainability and readiness for climate change. This Rectangular IV is a basic framework for the Ministry of Agriculture, Forestry, and Fisheries (MAFF) to develop the sector within the five years. In addition, with the progress of science and technology of the 4th Industry Revolutionary, the MAFF has prepared action plan integrating this key

technology into the development of agricultural economic development and creating opportunities for agriculture sector. The progress of agricultural engineering and mechanization has speeded up agricultural production and it is divertible agricultural labor into services and industry sectors.

The vision of the Royal Government is "A modern Agriculture Sector which is competitive, inclusive, resilient and sustainable leaded to increase farmers' income as well as the prosperity and wellbeing of the Cambodian people" through new approaches and scope to become this sector from a stage of extensive development which depending mainly on the own resources (land resource and other natural resources) into a new stage of intensive development which base strongly on the use of techniques, new technology, smart agriculture, research, mechanization development, and increasing irrigation capacity to promote productivity, potential crop diversification and market, including commercial livestock and aquaculture productions.

〈Figure 16〉 Overall Agricultural Policy Goals

With this regard, to achieve the development goal of agriculture sector of this sixth mandate, the MAFF sets policy goals "Increase competitive and inclusive agricultural growth, high quality, safety & nutrition products and taking into account the sustainable use of land and ensuring sustainable fisheries and forestry resource management."

Agriculture sector is still playing an important role in promoting the economic, social and rural development, especially in alleviating the poverty in Cambodia. Due to the economic development and increase in production, the two priority strategic targets, set for the development of Agriculture sector, are:

(1) Promoting agricultural productivity, diversification, competitiveness and commercialization

This goal is targeting for the promotion of modernization and mechanization in agricultural production to replace the decrease in agricultural labour with low cost, to reduce the production cost and to diversify crops with high economic potential and high profits for farmers and agricultural communities, which will lead to high market competitiveness; as well as the agribusiness process with inclusive, economic efficient, sustainable.

(2) Increasing the effectiveness of sustainable management and development of forest and fish resources

The goal is targeting for the sustainable conservation and development of land, forest and fish resources. Over the next five years, technical capacity in management must be developed to ensure a balance between

development and conservation in line with existing principles. To achieve the above priority policy goals, five strategies will be rolled out over the next five years:

a) Increase crops productivity, diversification and expand agribusiness
b) Promote animal health and commercial animal production
c) Strengthen the management and development of sustainable fish resources
d) Strengthen sustainable management and development of forest and wildlife resources
e) Increase the effectiveness of institutional management, support services and human resource development.

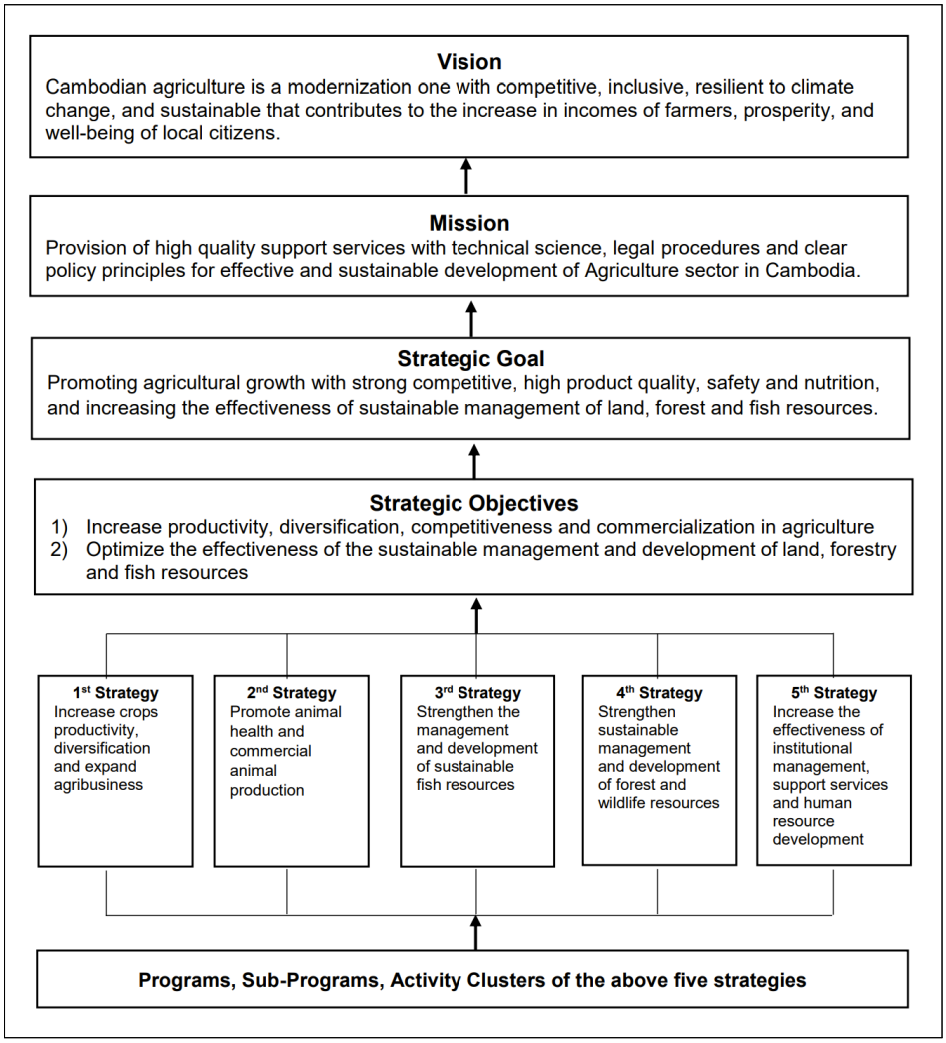
The government has realistically achieved some key indicators of the macro-economic framework by acquiring over 7% of annual economic growth and retaining 3% of the low inflation rate. In 2018, the evaluation of Cambodian economic show that Cambodia was still strong economic nation with 7.5% of economic growth. These achievements have attained in the context of political stability and security which are the key points for Cambodia to step forward in enhancing living standard to achieve the sustainable development affairs. In the implementation of Government's agricultural development policy, Ministry of Agriculture, Forestry and Fisheries (MAFF), has surely made efforts to collectively mobilize and utilize resources and potentials targeting the promotion of agricultural productivity, diversification and commercialization in order to increase the job opportunities and income in the rural areas. Meanwhile, this is also

able to ensure the food security for all people, to improve nutrition, and to increase the export of agricultural products, aiming mainly to promote rural livelihood and alleviate the poverty.

Agricultural modernization has been promoted focusing on the diversification in crops, animals, and aquacultures; the development of infrastructure for the support for agricultural production in competitive production chain system in the response to market demand; the strengthen in the capacity of services, agricultural technical transfer; the development of mechanization to enhance the development of and strengthen in capacity agricultural community to maintain the constant supply of agricultural products to the markets; and the implementation of contract farming to increase the entrepreneurship and the profession in agricultural business. Meanwhile, the enhancement of technological development, and promotion of smart agriculture, research and technical practices – in agricultural production value chain at all stages in response to the effects of climate change – have effectively been implementing.

The agriculture sector has undergone major structural changes in recent years. The major shift has been towards greater crop diversification, and increasing commercialization, compared to the previous almost complete domination of smallholder systems. Traditionally, the Cambodian agriculture economy has been focused on smallholder mixed rainfed crop-livestock systems, but with expanding areas of irrigation, with some areas relying on annual floods. Rice has traditionally been the dominant crop in these systems. This has changed in recent years, with the opening up of previous upland and forested areas to agriculture, resulting in diversification of crops, shifts to large agricultural investments and contract farming.

〈Figure 17〉 Cambodia Agriculture Development Strategies[15)]



The agricultural subsector, comprising crops, livestock, fisheries, and forestry/wildlife contributed approximately 21% (current price) of the Gross Domestic Product (GDP) in 2019, employing a large part of the workforce. However, this is now decreasing as a consequence of farm

15) Agriculture Sector Development Strategy Plan 2019–2023

mechanization and the growth of industry, including the garment industry that has attracted an increasing number of rural people, in particular women. Rice is Cambodia's major crop, its principal food, and its most important export commodity. Livestock including poultry ranks third with an 11.11% contribution to the Agriculture GDP (AGDP) behind fisheries (24.3%).

COVID-19 has impacted the whole economy. The pandemic has severely affected tourism, garment, and construction industries. and threatens to strain not only the national health system but the entire economy. The country GDP was expected to contract by 4.0% in 2020 and grow by 5.9% in 2021, according to the ADB.

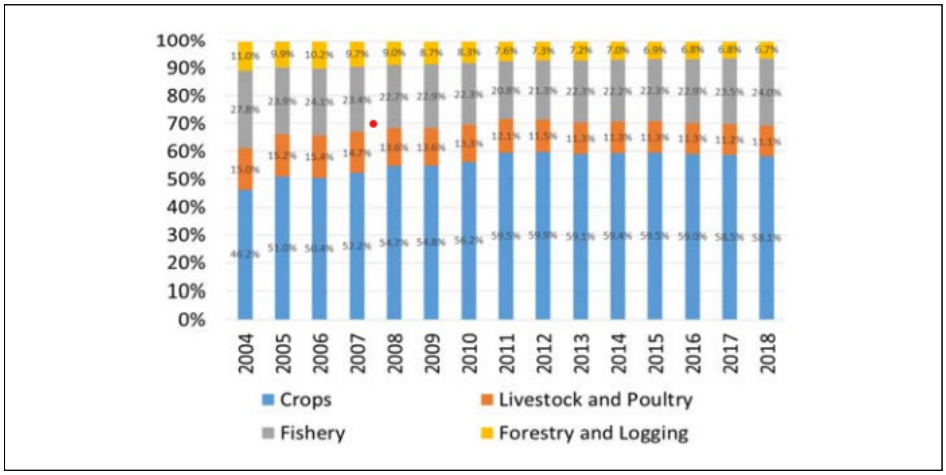
The share of agriculture in GDP declined from 33.5% to 21.7% between 2009 to 2019. Over the same time, industry share of GDP increased from 22.7% to 34.2% and that of services maintained at around 38%.[16] Livestock, including poultry, contributes 11.1% of agriculture GDP (AGDP), behind fisheries at 24.3%. The average annual growth rate for the agricultural sector was 1.07% between 2014 and 2018. For context, the industrial sector, grew at a rate of 10.48%, and the service sector grew at a rate of 7.5%, over the same period. The average annual growth rate for crop cultivators was 1.0%, fisheries grew at a rate of 1.0%, the livestock sector achieved only 0.50%, down from 4.3%, 4.7% and 1.6% per annum during 2009-2013.

The share of agriculture in employment has also been declining, although

16) Statista, 2019. Share of economic sectors in the GDP in Cambodia 2009–2019 Published by Aaron O'Neill, Mar 31, 2021. https://www.statista.com/statistics/438728/share-of-economic-sectors-in-the-gdp-in-cambodia.

it is till significant. Between 2009 to 2019, the share of agriculture in employment fell from 57% to 31%. Over the same time, employment in industry increased from 16% to 30% and that of services from 27% to 39%. Agriculture is becoming increasingly mechanized.

〈Figure 18〉 Share of Agriculture by Subsector



Meanwhile, MAFF has also taken serious consideration on promoting animal husbandry and aquaculture; and made strong efforts on the implementation of appropriate legal and technical measures for the sustainable use of natural resources particularly forest and fisheries. These efforts are to contribute to the increase in the added value of agricultural commodities, the job creation and the increase in income of Cambodian farmers, and to continuously promote agricultural business.

2.4. Agricultural Political Environment, Laws and Institutions

The government of Cambodia in 2016 enacted a new Law on Animal Health and Production and is updating existing bylaws and decrees of implementation. A joint multisectoral action plan to fight antimicrobial resistance (AMR) had been established by the Ministries of Health (MoH), MAFF, and Ministry of Environment (MoE). Several joint technical working groups (TWGs) have been established, including: (i) AMR TWG); (ii) Zoonosis TWG; (iii) Food Safety TWG; and (iv) an Inter-ministerial Foodborne disease outbreak Investigation and Response Team, 'FORT'. These were established to respond to "One Health" or" Health in All" policy initiatives, as promoted and supported by FAO, OIE, and WHO.

Amendment of sub-decree 16 on the sanitation of animal and animal products is in progress. Stakeholders understand the importance of controlling animal movement and traceability, the role of quarantine stations and that an animal identification system is necessary for control of animal hygiene and disease. It is recommended that reviews/amendments for all Prakas should be done at least once every 5 years. However, currently, there is a lack of technical capacity to administer disease-free zones. GDAHP has a preliminary strategy in place for establishing quarantine stations in selected provinces with external borders to major trade routes, enabling the holding of breeding animals under observation before permitting movements. Currently, this work is in a preliminary phase.

2.4.1. Livestock Policy and Strategy

The MAFF has developed the ASDP 2019-2023. This plan identifies the direction of Cambodian agricultural development and sets clear goals, outputs, indicators, and clustered activities. The ASDP also reflects the government's policy, especially its Rectangular Strategy Phase IV, and is in line with National Strategic Development Plan (NSDP) 2019-2023. The ASDP 2019-2023 was approved and declared officially effective on 25 December 2019. The vision is for agricultural development to be competitive, inclusive, resilient, and sustainable, leading to increased farmers' income and the prosperity and the well-being of the Cambodian people.

In 2015, the DAHP was upgraded to GDAHP. One of its first major activities was the development of the "Strategic Planning Framework for Livestock Development: 2016-2025" which identified strategic issues and planning to address the Cambodian livestock subsector during the next ten years, including animal production, animal health with the improvement of access to animal health and extension services, markets growth and access to markets for smallholders, food safety and increasing resilience to climate change and other shocks in poor rural households and communities, public health amelioration, poverty alleviation, and food security, strengthening of the private sector, support to farmer groups/associations, strengthening of the VAHWs, regional economic integration and important cross-cutting issues such as gender and climate change.

In order to attain this vision, two priority policy objectives are identified as follows:

a) Enhance productivity, diversification, competition, and commercialization; and

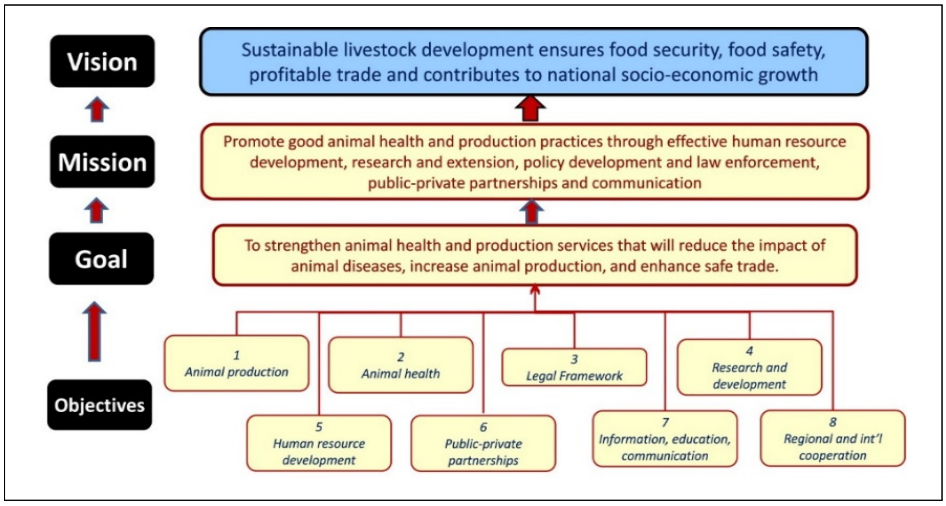
b) Increase the effectiveness of sustainable land, forestry, and fisheries management and development.

2.4.1.1. Strategies for Livestock Development 2016-2025

The strategic planning identified strategic issues affecting the Cambodian livestock sub-sector during the next ten years. These strategic issues include the positive and negative forces affecting the livestock industry and the value chain actors. These include issues related to animal production, animal health, expanding markets for animal products, food safety and public health, poverty alleviation and food security, role of the private sector, farmer group / associations, the Village Animal Health Workers (VAHWs), the regional economic integration and important cross cutting issues such as gender and climate change.

The DAHP vision, mission and values statements were formulated during the strategic planning process.

〈Figure 19〉 Strategic Planning Frameworks for Livestock Development, 2016 – 2025



To realize the policy objectives, eight strategies have been developed and implemented focusing on:

(1) Strengthen animal production, including the promotion of animal management and breeding:

a) Promote commercial animal husbandry in the community (farmers and other animal producers).

b) Implement and disseminate GAHP to all stakeholders involved in animal production.

c) Monitor and control the animal feed quality to ensure the efficiency of animal husbandry.

d) Identify, register, and better manage livestock farms and data.

e) Promote the use of technology in animal production and animal

breeding through the establishment of demonstration farms and technical training.

f) Encourage farmers to actively participate in the animal feed cultivation.

g) Promote waste management on livestock farms and in slaughterhouses, and processing plants.

(2) Strengthen animal health and public veterinary health:

a) Strengthen disease surveillance, conduct research in the communities, diagnose at the laboratory, prevent and control animal diseases and zoonosis transmission. An AHIS must operate effectively.

b) Provide technical and financial support to VAHWs to participate in activities to increase local animal productivity in the communities.

c) Management of live animals and animal products, including effective monitoring at quarantine and animal collection points.

d) Promote the implementation of biosecurity in the value chain.

(3) Promote the dissemination of laws, strengthen the implementation of laws and policies:

a) Strengthen the implementation and increase awareness of animal health and production laws and other regulations to improve animal health and production management.

b) Prepare procedures for issuing permits to farms, slaughterhouses, meat processing facilities, laboratories, research institutes, veter-

inarians and animal vaccines, veterinary services, and animal feed shops.

c) Establish procedures for issuing certificates for veterinary service providers and provide support for establishing a VSB.

(4) Promote research and development of animal health and animal production:

a) Implement and manage animal health and production research.

b) Strengthen the animal health and production research capacity.

c) Research and development of animal genetics, semen, and AI.

d) Strengthen the capacity and efficiency of animal disease diagnosis and animal disease monitoring.

e) Research on the quality and safety of veterinary drugs, animal feed, meat, and animal products.

f) Research on AMR, animal drug products, and vaccines.

(5) Develop institutional and human resource capacity:

a) Strengthen the capacity of human resources on animal health and production, value chains, and business management.

b) Strengthen veterinary medicine and animal sciences education systems.

c) Strengthen the capacity of animal health and production officers and all officers of the provinces and municipality's animal health and production services.

(6) Promote public-private partnerships in animal production:

a) Support private sector initiatives in animal health and production.

b) Facilitate consultations and cooperation with the private sector, civil society organizations, and animal husbandry communities.

c) Strengthen information sharing and cooperation between the public and private sectors.

(7) Strengthen national and international economic and technical cooperation on animal health and production subsector:

a) Organize and participate in animal health and production conferences at the national, ASEAN, and international levels.

b) Establish economic and technical partnerships at the national, ASEAN, and international levels and strengthen relations with development partners, multilateral organizations, and institutions on animal health and animal production sub-sectors.

c) Develop and implement all action plans in the strategic document and other national action plans related to the areas of expertise, especially action plans in strategic mitigation and adaptation to climate change, gender mainstreaming, and animal health sub-sectors and animal production, and Cambodian industrial development policy.

(8) Three main strategic goals shall be implemented:

a) Boost animal production at an annual growth rate of 3% (240,000 tons in 2019 to 270,000 tons in 2023) through the management and development of animal husbandry,

b) Increase the rate of commercial livestock production from 23% in 2019 to 30% in 2023,

c) Reduce infectious diseases to under 5% through strengthening animal hygiene and animal product monitoring.

2.4.1.2. Livestock Legal and Regulatory Framework

The government of Cambodia has enacted a new Law on Animal Health and Production in 2016 and is about to update existing bylaws and decrees related to the implementation of.

(ⅰ) Sub-decree 14 on the inspection of animal and animal products (1988);

(ⅱ) Sub-decree No.16 (2003) on Sanitary Inspection of Animal and Animal Products;

(ⅲ) No.108 (2007) on the Management of Slaughterhouse and Sanitary Inspection of Animal, Meat, and Animal Products;

(ⅳ) No. 227 (2008) on Domestic Protocol of Sanitary Inspection of Animal and Animal Products, dated 23 June 2008;

(ⅴ) No.178 (2009) on Procedure on Sanitary Inspection of Animal and Animals;

(ⅵ) No.224 (2008) on Internal Regulation of Slaughterhouses;

(ⅶ) No. 225 (2008) on Location and Technical Standard for Building Slaughterhouse;

(ⅷ) No. 463 (2008) on Protocol and Veterinary Measures for Transportation

of Meat and Animal Products from Slaughterhouse, dated on 22 October 2008;

(ix) Sub-decree No 26 on the 'Creation and Regulation of VAHWs';

(x) Inter-ministerial Prakas No.868 (2010) on Food Safety Management;

(xi) Directive number 115, titled 'Taking action to strengthen livestock and fishery production management' signed by MAFF which allows the operation of multiple slaughterhouses in the communes and districts of each province;

(xii) Sub-decree on Control of Slaughterhouse and Slaughtering Business and Primary Animal Product Processing Premises of 2017.

Policies, strategies, and laws impacting the livestock sector:

(i) Rectangular Strategy for Growth, Employment, Equity and Efficiency, Phase IV, 2018;

(ii) Policy on Environmental and Social Safeguards for Sub-National Democratic Development;

(iii) National Environmental Strategy and Action Plan (NESAP) 2016-2023;

(iv) MAFF Gender Mainstreaming Policy and Strategic Framework in Agriculture 2016 to 2020;

(v) Law on Environmental Protection and Natural Resources Management of 1996;

(vi) Sub-decree on EIA Process of 1999;

(vii) Climate change action plan;

(viii) Prakas No. 021 on Environmental Impact Assessment Classification for Development Projects.

2.5. Lessons Learned from Past Related Projects

The number of livestock has increased in previous years mainly as a reflection of improved production and income. The main livestock are cattle, pigs and poultry. Cattle were most often raised as draft animals in term of urgent cash needs. Pigs and poultry were mainly a cash enterprise for farm families or companies which were probably the most important animal protein after fish. However, the rearing of livestock such as cattle and pigs in Cambodia decreased due to several diseases especially African Swine Fever since 2019 that infected pigs throughout Cambodia. The diseases which infected pigs and cattle included Foot and Mouth Disease, Hemorrhagic Septicemia, Swine Fever, and Fowl Cholera and Fowl Pox affected poultry.

Cambodia has seen a substantial expansion in animal farming. Animals are kept for meat consumption, not for agricultural purposes, which now rely on machinery and tractors to replace animal labor. Numerous infectious diseases have been identified in Cambodia's livestock, which includes cattle, sheep, goats, and pigs, as well as poultry and ducks. Farmers often get serious infectious diseases such as foot-and-mouth disease, which have a devastating effect on both the family and national economy. Poor nutrition and viral diseases have significantly decreased

animal productivity and production example Africa Swine Fever (ASF) affected pigs throughout Cambodia and neighboring countries. In Cambodia, first ASF outbreak transmitted from bordering countries was reported in Ratanakiri province by MAFF (FAO, 2019). ASF virus has continued its transmission and spread quickly to Tboung Khmum, Svay Rieng, Takeo and Kandal provinces. While estimated 70% of ASF widespread all over the country, pig farmers in these areas experienced a greater economic loss. Majority of small and medium scale pig farms stop to operate temporally, and a small number of commercial farms are being operated (Siem Reap PDAFF, 2019). Regrettably, the majority of donors, including the FAO, the Asian Development Bank, and the World Bank, as well as numerous other local organizations, assist farmers with training and new animal breeds and methods (FAO, 2022). These departments and organizations aid in the following areas: 1) providing new breeds (chicken, pig, and cattle); 2) technical training for small-scale livestock production; 3) extension feed and animal feeding technique training; 4) grasses and new species cultivation training (for cattle); 5) agricultural diversification system training; 6) biogas training; and 7) village animal health worker or veterinarian training.

The new breed and processes were the most essential among them.EU-PGA-Livestock has set up 11 AI units for cattle and pigs in 11 provinces of Cambodia in addition to private AI centers. Whereas pig insemination has seen good adoption results, cattle insemination has not achieved the set targets. A critical issue is the limited quantity of liquid nitrogen that is produced NAHPRI (only about 40L per day) as commercial industrial gas suppliers do not produce liquid nitrogen in Cambodia and only accept

large orders before importing from Vietnam. Increased liquid nitrogen production is required for all AI activities, with increasing demand, both for livestock, health, research, and private enterprises requiring liquid nitrogen, is envisaged. Meeting this increasing regional demand for a decentralized supply and collaboration with other services is suggested, noting that liquid nitrogen plants of different capacities from 10L per day upwards[17] are now available in the market.

Waste management in livestock production is an important issue and since its creation in 2006, the NBP and other projects have targeted (farm) household waste by implementing over 28,000 family biogas digesters to reduce GHGe from farming and livestock keeping. In addition, 1,500 bio-digester projects were implemented in late 2019 under the grant from the PRC, with training of technical staff and construction workers in seven provinces from 9 December 2019 to 10 January 2020.

Food safety at slaughter is a major issue, with 225 public and private slaughterhouses currently nationwide, yet only half of the public slaughterhouses meeting the minimum requirement of sub-decree 108 on the "Control of Slaughterhouse and Slaughtering Business and Primary Animal Product Processing Premises". The MAFF annual report lists one modern slaughterhouse built and operated by a private investor (Soma Company, Takeo Province), and one modern poultry slaughterhouse (CP Company, Kandal Province).

The planned modern abattoir that commenced construction in Sihanoukville in 2014, with aims to slaughter up to 3,000 cattle per day

17) Cryomech Inc. 2020. Access Liquid Nitrogen Anywhere in the World. https://www.cryomech.com/liquid-nitrogen-plants/

imported from Australia and export 70% of its product to neighboring countries, was abandoned in 2020.

Local veterinary services in rural Cambodia are mainly provided by Village Animal Health Workers (VAHW), Investigation was made with VAHW's participation as measured by "dropout rates" in a December 2020 computer-aided survey of national VAHW data recorded between 2011 and 2020. Cambodian animal health authorities are calling for more effective policies to strengthen the existing VAHW system and improve the quality of services it provides. Keep "active", developing more sustainable roles with lower dropout rates and long-term gender inequality. Because of the limited availability of government-funded foot-and-mouth disease vaccines, an extension program is being proposed to engage VAHW and farmers in finding an appropriate, high-quality, multi-valent foot-and-mouth disease vaccine, including privately funded and managed foot-and-mouth disease vaccines. Vaccines delivered in low-dose vials on a reliable cold chain. This strategy will help VAHW contribute to providing private livestock immunization services that may be needed for sustainable prevention and control of foot-and-mouth disease in Cambodia.

Australian Centre for International Agricultural Research (ACIAR) project was conducted on 30 veterinary pharmacy stores in some provinces for evaluation their vaccine cold storage management and handling methods. According to the findings of the study, the cold chain system was insufficient. In this investigation, it was also investigated that vaccines were not maintained at the proper temperature range in many cold storage facilities, with temperatures either below the minimum or above the maximum being detected. In addition, the vast majority of the refrigerators

under investigation were not fitted with a maximum-minimum thermometer. The main findings of this survey are, VAHWs only produced less than 22% of their yearly household incomes from animal health services. Over half of the VAHWs had never vaccinated their own cattle against FMD, and just one-third of those VAHWs had vaccinated animals against the disease.

VAHWs only vaccinated animals against FMD when the government made vaccines accessible, as there were no privately funded FMD vaccination services in these communities and all vaccines were delivered through the government-subsidized program. It was discovered that the number of VAHWs in 2020 would be lower than it was in 2017 by about 24%. These findings demonstrate that the VAHW system in Cambodia has significant flaws, especially when it comes to helping curb the spread of FMD. VAHW service delivery, retention, establishment of more sustainable roles, and gender disparity are all issues that Cambodian animal health authorities need to address in order to strengthen the current VAHW system. VAHWs and farmers should be encouraged to seek private FMD immunization that contains appropriate multivalent FMD serotype vaccines of good quality provided in tiny dosage vials from a robust cold chain. In Cambodia, private livestock vaccination services are likely crucial for long-term FMD prevention and management. This strategy would help VAHWs to contribute to the provision of these services (Sieng et al., 2021).

In 2006, Cambodia received net official development assistance (ODA) of USD 529 million from members of the Organization for Economic Cooperation and Development's Development Assistance Committee (OECD-DAC). To supplement aid revenues, major donors such as Japan,

China, the Asian Development Bank, the World Bank, and the United States contribute an additional USD 180 million per year. Aid makes up around 8% of Cambodia's gross national income (GNI) and roughly half of the government budget. In comparison to the 2006 baseline survey, which identified only 18 donors, the 2008 Survey identified 24 donors, with their assistance accounting for almost 89 percent of aid provided by OECD-DAC members.

For KAPEX program, it is suggested from the study that more effective policies are needed for the GDAHP, to reinforce the current VAHW system and increase service delivery capacity selling higher-level services to increasingly expensive livestock is one way for promoting the VAHW position as a sustainable small business model. Stakeholders in the promotion of livestock development in Cambodia will need to implement gender sensitive training programs as part of their change management approach. If the VAHW system is to be bolstered and contribute to regional food security through improved cattle health and productivity, particularly TAD management, these needs to be implemented.

At the moment, there is no data available to confirm if any of the developing livestock vaccine ODA in terms of bilateral and multilateral cooperation. Vaccines for animals are being imported from a variety of countries. Cambodia has just recently begun work on a plan to make its own animal immunizations in order to counteract the fast spread of animal diseases facilitated by China. Cambodia's request for help in creating its own animal immunizations has been granted by the Chinese government. After Covid-19, China will assign specialists to conduct investigations on the (animal vaccination facility).

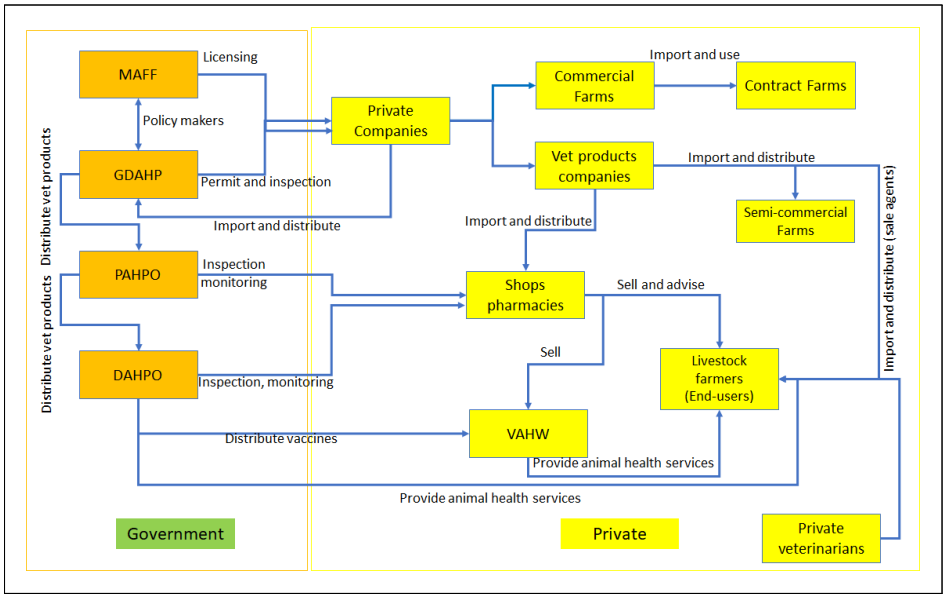
2.6. Stakeholder Analysis

Roles and relationship of stakeholders involving in trade and utilization of livestock vaccines, and vaccination campaign are shown in Figure 19. The diagram clearly showed that government institutions are responsible for licensing, monitoring and regulating the veterinary product businesses to ensure proper use of veterinary drugs and vaccines in the fields.

After receiving the application from the companies for importation of any veterinary products, the GDAHP will thoroughly review the accompanied documents. The company may be requested for additional supported documents if needed, and asked to submit the product for quality analysis. Once compliance met the company will receive the import permit and can start importation of the product. In order to operate the business each company need to have a local business registration certificate.

Private companies, on the other hand import and distribute the veterinary products to local shops or pharmacies, and/or directly to farmers through their agents. There are fifteen private veterinary drug companies registered as veterinary product importers with a total of 685 products, including veterinary drugs and vaccines. Veterinary products have also been imported by the registered commercial farms. In 2020, Cambodia imported 2,470 tons of animal medicine, 45 tons of animal vaccines and 75 tons of veterinary equipment and tools. The imported volume of most commodities increased in 2021, for instance animal medicine 6,300 tons, animal vaccines 1,000 tons, and veterinary equipment and tools 66 tons.

〈Figure 20〉 Stakeholder relationship



Animal health services are provided by local veterinary officers and VAHW. The VAHW play an important role in contributing to government disease control programs by reporting disease outbreaks, especially FMD to the District Office of Animal Health and Production. VAHWs should also assist in diagnostic investigations and participate in national vaccination campaigns, particularly against HS and FMD. VAHWs are recognized as an important local resource, enabling persons with some skills in animal health, albeit with limited training and support, to assist smallholder farmers. A new bylaw is in preparation for revising the procedure on the selection, training, sustainable management, and duties of VAHWs.

There are several private veterinarians in Cambodia, usually in private companion animal practice in the major cities or working for large integrated production companies. The number of private veterinarians

could not be established due to the absence of a Veterinary Statutory Body (Veterinary Council) mandated to keep registers and develop competencies and professional standards of all veterinarians working in the public and private sector in the country. The veterinary association remains in an embryonic stage and is also unable to provide details of all private veterinarians.

2.7. Value Chain Analysis

Through interviews and assessments with provincial veterinary officers, storage management, and veterinary drug store owners in the livestock vaccine supply chain of Cambodia, several challenges where identified, such as poor infrastructure, inadequate cold chin capacity, information scarcity, and insufficient funding. This is congruent with literature that describes many places in Cambodia still facing these challenges. Limited available data on vaccine demand is another important issue. Most of areas in Cambodia did not meet the criteria of necessary and appropriate equipment for safe storage vaccines in the cold chain. However, storage vaccine with ice pieces in a polystyrene box or a plastic bag is applicable while transporting from a drug store to an end-user. Ice pieces is used to maintain the cold chain in a refrigerator is another alternative for the drug store when the electricity cut-off.

Most livestock vaccines in Cambodia are stored in Phnom Penh before being distributed to the respective province and district. There is the

possibility for aggregation in the distribution of these vaccines sharing resources in order to reduce cost and improve availability of livestock vaccines, which in certain provinces and districts is extremely low. The lack of funds for transportation is a constraint that is also present in the livestock vaccine supply chain in Cambodia, as the interviews with Veterinary Officers and VAHW showed. It is due to the fact that turnover rates for provincial and district cold chain technicians are extremely high. The lack of funds or limited incentives, according to provincial and district officials, makes it difficult to fully compensate provincial and district cold chain technicians, maintain vehicles, and pay per diem for travel.

Reducing vaccines temperature sensitivity could address some challenges specific to the cold chain that are still relevant in Cambodia, such as an unreliable power grid, lack refrigerators, and short cold-life of passive cooled containers. Refrigeration at provincial and district level is identified as bottleneck of this supply chain. One key lesson from the FMD eradication effort was that thermostable vaccines can improve reach into remote locations where maintaining a cold chain can be demanding if not impossible. The planned development of a thermostable vaccine for any infectious viral diseases will benefit the eradication efforts by facilitating access to the vaccine. For smallholder livestock farmers who are historically less in integrated into molder service system, communities affected by conflict, climatic stresses, and disease outbreaks; and semi- or commercial animal farms, thermostability could be even more important.

The constraints mentioned above make vaccination efforts particularly challenging at the last-mile delivery. VAHWs are filling the role of last-time delivery in the supply chain of veterinary services in many places of

Cambodia especially for smallholder livestock farmers; but farm technical manager and/or veterinarians for backyard, semi-auto farms, full-auto farm and integrated farms. VAHW were rated as the most affordable animal health service providers for smallholder livestock farmers, but farm technical manager and/or external veterinarian either from veterinary clinic or non-vaccine/medicine product suppliers such as feed suppliers. In Cambodia, all of them are the option that offered the widest range of services and best quality of medicine. High quality and variety of veterinary services at an affordable price can be very beneficial to improving food security among livestock owners. VAHW, private veterinarians, farm technical manager, and veterinarian supported from non-vaccine product suppliers have played an important role in the control of diseases in livestock and the eradication of diseases. Another key issue identified through interviews and FGDs was that in Cambodia, all livestock vaccines available were those provided by government or NGOs with little to no access elsewhere and private veterinarian/farm technical manager purchased from vaccine traders in neighboring countries and other countries which increase price more especially on storage and transportation with probably reducing the quality of vaccine as arrival at the end users such as livestock farmers and farm owners. In addition to this, veterinary drug shops, farm technical officers, private veterinarian, and veterinary officers experience a highly variable lead time when it comes to veterinary suppliers or vaccines. Vaccines ordered and imported from other countries have a lead time ranging from 2 weeks up to three or more months, as sometimes the warehouse in the Phnom Penh/Provincial center is out of stock.

Vaccine efficacy and importance have been widely publicized in recent years, yet considerable obstacles remain. Some of these are also seen in animal diseases, such as the Porcine Reproductive and Respiratory Syndrome (PRRS), Bovine Viral Diarrhea (BVD), Salmonella, and Bovine Tuberculosis (BTV) (OIE, 2010). Due to the large variety of diseases involved, a single vaccine manufacturing template would be of limited utility. Vaccine makers have faced challenges in developing vaccine formulations that ensure efficacy, safety, storage, administration, distribution, and widespread usage. Vaccine transportation and storage are two examples where developing countries commonly fall short. 35 percent of vaccinations lost effectiveness during shipment because they were stored at an improper temperature, according to the National Institute of Standards and Technology (NIST) (Newswire, May 2021).

Development of vaccine and training of vaccine production technology in Cambodia should be as a component in the eradication plan for any infectious viral diseases in remote location and any animal farms and smallholder livestock production. An important part of the livestock vaccine development and its supply chain is a reliable long-term supplier. There are some interconnections (Figure 20) between the chains of each stakeholder as below:

- End users

  In Cambodia situation, the end users of animal vaccines mostly receive from the Village Animal Health Workers (VAHWs). Through this process, vaccines are providing in for free through national campaigns or other disease control programs. VAHWs are the key persons who actually play the important role in bring the vaccine injection for

farmers' livestock. These free offering of vaccines mostly for the cattle, i.e., FMD vaccine, HS vaccine, Lumpy Skin Virus vaccines, etc.

- Smallholders

  Cambodia is a low-income country with a population of 15.33 million (World Bank, 2016) who predominantly reside in rural areas (World Bank, 2016; NIS, 2014). Traditionally, Cambodian households raise poultry and pigs in their backyards for food and to supplement their household income (Heft-Neal et al., 2012; GDAHP, MAFF, 2012). The number of backyard animals varied from one to six pigs (GDAHP, MAFF, 2012), five to 13 ducks and 18 to 37 chickens (FAO, 2004). The pig population for the whole country has been estimated at about 2 million with 80 % raised in household backyards (GDAHP, MAFF, 2012; Sovann and San, 2010).

  For smaller animals such as pigs and chickens, farmers most of the time need to pay to the private service from VAHWs or other relevant private veterinarians who provide their service in the local communities. Some farmers also know how to vaccinate their animals; therefore, they just buy vaccines from the nearby animal drugs store and do it themselves. Education support is important in educating farmers how to prevent diseases in their animals; however, teaching them how to cure diseases successfully is challenging due to the fact that farmers' general knowledge is not the same as one another. Furthermore, VAHWs play an increasingly significant part in these services, despite the fact that some farmers wish to save money on treatment costs.

- Semi-Commercial producers

  Feed and veterinary products including antibiotics and vaccines for pigs and poultry are locally produced, imported and distributed by various private local and foreign companies (FAO, 2004; GDAHP, MAFF, 2012). Three categories of commercial food animal farming occur in Cambodia: contracted, semi-contracted and non-contracted farms (FAO, 2004). Contracted farmers are remunerated according to the number of animals they produce. Semi-contracted farmers sell the food animals to the contracting industry at an agreed price while these farmers provide their own animals, animal feed, and veterinary products. Semi-contracted farmers receive limited technical advice from the contracting industry. Non-contracted farmers are independent of the contracting industry.

- Commercial producers

  Commercial poultry production supported by foreign investment commenced in Cambodia in mid-1990s. The average number of animals on commercial poultry farms is 3500 broiler chickens, 5000layer chickens and 900 ducks (FAO, 2004).

  For the private companies that operate their business through animal farming, they have their own well-trained veterinarians who can bring and give vaccines to the livestock in their commercial farms and/or the contracted farms they might have.

  There are only three commercial industries that raise pigs and supply grandparent stock, breeding sows, piglets, feeds and veterinary products including vaccine to farmers (GDAHP, MAFF, 2012). Commercial pig farmers raise between 10 and 30 pigs, normally feed their animals

a mixture of rice, commercial food and vegetables while "some farmers" were reported to also use medicated feed or growth promoting feed (GDAHP, MAFF, 2012). At the present time, the commercial pig farm keeps up to around 4000 heads of growing pigs.

- Service providers

  Contracted farmers provide labor and animal housing while the contracting industry provides the animals, feed, veterinary products including vaccine, and technical supports to raise the animals.

- Village animal health workers

  Village Animal Health Workers (VAHWs) are local veterinary services providers in rural Cambodia. Cambodian health authorities advocate for tighter VAW policies in order to improve vaccine service quality by delivering vaccines in low-dose vials via a reliable cold chain. This plan enables VAHW to contribute to the provision of livestock vaccine services privately, which may be required for the long-term prevention and management of diseases for example foot-and-mouth disease in Cambodia.

- Private animal health

  Besides VAHWs, there are also some veterinarians who provides their service, while vaccinating services have seen to be observed from these group of people too. They purchase vaccine products from the agents they know or available including drug stores, private distributors and so on.

- Public animal health

  These group of veterinary officials are the ones who play important

role in disease reporting and distributing vaccines to the target community when the outbreaks are occurring. VAHWs report they contact the district and/or provincial officer either once per month or more, and over 80% indicated they report cattle diseases to the district or provincial officer either monthly and/or more frequently. FMD was the most frequently reported disease, closely followed by HS. Reporting predominately involved telephone or individual face-to-face meetings, with few VAHWs submitting documentation (18%) (Stratton et. al., 2015).

- Suppliers

  There are some companies in Cambodia which import veterinary products including vaccine and supply into the markets.

- Importers

  Some companies in Cambodia do their business by importing vaccine from abroad and distribute direct to another distributors as well as supply directly to the local drug stores.

- Distributors

  Connecting with the importers or suppliers, the veterinary vaccine distributors are the group or the company that bring vaccines and other veterinary product directly to the local drug stores and sometime they also work closely with the farmers for the vaccine distribution.

- Local drug stores

  At least one or more veterinary drug stores are available in each district in Cambodia. And each of them mostly has vaccine stored in the

refrigerator for selling to their customer. It has been reported that there are 780 veterinary drug sales locations in Cambodia, spanning throughout 141 districts.

- Policy and strategy

  The Cambodian Government commenced VAHW training in the 1990s, with initial support from non-government organizations (NGOs) and the Food and Agriculture Organization of the United Nations (FAO) (Calba et al., 2014). Refresher training is undertaken by government officers; however, the FAO and a number of NGOs have continued to contribute to training activities. Government engagement with VAHWs comprises registration, informal contacts for the purposes of surveillance and reporting, and engagement for delivery of a national hemorrhagic septicemia (HS) vaccination program. VAHWs privately purchase veterinary drugs and equipment, usually from local veterinary drugstores or suppliers. Historically, NGOs and government groups provided subsidized access to drugs and equipment for VAHWs, but in almost all cases, a private fee-based drug purchase and provision system appears to have evolved.

According to the survey, the three terms supplier, importer, and distributor may be used by only one or two companies. For instance, if a local company A purchases a vaccine from an overseas producer and the company A does not intend to import the vaccine on its own, the company may contract with a third party to import the vaccine while remaining the supplier and distributor. At times, the overseas producer acts as importer and supplier, while also seeking a distributor. In Cambodia, five

companies have been registered such as Vyphavet, B.K.P., Medivet, Phal Heng, and Hok Heang. However, it has been reported that there are fifteen, but several are inactive.

Based on the survey, the prices from the drug store are slightly different between end user as farmers and VAHWs as well as the country sources of vaccines (Table 14).

〈Table 14〉 The prices of vaccine to be sold at a drug store for farmer and VAHW

Vaccine	Company/(Country)	Dose	Price (US$)	
			Farmer	VAHW
FMD	B.K.P.	15	15	14
HS	(India)	40	Free	Free
	(Vietnam)	25		
ASF or Aujesky	(Korea)	10	4.50	4.25
New castle	(Vietnam)	25	1.15	1.15
	(Indonesia)	100	4.25	4.25
		1000	7.50	7.50
Fowl cholera	(Vietnam)	50	3.75	3.75
	(Thailand)	100	2.50	2.50

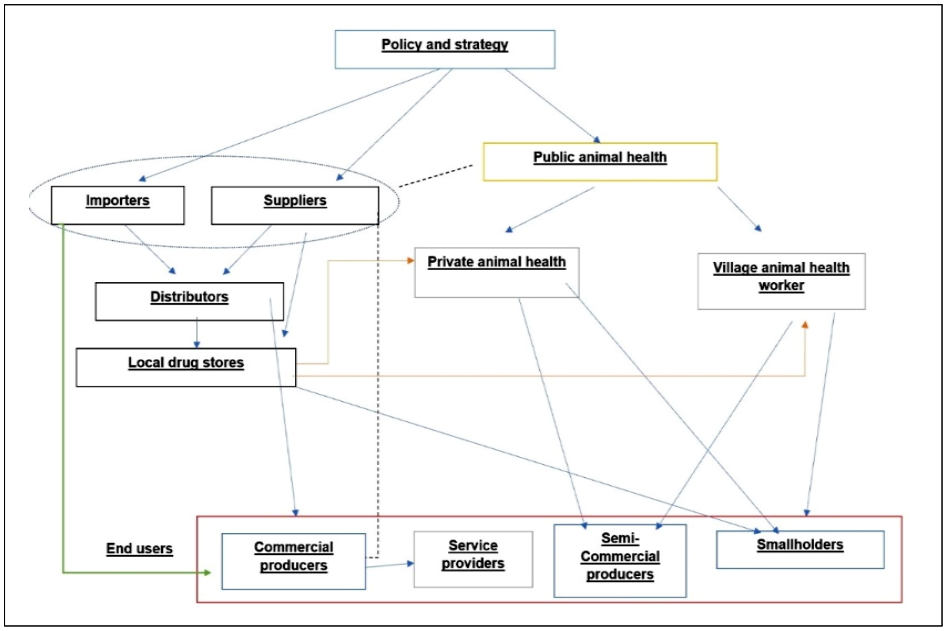
The Cambodian Ministry of Agriculture Forestry and Fisheries (MAFF) Annual Report states that in 2010, there were 12 474 VAHWs in Cambodia, increasing to 14 563 in 2011 and approximating the specified aim of having one VAHW per Cambodian village (MAFF, 2011, 2012).

Following the policy and strategic plan that have established and applied by the health-relevant governor, vaccine was imported from other countries by the veterinary or pharmaceutical companies. Some importers also operate their business as suppliers, while some need other supplying companies to fulfill their process of vaccine distribution. These two types

of companies need the distributers who bring their products directly to the local drug stores because the stores mostly locate close to the end users including smallholders and some semi-commercial producers. However, distributors can bring their products directly to the commercial producers due their large amount of the vaccine need.

Beside the commercial vaccine distribution, there is also another way to ensure that the end users can apply vaccine for their livestock. This happens when there are some project supports, disease outbreak control or elimination programs etc. The sponsored vaccine usually bought or brought from the suppliers or supporters in the national level; officially GDAHP, MAFF is the governmental institution that work on this matter.

〈Figure 21〉 An illustration on how the connection of the livestock vaccine distribution management and usage in the Cambodia context



But they need some sub-national veterinarian to help such as the provincial and district veterinarians who need to work closely with the local VAHWs. The VAHWs provide the vaccination for the larger animal such as buffalos and cattle with free of charge following the guideline from the district vets. This vaccine is available only in the local department to offer freely to the animal owner by VAHWs. However, the VAHWs as well as the private animal health workers can buy vaccine from the local drug stores and provide the service to smallholders and/or semi-commercial producers. The service providers they just have animal house and labor for animal raising service and the vaccine mostly applied by the renting companies for raising their animals; and usually these rending companies are the commercial producers which have the vaccine from distributes and some of them have their own vaccine from abroad.

It is suggested to guarantee the quality of manufacture, distribution (the cold chain) with a low-cost tracking system with geo mapping has been developed for each batch, which will be extremely useful for finding out where and when vaccines are distributed, as well as for spotting counterfeit batches.

2.8. General Status and Prospect in Agriculture and Food Industry (Private Sector Engagement)

The agriculture sector continues to contribute to Cambodia's economic growth although not yet to its full potential. While it offers the majority employment in Cambodia, much of this labor can be considered "informal" and unskilled in nature. Agriculture is a key focus in government and investment policies as Cambodia looks to diversify its economy and generate more value-added jobs with more industrial opportunities.

Agricultural production, by its very nature, is heavily dependent on rainfall and seasonal weather patterns, all impacted today by climate change. Cambodia's main crop is rice, which generates an estimated 70 percent of total country production during the wet season. Irrigation systems play an important role in managing water supplies, addressing weather changes, and diversifying agriculture production in Cambodia. Despite the importance of irrigation, current irrigation systems in Cambodia can be described as large works of public infrastructure, covering an estimated 22 percent of area under paddy rice cultivation in 2015. The opportunity for investment lies in modern and innovative irrigation systems for Cambodia's agriculture sector and present opportunities for all types of investors but in particular exporters, and SMEs investors and innovators.

In recent years, Cambodia society can afford such morals, less tangible, elements of food quality, especially animal welfare and the quality of the environment. Farmers and retailers involved in livestock production have

responded to this demand by developing alternative husbandry systems that give attention to animal welfare and environmental sustainability through developments and improvements to husbandry.

2.8.1. Livestock Production

The livestock sector is dominated by a few commercial farms. Most households and farms that raise livestock for consumption are focused on domestic demand, although they have begun to venture into exports. Similar to the produce market, Cambodia still imports large quantities of livestock to meet domestic demand for meat. Imports have posed challenges for local producers due to lower pricing, although the government has intervened to protect them. The opportunity for investment in the livestock sector includes providing inputs such as feed, and veterinary services. Niche investment opportunities for large investors also exist – for example most of Cambodia's pigs and chickens raised on local farms are also raised "organic." Further study on value-added products would be useful to guide investment. For example, there are very few value-added livestock products in the domestic industry except for a few entrepreneurs experimenting in sausage making or curing meats.

2.8.2. Dairy Production

Cambodia is not a dairy producing country, although it imports milk and dairy products to meet domestic demand. Most of the milk in Cambodia is

imported from well-known and established dairy companies in the region or further abroad, mainly providing ultra-heat-treated milk or UHT. Cambodia has increased its imports of milk and cream products in the past few years. In 2019, Cambodia imported $55 million in milk, becoming the 31st largest importer of milk in the world. At the same year, milk was the 102nd most imported products in Cambodia. Cambodia imports milk primarily from Thailand ($48.6M), Australia ($1.4M), France ($1.32M), Poland ($793k), and New Zealand ($538k). The fastest growing import markets in milk for Cambodia between 2018 and 2019 were Thailand ($8.86M), Germany ($310k), and Poland ($188k).

Vietnamese and Cambodian interests have recently established a dairy operation in Cambodia, using raw materials imported from Vietnam. The establishment of a dairy supply chain in Cambodia is possible but not likely in the medium term, although there is a developing SME sector that processes yoghurt and ice-cream. Investment opportunities in milk and dairy products remain mostly in exporting products to Cambodia. There are, however, opportunities for SME investors to set up small production facilities. Machinery for processing milk and dairy products is another potential investment opportunity for exporters, depending on how the sector develops. Processing would also increase demand for inputs like lactic acid bacteria for fermentation and dry milk.

Production of fresh milk in Cambodia, has seen an increase in the recent years. The main producers are Khmer Fresh Milk (Kirisu Farm), Moo Moo and Techo Sen Reussey Treb farms. Kirisu Farm has been established jointly between Cambodian and Israeli ventures in 2018, in Takeo province. The farm raises 600 dairy cows with capacity to produce approximately 12,000 liters daily. Of these 8,000 liters are sold as fresh

milk, 2,000 liters for yogurt production and the remaining is feeding to the calves.

Moo Moo Farms operates in Phnom Penh with 50 dairy cows and has capacity to produce approximately 500 liters of fresh milk daily.

Techo Sen Reussey Treb Milk operates in Preah Vihear province by the Cambodia Royal Academia. The farm has 99 dairy cows with capacity to produce and sell approximately 200-250 liters daily.

2.8.3. Animal Feed

Animal feed improvement program for ruminants is the main task of GDAHP to promote local beef production. The animal fodder program has been scaled up across 25 provinces comprising of 823 demonstration places on 363 hectares of land. Additionally, GDAHP has stimulated the implementation of training program, and dissemination on production and processing of animal feed from raw materials that can be collected in the country. Training on planting and harvesting technique has been provided to a total of 1,230 participants (392 female).

Currently, Cambodia has 21 companies and enterprises (CP Cambodia, Agri-Master, Green Feed, Betagro, New Hope, East Hope, CJ, Sanagro, M's Pig ACMC, CKYE, Bright Agri Star, World Vet, Kandoldom Animal Feed, ANT feed, Deheus TMH, Vattanak Animal Health, Feed Bro KH, PWR, Noble Taste Food, I Tao Pet Supply, and Lodi Pet Products) that manufacture animal feed with a capacity to produce about 2.27 million tons of feed per annum. However, they are only able to run at about 56 %

of their capacity for various reasons, including deficiencies of local raw materials. Compensating for these deficiencies, Cambodia imported animal feed, raw materials and substantial additives. In 2020, Cambodia imported 203,000 tons of animal feed, 254,000 tons of raw materials, 14,000 tons of substantial additives. The imported volume of most commodities increased in 2021, for instance animal feed 322,000 tons, raw materials 679,000 tons, substantial additives 29,800 tons.

2.8.4. Agro-processing Business

Cambodia's agro-processing sector can be termed a sector in its infancy requiring innovation and investment in development of agro-processing as well as adding value to the wide range of produce in the country. Agro-processing has been predominately focused in the rice sector but other sectors developing such as milk and dairy processing in the country. For investors, the unique flavours of Cambodian agriculture produce are yet to be tapped and transformed into agro-processing opportunities. Opportunities exist for exporters, large investors and SME investors. The use of agriculture inputs such as seeds, fertilizers and pesticides – which includes insecticides, herbicides and other chemicals – have increased dramatically in the last five years. Seed production has seen limited private sector investment as the industry is dominated by Cambodia Agricultural Research and Development Institute (CARDI) for both vegetables and rice. Demand, however far exceeds supply and farmers depend on imported seeds. There are a few commercial production companies producing

fertilizer, but most Cambodian farmers rely on cheap imports. There are no pesticide production facilities at the present time and farmers also rely on imports. For all agriculture inputs, there are investment opportunities in exporting products to Cambodia, and investment opportunities for large investors and SME investors for research and development of seed and seed varieties, as well as promoting the use of "green-technology" like biofuels and recycled agricultural waste.

2.8.5. Veterinary Medicines and Vaccines

In the animal medicine and feed industries, for example, there are some examples of challenges for the private sector. With a restricted or seasonally fluctuating supply of feed components for livestock feed production in the local market, which forces the importation of feed materials, as well as with some tax and customs excise levied on specific animal feed ingredients. Electricity and competitive pricing have also been a source of difficulty for local manufacturers. When compared to domestically produced goods, the prices of imported feed and live animals from neighboring nations are competitive. In this context, human resource development, particularly skill labor, grant support from development partners, and government incentives may help to speed the growth of these types of industries in order to maximize their performance and output.

Due to the lack of the supplied local resources and pharmaceutical and vaccination products, livestock farm business in Cambodia is likely growing slowly compared to the neighboring countries. We have larger

numbers of the companies that import animal drugs, animal feeds, animal products and livestock from abroad. The local farms are able to apply animal production for the domestic consumption other than for export and are facing the higher cost of production compared to the import livestock products. However, there is no report to show that animal vaccine has been produced yet in Cambodia. MAFF intends to increase livestock production by 3 percent per year, from 240,000 tons in 2019 to 270,000 tons in 2023. This will be accomplished primarily by raising the ratio of commercial livestock farms to smallholder farms to 30 percent by 2023, from 20 percent in 2019.

In Cambodia, animal mortality and morbidity are very high because of a lack of basic animal health services at the village level. Since 1991, the VAHW was trained by AVSF in order to offer local veterinary services to smallholder families. The trained VAHW are essential for insuring food security and a decent income for smallholder families.

To ensure the sustainability of this income-generating activity, training on topics such as communication, how to develop a business plan, etc. can also be organized to increase the number of customers and income. Feedback meetings are also organized for the VAHW to share best practices and to enhance collaboration between relevant stakeholders (private veterinarians, local veterinarians). (AVSF, 2021).

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animal feed ingredients. Electricity and competitive pricing have also been a source of difficulty for local manufacturers. When compared to domestically produced goods, the prices of imported feed and live animals from neighboring nations are competitive. In this context, human resource development, particularly skill labor, grant support from development partners, and government incentives may help to speed the growth of these types of industries in order to maximize their performance and output.

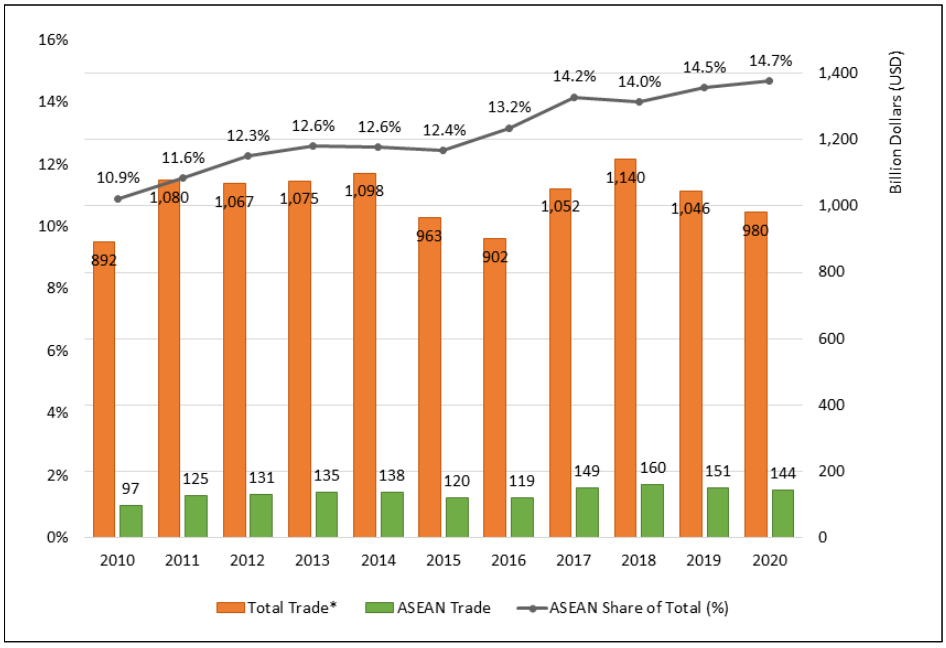
3 Policies and Experiences of Korea

3.1. Policies and Supporting Systems in Agricultural Sector

3.1.1. Status of Korea's External Economic Development

With the flow of trade opening and internationalization, Korea's external economy is gradually expanding all over the world. The volume of trade has nearly tripled over the past 20 years, and among them, the share of trade with ASEAN countries has risen from around 10% in the early 2000s to about 15% in recent years (Figure 21). In addition, according to domestic research results, the trade volume with ASEAN among the three major trade markets (China, ASEAN, and the United States) in the past three years ('16~'18), around the time when the New Southern Policy was implemented, it was grown-up 15.9% per year, recording the highest growth rate. (Cho, 2019).

〈Figure 22〉 Changes in Korea's Trade Between ASEAN Countries (2000~2020)



Source: Korea Customs Service, https://unipass.customs.go.kr/ets/(Data extracted on 14 Sep 2021).
* Trade = Sum of Imports and Exports.

3.1.2. Korea's foreign policy

3.1.2.1. New Southern Policy

The New Southern Policy refers to strengthening relations with the new southern countries such as ASEAN and India in a wide range of fields such as politics, economy, society, and culture to a level similar to that of the four neighboring powers (USA, China, Japan, and Russia), for realizing common prosperity and peace, not only on the Korean Peninsula but also in East Asia and around the world (Presidential Committee on New Southern Policy, 2019). In particular, after the ASEAN-ROK Commemorative

Summit and the Mekong-ROK Summit held in November 2019, and the Mekong-ROK Summit via Video Conference held in November 2020, discussions on the New Southern Policy have accelerated. Meanwhile, as the COVID-19 pandemic spreads around the world, changes in the internal and external policy environment, and new demands for cooperation in the New Southern countries, the 'New Southern Policy Plus' was launched.[18)]

The newly-promoted New Southern Policy established seven strategic directions (initiatives) to maintain the momentum of the existing New Southern Policy and improve policy outcomes. The main seven strategic directions and details are shown in (Table 15). Among them, 'Supporting rural villages and urban infrastructure development' is closely related to agriculture and rural areas, and the detailed goals of the strategy include improving the quality of life through support for rural development and strengthening agricultural and fishery production and export capabilities. As examples of specific support for the implementation of detailed goals, sharing of a Korean smart farm model using appropriate technology, modernization of quarantine facilities, and improvement of quarantine capabilities for agricultural and livestock products such as pest identification have been introduced.

18) Presidential Committee on New Southern Policy (2021) summarized the background of the New Southern Policy Plus as follows. 1. Increasing demand for health and medical cooperation in response to COVID-19 and the rise of new cooperative methods such as non-face-to-face; 2. Reorganization of the global supply chain due to the intensification of protectionism and the suspension of movement of goods and manpower; 3. Promoting the transition to the digital economy following the 4th industrial revolution such as 5G and AI and widening the digital divide; 4. In particular, the New Southern countries also have increased demand for COVID-19 response, improvement of people's quality of life, and sustainable growth.

〈Table 15〉 Initiatives of New Southern Policy Plus

No	Detailed Initiatives	
1	Comprehensive public health cooperation in the post COVID-19 era	
	①	Support the control of infectious disease and share Korea's disease control experience
	②	Support the reinforcement of medical personnel competency and health care system
	③	Establish a network for healthcare cooperation in the region
	④	Conduct medical technology R&D and win-win cooperation in the medical industry
2	Sharing Korean-style education model and supporting the development of human resources	
	①	Develop human capacity and share K-Education
	②	Expand the base of Korean language use in tune with the expansion of exchanges
	③	Contributing to the development of future technological human resources capabilities
	④	Support capacity-building for the advancement of public administration
3	Promote two-way cultural exchanges	
	①	Expand two-way cultural exchanges
	②	Spread the Hallyu with the growth of related industries
	③	Expand the horizons for tourism and sports exchanges
	④	Enhance multicultural inclusion
4	Build the foundation of mutually beneficial and sustainable trade & investment	
	①	Promote mutually beneficial trade and investment
	②	Lay the foundation for the expansion of trade through a spirit of solidarity and cooperation
	③	Expand corporate social responsibility and local community involvements
	④	Lay the foundation for the expansion of energy and resource sector
5	Supporting rural villages and urban infrastructure development	
	①	Improve quality of life by supporting rural development
	②	Strengthen agricultural and fishery production and export capabilities
	③	Develop smart cities and improve infrastructure
	④	Facilitate the financing of infrastructure projects
6	Cooperation on future industries for common prosperity	
	①	Cooperation in the era of the Fourth Industrial Revolution
	②	Expand the R&D cooperation and human exchanges
	③	Strengthen partnership for start-ups
	④	Establish the cooperation platform for future industry
7	Transnational cooperation for the fostering of safety and peace	
	①	Cooperation to address to climate change and reduce the carbon footprint
	②	Consolidate disaster response capability and cooperation system
	③	Cooperation to protect the oceans and environment
	④	Cooperation on transnational crime and on the promotion of international peace

Source: Presidential Committee on New Southern Policy (2021).

3.1.2.2. Cooperation with Cambodia

The achievements of ASEAN-ROK economic cooperation resulting from the New Southern Policy were shown in three aspects, including high growth in mutual trade, selection of key cooperation areas by country, and strengthening of domestic support systems (Cho, 2019). Trade and exchanges with Cambodia are also gradually increasing. Currently, the amount of trade and investment in Cambodia itself is lower than that of ASEAN countries with large economies such as Vietnam, Indonesia, Thailand, and Singapore, but in terms of growth, it is relatively higher than that of Myanmar, which is recently attracting attention as an emerging market (Jeong and Kim, 2019). In addition, Korea's official development assistance (ODA) support to Cambodia is evaluated to be so active that Cambodia ranks second after Vietnam among Korea's total recipient countries since 2000.

In particular, on the occasion of the 2019 ASEAN-ROK Commemorative Summit in Busan on November 25, the Republic of Korea and Cambodia Foreign Ministers discussed ways to reinforce the institutional foundation of the Republic of Korea-Cambodia cooperation and to step up mutually beneficial cooperation for shared prosperity as well as the ASEAN-ROK and Mekong-ROK cooperation. Also, during the meeting, 「Agreement for the Elimination of Double Taxation」 and the 「Treaty on Mutual Legal Assistance in Criminal Matters」 were signed. In addition, they agreed to continue to explore concrete ways to promote cooperation, through the renewal of the 「Memorandum of Understanding on Cooperation in the Field of Agriculture」, stepping up financial cooperation, strengthening infrastructure cooperation with the Economic Development Cooperation

Fund (EDCF), and starting a joint feasibility study on an ROK-Cambodia FTA.[19]

Of course, even before the implementation of the New Southern Policy, since the establishment of diplomatic ties on October 30, 1997, the two countries have signed various economic, social, and cultural agreements (Table 16). In particular, relatively recently, both Korea and Cambodia have focused on cooperation in rural areas development such as infrastructure construction, water resource development, and expansion of Saemaul Undong projects through the ROK-Cambodia Joint Economic Commission twice. Since 2018, two sides also discussed ways to cooperate in areas such as support for strengthening industrial capacity, improvement of connectivity in four key areas (transport infrastructure construction, urban development projects, water resource development, power generation), finance, investment, agricultural trade, and labor etc. In this regard, the Cambodian side praised Korea's active activities in the field of development cooperation, which plays an important role in its socio-economic development, and said that Korea's ODA support is also contributing to improving Cambodia's investment environment.[20]

The increase in exchanges and cooperation between Cambodia and Korea is also reflected in changes in the agricultural food trade. Since the conclusion of the FTA between the two countries in 2010, the trade volume has increased rapidly. According to (Figure 22), imports from Cambodia in 2020 increased about 4 times compared to 2010, and exports to Cambodia

19) Source: Ministry of Foreign Affairs, "ROK-Cambodia Foreign Ministers' Meeting Held on Occasion of 2019 ASEAN-ROK Commemorative Summit (Nov. 25, 2019)."

20) Source: Ministry of Foreign Affairs, "2nd Meeting of ROK-Cambodia Joint Economic Committee Takes Place (Feb. 09, 2018)."

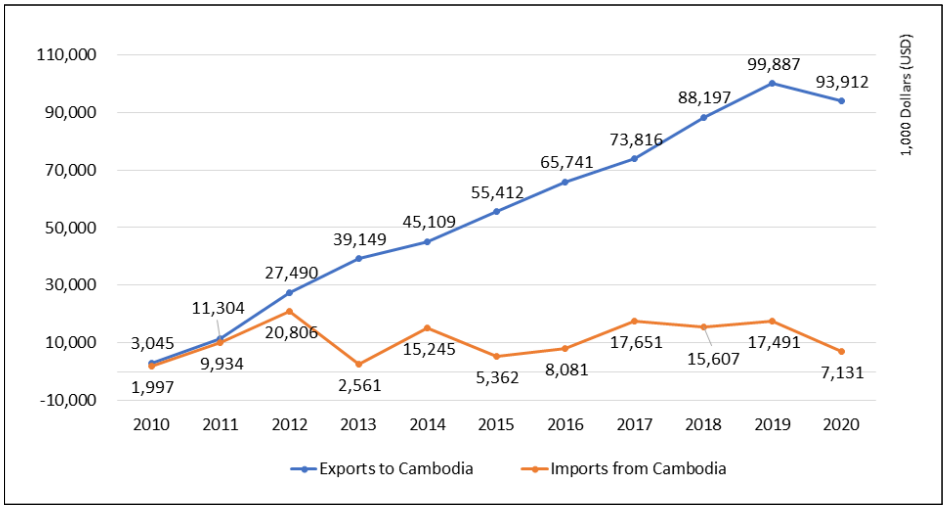
increased about 30 times. Of course, it is confirmed that economic cooperation between the two countries has expanded due to the increase in the total amount of trade between the two countries, but Korea has a larger trade balance, so it seems that clear research on this issue and preparation of export expansion plans are necessary.

〈Table 16〉 Agreements Status between Korea and Cambodia

Agreements Title	Effective Date
Agreement on Economic, Scientific and Technical Cooperation	March 15, 1997
Agreement on Investment Guarantee	March 12, 1997
Agreement on EDCF Grant Framework	April 10, 2001
Agreement on Aviation	May 01, 2001
Agreement on Cultural Cooperation	August 24, 2006
Agreement on Korea-ASEAN FTA Product	November 01, 2008
EDCF Basic Agreement	December 30, 2008
Agreement on Grant Aid Framework	June 19, 2009
Agreement on Korea-ASEAN FTA Investment	October 17, 2010
Agreement on Korea-Cambodia Extradition	October 01, 2011
Agreement on Korea-ASEAN FTA Service	November 29, 2019
Agreement on Korea-Cambodia Double Taxation Prevention	January 29, 2021
Korea-Cambodia FTA negotiations	February 03, 2021
Korea-Cambodia Criminal Justice Cooperation Treaty	February 24, 2021

Source: Embassy of the Republic of Korea in the Kingdom of Cambodia

〈Figure 23〉 Changes in Korea's Agri-Food Trade Between Cambodia (2000~2020)



Source: Korea Customs Service, https://unipass.customs.go.kr/ets/(Data extracted on 27 Sep 2021).
*Agri-Food products are based on 2 digits of HS code (Sum of HS01 to HS22 products).

3.1.3. Korea's Overseas Agricultural Sector Support Policy[21)]

3.1.3.1. MAFRA's ODA Project

(ⅰ) Status

- (Purpose) To share Korea's successful experience in the field of agriculture with developing countries and to support the development of farming village and the eradication of poverty
- Progress
  - Promoted the international agricultural cooperation project (ODA, Official Development Assistance) since 2006

21) Source: Ministry of Agriculture, Food and Rural Affairs, https://www.mafra.go.kr/english/1401/subview.do(Access date: 29 Sep 2021).

- Expanded mid to long term and largescale projects in the form of supports for agricultural infrastructure since 2011
- Promoted food assistance projects by utilizing Korean rice from 2018

〈Table 17〉 Recent Project Cost and Project Numbers

Year	2015	2016	2017	2018	2019	2020
Project Cost (KRW million)	14,805	15,561	17,218	65,163	66,413	66,977
Number of Project	22	25	26	30	28	33

• Status
  - 2021 Budget: KRW 82,791 million (68.4 million US dollars)
  - Implemented 45 projects with 13 countries (8 in Asia, 3 in Africa, and 2 in CIS and Latin America) and 4 international organizations (FAO, ADB, UNDP and WFP)

(ii) Project Type

a. A project for a direct consultation between Korea and a beneficiary country (Planned Cooperation Project)
  - To provide an agricultural infrastructure over a mid-to long-term period (3 to 5 years) and provide a software assistance such as operational education and consultation, etc.
    * Support in diverse fields such as comprehensive rural development, transfer of agricultural technologies, mechanized farming and agricultural irrigation.
  - Implementing Agencies: KREI, KRCC, EPIS and KAPE

- Project Size: 34 projects in 12 countries with 2021 budget of KRW 26 billion
  * Assistance of KRW 3 to 8 billion per project over 3 to 5 years

b. Consulting Services in Agricultural Policies for Developing Countries

- Project Size: 34 projects in 12 countries with 2021 budget of KRW 26 billion
- To provide consulting services regarding agricultural policies, including joint investigation, invitational training and workshop by selecting sectors based on the demand of 3 developing countries each year (KAPEX)
- Implementing Agency: Korea Rural Economic Institute
- Project Size: 5 countries (Vietnam, Armenia, Cambodia, Mongolia, Myanmar) with 2021 budget of KRW 1.4 billion

c. Project via International Organization (Multi-bilateral Project)

- To provide guidance on agricultural technologies and support improvement of distribution channel structure in developing countries via FAO, ADB, UNDP and WFP and provide food aid via WFP
- Implementing Agencies: FAO, ADB, UNDP and WFP
- Project Size: Implementing 6 projects with 2021 budget of KRW 53.3 billion (Food assistance: 50.3 billion won)
  * Enforcement of food aid projects via WFP since 2018 (KRW 138 billion / Accumulated 150,000 tons)

(iii) Project Implementation System

a. Project Planning (Start planning 2 to 3 years prior to its execution)

- New projects are developed after reviewing the proposals produced by developing countries based on local demands, preliminary joint investigation and consultation.
- Some of the proposals will be selected for consultation, and be reflected in the new budget plan after deliberation of experts and feasibility studies.

  * ODA Budget Procedures: Deliberation of suitability by the Ministry of Foreign Affairs for a grant-type aid → Comprehensive analysis of a grant or non-grant type aid by the Office for Government Policy Coordination → Ministry of Strategy and Finance

b. Project Implementation

- The projects are managed by institutions such as the Korea Rural Community Corporation, and consigned to the Project Management Consultancy* for implementation in the local area of the beneficiary countries.

  * In general, PMCs are domestic institutions such as engineering companies and academic-industrial cooperation groups at universities. PMCs dispatch employees as the Project Managers (PMs), and design and construction companies are recruited locally.

c. Post Assessment and Management (In 2 to 3 years after completion)

- Perform a post assessment to derive performance and problems, and allocate certain amount of budget after the completion to continuously repair facilities and reeducate local people.

3.1.3.2. MAFRA's Overseas Expansion of Agri-Food Industry Policy

(ⅰ) Implementation Status

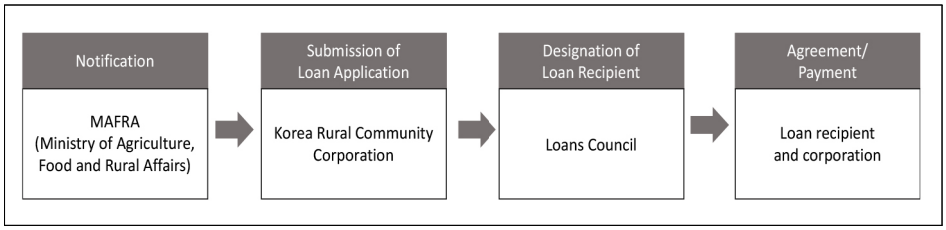
- Purpose: To expand basis of agri-food industry in Korea, strengthen national competitiveness and provide basis for securing overseas food in the future by supporting the private sector to advance and settle in overseas agricultural sector.
- 2021 Budget: 9.4 billion won (Financial source: Farmland Management Fund)

〈Table 18〉 MAFRA's Project Information

Detailed Project	Budget (KRW millions)	Requirements	Project Entity
Overseas Advancement Support to Agriculture and Food Industry (Loan)	6,870	Within 70% of required project cost • 5-year loan, 10-year repayment, 1.5~2% annual interest (1.5% for grains, 2.0% for others)	• Project Agency: Korea Rural Community Corporation • Beneficiary: Overseas agricultural developers, etc.
Overseas Advancement Support to Agriculture and Food Industry	2,522	• 50% – 70% subsidy (private environmental survey, consulting, etc.)	• Project Agency: Korea Rural Community Corporation, Korea Overseas Agro-resources Development Association • Beneficiary: Overseas agricultural developers, etc.

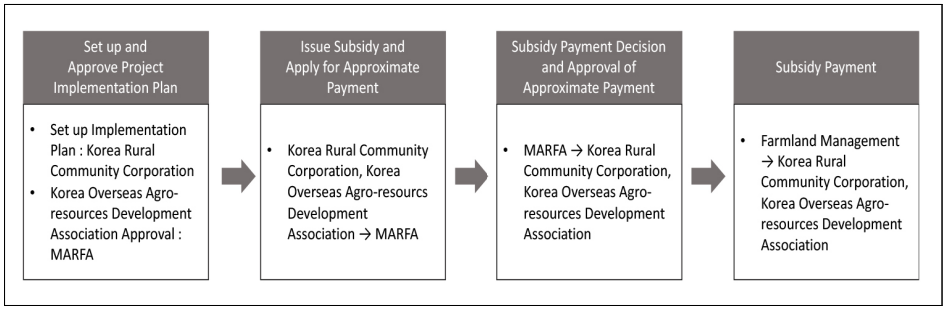
- (Loan Project: KRW 6.9 billion) To provide enterprises with loans to fund for overseas advancement
  - (Support) To purchase farming machinery necessary to produce and distribute agricultural products, and support cost and agricultural expenses necessary to install supplementary facilities, drying, warehousing, and processing facilities

〈Figure 24〉 Loans Provision Process



- (Supplementary Project: KRW 2.5 billion) To support the private sector with overseas investment environmental survey, professional education, operation of an agricultural support center, consulting, provision of information and workshop, etc.

〈Figure 25〉 Implementation Process of Supplementary Project



(ii) Step-by-Step Supports

a. (Exploration Step) Difficulty of candidate enterprises to collect overseas information and explore investment environment

• Supports such as provision of overseas information, education, local environmental survey in early steps of advancement, etc.

- Provision of a local environmental survey cost to candidate enterprise to explore investment environment

- Provision of a localized professional training to foster professional talents in overseas agriculture (20 trainees per year)
- Provision of information by running overseas agricultural information portal, and publishing quarterly magazines and advancement casebooks, etc.

b. (Advancement Step) Difficulty to procure massive investment costs in early steps of advancement

• Provision of loans to overseas advancing enterprises to fund for advancement

- Facility and operational funds such as farmland lease and equipment purchase, etc. (2% annual interest, 5-year loan, 10-year repayment)

c. (Settlement Step) Difficulty in adapting to local environment, improving productivity and securing sales route, etc.

• Resolve on-site difficulties through consulting and local agricultural support center

- Provision of a professional consultation to resolve difficulties in cultivation technology and management improvement, etc on the field.
- Support enterprises to recruit overseas interns
- Exchange of information to enterprises through regular meetings and workshops, etc.

- Setup and installation of a local agricultural support center to provide administrative supports for consent, etc.

※ Overview of Far-East Agricultural Support Center

- Setup in Ussuriysk, Maritime Province in March 2014 (Changed title in 2018: Maritime Agricultural Support Center → Far-East Agricultural Support Center), 5 employees including 2 from Korea Rural Community Corporation
- (Major Roles) Governmental consultation of enterprises, supports in agricultural technology and farming machine management, group purchasing of farming apparatus, local agricultural environmental survey, exchange and cooperation between enterprises.

(iii) Implementation Performance

- (Performance) Providing fund to the private sector to facilitate advancement in overseas agricultural development
  - Loan Project: 184.5 billion won by 2020 (41 enterprises)
  - Supplementary Project: Support such as fostering talents to go overseas, agricultural technology and survey & information, etc.
- (Implementation Status) 202 enterprises in 32 countries reported overseas agricultural development by 2020
  - From above, 60 enterprises produced and distributed 1,634,000 tons of maize, beans, wheat, etc. and imported approximately 109,000 tons to Korea.

3.1.4. Agricultural ODA project for Cambodia

3.1.4.1. By Aid Type

Agricultural ODA projects are being conducted not only by the Ministry of Agriculture, Food and Rural Affairs (MAFRA), but also by the Korea International Cooperation Agency (KOICA), Rural Development Administration (RDA), and other related organizations. ODA projects in the agricultural sector of Cambodia are carried out in a variety of ways by each organization, and the main Aid types are largely divided into project cooperation, technical cooperation, fellowship program, and NGO, PPP support. According to Table 17, among the organizations supporting the agricultural sector of Cambodia for the last five years, KOICA was the largest with $11.8 million, followed by the MAFRA with $7.6 million and the RDA with $3.5 million.

〈Table 19〉 Amount of Agricultural ODA Support by Organization and Aid Type (2016–2020)

No.	Organization	Aid Type	2016	2017	2018	2019	2020	Total
1	KOICA	Project Cooperation	3,219	2,987	1,685	899	523	9,313
		Technical Cooperation	611	669	358	218	105	1,959
		Fellowship Program	114	69	102	134	135	554
		Subtotal	3,943	3,724	2,144	1,251	763	11,826
2	MAFRA	Project Cooperation	1,786	347	676	2,166	1,180	6,155
		Technical Cooperation	7.0	4.5	376	–	–	388
		Fellowship Program	26	17	34	25	8.6	111
		NGO, PPP Support	108	111	151	601	–	970
		Subtotal	1,927	479	1,238	2,791	1,188	7,623
3	RDA	Project Cooperation	339	933	652	594	554	3,072
		Technical Cooperation	420	27	23	–	–	470
		Subtotal	758	960	675	594	554	3,541

No.	Organization	Aid Type	2016	2017	2018	2019	2020	Total
4	EDCF	Project Cooperation	-	-	1,338	878	-	2,216
		Subtotal	-	-	1,338	878	-	2,216
5	Gyeongsangbuk-do	Project Cooperation	-	143	409	529	538	1,619
		Fellowship Program	-	-	-	41	-	41
		Subtotal	-	143	409	570	538	1,660
6	KFS	Project Cooperation	172	354	364	343	339	1,572
		Subtotal	172	354	364	343	339	1,572
7	Gyeonggi-do	Project Cooperation	-	-	91	-	-	91
		Technical Cooperation	12	-	-	-	-	12
		NGO, PPP Support	448	-	-	-	-	448
		Subtotal	460	-	91	-	-	551
8	MOFA	Project Cooperation	275	132	-	-	-	407
		Subtotal	275	132	-	-	-	407
9	Seoul	Project Cooperation	-	-	-	-	50	50
		Subtotal	-	-	-	-	50	50
10	Busan	Fellowship Program	6.5	6.5	-	6.5	-	20
		Subtotal	6.5	6.5	-	6.5	-	20
11	MOIS	Project Cooperation	-	-	-	15	-	15
		Fellowship Program	-	-	-	-	0.3	0.3
		Subtotal	-	-	-	15	0.3	15.3
12	Jeollanam-do	Fellowship Program	1.0	-	-	-	-	1.0
		Subtotal	1.0	-	-	-	-	1.0
Total			7,543	5,798	6,259	6,449	3,431	29,481

* KOICA: Korea International Cooperation Agency, MAFRA: Ministry of Agriculture Food and Rural Affairs, RDA: Rural Development Administration, EDCF: Economic Development Cooperation Fund, KFS: Korea Forest Service, MOFA: Ministry of Foreign Affairs, MOIS: Ministry of the Interior and Safety

* Local Governments (5): Gyeongsangbuk-do, Gyeonggi-do, Seoul, Busan, Jeollanam-do.

* Based on expenditure price.

3.1.4.2. By Detailed Sector

Table 19 shows the agricultural ODA supported by Korea to Cambodia by dividing it into detailed sectors. First of all, according to OECD statistics, the amount of agricultural ODA to Cambodia was 4.73 million dollars based on commitments in 2019, which is 4.6% of the total ODA amount of

102.6 million dollars. Secondly, it was found that Agricultural development corresponding to CRS code 31120 was supported the most among sub-sectors in 2019, followed by rural development (43040), Agricultural education/training (31181), and Agricultural services (31191).

〈Table 20〉 Changes in Korea's ODA for Cambodia's Agricultural Sector (2010-2019)

(Unit: US Dollar, Millions, (%))

Sector	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019
Total All Sectors	84.4	81.9	72.2	86.7	215.5	37.7	183.3	39.6	148.5	102.6
Agriculture, Forestry, Fishing, and Rural development Sector (Percentage of Total)	4.06 (4.8)	3.78 (4.6)	6.12 (8.5)	4.20 (4.8)	11.80 (5.5)	4.17 (11.1)	8.04 (4.4)	2.79 (7.0)	4.25 (2.9)	4.73 (4.6)
31110: Agricultural policy and administrative management	..	0.10	1.06	0.26	0.08	0.34	0.06	0.03	0.37	0.003
31120: Agricultural development	0.35	2.27	2.29	1.61	9.25	2.46	3.98	1.34	2.48	2.87
31140: Agricultural water resources	..	..	..	0.02	..	..	..	0.02	..	..
31161: Food crop production	0.10	0.07	..	0.11	0.04	0.04	..	0.05	0.03	0.04
31162: Industrial crops/export crops	..	..	..	..	..	..	..	0.05	..	..
31163: Livestock	0.07	0.07	0.02	..	0.03	0.08	0.16	0.13	0.03	..
31166: Agricultural extension	2.78	..	..	0.03	..	..	0.04	0.02	0.07	0.04
31181: Agricultural education/training	0.10	0.07	0.45	0.30	0.64	0.16	2.11	0.06	0.04	0.06
31182: Agricultural research	0.01	0.10	0.19	..	..	..	0.24	0.05	0.06	..
31191: Agricultural services	..	0.01	..	..	..	..	0.44	0.11	0.14	0.60
31192: Plant and post-harvest protection and pest control	..	..	..	0.05	0.11	0.82	0.18	0.13	..	..

Sector	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019
31193: Agricultural financial services	0.05	0.07	..	..	..	..	..	..	..	0.02
31194: Agricultural co-operatives	0.27	..	..	..	..	0.07	0.11	0.09	0.10	0.12
31195: Livestock/veterinary services	0.03	0.05	0.01	0.31	0.31	..	..	..	..	..
31210: Forestry policy and administrative management	0.06	0.11	0.13	..	..	..	..	..	..	..
31220: Forestry development	..	0.43	0.99	0.73	..	..	0.17	0.34	0.34	0.34
31281: Forestry education/training	..	..	..	..	..	0.02	0.01	..	..	..
31282: Forestry research	..	..	..	..	0.93	..	..	..	..	..
31310: Fishing policy and administrative management	..	0.05	..	..	0.02	0.003	..	..	0.08	..
31320: Fishery development	0.02	0.01	..	..	0.05	0.03	0.01	..	0.03	0.01
31381: Fishery education/training	..	..	..	..	..	..	..	..	..	0.004
31391: Fishery services	..	..	..	..	..	..	0.04	..	..	..
43040: Rural development	0.23	0.38	0.97	0.79	0.35	0.15	0.50	0.37	0.47	0.63

Source: OECD, https://stats.oecd.org/Index.aspx?DataSetCode=crs1(Data extracted on 25 Sep 2021).
* Based on commitments price.

3.1.4.3. Examples of Projects

In the past five years, the two organizations that have implemented the most cooperative projects in the agricultural sector in Cambodia are the MAFRA and KOICA. Table 19 shows agricultural project-type projects that the two organizations recently conducted for Cambodia. In the case of the

MAFRA, it was focused on the agricultural production and technology, while KOICA supported various sectors such as rural development and the education sector, also the budget was larger. In particular, Heo et al. (2017) selected key cooperation areas for international agricultural development cooperation projects in seven Asian countries (Cambodia, Vietnam, Myanmar, Laos, Indonesia, Philippines, Mongolia) in consideration of the agricultural and rural status of the target country, national strategies, strategies of international organizations, and Korea's key areas of cooperation. As a result of the research, comprehensive rural development, improvement of productivity of food crops (all agricultural products), establishment of the Agricultural distribution system, establishment of the technology supply system, and fostering of agricultural manpower were selected as the key areas of Cambodia. According to Heo et al. (2017), the projects implemented by MAFRA and KOICA seem to be progressing well under the key areas of international agricultural development cooperation.

〈Table 21〉 Agricultural sector cooperation project for Cambodia (2017–2021)

Organization	Projects Details
MAFRA	• Dry Storage Facilities for Rice Industry Development in Cambodia (2015~2018, 2.6 million dollars) • Increasing agricultural productivity through Farming Technology Transfer in Cambodia (2017~2021, 3.5 million dollars • KAPEX–Establishment of Demonstrative Vegetable Production Complex in Cambodia (2018, 320 thousand dollars) • KAPEX–Enhancing Policy Capacity for Development and Dissemination of Livestock Vaccine in Cambodia (2021, 230 thousand dollars) • Project for Supporting the Agricultural Center in Kratie, Cambodia (2020~2024, 3 million dollars)
KOICA	• The Self-Supporting Rural Development Project with Saemaul Undong (SMU)'s Participatory Approach (2014~2020, 8.95 million dollars)

Organization	Projects Details
	• WFP Home Grown School Feeding Programme in Cambodia (2020–2024, 10 million dollars) • The Project for Quality Improvement and Innovation of KampongCham National School of Agriculture (KCNSA) base on Saemaul-Undong, Cambodia (2016~2021, 2 million dollars)

Source: "Comprehensive Implementation Plan for International Development Cooperation (2017~2021)", ODA Korea, https://www.kodaportal.go.kr/portal/main(Data extracted on 28 Sep 2021).

3.2. Lessons Learned from Past Projects, Policies and Systems

3.2.1. Overview of Korea-related past projects (or proposal projects)

For Cambodia's vaccine-related support project, it has not yet been decided whether to support with hardware or just software. With hardware, the project includes the construction of a vaccine factory, which will have specialized veterinary and testing facilities to prevent outside contamination. On the other hand, with just software, the project will support the export of Korean or foreign vaccines or the distribution and monitoring of those imported by Cambodia.

A similar arrangement with both hardware and software support is the Korea-backed "Capacity Building for the National Center for Veterinary Diagnosis (NCVD) in Vietnam" (hereinafter Project 1).[22] If expanding

[22] Refer to the following article: Kim Jongsun, Huh Duk, and Won Jieun, "Ex-Post Evaluation: Capacity Building for the National Center for Veterinary Diagnosis (NCVD) in Vietnam," Korea Rural Economic Institute (KREI), December 2019.

support to livestock and related industries in terms of the value chain, starting with the Korea-supported "Project for Processing and Hygienic Control System of Animal Products in Mongolia" (hereinafter Project 2),[23] we can refer to a series of similar projects. For example, the "Project of Enhancing Mongolia's Livestock Industry Export Capacity Through Establishing Modern Slaughterhouses in Khalkhgol District (Draft)" (hereinafter Project 3)[24] and the "Project for Establishing a Livestock Value Chain Linked to Mongolia's Khalkhgol District (Draft)" (hereinafter Project 4),[25] which is planned by expanding Project 3 from a value chain perspective.

1) Project 1

The capacity building project, which was conducted in 2014 by Korea's Ministry of Agriculture, Food and Rural Affairs (MAFRA) for about four years with a USD 2.4 million budget, is designed to improve Vietnam's overall veterinary health environment by strengthening the diagnostic

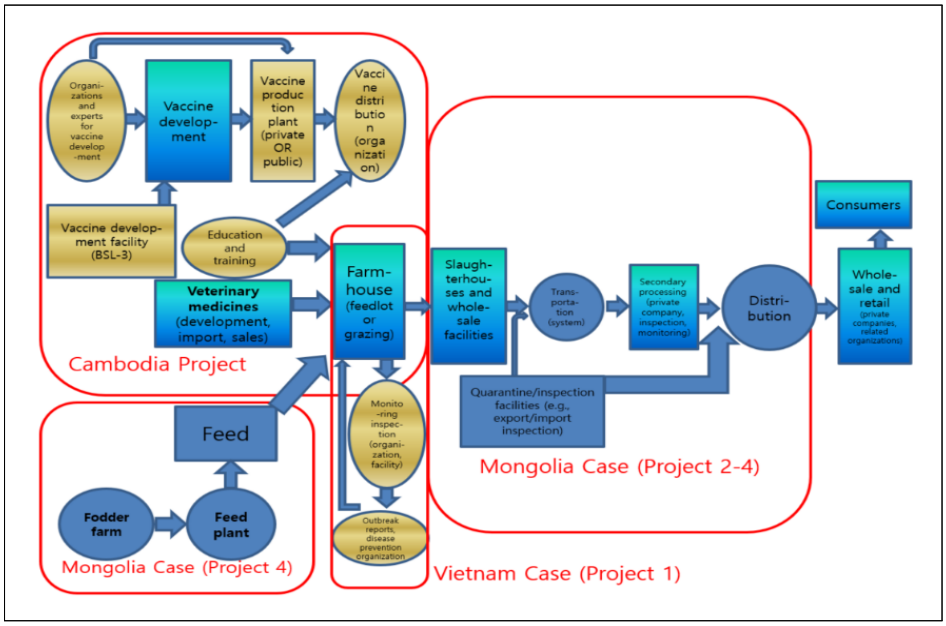
23) Refer to the following article: Kim Jong-sun, Huh Duk, and Lee Mi-na, "Ex-Post Evaluation: Project for Processing and Hygienic Control System of Animal Products in Mongolia," KREI, December 2018.

24) Refer to the following articles by KREI's Center for International Agricultural Partnership (CIAP): "Project of Enhancing Mongolia's Livestock Industry Export Capacity Through Establishing Modern Slaughterhouses in Khalkhgol District (Draft)," April 2018, and "Planning of the Project of Constructing the Livestock Education and Training Center in Mongolia's Dornod Province (Draft)," April 2019.

25) Refer to the following materials: KREI CIAP, "Planning of the Project of Constructing the Livestock Education and Training Center in Mongolia's Dornod Province (Draft)" April 2019, and KREI, "Korean Presentations and Business Trip Reports at the Relevant Local Joint Meeting," April 2019.

capacity of NCVD, a national veterinary disease diagnosis center under the Department of Animal Health of Vietnam's Ministry of Agriculture and Rural Development (MARD). This project provides a capacity building program through renovation of the research and experiment building, support for experimental and office equipment, expert dispatches, invitational training, and local education.

〈Figure 26〉 Project Scope of Key Cases from a Livestock Value Chain Perspective



Source: The authors

2) Project 2

MAFRA implemented Project 2 to nurture a workforce for the processing and hygiene of Mongolian livestock products, safeguard processed milk and meat products, and enhance export competitiveness. In the project 2,

The Korea Rural Community Corporation (KRC) implemented and promoted this project, and the Korea Food Research Institute (KFRI) and the Institute of Technology Mongolia jointly conducted it for four years, from 2012 to 2015, at an operating cost of KRW 2.5 billion.

3) Project 3

Khalkhgol District's quarantine and sanitation zone includes the Mongolian border office adjacent to the Chinese border (Inner Mongolia), which necessitates establishing slaughterhouses and quarantine stations in the area to expand exports of livestock products.

In addition, it will be necessary to check livestock breeds and establish facilities and systems for controlling diseases such as bird flu, smallpox, and foot-and-mouth disease (FMD), as well as modernize the meat processing and slaughter industry.

4) Project 4

This project was proposed as a follow-up assuming the confirmation and support of Project 3. Project 4 is a long-term plan for establishing a livestock-related value chain in Dornod Province in Khalkhgol District, proposed with the city of Choybalsan, the provincial center, assuming that quarantine facilities have already been built.

It includes, near the western part of Khalkhgol District: the (1) creation of a fodder farm, (2) support for the installation of feed-drying facilities, and (3) support for the creation of a grain feedlot, (4) construction of a

secondary meat processing plant near Choybalsan, the provincial center, and (5) promotion of exports to neighboring countries such as China and Russia, as well as the Middle East. Also, it includes support for installing additional quarantine facilities in the northern and northwestern regions to expand export and import quarantine.

3.2.2. Project 1

In Vietnam, recent outbreaks of virulent livestock diseases such as FMD, highly pathogenic avian influenza (HPAI), and African swine fever (ASF) are emerging as a national challenge. Accordingly, there is an urgent need to strengthen regional and national capacity for diagnosing and managing animal diseases to promptly respond to the challenge.

Thus, MARD established the "Mid to Long-Term Plan for Enhancing the National Management Capacity of Vietnam Veterinary Services 2011-2020" to improve public veterinary health capabilities and minimize economic damage in the livestock sector because of disease outbreaks. The transfer and reconstruction of NCVD was promoted in line with this strategy. As part of this process, the Vietnamese government requested official development assistance (ODA) from the Korean government in April 2012.

NCVD's capacity building project is carried out to control and prevent the spread of diseases from major Vietnamese livestock products. Project 1 is designed to prevent the spread of animal diseases and improve Vietnam's veterinary health environment through facility construction, equipment support, dispatch of experts, and education for capacity building.

Before this project, NCVD was located in a two-story building in downtown Hanoi and unable to meet demand for diagnosing animal diseases in Vietnam because of aging of facilities, infrastructure, research, and diagnostic equipment. In particular, there is a risk of harmful pathogen leakage in this Center.

〈Table 22〉 Project 1 Overview

<table>
<tr><th>Category</th><th colspan="4">Contents</th></tr>
<tr><td>Title</td><td colspan="4">Capacity Building for the National Center for Veterinary Diagnosis in Vietnam</td></tr>
<tr><td>Period</td><td colspan="4">2014-2018 (49 months)</td></tr>
<tr><td>Target Organization</td><td colspan="4">NCVD</td></tr>
<tr><td>Expense</td><td colspan="4">USD 2.4 million (KRW 2.8 billion)</td></tr>
<tr><td>Main Goal</td><td colspan="4">Prevention of livestock disease outbreaks</td></tr>
<tr><td>Goals</td><td colspan="4">1. Improving response capability to animal diseases through NCVD remodeling and new experimental facilities
2. Improving the use conditions of diagnostic equipment
3. Enhancing the workforce of NCVD and affiliated regional unit centers</td></tr>
<tr><td>Beneficiaries</td><td colspan="4">NCVD staff, local veterinary office (Regional Animal Health Offices (RAHO), Sub-Department of Animal Health (Sub-DAH)) staff, livestock farms, etc.</td></tr>
<tr><td rowspan="8">Contents</td><td colspan="2">Category</td><td>Contents</td><td>Unit</td></tr>
<tr><td colspan="2">Facility establishment</td><td>Construction of a research experiment building</td><td>Construction of an NCVD research experiment building (1,566 ㎡, 3 stories)
Renovation of laboratories in the existing building (2,550 ㎡, 3 stories)</td></tr>
<tr><td colspan="2" rowspan="3">Equipment support</td><td>Experimental equipment</td><td>7 types</td></tr>
<tr><td>Vehicles</td><td>1 type</td></tr>
<tr><td>Office equipment</td><td>4 types</td></tr>
<tr><td colspan="2">Expert dispatches</td><td>PM (construction)
Project management
Consulting
Quarantine (disease prevention)</td><td>14 months
16 months
2 months
5 months (15 days each in 10 fields)</td></tr>
<tr><td rowspan="2">Capacity building</td><td>Invitational training</td><td>Related officials and researchers</td><td>10 people, 2 weeks</td></tr>
<tr><td>Others</td><td>Workshops, local education, and training</td><td>Conducting capacity building education in 5 fields</td></tr>
</table>

Category	Contents	
Expected Effects	Economic Effects: - Reduction of direct economic harm to Vietnamese livestock farmers from malignant livestock diseases by consolidating the technical infrastructure of Vietnam's national livestock disease prevention system with quarantine authorities' cost reduction - Raised awareness of the animal hygiene field; increased demand for veterinary medicines, diagnostic reagents and related equipment caused by the reinforcement of related infrastructure; expansion of related domestic companies into the Vietnamese market; and an increase in exports - Risk reduction of the possibility of introduction of malignant livestock infectious diseases into Korea because of the improvement of the Vietnamese livestock disease situation, and reduction of domestic disease prevention costs Technological Effects: - Improvement of efficiency of livestock disease diagnosis and research as well as precision of biosafety and security through facilities compliant with Biosafety Level 2 (BSL-2) or higher - Enhancement of Vietnam's livestock disease prevention and control by strengthening the livestock disease diagnosis system and workforce - Utilization of NCVD as an "overseas base research facility" to conduct preemptive research on new diseases that do not transmit locally in Korea Social Effects: - Stable growth of Vietnamese livestock industries, improvement of public health of Vietnamese people, promotion of friendship and cooperation between the two countries, etc.	
Executive Organization	Korea	KRC (Project management consultant [PMC]: WOSEM Co., Ltd., Animal and Plant Quarantine Agency [APQA])
	Vietnam	NCVD

Source: Kim Jongsun, Huh Duk, and Won Jieun, "Ex-Post Evaluation: Capacity Building for the National Center for Veterinary Diagnosis (NCVD) in Vietnam," KREI, December 2019

〈Figure 27〉 Location of Project Site

Source: MAFRA, et al. (2018)

〈Figure 28〉 Aerial View of NCVD

Source: KRC (2012)

This project was conducted with a budget of KRW 2.8 billion for about 49 months from 2014 to 2018 following a one-year extension of the project. WOSEM Co., Ltd., a project management consultant (PMC), provided

construction and equipment to promote the project, while APQA was in charge of the consulting and outreach education of quarantine experts.

〈Table 23〉 Results of Project 1's Ex Post Evaluation

Evaluation Criteria	Evaluation Items	Score Distribution			
1. Appropriateness	• Suitability with the recipient country's developmental strategy and demand and the Korean government's support strategy	4	③	2	1
	• Appropriateness of project plan	4	③	2	1
	• Appropriateness of project process	4	3	②	1
	Average Score (a)	2.7/4			
• Reasons for scoring The goal of this project is in line with the recipient country's national strategy, agricultural sector strategy, and sustainable development goals (SDGs). However, for the establishment of a BSL-3 level facility plan that is difficult to use in this project and the considerable delay in project execution, the appropriateness of the project plan and execution process are insufficient.					
2. Efficiency	• Economic efficiency in utilizing resources	4	③	2	1
	• Efficiency of project execution	4	③	2	1
	• Efficiency of technical application	④	3	2	1
	Average Score (b)	3.3/4			
• Reasons for scoring Despite changes in the project period and contents, project budget execution and management were relatively efficient, and Korean technologies were efficiently applied through continuous cooperation and joint research with APQA.					
3. Effectiveness/ Influence	• Short- and long-term effects of the project	④	3	2	1
	• Solidity, Achievability and ripple effects of the project	4	③	2	1
	Average Score (c)	3.5/4			
• Reasons for scoring Diagnosis capacity (i.e., number of diagnoses, time required for diagnosis) for livestock diseases that occurred in 2019 such as ASF has greatly improved because of quarantine facilities and equipment as well as the enhancement of workforce capabilities, which were a project focus. It is evaluated that the ripple effect of the project will be relatively large as the capacity to manage livestock diseases increases.					
4. Sustainability	• Independent operation abilities such as workforce and capacity	④	3	2	1
	• Sustainability of securing finances	4	③	2	1
	Average Score (d)	3.5/4			
• Reasons for scoring With the enhancement of NCVD's capability to diagnose livestock disease, the diagnosis task will be expanded to provincial-level livestock disease diagnosis. In addition, the degree of financial independence is expected to increase because of an increase in diagnosis fees.					
Overall Score (a + b + c + d)		13/16 points			
Comprehensive Evaluation Grade		Partly Successful			

Source: Kim Jongsun, Huh Duk, and Won Jieun, "Ex-Post Evaluation: Capacity Building for the National Center for Veterinary Diagnosis (NCVD) in Vietnam," KREI, December 2019

3.2.3. Project 2

The livestock industry accounts for 90% of Mongolia's total agricultural sector. Although this country produces a high proportion of meat and dairy products, public access to safe food and health is threatened because of insufficient livestock processing technology and hygiene management systems. Thus, The Mongolian government set and promoted policy goals for agricultural and food industry development through the Millennium Development Goals (MDG)-Based Comprehensive National Development Strategy of Mongolia and the National Program for Food Security (2009-2016).

However, this policy is difficult to promote because of a lack of related facilities and the absence of experts and programs. So, In 2010, the Mongolian government requested technical support for livestock processing and sanitation management from their Korean counterparts through the agenda of the "Fourth Korea-Mongolia Agricultural Cooperation Committee."

Representatives from Mongolia's Ministry of Food, Agriculture, and Light Industry (MoFALI) and Korea's MAFRA and KRC agreed to a joint project between the two countries during the Fifth Korea-Mongolia Agricultural Cooperation Committee in July 2012. This project aimed to disseminate Korea's livestock product processing technology and hygiene standards in Mongolia by establishing a processing plant and introducing a sanitation management system. It also attempted to develop the capabilities of the Mongolian workforce in the field, and it was conducted with a total budget of KRW 2.5 billion from 2012 to 2015.

〈Table 24〉 Project 2 Overview

Category	Contents	
Title	• Project for Processing and Hygienic Control System of Animal Products in Mongolia	
Country (Region)	• Mongolia (Ulaanbaatar)	
Purpose	• Improvement of public health and enhancement of export competitiveness through quality improvement of processed livestock products	
Period/Scale	• 2012–2015 (4 years) / KRW 2,500 million	
Execution Organization	Korea	Korea Food Research Institute
	Mongolia	Institute of Technology
Management Organization	Korea	KRC (General Project Management Organization)
	Mongolia	MoFALI (Partner Organization)
Main Contents	Construction	• Construction of a livestock dairy and meat processing pilot plant (540 ㎡) • Support for livestock dairy and meat processing facilities, sanitation facilities, and analysis facilities for quality inspection • Remodeling of laboratories and educational facilities
	Invitational training	• Manager course (19 people, 1 week), Practitioner course (10 people, 2 weeks)
	Dispatch of experts	• Livestock product processing and sanitation management (PM, 18 months), construction (8 months), dairy processing (5.7 months), meat processing (0.8 months), and analytical inspection (1.5 months)
	Equipment	• One vehicle, two desktops, two notebooks, and one printer

Source: Kim Jongsun, Huh Duk, and Lee Mi-na, "Ex-Post Evaluation: Project for Processing and Hygienic Control System of Animal Products in Mongolia," KREI, December 2018

The livestock dairy and meat processing plant were established in the Institute of Technology in downtown Ulaanbaatar, which is a government institution managed by Mongolia's Ministry of Education and Science, established in 1965 for vocational education, and is currently affiliated with the Privatization Steering Committee under the Prime Minister's Office. The Institute is operating education programs that can be linked to industrial sites and training programs for food and technology-related workers, so it was selected as suitable for the promotion purpose of this project.

The project's major contents include support for the construction of livestock products, dairy/meat processing plants and related facilities, support for analysis equipment for quality inspection, support for equipment, dispatch of experts, and invitational training. The project's stakeholders include the KRC's International Agricultural Cooperation Team, one of Korea's general project management organizations, and the KFRI, a PMC. On the Mongolian side, these include the Institute of Technology, a project implementation organization, and the MoFALI's Bureau for Food Production Policy Coordination, a project monitoring and management organization.

〈Figure 29〉 Design Drawing and Panoramic View of Project 2

Source: Kim Jongsun, Huh Duk, and Lee Mi-na, "Ex-Post Evaluation: Project for Processing and Hygienic Control System of Animal Products in Mongolia," KREI, December 2018.

The Institute of Technology's livestock dairy and meat processing plant established Khan Brand LLC in 2016 and produces 20 types of dairy products (e.g., milk, yogurt, and curd) and 9 types of meat products (e.g., dumplings and sausages). Also, students and teachers from the Institute of Technology can work at the plant and be provided with regular education.

During the project feasibility study, this plant produced 1.5 t of dairy products and 50 kg of meat products per day on a producible scale and sold them to the market, with sales profits used for operating expenses. In addition, this plant is equipped with a Freon refrigeration storage facility that can store 200 t of processed dairy and meat products as of 2018.

〈Table 25〉 Results of Project 2's Ex Post Evaluation

Evaluation Criteria	Evaluation Items	Score Distribution			
1. Appropriateness	• Suitability with the recipient country's developmental strategy and demand and with the Korean government's support strategy	4	3	2	1
	• Appropriateness of the project design and execution process	4	3	2	1
	• Ownership of the recipient country	4	3	2	1
	Average Score (a)	3			
• Reasons for scoring – This project was established through consultation with the "Korea–Mongolia Agricultural Cooperation Committee" during the project discovery process and consistent with Mongolian government policy. However, when designing the project, it was insufficient to present a "profit model" for the project's financial stability. – The role division between the Mongolian government and the Institute of Technology (a project execution organization) was clearly established, and the government actively participated in the project promotion process, such as forming the Project Steering Committee.					
2. Efficiency	• Efficiency of project expenses	4	3	2	1
	• Efficiency of project period	4	3	2	1
	• Degree of achievement compared to expended resources	4	3	2	1
	Average Score (b)	3.3			

Evaluation Criteria	Evaluation Items	Score Distribution			
• Reasons for scoring – There was no additional budget support or delay in the project period, and the project's original goal was achieved.					
3. Effectiveness/ Influence	• Degree to which the planned outcomes, purposes, and goals have been achieved	4	3	2	1
	• Positive/negative impacts on society, economy, and institutions	4	3	2	1
	Average Score (c)	4			
• Reasons for scoring – This project fully achieved the project goal of "building a livestock sanitation management system and strengthening the workforce." This project had educational effects benefits for students, as well as research and product development effects, profit creation effects, social awareness system effects, and institutional ripple effects.					
4. Sustainability	• Sustainability of human resources, institutions, and finances	4	3	2	1
	• Suitability of the maintenance and management system and the degree of risk response	4	3	2	1
	Average Score (d)	4			
• Reasons for scoring – For the continuous operation of the project, Khan Brand LLC was established under the Institute of Technology to produce and sell processed livestock products. In addition, with a loan from the Asian Development Bank (ADB), the second plant was built to expand dairy product production. By achieving profit through this, project sustainability is high.					
Overall Score (a + b + c + d)		14.3/16			
Comprehensive Evaluation Grade		Successful			

Source: Kim Jongsun, Huh Duk, and Lee Mi-na, "Ex-Post Evaluation: Project for Processing and Hygienic Control System of Animal Products in Mongolia," KREI, December 2018

This project was conceptualized and planned through the official consultation of the Korea-Mongolia Agricultural Cooperation Committee, and its appropriateness was rated highly, owing to its close linkage with Mongolia's national policy. However, some equipment could not be utilized because of parts failure.

Because of the organized project management and operation of the Mongolian project operator (Institute of Technology), both the public

interest in educating the workforce and the business interest in financial profit were clearly achieved, so the project's effectiveness, influence, and sustainability were rated highly.

3.2.4. Project 3

In Mongolia, 20 million livestock out of 66 million domesticated animals are produced annually, but only about 10 million livestock are consumed for domestic consumption. On the other hand, about 120 meat processing plants produce 450,000 t of meat products per year, exporting 20,000–30,000t. in the case of milk, at 70 dairy processing plants nationwide, 493,000t of milk are processed, and dairy products are produced. Thus, boosting exports of surplus livestock is crucial for the national economy and farmers' household income.

So, the Mongolian government plans to install quarantine zones in 13 Aimags (hereinafter "provinces") in 2017, build meat processing plants by attracting private capital, and secure export areas by attracting foreign capital. However, the levels of livestock processing technology and sanitation management in Mongolia are far below international standards, thus threatening public health and lowering export competitiveness. Mongolia's livestock industry has a serious FMD problem because of the influence of traditional nomadic culture.

To foster export-oriented livestock industry, the Mongolian government has selected the improvement of livestock processing and sanitation management as an important national policy task and is promoting the

introduction of advanced technologies. However, the related facilities, human resources, and programs are very insufficient. As of 2018, there were 32 slaughterhouses in Mongolia, but only 18 were continuously operational. The rest are inactive because of mechanical, equipment, technical, and economic difficulties.

Also, The Mongolian government has designated "Khalkhgol District" as a national agricultural development zone to control livestock diseases and promote livestock products through intensive farming. However, there are no slaughterhouses and quarantine stations necessary for exporting livestock products in this zone.

〈Table 26〉 Overview of "Khalkhgol District," a National Agriculture Development Region

Sector	Contents
Management organization	Administration of Khalkhgol District for national creation and establishment
Total area of the Khalkhgol District	About 50,000 ha (national land)
Livestock industry pasture	About 65% of the total area
Crop land	About 14% of the total area
Quarantine zone	About 5% of the total area
Other areas	Lakes, roads, etc

※ "Khalkhgol District" for national reconstruction and establishment, selected in the national resolutions (No. 46, No. 328) issued in 2016, is an environmentally friendly and export-oriented area, as well as an area for intensive livestock industry and crop cultivation. Within these 500,000 ha, plans are currently in place for the development of infrastructure, manufacturing, and tourism in cooperation with domestic and foreign investors, charitable organizations, municipalities, and administrative agencies.

Mongolia manages livestock through grazing, a traditional livestock breeding method, but livestock are sensitive to climate change and vulnerable to disease and safety management because of hazard cold in winter. So, it is common to slaughter most livestock before the season

comes. Accordingly, there is a great need for modern slaughterhouses and processing or storage of surplus carcasses.

Dornod Province, the project site, is geographically suitable for export and has a relatively well-established infrastructure for feed production and meat processing, but the lack of meat processing plants is an obstacle. This is especially because livestock food is sold at room temperature even in summer, and sellers must change their perception of distribution management, owing to their lack of awareness about food safety.

The Quarantine Administration is located in the border area near the province. However, because of the lack of experimental equipment and laboratories to inspect livestock products, this situation does not meet the importing country's hygiene standards. This causes frequent disputes with importing countries during quarantine, and technology levels have fallen behind. Quarantine equipment support and experimental technology training are required to strengthen quarantine capabilities.

The overall problems in the Mongolian livestock market are the lagging of livestock technologies of each stakeholder in the entire value chain, from breeding to quarantine, and an information gap in the livestock market between livestock farmers, processing plants, and sellers.

Therefore, education is needed to enhance the capabilities of stakeholders participating in the entire process of breeding, slaughtering, processing, and sales, and it is urgent to establish a livestock production base with unified integrated management.

This project's goal is to promote the export of livestock products and contribute to the development of the Khalkhgol District's livestock industry by installing modern slaughterhouses and livestock product

quarantine facilities within the zone following the development and operation plan.

In addition, the goal is to contribute to the management of livestock diseases and the establishment of a quarantine system for livestock products in Mongolia by establishing and educating the field on the operation plans of modern slaughterhouses and quarantine stations that meet international standards.

〈Table 27〉 Project Outcome Indicators

Project Purpose	Outcome Indicators	Baseline
Contribute to the promotion of livestock export and the development of the livestock industry through the establishment of modern slaughterhouses and quarantine facilities within Khalkhgol District	- Increased livestock product exports in Khalkhgol District - Increased number of intensive livestock farmhouses and livestock - Increased number of slaughterhouses and quarantine workers	- Exports of livestock products in Khalkhgol District: None - Number of intensive livestock farmhouses and livestock: 1 Korea International Cooperation Agency (KOICA) pilot farm and about 90 cattle - Number of the related workers: None

Source: KREI CIAP, "Project of Enhancing Mongolia's Livestock Industry Export Capacity Through Establishing Modern Slaughterhouses in Khalkhgol District (Draft)"

3.2.4.1. Expected Effects

○ For Korea

① Transfer of a Korean livestock technology and disease control system, laying the groundwork for the advancement of domestic livestock processing-related private companies and vitalizing the entry of livestock equipment-related industries into the local market

② With regard to education and training facilities, it is possible to transfer the highest level of Korean livestock technology by support-

ing the establishment of the livestock education and training center, securing a bridgehead for entering the global market in each field of breeding, slaughtering, processing, and sales, and enhancing the competitiveness of the Korean industry.

③ Improving Korea's national image and expanding exchanges and cooperation between the two countries in the livestock sector

○ For Mongolia

① Increased meat exports by establishing modern slaughterhouses related to livestock disease management, quarantine areas, and key quarantine systems

② Increased economic benefits, job creation, and food safety

③ Establishment of this education and training center as a leading livestock education facility in Mongolia by efficiently training advanced skills throughout the livestock value chain

④ Increased income of Mongolian livestock farmers and fostering of livestock expertise through the dissemination of Korea's advanced livestock technology, theory, field, and business operation knowledge

⑤ Growth of Mongolia's livestock market and strengthened business competitiveness

3.2.4.2. Main Contents

○ Period/Expenses: 2020-2024 (5 years) / KRW 4.5 billion

○ Site: Dornod Province, Khalkhgol District quarantine zone

3.2.4.3. Components

① **Overall**: Establishment of a master plan for mid- to long-term promotion including performance management and measurement methods (i.e., baseline surveys, interim monitoring plans, end-line surveys, performance management plans, follow-up management plans, and technical education programs)

② **Facility construction**: Slaughterhouses, quarantine facilities, mooring areas, biopsy rooms, workrooms, disinfection rooms, waste treatment (drainage) facilities, etc.

③ **Equipment support**: Support for equipment for biopsies, slaughtering, quarantining, sterilization, freezing and refrigerating, etc.

④ **Dispatch of experts**: Education on the skills, grading, shipping, and slaughterhouse wastewater and sanitation management related to slaughter works (slaughter, evisceration, dismantling, cleaning, etc.)

⑤ **Capacity building**: Establishment of a comprehensive facility plan including slaughterhouse and quarantine station operation procedures and domestic and overseas training for related public officials

※ Facilities (i.e., slaughterhouses and quarantine stations) and equipment are managed and operated directly (or in trust) by the Mongolian government (Khalkhgol Project Promotion Team).

3.2.4.4. Education and Training Project Components

① **Establishment of the Livestock Education and Training Center**: Installation of audiovisual education rooms and meeting rooms, livestock breeding grounds, pastures, etc.

② **Dispatch of experts**: Dispatch of domestic experts in livestock breeding, sanitation, slaughter, processing, quarantine, etc.

③ **Invitational training**: Stakeholders such as cattle breeders, slaughterers, processors, quarantine officers, and public officials related to livestock policy, etc.

④ **Equipment support**: Livestock hygiene inspection equipment, educational equipment, etc.

3.2.4.5. Location Conditions

○ The distance from Ulaanbaatar, the Mongolian capital, to Choybalsan in Dornod Province is about 660 km, and the road is paved according to the Mongolian Ministry of Land's Millennium Road Plan. Travel time is about 6 hr. by car, or about 1.5 hr. by domestic flight.

○ The distance from Choybalsan to the Khalkhgol zone is about 340 km, and the travel time is about 6.5 hours by car. The road is paved for about 30 km from the departure point in Choybalsan and about 60 km from the arrival point in Khalkhgol District, but the rest of the middle section is unpaved.

○ The distance from Ulaanbaatar to the project site is very long, and only

some sections are paved, so accessibility is poor. However, as the area is adjacent to the border quarantine station, accessibility is very good in terms of primary processing (slaughter) and quarantine for export of livestock products.

- Because of oil field development, 10 kWt of electricity is supplied to the project site.

3.2.4.6. Detailed Plans for Each Component

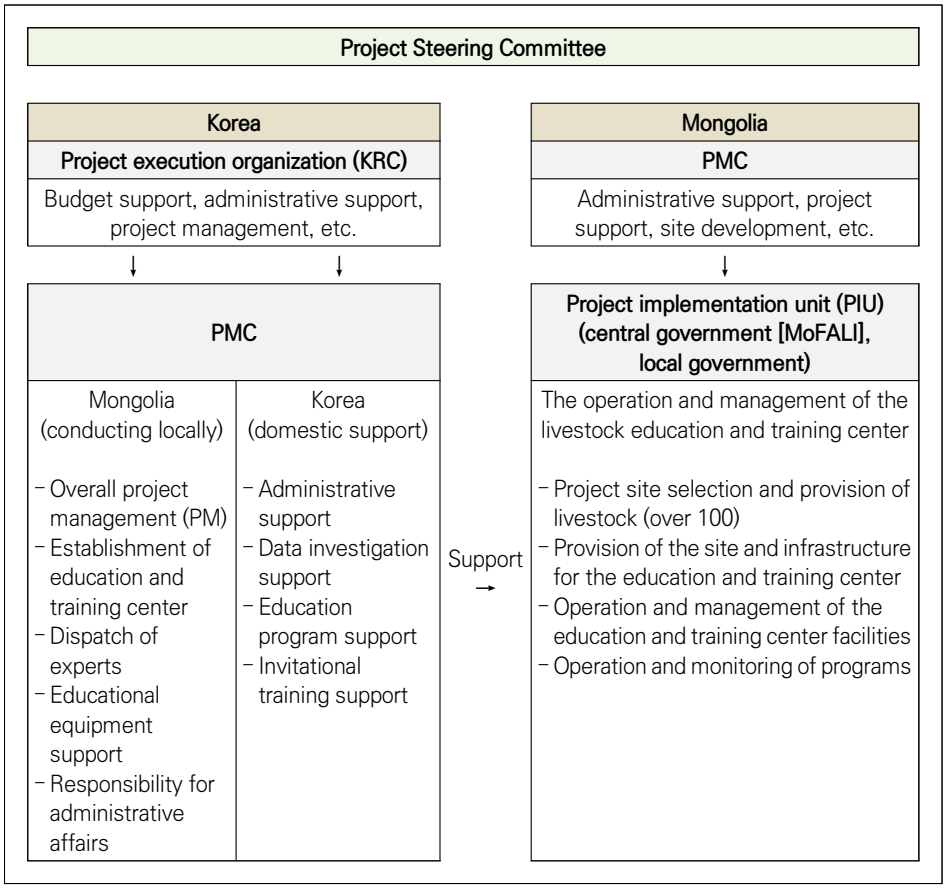
- Establishment of a master plan for short-term and mid- to long-term project promotion procedures and the future creation and operation of slaughterhouses and quarantine stations
- Preparing mid- to long-term operation plans, including roles for each public and private participant
- Preparing quarantine and sanitation-related systems and procedures for livestock products in Khalkhgol District
- Performance management plan (including a baseline survey plan, monitoring plan, end-line survey, and a post project evaluation)

This project includes the construction of primary livestock processing facilities (slaughterhouses), mooring areas, and quarantine facilities in the quarantine zone of Khalkhgol District. It includes support for related equipment, the establishment of slaughterhouses and quarantine facilities in the area adjacent to the Mongolian border management office, fence installation in the quarantine zone, construction of slaughterhouses

capable of slaughtering up to 80 cows per day, refrigeration facilities, residue (e.g., cowhide and blood) treatment facilities, drainage facilities, inspection facilities, mooring areas capable of holding cattle for at least 21 days immediately before slaughter, installation of quarantine facilities of livestock products during import and export and support for the related equipment, and installation of office spaces.

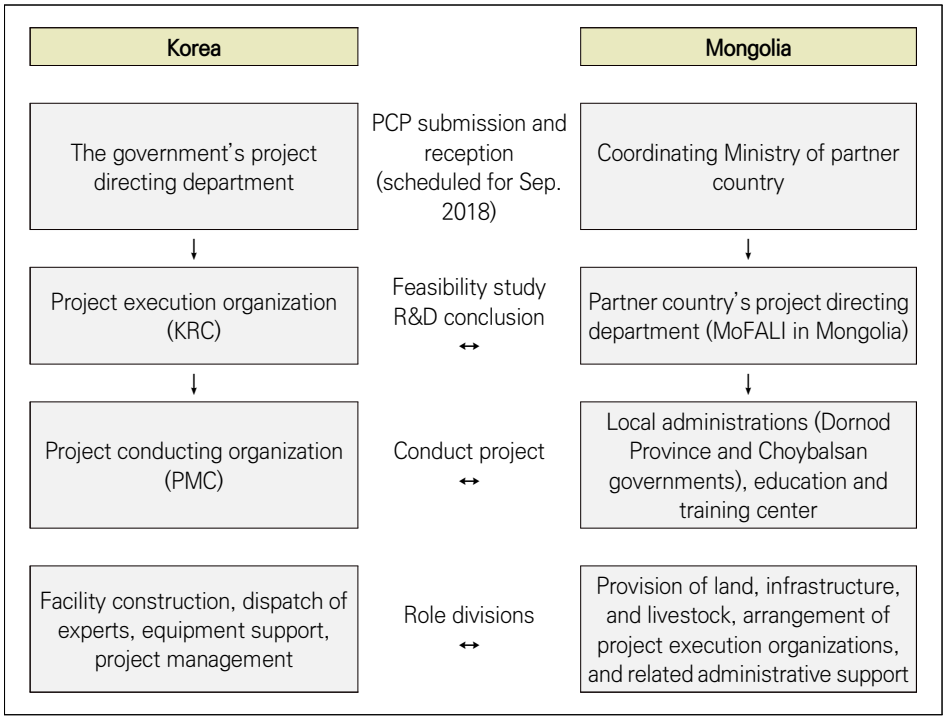
Also, it entails conducting education on slaughter and quarantine skills, management of slaughterhouse wastewater and hygiene, and operation of slaughterhouses and quarantine stations. It also includes the dispatch of Korean experts in the field (e.g. slaughter, evisceration, dismantling, and cleaning), packaging, grading, shipping, slaughtered residue treatment, and wastewater management. There is a planned skill transfer through education and training for the relevant officials (e.g., quarantine) and slaughterhouse operation technicians on facility management and administration, and educational materials, facility operation manuals, and equipment and management training materials will be produced and utilized for education and training.

〈Figure 30〉 Project Steering System



Source: KREI CIAP, "Planning of the Project of Constructing the Livestock Education and Training Center in Mongolia's Dornod Province (Draft)" April 2019

〈Figure 31〉 Promotion System and Role Division Between the Two Countries



Source: KREI CIAP, "Planning of the Project of Constructing the Livestock Education and Training Center in Mongolia's Dornod Province (Draft)" April 2019.

3.2.4.7. Detailed Plans for Each Education and Training Center Component

○ Construction of an education and training center: A main building with education and training facilities (1 3-story building, 1,000 ㎡), offices, meeting rooms, restaurants, sleeping quarters, 4–5 audiovisual education rooms for theoretical education on livestock breeding, slaughter, processing, and sanitation

○ Construction of a 700 ㎡ feedlot for practice: A facility capable of raising at least 100 livestock (cows and sheep) throughout the year

○ Construction of a grazing farm (50 ha): Installation of simple feed cultivation and manufacturing facilities (10 ha) and fences

○ Dispatch of experts, invitational training: Dispatch of 1 domestic expert in each field such as livestock breeding, feed, hygiene, slaughter, meat and milk processing, and quarantine; production and provision of education programs by field, conducting local education, and invitational training (3 times) for more than 10 people, including instructors and public officials (central and local government officials) related to the Mongolian livestock industry

○ Equipment support: E.g., practice and educational equipment.

3.2.5. Project 4

This project was planned under the premise that quarantine facilities will be installed near Khalkhgol, and it was prepared as part of the mid- to long-term livestock development plan in Dornod Province in connection with the Khalkhgol project. It proposed a comprehensive framework plan of a livestock value chain for export, including the establishment of fodder farms, feed-drying facilities, feedlots, slaughterhouses (for primary meat processing), livestock transport facilities, secondary meat processing plants, quarantine facilities, and an export system

○ Livestock value chain: Fodder farm → feed-drying facility → feedlot → designated slaughterhouse → transportation of livestock products (meat) → second meat processing plant → export quarantine → export (to China, Russia, the Middle East, etc.)

3.2.5.1. Fodder Farm Location Conditions

- Soil characteristics: sandy, not muddy, good water retention capacity
- Climate: Areas with minimal wind if possible
- Water: Areas where water can be supplied even with irrigation
- Other features: nearby fodder demand areas, feedlot, fodder packing (fodder farms), cattle number, etc.
- Appropriate seeds: To promote seed improvement through the improvement of feed seeds (e.g., grass, feed grains, feed crop seeds)
- Harvesting time: Mechanized (Facilities should be fully equipped with farm machines such as harvesters.)

3.2.5.2. Feed-Drying Facility Installation Conditions

- Avoidable rain or snow after harvest (Check the need for roofs.)
- Potential need for drying facilities

3.2.5.3. Feedlot Location Conditions

- Abundant feed resources (optimal soil characteristics, water, climate, etc.)
- Appropriate weather: Not too hot or cold and well-ventilated; for Mongolia, roofed and walled barns are necessary.
- Smooth logistics: Steady supply of production materials (e.g., feeds, veterinary drugs, and equipment)

- Quarantine facility: Livestock disinfection, etc. to minimize the quarantine zone; a fence installation fee is required.

3.2.5.4. Quarantine Facility Location Conditions

- Must be near the national border
- Inspection facilities may be slightly separated from each other, but facility conditions must be met to prevent recontamination according to inspection criteria.

3.2.5.5. Export Slaughterhouse and Livestock Product Processing Plant Location Conditions

- Logistics infrastructure
- Product demand in neighboring areas (in the case of failure to export)
- Available professional workforce for employment
- Water and electricity access

3.2.5.6. Export Base Prerequisites

- Establishment and implementation of a plan in connection with the livestock value chain (mentioned above)
- Region designation: Required from feed resources (e.g., grass, feed crops, feed grains) to export quarantine

- Construction of feedlots as semi feedlots where livestock are reared only in winter
- Requirement of inspection facilities for livestock products
- Located near institutions that can inspect importing country needs

〈Figure 32〉 Project Site Location

Source: KREI, "Korean Presentations and Business Trip Reports at the Relevant Local Joint Meeting" April 2019

〈Figure 33〉 Overview (Schematic Diagram) of the Proposal

Source: KREI, "Korean Presentations and Business Trip Reports at the Relevant Local Joint Meeting," April 2019

3.3. Lessons from Each Country's Projects

3.3.1. Vietnam

First, after the project's completion, the Vietnamese government's satisfaction was high, and even after the completion, policy support is being prepared to stably and continuously expand the center's capabilities and authority to sustainably manage the project's outcomes.

Second, Local stakeholders believe that the diagnosis capability and facility expansion of NCVD because of this project greatly contributed to

the rapid response and prevention of the spread of ASF, which occurred in Vietnam in early 2019.

Because of inadequacies and unexpected circumstances during the establishment and execution of the project plan, the project contents were changed several times, and the project promotion was delayed, resulting in its one-year extension. One reason is that the original plan was for a BSL-3 facility, but Korea lowered it to BSL-2. This project is a good example of how important the formation process and planning stage of an ODA project are for efficient project implementation.

3.3.1.1. Lessons for the importance of the planning stage

The ODA project should clearly match the policy goals of recipient countries, and its effectiveness and sustainability can be increased only when it is based on those countries' policy demands. Accordingly, the active project participation and accountability of recipient countries can be increased, and as in the case of the project for evaluation, countries can provide institutional or financial support for continuous operation even after project completion.

First, in the project planning stage, the recipient country's policy implementation system, technology level, and capability in related fields should be thoroughly analyzed. In the field of livestock diseases, it is true that laboratory facilities at the BSL-2 level or higher are needed to efficiently respond to diseases such as ASF and anthrax that have had serious outbreaks recently. However, we had no choice but to accept Vietnam's unreasonable demands because we did not clearly understand

that operating costs and a lack of management capabilities would constrain BSL-3 facilities in the region. As a result, the BSL-3 equipment (Autoclave) and laboratory space were abandoned.

Thus, if Vietnam's livestock disease-related technology level or capabilities were analyzed in the planning stage, a more realistic plan would have been established to support the BSL-2+ facilities that provide shielding testing facilities for only a few laboratories instead of the BSL-3 equipment.

Second, when discussing project design and policy demand, high-level decision makers from recipient countries should be encouraged to participate in the discussion and project promotion organizations (e.g., Project Steering Committee), therefore allowing them to play a role in project implementation inspection (monitoring). This is because the project content can be modified not to be easily changed, and even if they are inevitably changed, snap decisions can be made.

3.3.2. Mongolia Mid- to long-term support required in terms of the value chain

The three projects and project plans (drafts) in Mongolia were conceptualized and planned through the official consultation of the Korea-Mongolia Agricultural Cooperation Committee following the active request of the Mongolian government. These projects are closely related to Mongolia's national policy, so they are considered highly appropriate.

However, in the case of Project 2, it is somewhat regrettable that the project is having operational difficulties because of parts replacement

issues in terms of facility and equipment management. If additional support is provided as part of the mid- to long-term projects in the livestock sector considering the value chain, these problems will be resolved.

3.3.3. Comprehensive lessons

As a follow-up to the Vietnam project, a more practical and professional education and training project can be proposed by utilizing the existing research cooperation system between APQA and NCVD. In addition to this project, when Vietnam introduces its own BSL-2+ test facility, we can provide mid- to long-term consulting on the related content.

Project 2 is one where Korea supported plant facilities and equipment (hardware), and Mongolia took charge of the education and research program (software) to establish Mongolia's livestock processing and sanitation management system. This is a representative case of the project's success rate increasing because of the recipient country government (Mongolia)'s active participation.

However, it is necessary to promote additional linked projects from a value chain perspective under a mid- to long-term plan. In addition to presenting short-term support plans from the project planning stage, it is necessary to provide a comprehensive support plan considering the value chain under a mid- to long-term plan to help recipient countries achieve definite development in the relevant field.

In turn, the Mongolian government had difficulties raising financial

resources and using facilities for project operation, but continuous operation was possible, owing to the ownership and active participation of the Mongolian government and the Institute of Technology (the project implementation institution). Thus, when planning and promoting a project, it is necessary to present a business model and a public interest operation model for the project's continuous activity.

Project 2 is an example of the importance of the project operator's enthusiasm and ownership in the recipient country in improving the ODA project's outcomes. However, it was insufficient to present a "profit model" for the continuous operation of the project and a "manual" for the maintenance of supported facilities and equipment. Therefore, it is necessary not only to present a business model for its continuous activity but also to suggest a public interest operation model to induce the active participation of the recipient country's government (or project operating entity).

Accordingly, the project benefits will be expanded to various classes, and the ODA project will be utilized as a direct policy tool by the recipient country's government, ultimately increasing the project's effectiveness and influence.

3.4. Lessons Learned from Korean Agricultural Experiences

3.4.1. Veterinary drug development history[26)]

Korea's oriental medicine-style veterinary medicine developed even before the Joseon Dynasty. In the modern era, a cattle plague serum manufactory was built in Korea by Japan in 1911, and an antiserum against cattle plague was manufactured and distributed to minimize damages caused by cattle plague.

In the 1930s, 10 products were produced in the epizootic serum manufactory, such as antisera and vaccines against cattle plague, blackleg, and anthrax, an antiserum against fowl cholera, an antiserum against fowl typhoid, and a pullorum disease diagnostic solution. There were no further cattle plague cases in this decade because of provided cattle plague vaccines and sera.

The veterinary service research institute established in 1942 investigated veterinary diseases and manufactured antisera; it is now called the Animal and Plant Quarantine Agency (APQA), a central veterinary quarantine institution. In 1947, African swine fever (ASF) first broke out in Korea in a swine farm near Seoul, which led to the first production and nationwide deployment of an ASF vaccine. In 1951, inactivated ASF and Newcastle disease vaccines (for chickens) were developed and distributed to farms.

26) Source: Korean veterinary medicine history (2010), National Veterinary Research and Quarantine Service

National accreditation started in 1961, when the veterinary service research institute was designated as a national accreditation institute for veterinary biologics and antibiotics. Newcastle disease, fowl pox, and canine distemper vaccines began to be produced by private veterinary drug manufacturers for veterinary quarantine in 1962. As mass breeding of poultry began in the 1960s, drugs for disease prevention, increased production, veterinary clinic treatment, etc. were developed.

The 1970s veterinary drug industry was characterized by technological growth as it produced raw pharmaceutical materials that were formerly dependent on imports.

In the 1980s, the number of companies importing veterinary drugs increased dramatically (from 5 in the 1960s to 9 in the 1970s to 57 in the 1980s), and excellent foreign veterinary drugs were imported for domestic manufacturers to obtain their technological information. These companies became motivated to develop such drugs, thereby having a positive impact. Thus, whereas veterinary drugs used to be manufactured from raw material imports, production has become much more independent, developing the domestic industry.

The domestic veterinary drug industry matured after the 1990s. Although demand in the domestic market has become saturated and foreign product shares have increased in the domestic market because of import opening (inducing cost competition among similar products), the system has maintained stability by exporting veterinary drugs, developing aquatic veterinary drugs, providing drugs for pets, etc.

3.4.2. Veterinary drug industry overview

Veterinary drugs belong to a customized health care technology, and they are defined as drugs or other raw materials for treating animals.[27] Vaccines, feed additives for medicine, etc. are used to prevent or treat various animal diseases. Veterinary drugs include various types of products such as anti-infective agents that suppress or kill bacteria, fungi, and pathogens that induce other diseases.

3.4.2.1. Veterinary drug management system

The Ministry of Agriculture, Food, and Rural Affairs (MAFRA) manages veterinary drugs and medical devices, while the Ministry of Maritime Affairs and Fisheries (MMAF) does the same for aquatic veterinary drugs. MAFRA establishes veterinary drug policies, while APQA handles veterinary drug authorizations, national accreditation, pharmacist auditing, veterinary drug standard and specification setting, administrative decisions, etc.

3.4.2.2. Korean veterinary drug industry status[28]

As the livestock industry has grown rapidly, the number of veterinary drug manufacturing companies skyrocketed in the early 1970s. Veterinary drug manufacturing and authorization guidelines were announced in July

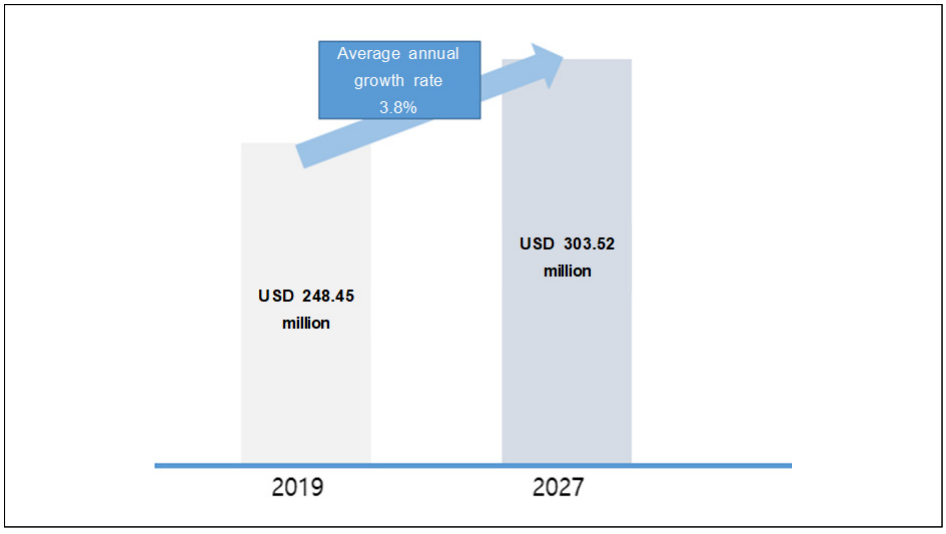
[27] Source: Veterinary drug market, global market trend report (May 2021)

[28] Source: Korea Animal Health Products Association (KAHPA) 50-year history

1975 to curb expected excessive competition and encourage research and development (R&D) and quality improvement.

The Korean veterinary drug market is to reach USD 303.52 million in 2027 from USD 248.45 million in 2019 with an average annual growth rate of 3.8%.

〈Figure 34〉 Korean veterinary drug market size and prospects[29)]



The statuses of veterinary drug manufacture and import companies as of late 2020 are shown in Table 27, and notably, the law was revised in Oct 2015 so that veterinary drugs could be sold through consignment manufacturing without having their respective manufacturing facilities.

29) Source: Mordor Intelligence Pvt Ltd, Veterinary Medicine Market, 2020

〈Table 28〉 2020 Korean veterinary drug industry status

(Unit: No. of companies)

Classification	Veterinary drug	Quasi-drug	Medical device	Sum
Manufacturing companies	60	164	253	477
Importing companies	112	124	205	441
Consignment and repair companies	2	0	11	13
Sum	174	288	469	931

A total of 17,573 veterinary drugs, quasi-drugs and medical devices were approved (as of late 2020), an increase of 6.1% versus the previous year.

〈Table 29〉 2020 Korean veterinary drug status

(Unit: No. of types)

Classification	Manufacture		Import		Sum	
	2019	2020	2019	2020	2019	2020
Veterinary drug	7,095	7,076	1,742	1,743	8,837	8,819
Veterinary quasi-drug	2,875	3,407	2,320	2,380	5,195	5,787
Veterinary medical device	1,173	1,386	1,363	1,581	2,536	2,967
Sum	11,143	11,869	5,425	5,704	16,568	17,573

The Korean veterinary drug market size was KRW 1.237 trillion as of 2020; its domestic product market size was KRW 853.2 billion (domestic demand: KRW 503.3 billion; export: KRW 349.9 billion), and the imported finished product market size was KRW 383.8 billion.

Korea's domestic veterinary drug market demand is about KRW 850 billion, with about 800 competing companies, and has reached its limit because of advancing international companies, the shrinking feed additive market, strict regulations on veterinary drugs, etc. Thus, since the

mid-2000s, Korean manufacturing companies have been actively seeking export markets, thereby increasing exports.

In 2020, exports were worth KRW 349.9 billion (i.e., USD 290 million) for exporting 1,269 products to 114 countries (chiefly to Vietnam [14.6%], Thailand [9.3%], and Brazil [8.8%]). For the last five years (2016-2020), the average annual export growth rate was 5.0% (refer to Table 29).

〈Table 30〉 Export status

Classification	2014	2015	2016	2017	2018	2019	2020
No. of companies	60	63	75	79	78	88	90
No. of products	932	1,039	1,132	1,231	1,257	1,280	1,269
Export amount (in USD 1,000)	180,916	214,918	236,534	270,934	290,562	300,188	290,513
Growth rate (%)	18.2	18.8	10.1	14.5	7.2	3.3	-1.3

In 2020, the Korean veterinary drug market size was KRW 1.237 trillion; the domestic product market size was KRW 853.2 billion, while the imported product market size was KRW 383.8 billion.

Among domestic products, products for domestic consumption were worth KRW 503.3 billion, and products for export were worth KRW 349.9 billion. The domestic product amount was about 3% of the global veterinary drug market.

3.4.3. Veterinary drug national accreditation and quality control policy

3.4.3.1. National quality control policy changes

Biologic production began when the government built a cattle plague serum manufactory to prevent livestock infectious diseases because of cattle plague occurrences in 1907. After that, to prevent and treat veterinary diseases, promote growth, and improve feed quality, various veterinary drugs were circulated, leading to national accreditation of veterinary drugs to confirm product efficacy and safety.

Therefore, biologics' national accreditation-related laws (Pharmaceutical Affairs Act, veterinary drug handling rules and accreditation standards, etc.) were announced to prepare a legal basis for national accreditation of veterinary drugs. Additional relevant laws were revised or established for implementation of veterinary drug national accreditation, quality control, and standardization.

In 1963, including Korea's first antibiotic (i.e., penicillin oil injection), national accreditation was performed on vaccines for anthrax, blackleg, Newcastle disease, rabies, etc. The government's veterinary service research institute transferred biologic manufacturing technology formerly produced and distributed by them, to private manufactories for free. In addition, by fully supporting national accreditation with the government budget, veterinary drug–related businesses were promoted.

In 1987, to increase private manufactories' independence, accreditation materials and costs became responsibilities of private companies (i.e., end

users). In 1981, to boost veterinary drug exports, the national accreditation exemption policy began, and by designating top veterinary drug quality control companies with the authority to grant Korea Veterinary Good Manufacturing Practice (KVGMP), manufacturing facilities and quality improved.

In 2000, to boost KVGMP, manufactories evaluated as excellent were exempted from national accreditation of veterinary drugs, thereby encouraging quality control. The national accreditation exemption policy was improved in 2007 so that domestically manufactured or imported biologics approved for shipping for 10 or more consecutive manufacturing numbers were exempted from national accreditation.

3.4.3.2. National accreditation of biologics

General accreditation standards for veterinary biologics include characteristics, vacuum level, moisture content, purity, mycoplasma testing, and safety and titer tests for laboratory animals. The number of national accreditation cases for biologics was about 150 in the 1960s, and 951 in 2000 (i.e., maximum no. of cases). However, after the national accreditation exemption policy's introduction in 2007, the trend has been decreasing, and the number has been about 300 cases per year since 2011 (Table 30).

〈Table 31〉 National shipping approval accreditation and fail case status

(Unit: No. of cases)

Accreditation	2011	2012	2013	2014	2015	2016	2017	2018	2019
National shipping approval accreditation	331	301	321	410	308	212	332	308	313
Fail	17	15	38	19	22	14	9	2	5
Failure rate (%)	501	5.0	11.8	4.6	7.1	6.6	2.7	0.65	1.6

In 2017, reasons for failure were mostly a lack of bacterial content (five cases) or inappropriate antibody titer (four cases), but further reasons were found in 2018 and 2019, such as inappropriateness for sterility testing (one case), safety testing (one case), inactivation testing (one case), and characteristic tests.

Since 2018, the failure rate has been about 1%, which has been attributed to general quality control system improvement efforts, including manufacturing facilities while biologic manufacturing veterinary drug companies prepare for inspection from top quality control companies for exported veterinary drugs. Moreover, the government has made continuous quality control efforts for customized consulting and quality control of products with national shipping approval accreditation exemption.

3.4.2.3. Biologic national accreditation exemption and quality control

As of May 2020, among biologics, there were 419 products with national shipping approval accreditation exemption (278 manufactured and 141 imported products). Reported cases of national shipping approval

accreditation exemption have increased continually for the last 10 years, reaching over 1,000 cases per year (refer to Table 31).

〈Table 32〉 Status of reported cases with national shipping approval accreditation exemption

Year	2011	2012	2013	2014	2015	2016	2017	2018	2019
No. of exemption cases	897	997	912	882	940	1,012	901	1,001	1,009

For products with national shipping approval accreditation exemption, they are circulated in the market only after those products are exempted from manufacturer test reports based on national accreditation tests. Thus, post-quality control is important, with the government testing over 120 cases every year.

Products that fail national shipping approval accreditation exemption tests have their exemption approval status canceled, and all products of the corresponding lot will be collected and discarded. They will also require national shipping approval accreditation, and to obtain the exemption status, those 10 products with consecutive manufacturing lot numbers must go through national shipping approval accreditation processes.

3.4.2.4. Self-biologic report status for farms and quality control

The government allows the manufacture and use of preventive drugs using farm-derived pathogens for diseases for which manufacturers have difficulties producing drugs because of various pathogen serotypes.

Self-biologics (i.e., self-vaccines) for some farm uses are vaccines limited to chicken and porcine Escherichia coli (E. coli), porcine pleuropneumonia and pasteurellosis. They can be produced only through a written contract between a domestic KVGMP manufactory and a veterinary breeding farm.

For separated disease-causing in farms, self-vaccines may be used in the corresponding farms only after pathogenicity is removed through the inactivation process, and once the safety, inactivation confirmation, sterility, and preservative quantitative tests are performed. Self-vaccines are those manufactured by inactivating pathogens; the government performs the sterility test as quality control while focusing on safety.

3.4.2.5. Disinfectant quality control for quarantine

Given the continued occurrence of foot-and-mouth disease (FMD), ASF and highly pathogenic avian influenza (AI), the government is strengthening quality control by inspecting all or collected disinfectants for quarantine to ascertain their credibility for quarantine.

Because of inspecting all disinfectants for quarantine that have been approved for FMD and highly pathogenic AI, 1.7% and 3.7% of them had inappropriate disinfectant contents in 2016 and 2017, respectively. Moreover, some products lacked disinfection efficacy for either FMD or AI (refer to Table 32).

〈Table 33〉 Inspection of all or collected disinfectants for quarantine

Year	Inspection details	Inspection results
2016	Inspecting all approved disinfectants for quarantine	- Inappropriate content: 1.7% (3/172) - Lack of efficacy for FMD: 1.3% (2/150) - Lack of efficacy for AI: 16% (26/163)
2017	Inspecting collected disinfectants for quarantine	- Inappropriate content: 3.4% (4/119) - Lack of efficacy for AI: 0.8% (1/122)

As inappropriate products are found while inspecting all or collected disinfectants for quarantine, the government has mandated content and efficacy tests for initial products before distribution to strengthen overall quality. Disinfectants in circulation are also collected, and content and efficacy tests are performed on them every year.

Since ASF broke out in China in 2018, it has spread to nearby Asian countries, with South Korea experiencing an outbreak in Sep. 2019. Because there was no approved anti-ASF disinfectant, domestic disinfectants containing active ingredients recommended by the Food and Agriculture Organization (FAO) and World Organization for Animal Health (OIE), were used for emergency quarantine. Furthermore, the government approved veterinary drug companies' disinfectants promptly through the efficacy test for use against ASF.

Because the government does not allow the evaluation of disinfectants against foreign malignant diseases that have never occurred in South Korea, a national research project is ongoing to identify viruses that represent all viruses in the disinfectant efficacy test.

3.5. General Status and Supporting Systems for Korean Private Companies to Advance to Partner Country

3.5.1. Details of the 2021 comprehensive veterinary drug industry support project

- Manufacturing facility construction and repair (or loan): Veterinary drugs (or quasi-drugs), veterinary medical device manufacturing (or testing/research) facility construction, repair loans, etc.
- Export company operation (or loan): Financial support for purchasing raw materials and manufacturing veterinary drugs (or quasi-drugs) and veterinary medical devices for overseas export
- Support for pioneering overseas export markets: Booth lease fee, equipment fee, participation fee, consultation fee, brochure-making costs, website and advertisement videos, workshop costs, etc.
  - To expand the veterinary drug market, pioneering markets in countries (e.g., China) where no veterinary drug has been exported yet was prioritized for support.
  - Booth lease, equipment, and participation fees for participating in overseas exhibitions
  - Fees for overseas veterinary drug market surveys, finding new buyers, consultation sessions, etc.

- Advertisement fees, including brochure production (in foreign languages), website and advertisement video making (in foreign languages), and local media advertisements
- Fees for workshops where foreign public officials in charge of export approval participate
- Good Manufacturing Practice (GMP)[30] consultation support: Covering veterinary drug GMP consultation fees for business agents (as below) seeking designation (or operation) of veterinary drug GMPs of international standards[31] to improve manufacturing and quality control
- Audit and improvement of veterinary drug manufacturing and quality control-related standard operating procedure (SOP)[32]
- Matters related to standard reports, case studies, excellent manufacturing processes and quality control
- Standard report production (or renewal), including workplace facility appropriateness, work efficiency facilities, equipment arrangements, workplace audit result summaries, facility improvement measures, etc.

30) GMP: Comprehensive manufacturing process management system including manufacturing facilities, purchase of raw materials/manufacturing/packaging/shipping, etc.

31) WHO GMP, EU GMP, US cGMP or PIC/S GMP, and other foreign standards.

32) Raw materials/semi-finished & finished products manufacturing process, manufacturing instructions and records, quality control records, basic test method and manufacturing environment monitoring, document review and quality control (test method, test operation), eligibility assessment and validation, automation device management, inspection for deviation, change management, annual quality control, self-inspection, collecting complaints and products, on-site GMP application and assessment method, etc.

- GMP education for employers and employees
- Manufacturing and quality control improvement

• Innovative export product promotion support: Among veterinary drug (or quasi-drug) or veterinary medical device manufacturing (or export) companies, some approved products are to be promoted as innovative export products, and fees are supported for testing and certification (clinical, nonclinical, and efficacy), overseas product registration (registration fee, translation fee, consultation, etc.), industrial property right application, and local inspection in overseas countries as follows.

- Testing and certification: Clinical, nonclinical, and efficacy test fees of veterinary drug (or quasi-drug) and medical devices for overseas registration, and consultation fee* for testing and certification utilizing consultation companies specialized in overseas export.

* Maximum of KRW 20 million for testing and certification-related consultation fee

- Overseas product registration (or renewal): Overseas government product registration (or renewal), registered document translation such as testing results, consultation fees* for product registration utilizing consultation companies specializing in overseas export

* Maximum of KRW 20 million for product registration-related consultation fee

- Industrial property right application: Application and agent fees for patent, utility model, trademark, design, and other rights
- Local inspection fee in foreign countries: Local government in-

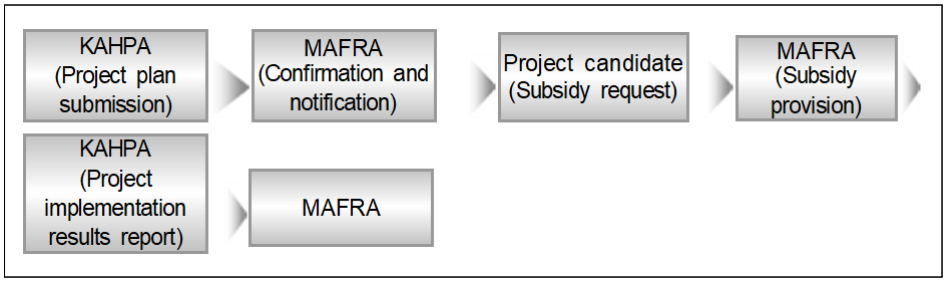
spection fee in foreign countries for local manufacturing facility GMP certification (or renewal) required for exporting veterinary drugs (including flight fares, accommodation, and transportation fees for two-person inspection teams)

- Institutions' roles and implementation systems based on comprehensive support project standard processes of veterinary drugs

〈Table 34〉 Project implementation system

Classification	Main tasks
MAFRA (AI quarantine department)	• Project plan establishment/instruction • Final selection of project candidates and provision of government funds • Project management, implementation (including benefit fraud), and status inspection
APQA	• Project candidate selection and assessment • Technology support and guide for project candidates • Technology support for local governments and cooperation for guide/audit
Local government	• Project advertisement and participation registration of local veterinary drug manufacturing companies • Requesting MAFRA for government funds • Subsidy provision to project candidates, and guidance/supervision of project • Report and assessment of project results (MAFRA)
Korea Animal Health Products Association (KAHPA)	• Project advertisement and participation registration of local veterinary drug manufacturing companies • Introduction and promotion of project to veterinary drug manufacturing companies nationwide • Establishment and implementation of overseas export market pioneering support project • Confirmation of project plan qualification status for promoting innovative export products
Business agents	• Project application, project plan establishment, subsidy request, project implementation, and subsidy spending • Report of project implementation results and subsidy spending

〈Figure 35〉 Overseas export market pioneering support



3.5.2. Comprehensive veterinary drug industry support project (2014-2021)

Through veterinary drug manufacturing facility construction/repair, export company operation, pioneering overseas export markets, GMP consultation, support for promoting innovative export products, etc., the veterinary drug industry's competitiveness can be strengthened, and export will be increased. By providing excellent veterinary drugs, livestock farms' breeding and production costs can be reduced.

〈Table 35〉 Annual financial spending plan

(Unit: KRW 1 million)

Classification	2014	2015	2016	2017	2018	2019	2020	2021
Sum	24,663	12,230	14,100	11,034	31,227	19,474	33,982	37,791
Assistance	500	700	600	630	720	3,020	4,780	8,210
Local cost	-	-	-	-	75	2,375	7,075	6,675
Loan	14,800	8,221	9,600	7,883	21,403	10,011	16,010	16,614
Self-pay	9,363	3,309	3,900	2,521	9,029	4,068	6,117	6,292

3.6. Government Support for Expanding Veterinary Drug Export Market

3.6.1. Necessity of pioneering export market

For Korea, because of a 2000 livestock industry-related free trade agreement (FTA), the overall industry shrank, and the domestic demand market did not grow further. In addition, livestock infectious diseases such as FMD, highly pathogenic AI, and ASF caused economic damages to the domestic livestock industry with negative repercussions for the veterinary drug industry.

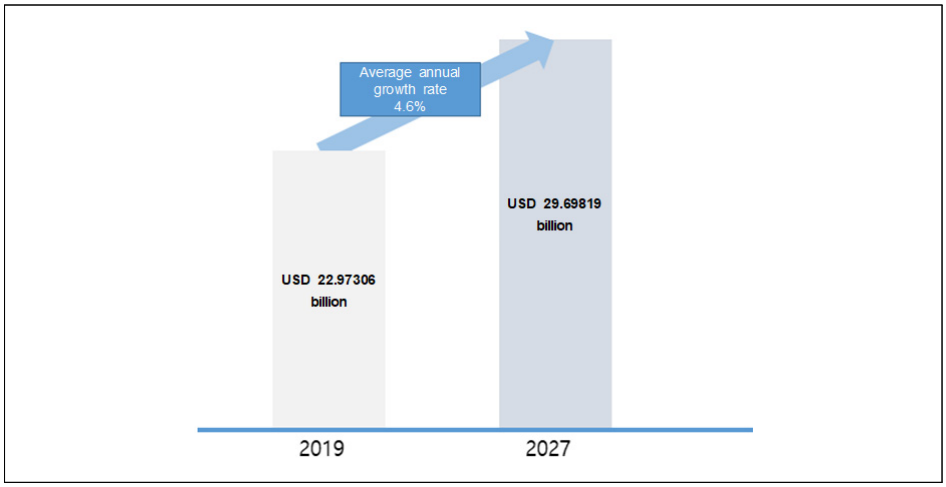
As veterinary drug use policy and regulations (national accreditation abolition for antibiotics, mandatory veterinary pharmaceutical GMP in Korea [KVGMP] for the veterinary drug industry, implementation of product liability, etc.) were strengthened, domestic demand became even smaller.

3.6.2. Overseas industry trends

The global veterinary drug market size is expected to increase from USD 22.97306 billion in 2019 to USD 29.69819 billion in 2027 with an average annual growth rate of 4.6%.[33)]

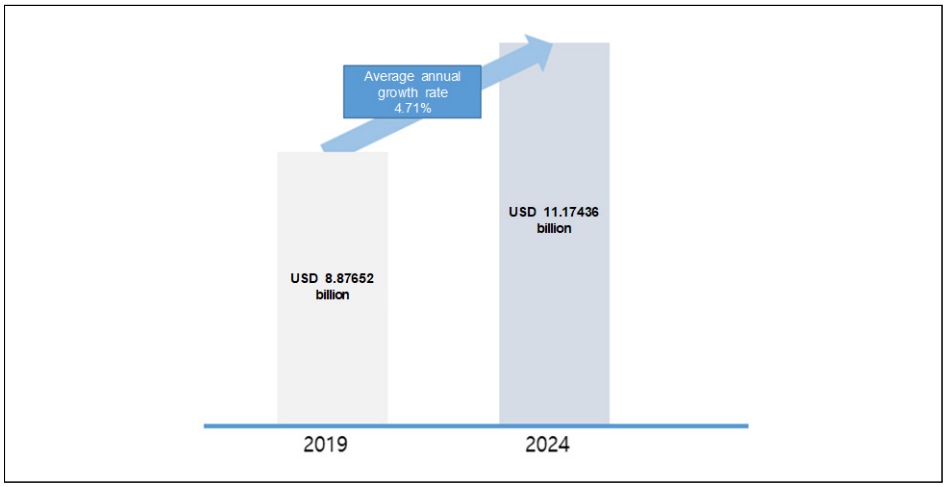
33) Source: Mordor Intelligence Pvt Ltd, Veterinary Medicine Market, 2020

〈Figure 36〉 Global veterinary drug market size and prospect



The global specialized pet drug market is expected to increase from USD 8.87652 billion in 2019 to USD 11.17436 billion in 2024 with an average annual growth rate of 4.71%.[34]

〈Figure 37〉 Global specialized pet drug market size and prospect



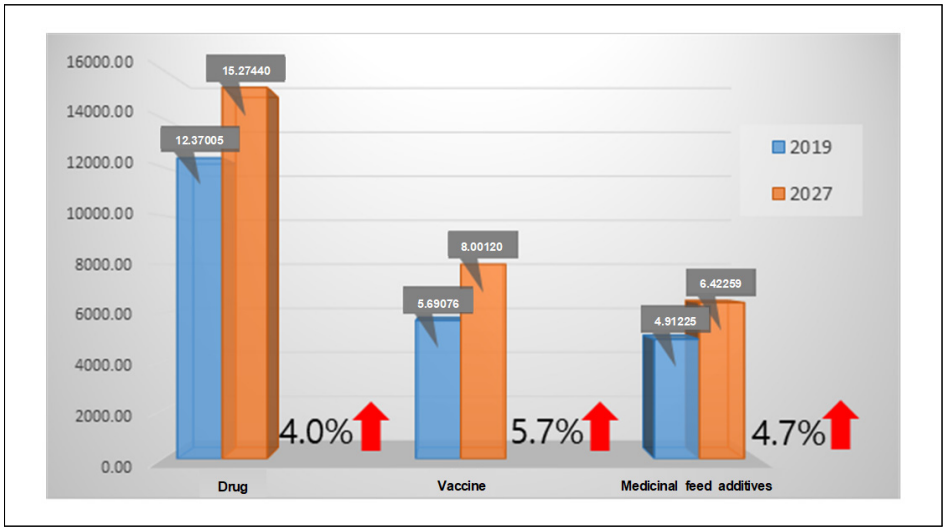
[34] Source: TechNavio, Global Companion Animal Specialty Drugs Market, 2020

The global veterinary drug market is classified into drugs, vaccines, and medicinal feed additives.

- Drug: Expected to increase from USD 12.37005 billion in 2019 to USD 15.27440 billion in 2027 with an average annual growth rate of 4.0%
- Vaccine: Expected to increase from USD 5.69076 billion in 2019 to USD 8.00120 billion in 2027 with an average annual growth rate of 5.7%
- Medicinal feed additive: Expected to increase from USD 4.91225 billion in 2019 to USD 6.42259 billion in 2027 with an average annual growth rate of 4.7%

〈Figure 38〉 Global veterinary drug market size and prospect per type[35)]

(Unit: USD 1 billion)



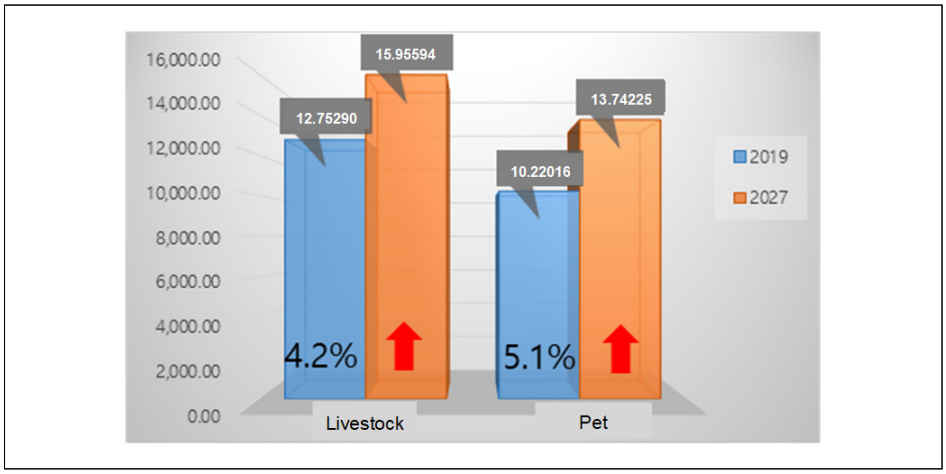
35) Source: Mordor Intelligence Pvt Ltd, Veterinary Medicine Market, 2020

The global veterinary drug market can also be classified into livestock and pets according to animal types.

- Livestock: Expected to increase from USD 12.75290 billion in 2019 to USD 15.95594 billion in 2027 with an average annual growth rate of 4.2%
- Pet: Expected to increase from USD 10.22016 billion in 2019 to USD 13.74225 billion in 2027 with an average annual growth rate of 5.1%

〈Figure 39〉 Global veterinary drug market size and prospect per animal type[36)]

(Unit: USD 1 billion)



In terms of global veterinary drug market size per region, North America has the highest share at 41.3%, the largest as of 2019.

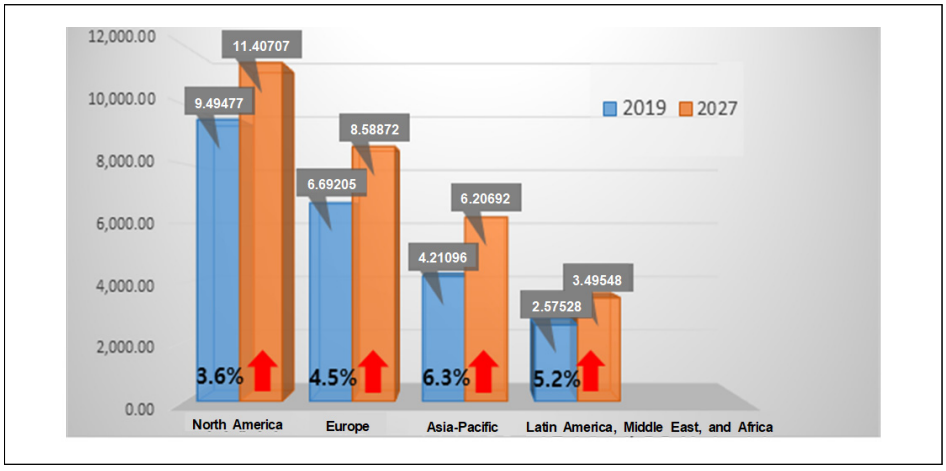
- North America: Expected to increase from USD 9.49477 billion in 2019 to USD 11.40707 billion in 2027 with an annual average growth rate of 3.6%

36) Source: Mordor Intelligence Pvt Ltd, Veterinary Medicine Market, 2020

- Europe: Expected to increase from USD 6.69205 billion in 2019 to USD 8.58872 billion in 2027 with an average annual growth rate of 4.5%
- Asia-Pacific: Expected to increase from USD 4.21096 billion in 2019 to USD 6.20692 billion in 2027 with an average annual growth rate of 6.3%
- Latin America, the Middle East, and Africa: Expected to increase from USD 2.57528 billion in 2019 to USD 3.49548 billion in 2027 with an average annual growth rate of 5.2%

〈Figure 40〉 Global veterinary drug market size and prospect per region[37)]

(Unit: USD 1 billion)



Veterinary drug industries and markets in developing countries are expanding because of economic growth and increasing meat demand. Among Asian countries, Thailand's veterinary drug market is expanding

37) Source: Mordor Intelligence Pvt Ltd, Veterinary Medicine Market, 2020

continually because of livestock industry and pet market expansion, while Vietnam's pig consumption is increasing with an average annual rate of 7.8% because of the government's pig supply expansion policy. Thus, demand for vaccines and veterinary drugs is expected to increase.[38)]

Although multinational corporations (including Zoetis, the world's no. 1 veterinary drug manufacturing company) have about 86% of the global market share, they are passive about producing veterinary drugs for endemic Asian and African diseases. Thus, veterinary drug demand for endemic veterinary diseases in Asia is expected to increase.

〈Table 36〉 Major companies and business areas of the global veterinary drug market (2019)[39)]

Rank	Company	Characteristics
1	Zoetis (United States)	Multinational corporation that develops and sells veterinary drugs focusing on both livestock and pets, vaccines, and diagnostic kits. Provides vaccines, anti-infective agents, antiparasitics, other drugs, feed additives, and pet and livestock health checkup products for pets and livestock
2	Merck & Co (United States)	Company focused on innovative medical solutions through drugs, vaccines, and animal health and treatment products
3	Boehringer Ingelheim International (Germany)	Company that manufactures and sells health management products and drugs for both animals and humans
4	Elanco Animal Health (United States)	Global leading animal health company that manufactures and sells products for pets and livestock
5	Ceva Santé Animale (France)	Veterinary pharmaceutical company that develops and manufactures vaccines, antibiotics, anti-infective agents, metabolic stimulants, and reproductive treatment products

38) Source: Veterinary drug market, Global market trend report. May 2021

39) KAHPA's 50-year history

For Korea's veterinary drug companies, there will be an opportunity to produce and export drugs for endemic diseases occurring in Asia or Africa, where multinational corporations do not actively operate.

3.6.3. Overseas market pioneering by the government and veterinary drug companies

To overcome the difficulties experienced in the domestic veterinary drug market, KAHPA suggested a veterinary drug industry mid- and long-term development plan in 2012, and the government established industry stimulus measures. In 2013, a comprehensive support project was started to pioneer overseas export markets, leading to participation in foreign exhibits (Korean booths representing the country as a group or individually), sending groups to pioneer overseas markets, establishing intercountry networks, and export marketing support (Table 37).

〈Table 37〉 Overseas export market pioneering project

1. Participating in foreign exhibits (representing Korea as a group; 70% government subsidized, 30% self-funded)	
Support purpose	- Promoting Korean veterinary drugs and finding buyers - Creating future demand from potential buyers through networking with foreign buyers and maximizing advertisement effects
Support items	- Exhibit booth lease fee, booth installation fee, advertising materials delivery fee, Korean advertisements, etc.
2. Participating in foreign exhibits (representing Korea individually; 70% government subsidized, 30% self-funded)	
Support purpose	- Advertising individually to major markets per company and expanding exports - Pioneer overseas routes for exporting Korean veterinary drugs and improve corporate image

Support items	– Exhibit booth lease fee, booth installation fee, advertising materials delivery fee, etc.
3. Establishing networks between countries (100% government subsidized)	
Support purpose	– Inviting veterinary drug-involved public officials of major export countries, nongovernment experts, etc. – Communicating with veterinary drug-approving institutions
Support items	– Invitation fee of overseas veterinary drug approval-involved public officials, seminar room lease fee, etc.
4. Sending groups to pioneer overseas markets (70% government subsidized, 30% self-funded)	
Support purpose	– Improving export capability through local buyer consultations
Support items	– Overseas market inspection fee, overseas advertisement fee, buyer invitation fee, airfare for dispatched employees, etc.
5. Export marketing support (70% government subsidized, 30% self-funded)	
Support purpose	– Expanding exports of preexisting export companies by increasing their marketing efficiency
Support items	– Foreign language advertisement materials (websites, advertisement videos, catalogs, etc.), overseas advertisement fees, etc.

To pioneer the global market, KAHPA and the industry have established Korean booths for veterinary drug companies in overseas exhibitions such as Vakbeurs Innovative Veehouderij (VIV) Asia, VIV China, etc. since 2018. In 2012, government support for participating in overseas livestock exhibitions was requested, resulting in active government support for Korean booths in overseas exhibitions from 2013 onward.

Because manufacturing companies have operated Korean booths, the Korean veterinary industry has been strengthened through recruiting buyers with consultations and maximizing contracts. Regarding the number of companies that have participated in overseas exhibitions, there were 19 in 2013, 45 in 2016, and 47 in 2019, indicating that more companies have actively advanced into the global market. From 2013–2019 (7 years), the export consultation amount was USD 306 million while the export contract amount was USD 22 million, so it has become an important project.

Participating in overseas exhibitions as a group has a big effect on advertising Korean veterinary drugs, but for medical devices and diagnostic kits, only a few companies participated in related exhibitions in advanced countries such as the United States and Europe, compared to veterinary drug companies. Thus, group participation was not possible and individual participation seemed necessary.

To overcome such problems, since 2017, the government has supported individual participation in overseas exhibitions to expand export by promoting the quality of Korean veterinary drugs to the corresponding foreign countries. Regarding individual overseas exhibition participation results, a total of 26 companies (7 in 2017, 9 in 2018, and 8 in 2019) participated; the export consultation amount was USD 49 million, and the export contract amount was USD 21 million, thereby producing good results (see Table 38).

〈Table 38〉 2017–2020 Individual overseas exhibition participation results

Year	No. of companies	Government subsidy (KRW)	Self-funding amount (KRW)	Consultation amount (USD 1,000)	Contract amount (USD 1,000)
2017	7	17,612,484	7,179,400	14,220	2,488
2018	9	34,884,857	17,958,232	6,637	3,455
2019	8	34,278,532	33,718,374	16,858	10,472
2020	2	10,481,000	24,461,000	12,000	5,000
Sum	26	97,256,873	83,317,006	49,715	21,415

3.6.4. Export marketing support project

The government's export marketing support project is the most competitive among overseas export market pioneering projects; 21

companies participated in 2015 (the project's first year). It funds company marketing initiatives such as advertisements in overseas livestock magazines, brochures used in overseas exhibitions, websites written in foreign languages, overseas advertisement video production fees, etc.

Through the export marketing support project, 107 companies participated, with government subsidies totaling KRW 620 million for 6 years. Many companies competed to participate in this support project, which has led to it becoming an exemplary project for export. By supporting market fees for advertising the quality of Korean veterinary drugs, this project directly helps companies' brand marketing.

Aside from the export marketing support project, sending groups to pioneer overseas markets plays a large role in the advancement of Korean veterinary drugs into the global market.

3.6.5. Project of sending groups to pioneer overseas markets

To improve export capability, this project involves sending Korean quality- and management-related groups to countries where veterinary drug potential is high. Local export consultation sessions with buyers aim to find new partner companies and expand export markets.

By sending groups to pioneer overseas markets, individual country market surveys are conducted by visiting local Korean institutions (Korea Trade-Investment Promotion Agency [KOTRA], etc.) and veterinary drug-related companies to study their respective veterinary drug industries.

In 2013, the group for pioneering overseas markets, composed of

KAHPA and 11 companies, was dispatched to Kenya and Ethiopia for about 10 days; they visited government institutions and performed market surveys rather than contacting buyers.

From 2013–2017 (5 years), 68 companies joined groups to pioneer overseas markets and received about KRW 500 million in government subsidies. Moreover, they achieved the export consultation amount of USD 24 million and the expected contract amount of USD 7 million (Table 38). The project of sending groups to pioneer overseas markets has opened a door to a new export market; there's no longer a need to be limited to Southeast Asia.

〈Table 39〉 2013–2017 Results of sending groups to pioneer overseas markets

Year	Country	No. of companies	Government subsidy (KRW)	Export consultation amount (USD)	Expected contract amount (USD)
2013	Kenya, Ethiopia	11	49,000,000	-	
2014	Chile, Peru	11	126,000,000	-	
2015	Uganda	3	134,890,511	4,400,000	2,950,000
	Uzbekistan, Kazakhstan, Azerbaijan	9			
2016	Brazil	6	123,900,000	680,000	750,000
	Iran	10		5,720,000	2,180,000
2017	Russia	6	92,400,000	4,317,000	470,000
	Belarus	6		4,436,000	411,000
	Ukraine	6		4,520,000	520,000
Sum		68	526,190,511	24,073,000	7,281,000

3.6.6. Project of establishing networks between countries

This project aims to establish personal networks by exchanging information of approval institutions between Korea and countries for export. Thus, it contributes to information sharing and policy understanding between countries through relevant presentations by inviting public officials in charge of overseas veterinary drug approval.

An advantage of intercountry networks is an opportunity to promote the quality of Korean veterinary drug management policy, testing facilities, etc. Moreover, by improving national brand recognition, it has helped to establish the Korean industry in the global market. The project of establishing networks between countries has been ongoing since 2013 when public officials handling East African veterinary drug approval were invited to hold a "Korea-Africa veterinary drug workshop." This project contributes not only to intercountry cooperation but also to pioneering the global export market (see Table 39).

〈Table 40〉 2013–2020 Status of the project of establishing networks between countries

Year	Classification	Period	Government subsidy (KRW)	Invited countries	Affiliation
2013	Korea-Africa veterinary drug workshop	Oct. 21–25	50,000,000	Ethiopia	Vet Drug and Animal Feed Administration
				Kenya	Veterinary Service in Charge of Veterinary Laboratories
				Uganda	Drugs Assessment and Registration
2014	Korea-South America and Taiwan	Apr. 21–25 Dec. 1–4	37,315,776	Chile	Livestock Protection Division, SAG, Ministry of Agriculture

Year	Classification	Period	Government subsidy (KRW)	Invited countries	Affiliation
	veterinary drug workshop			Peru	National Agrarian Health Service (SENASA), Ministry of Agriculture and Irrigation
				Taiwan	SAG (Agriculture and Livestock service)
2015	Korea-CIS veterinary drug workshop	Apr. 18-24	51,013,100	Azerbaijan	State Veterinary Service
				Kazakhstan	National Reference Center for Veterinary Medicine (RSE)
				Uzbekistan	Main State Veterinary Department
2016	Korea-Middle East veterinary drug workshop	Apr. 24-29	35,279,289	Iran	Iran Veterinary Organization
				Saudi Arabia	Saudi Food & Drug Authority
2017	Korea-CIS veterinary drug workshop	Apr. 23-29	52,181,100	Belarus	Ministry of Agriculture and Food of the Republic of Belarus
				Russia	Ministry of Agriculture of the Russian Federation
				Ukraine	Ministry of Agrarian Policy and Food of Ukraine
2018	Korea-Asia veterinary drug workshop	Apr. 23-27	28,954,380	Malaysia	Ministry of Agriculture and Agro-based Industry
				Vietnam	Ministry of Agriculture and Rural Development
2019	(1st) Korea-North Africa veterinary workshop	May 20-24	37,410,345	Egypt	Egyptian Drug Authority
				Morocco	Ministry of Agriculture, Fisheries, Rural Development, Water and Forests (Morocco)
	(2nd) Korea-China veterinary drug workshop	Oct. 28-Nov. 1	20,415,880	China	China Institute of Veterinary Drug Control
Sum			312,569,870		

From 2013–2019 (7 years), public officials from 19 countries were invited with a government subsidy of about KRW 500 million to foster cooperation between countries and expand exports.

3.6.7. Pioneering export market through private–public cooperation

The global veterinary drug market size increased from USD 19.1 billion in 2008 to USD 33.5 billion in 2018 with an average annual growth rate of 6%. The market continues to expand, but as domestic demand stopped growing, the industry and government agreed that entering the global export market was necessary for domestic veterinary drug market development.

Through the joint support of veterinary drug manufacturing companies and the government, as well as the pioneering and expanding of export routes, export amounts were USD 200 million in 2015 and USD 300 million in 2018. As of 2019, 1,280 products worth KRW 349.9 billion (USD 330 million) were exported to 113 countries (3.3% export growth versus the previous year; see Table 38).

〈Table 41〉 2014–2020 Veterinary drug export

Classification	2014	2015	2016	2017	2018	2019	2020
No. of companies	60	63	75	79	78	88	90
No. of products	932	1,039	1,132	1,231	1,257	1,280	1,269
Export amount (KRW 100 million)	1,905 (USD 180.916 million)	2,433 (USD 214.918 million)	2,745 (USD 236.534 million)	3,064 (USD 270.934 million)	3,197 (USD 290.562 million)	3,499 (USD 300.188 million)	3,499 (USD 296.513 million)
Increment rate (%)	18.2	18.8	10.1	14.5	7.2	3.3	−1.3

3.7. Cambodia's General Veterinary Drug Status

3.7.1. Cambodia's agriculture status[40)]

Within Cambodia's gross domestic product (GDP), agriculture's weight decreased from 30.7% in 2014 to 23.5% in 2018, showing a downward trend every year. On the other hand, the manufacturing industry's weight was low (27.2% until 2014) but has continuously increased, reaching 34.4% in 2018 and notably higher than agriculture.

〈Table 42〉 Cambodia's GDP weight trends per industry

(Unit: %)

Industry classification	2014	2015	2016	2017	2018
Agriculture	30.7	28.2	26.3	24.9	23.5
Manufacturing	27.2	29.4	31.3	32.8	34.4
Service	42.2	42.3	42.4	42.3	42.1

Analyzing GDP weight based on agriculture type, the GDP weight of crops decreased from 18.4% in 2013 to 13.0% in 2017, and during the same period, the GDP weight of marine products shrank from 6.9% to 5.5% (a decrease of 1.4%).

For livestock and fowl, either the weight or change is not too large compared to other types of agriculture, but livestock and fowl were recognized in the Cambodian Ministry of Agriculture, Forestry, and Fisheries (MAFF)'s 2019 annual report as needing continuous development for export and to meet domestic demand. Crops and marine products were emphasized to be important agricultural resources.

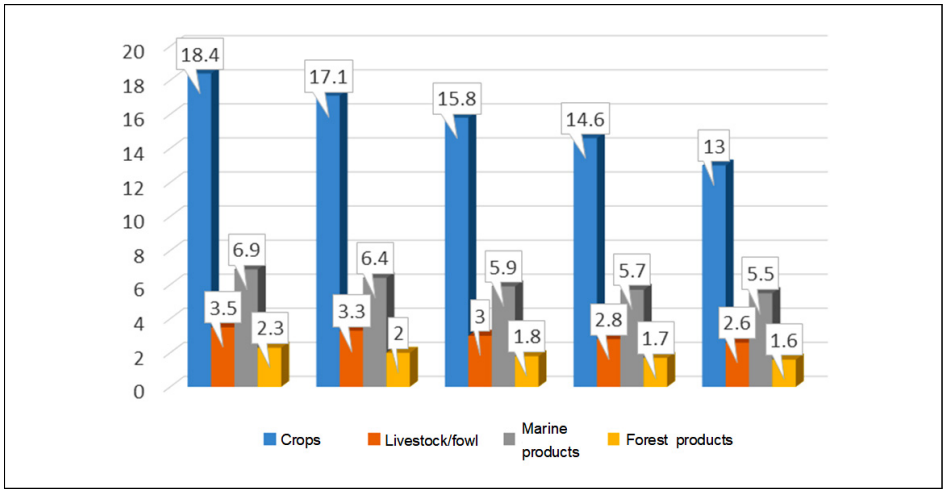
40) Source: Ministry of Agriculture, Forestry, and Fisheries (MAFF) (2019)

For future livestock industry development, the Cambodian government's goal is to reduce disease incidence rates and increase livestock products; as of 2019, the General Directorate of Animal Health and Production (GDAHP) aims to increase the production amount from 319,000 t in 2019 to 356,000 t in 2023.

The Cambodian government set a detailed goal of reducing the livestock disease occurrence rate to about 5% by 2023. Just as Korea transformed small livestock farming to massive, modernized livestock infrastructure, Cambodia is transitioning from current small-scale farming to a commercial farming structure.

〈Figure 41〉 Cambodia's GDP weight change trend per agriculture type

(Unit: %)



However, despite the Cambodian government's efforts, the number of major livestock has been decreasing because of livestock disease outbreaks in the last five years, thereby shrinking the livestock industry. The breeding size of important animals (i.e., cows and pigs) were noticeably reduced in

small livestock farms (refer to section 3.6.2.) because a lack of finances prevented those small farms from purchasing vaccines on time, while commercial livestock farms had directly purchased vaccines to prevent disease.[41)]

After recognizing the above problems, the Cambodian government enacted the Animal Health Production Act in 2016 to prepare a legal basis for livestock disease management and introduced Enforcement Decrees on Animal Breeding Registration Procedure and Veterinary Drug Registration Guidelines in 2018. However, because of lack of implementation of such laws, disease management skills, and a lack of detailed policies, livestock diseases have not been managed well.

3.7.2. Cambodia's livestock breeding status

Cambodia's total number of breeding livestock increased from 40.75 million in 2015 to 45.85 million in 2019, and per type, there were 2.77 million cows, 440,000 water buffalos, 2.18 million pigs, and 40.39 million chickens. However, as of 2019, the number of breeding cows, water buffalos, and pigs decreased compared to 2015 the number of breeding pigs notably decreased from 3.07 million in 2017 to 2.18 million in 2019, a roughly 30% reduction.

Chickens are some of the most commonly bred animals in Cambodia and mostly bred at a small scale in homes rather than massive commercial

41) World's agriculture. Sep. 2020 (Cambodian policy against livestock diseases)

breeding. The number has increased continually, from 34.52 million in 2015 to 40.39 million in 2019, a roughly 15% increase.

〈Table 43〉 Cambodia's breeding livestock trends[42)]

(Unit: No. of animals)

Classification	2015	2016	2017	2018	2019
Cow	2,916,709	2,920,314	2,971,722	2,928,534	2,779,762
Water buffalo	506,228	523,514	508,656	500,995	447,385
Pig	2,774,364	2,970,624	3,074,283	2,747,855	2,185,924
Chicken	34,519,073	35,733,761	36,244,939	38,166,751	40,395,453
Sum	40,753,404	42,183,394	42,834,168	44,375,395	45,855,143

Meanwhile, the total number of breeding livestock in small farms reached a high of 34.47 million in 2017 but decreased to 32.04 million in 2019. Notably, more than 2.3 million pigs were bred from 2015–2017, but the number decreased to 1.93 million in 2018 and 1.03 million in 2019, thereby being reduced by about half in 2 years.

A livestock industry issue is that humans develop antibiotic resistance because of overuse in pigs. In Cambodia, antibiotics were so overused in pigs that they became resistant. Cambodian consumers grew to prefer eating pork less because of the risk of developing resistance, thereby reducing pig prices significantly. Along with ongoing ASF outbreaks in Asian countries including China since 2018, the number of breeding pigs in Cambodia has decreased significantly.

OIE and the Cambodian government have worked hard to prevent AFS and FMD, which have significantly affected pig breeding, but infected wild pigs have been introduced to Cambodia from nearby countries. Thus,

42) Source: MAFF (2019)

blocking such wild pigs could not have been done effectively, and the number of infected bred pigs, as well as dead ones, infected through such wild pigs has been increasing.

〈Table 44〉 Cambodia's breeding livestock trends in small farms[43)]

(Unit: No. of animals)

Classification	2015	2016	2017	2018	2019
Cow	2,903,420	2,897,126	2,951,359	2,917,302	2,769,885
Water buffalo	506,165	523,320	508,458	500,778	447,167
Pig	2,357,839	2,371,283	2,331,512	1,934,917	1,030,494
Chicken	26,688,675	28,402,486	28,652,409	28,956,342	27,763,479
Sum	32,487,499	34,223,007	34,477,859	34,339,810	32,043,535

Since 2016, the number of commercially breeding livestock size has expanded and increased significantly, except for cows whose number decreased by about 25.7% in 2019 compared to 2015. On the other hand, the number of breeding pigs and chickens increased so that there were 13.81 million in 2019 compared to 8.26 million in 2016, a 42.4% increase. The number of chickens was 12.63 million in 2019, which is a significant increase from 7.33 million in 2016. For pigs, there were 1.15 million in 2019 versus 410,000 in 2015, so their breeding number increased by about 3 times.

43) General Directorate of Animal Health and Production (2019)

〈Table 45〉 Cambodia's commercially breeding livestock trends[44]

(Unit: No. of animals)

Classification	2015	2016	2017	2018	2019
Cow	13,289	23,188	20,363	11,232	9,877
Water buffalo	63	194	198	217	218
Pig	416,525	599,341	742,771	812,938	1,155,431
Chicken	7,830,398	7,331,275	7,592,530	9,210,409	12,631,974
Sum	8,265,905	7,960,387	8,356,309	10,035,585	13,811,608

3.7.3. Cambodia's company characteristics[45]

Price is more important than quality in the Cambodian market, and it has sometimes been an obstacle to advancement into the country's veterinary drug market. If a product's price is competitive with similar products, it must be appealed because price comes first.

Compared to nearby countries, Cambodia totally lacks a manufacturing foundation, so it highly relies on importing consumer and industrial goods from Vietnam, Thailand, and China. If a corresponding product is sold to countries near Cambodia, and this point is appealed, it would be helpful for Korean veterinary drug companies to advance into the Cambodian market.

Although small- and medium-sized enterprises (SMEs) comprise more than 97% of all companies, their sales are only 12% in total so their influence is small. There are several unofficial companies, and there is a lack of variety in industrial bases. They also tend not to have transparent accounting.

44) General Directorate of Animal Health and Production (2019)

45) Relevant veterinary drug company market analysis data (nondisclosure)

3.7.4. Cambodia's veterinary vaccine market

Livestock diseases are usually common in Cambodia and nearby East Asian countries such as Vietnam, Laos, and Myanmar. Instead of actively culling diseased animals to terminate diseases, policy is focused on reducing disease spread through vaccination. This is true for Cambodia as well.

In Cambodia, multiple infectious diseases such as FMD and hemorrhagic septicemia (HS) for cows occur, but most of the vaccines for these diseases depend on overseas imports. For cow HS, although vaccine R&D and production were pursued with US support until 2001, its production was terminated because of low production yield and economic burden. Aside from this HS vaccine, no other vaccines are being produced; all vaccines are imported.

Cambodia's total vaccine import amount increased from USD 14.732 million in 2016 to USD 16.733 million in 2017, with similar amounts since then until 2020.

〈Table 46〉 2016–2020 Veterinary vaccine import statistics[46)]

(Unit: USD 1,000)

Exporters	Imported value in 2016	Imported value in 2017	Imported value in 2018	Imported value in 2019	Imported value in 2020
World	14,732	16,733	16,083	16,157	16,721
Thailand	6,773	5,921	6,107	4,864	5,408
Netherlands	1,287	2,104	3,194	2,445	2,682
United States of America	1,538	1,961	937	2,165	1,811
France	1,467	1,446	739	1,073	1,364

46) trademap.org

Exporters	Imported value in 2016	Imported value in 2017	Imported value in 2018	Imported value in 2019	Imported value in 2020
Belgium	412	95	20	208	1,018
Republic of Korea	417	685	426	503	771
Indonesia	241	257	110	513	754
Hungary	129	54	0	126	572
Vietnam	698	652	802	1,642	488
India	69	195	46	50	271
Spain	86	71	174	430	268
Germany	300	50	112	326	205
United Kingdom	297	353	327	432	203
Bulgaria	8	33	33	66	127
China	862	2,168	2,557	580	114
Italy	9	28	53	131	104
Chinese Taipei	2	9	60	69	86
Singapore	0	43	66	128	82
Israel	74	541	85	112	78
Switzerland	0	0	9	0	70
El Salvador	0	0	0	58	54
Japan	0	0	0	0	53
Argentina	4	37	48	18	51
Turkey	0	0	25	32	23
Iceland	0	0	0	8	22
Malaysia	3	0	14	12	22
Mexico	0	0	0	0	11
Eswatini	0	0	0	22	8
Brazil	5	12	0	16	2
Australia	4	0	0	16	0
Georgia	0	0	0	10	0
Honduras	0	0	0	2	0
Ireland	43	16	115	78	0
Curaçao	0	0	2	0	0
Norway	5	0	0	0	0
Peru	0	0	22	20	0

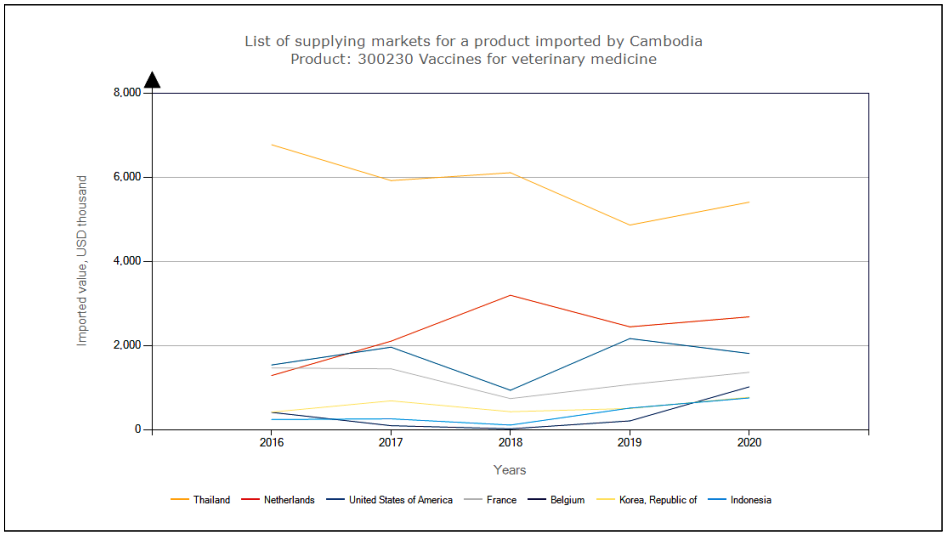
As of 2016, the major importing countries were Thailand, the United States, France, China, Vietnam, Netherlands, Belgium, and Korea in descending order. Compared to 2016, the United States, France, Belgium,

and Korea saw increasing import amounts in 2020. For Belgium, in particular, imports increased from USD 412,000 in 2016 to USD 1.018 million in 2020.

On the other hand, compared to 2018, imports decreased significantly in 2020. Although there are some changes regarding the amount of imports from Thailand, that country still imports more than others because US and French products are imported through Thailand (i.e., they are not produced there).

According to Thailand's veterinary vaccine export statistics, Myanmar, Cambodia, Philippines, and Hong Kong are the top exporters, in descending order. When importing veterinary vaccines to Cambodia, there are no import duties except for the 10% value added tax (VAT), and importing is done via plane for storage and management.

〈Figure 42〉 Graph of vaccine amounts supplied by each country to Cambodia[47)]



47) trademap.org

According to data on Korean veterinary drugs exported to Cambodia in the last three years, the weight of raw materials export was high, and export amounts were increasing for vaccines and chemicals.

〈Table 47〉 Status of exports to Cambodia in the last three years[48)]

(Unit: KRW 1,000)

Classification	2018 export amount	2019 export amount	2020 export amount
Raw materials	703,663	1,712,546	1,384,935
Vaccine	297,665	375,583	436,275
Chemicals	208,553	248,057	457,761
Sum	1,209,881	2,336,186	2,278,971

3.7.5. Cambodia's major vaccines

In Cambodia, most veterinary drug-selling companies handle products imported from the United States, France, Vietnam, etc.; there is an especially high demand for European vaccines. Veterinary vaccines are divided into expensive and inexpensive products based on prices. Large livestock farms or companies use expensive products such as French ones, while Vietnamese and Thai products are inexpensive. Some companies handle Korean products, but most procure French, American, and Vietnamese products.

In Cambodia, veterinary vaccines are most frequently used in the poultry industry, and they are also used frequently for pigs, dogs, and cows, in descending order. For chickens, Newcastle disease, Gumboro, fowl

48) Provided by Korean veterinary drug-relevant companies (nondisclosure)

cholera, and AI vaccines are often used. Compared to chickens, only one or two vaccine types of vaccines are used, and as a prime example, there is a vaccine called Kapavac (for duck plague). Because the breeding period for ducks is longer than chickens, demand for excellent efficacy is high because of the long-term risk.

For pigs, vaccines for mycoplasma, porcine circovirus, parvovirus, porcine reproductive and respiratory syndrome (PRRS), Aujeszky's disease, FMD, swine fever, etc. are sold, while five vaccine types are sold for dogs, such as against rabies and distemper, hepatitis, leptospirosis, parainfluenza, and parvovirus (DHPPL). For cows, there is demand for vaccines against FMD, diarrhea, and brucella.

3.7.6. Cambodian market prospect[49)]

According to interviews with local companies, they see Cambodia's future vaccine market positively, and based on the annual population growth rate of 1.6%, continuous annual economic growth of 7%, and an increase in tourists, the meat consumption increase is a positive factor for market expansion. Currently, various brands from different countries are competing each other. Thus, for Korean products to be competitive, market analysis per animal type, prices, and marketing based on them are essential.

Unlike Vietnamese or Thai products limited to certain areas, Korean

49) Business partner network support (Aug 14, 2017). KOTRA

products must compete with European products comprised of various types of quality goods. If the quality of Korean products is proven in the European-dominated market, Korean products can be trusted. Thus, with better prices compared to those of European products, Korean products can easily advance into the market.

Small livestock farms cannot compete with cheap meat imported from nearby countries, and small livestock farmers are currently losing their competitiveness, leading some to argue that only corporate farms (e.g., CP and Betagro) will survive.

4 Project Plan

4.1. Project Scope and Description

The livestock subsector in Cambodia has considerable potential for growth due to increasing meat consumption from urbanization and population expansion. However, continued growth depends the effectiveness of Cambodia to improve the efficiency and competitiveness of its livestock industry. The major constraints of the livestock industry in Cambodia are the high costs of local animal production, including the lack of access to quality breeding stock, widespread poor animal husbandry knowledge of nutrition and endemic diseases, although are also compromised by poor infrastructure and high market volatility.

Cambodia is vulnerable to TADs, particularly FMD, ASF, PPR, LSD. These diseases are often used as non-tariff trade barriers to for live animals and frequently, animal products, as per the SPS Agreement of the World Trade

Organization. The prevention and control of TADs remain a challenge in Cambodia. Weak field animal health services and a limited budget for the promotion of awareness and behavior change is exacerbated by an inadequate budget for operations, including the lack of supply of sufficient vaccines and a robust cold chain. Stronger veterinary services are needed to protect livelihoods that are reliant on livestock production and to enable the livestock subsector to achieve its potential for socioeconomic growth. The animal health service must efficiently prevent, detect and control diseases that can adversely affect domestic and regional markets, demonstrating to importing countries that national veterinary risk management systems are effective.

A further obstacle to rapid livestock development is the continuous threats of losses from TADs and endemic disease, with the weakness of the animal health services reflected by a dependence on a 'front line' of VAHWs with limited training and supervision, minimal disease surveillance capacity, and ineffective organization. This is urgently required to enable Cambodia to advancement on the OIE-led FMD Progressive Control Pathway (FMD PCP). Bylaws on the procedure for issuing licenses, veterinary certificates, and technical standards for animals and animal products movement are all steps towards better control of both endemic diseases and particularly TADs.

Vaccination and improved biosecurity are key control methods for TADs and other infectious diseases in pigs and poultry in Cambodia, with immunization generally an effective method of protecting individuals and communities. However, successful vaccination campaigns require proper manufacture and/or import, storage, transportation, and handling of

vaccines by vaccine suppliers or handlers in both the private and public sectors. Implementing successful vaccination campaigns remains a major challenge in Cambodia due to the limited knowledge of vaccine retailers and wholesalers on veterinary vaccine handling and cold storage management practices. The uptake of vaccination by smallholder farmers is discouraged if vaccine integrity is damaged by a poor cold chain with failure of provision of the expected protection. Licensing of vaccine retailers or wholesalers is an important option to consider, enabling auditing of commercial vaccine cold chain conditions, presumably by government officers. Training to improve cold chain standards should be offered to relevant stakeholders.

The above-mentioned issues can be solved through the current proposed project entitled "Policy Capacity for Livestock Vaccine Development in Cambodia" with the aims to reduce morbidity and mortality of livestock diseases contributing to food security, food safety and profitable trade.

Relevance to Higher Level Objectives

The proposed project is in line with the government's vision and the main features of national development policy and poverty reduction objectives laid out in the Rectangular Strategy (RS), the National Strategic Development Plan (NSDP), and the Agriculture Sector Development Plan (ASDP). The RS's Phase IV (2019-2023) focuses strongly on enhancing productivity and competitiveness, reforming and economic diversification in high value-added activities. The four pillars of the Rectangular Strategy include: (1) Human resource development; (2) Economic diversification; (3) Private sector and job development; and (4) Inclusive and sustainable

development. Promotion of agriculture sector and rural development. This Rectangular IV is a basic framework for the Ministry of Agriculture, Forestry, and Fisheries (MAFF) to develop the sector within the five years.

The ASDP prioritizes one strategic goal to the livestock subsector and describes the activities required to transform the sector from being primarily dependent on the expanded use of available resources and traditional production inputs, into one which primarily depends on the application of new techniques, new technologies, and mechanization to improve productivity, and diversification into high value livestock in an environmentally sustainable manner. Alongside this the need to promote commercialization of livestock and livestock products is recognized, include improved productivity diversification and commercialization, promotion of livestock farming. The project would contribute to all of these pillars by supporting rural farmers and collaboration with agribusinesses, and provide capacity building to exploit newly created opportunities.

The project would likewise help in achievement of the following Sustainable Development Goals: (a) to end poverty in all its forms everywhere; (b) to end hunger, achieve food security and improved nutrition and promote sustainable agriculture; (c) to ensure healthy lives and promote well-being for all at all ages; (d) to achieve gender equality and empower all women and girls; (e) to promote sustained, inclusive and sustainable economic growth, full and productive employment and decent work for all; (f) to build resilient infrastructure, promote inclusive and sustainable industrialization and foster innovation; (g) to reduce income inequality within and among countries; (h) to make cities and human

settlements inclusive, safe, resilient and sustainable; (i) to ensure sustainable consumption and production patterns; (j) to take urgent action to combat climate change and its impacts by regulating emissions ad promoting developments in renewable energy; (k) Promote peaceful and inclusive societies for sustainable development, provide access to justice for all and build effective, accountable and inclusive institutions at all levels; and (l) Strengthen the means of implementation and revitalize the global partnership for sustainable development.

The two pillars to which the proposed project will directly respond are: i) enhancing export competitiveness and economic diversification to sustain strong growth and create jobs; and ii) ensuring a more sustainable growth pattern by investing in natural capital, climate resilience, and sustainable urban development. However, the project will also respond to the third pillar: building human assets to facilitate economic mobility and shared prosperity, by improving household food and nutrition security and the availability, accessibility, affordability of nutritious diets and improved knowledge and skills.

The interventions under the proposed project are aligned with the ROK-Cambodia Joint Economic Commission goals for strengthening industrial capacity, improvement of connectivity in four key areas (transport infrastructure construction, urban development projects, water resource development, power generation), finance, investment, agricultural trade, and labor, and so forth. The project will contribute to the overall goal of decreasing rural poverty, enhancing rural employment, increasing the resilience of farmers and enhance the competitive of small-scale farmers and small businesses.

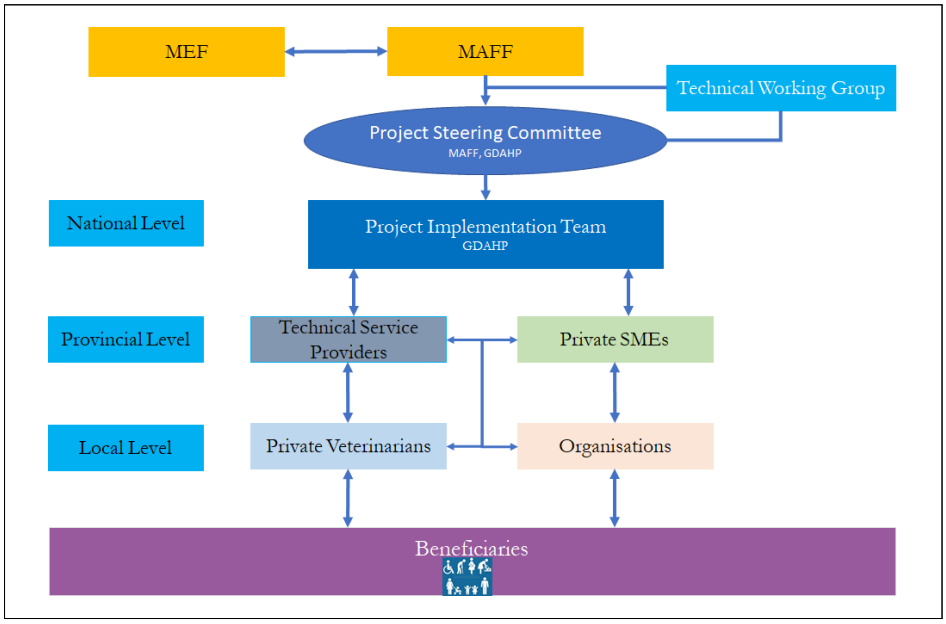
Project activities would include support to public services and infrastructure provision that are core government tasks. Facilitating access to or directly providing capacity building, training opportunities, and provision of basic infrastructure are public sector functions, expected to prepare the ground for private sector engagement with farmers, groups, and project communities and in broader areas of agribusiness development. Public invest would leverage private capital that would exploit new and improved opportunities in areas where private entrepreneurs alone could not overcome bottlenecks.

The Korea ODA will be able to support planning and implementation with leading international experts in livestock vaccine research and development, to assist the design and support the implementation of the proposed operation. The project design and implementation will benefit from lessons learned from other similar ODA-supported animal health and vaccine development projects in the region and elsewhere where multi-sectoral approaches, the establishment of public-private partnerships, and livestock development issues have been successfully addressed.

4.2. Cambodia's ODA Governance Structure

The Project Organizational Structure is below.

〈Figure 43〉 The project organizational structure



4.3. Project Implementation Structure

The proposed project will be implemented over a period of five years. The institutional arrangements for implementation will follow Government's Institutional setup. The GDAHP under MAFF is the executing agency (EA) tasked to implement the **Policy Capacity for Developing Livestock Vaccine in Cambodia (PCDLVC)**, and the provincial animal

health and production office (PAHPO) under department of agriculture, forestry and fisheries (PDAFF) is the implementing agencies (IA) tasked to implement the related field activities. The EA have experiences in implementing several development partner-funded projects. The above diagram provides details on the institutional and implementation arrangements for the proposed project. The EA and the IAs are responsible for the respective project activities of each component, including technical supervision, execution, contracting and direction of all consultants and firms, and will carry out procurement, financial management activities at national level for their respective activities.

- ***Steering Committee***. The steering committees from the senior officials (Policy Makers) of MAFF, MEF and GDAHP will be established to provide key guidance including policy, regulation, guidelines and strategic development framework for conceptual vision and problem solution. The steering committee is chaired by senior official of MAFF.

- ***Project Teams***. EA will establish a project director based in GDAHP who will provide overall direction for day-to-day management activities and monitoring the progress of the project implementation. A project coordination office with management team comprising a Project Manager, an Administrative/Accounting officer, a Procurement Officer and M&E Officer to coordinate the management system and coordination activities including procurement aspects for the technical team is located in GDAHP. IAs will set up their project team (PT) to carry out their role and responsibility for technical supports to the field project implementation.

A project coordination office in each target province will be based in the PDAFF that will be responsible by 3 persons including a Project Implementation Coordinator, Admin/Accounting Officer and Marketing officer to provide coordination service relating to annual workplan, progress report and related arrangement for field activities. A project team (PT) at provincial level is established to directly provide technical assistance relating to their specific tasks including field monitoring and reporting to the service providers as well as project beneficiaries at field level. This project team will include technical staff from AHPO/PDAFF.

- *Village Animal Health Worker (VAHW)*. The VAHW will be contracted on a part-time basis to provide technical service, data collection and facilitation assistance for the project activities at the community level.

- *Technical Working Group*. This group will hire an expert to provide periodic and intermittent support to the project management team and technical team at National level, and to help develop the project operations manual, financial management, procurement and progress report systems.

- *Agriculture and Water and other Technical Working Groups*. The Royal Government of Cambodia decided to establish the Technical Working Group on Agriculture and Water, and the roles and responsibilities had been drafted since February 2019. Other technical working groups such as Zoonotic TWG, Food Safety TWG, Antimicrobial Resistance (AMR) TWG have also been established in re-

sponse to the need in the country and relevant sectors. The TWG-Z have the following responsibilities:

(ⅰ) Convene and chair meetings to guide and review zoonotic diseases and related topics and ensure follow up on actions agreed in the previous meetings;

(ⅱ) Develop annual workplan with monitoring indicators for the works of TWG-Z, considering the availability of human and financial resources and mobilizing additional resources as required;

(ⅲ) Develop and advise on technical, legislative, policy and strategy documents related to zoonotic diseases and ensure their implementation;

(ⅳ) Facilitate information sharing on surveillance, outbreaks and zoonotic events, including the sharing of research findings and lessons learned;

(ⅴ) Develop and coordinate capacity building programs and provide recommendations and advice to policy makers; and (vi) Coordinate and collaborate, also with non-members of the TWG-Z, on One Health matters.

○ *Project Advisory*. An advisory group led by a Korean expert (Team Leader) will be hired to provide periodic and intermittent support to the project management team and technical team at National level, and to help develop the project operations manual, financial management, procurement and progress report systems.

- *Provincial*. At the provincial level, National consultants will be contracted on a full-time basis to support the project coordination team and technical team to carry out their role and responsibility at the field level, in effective, efficient and consistent manner.

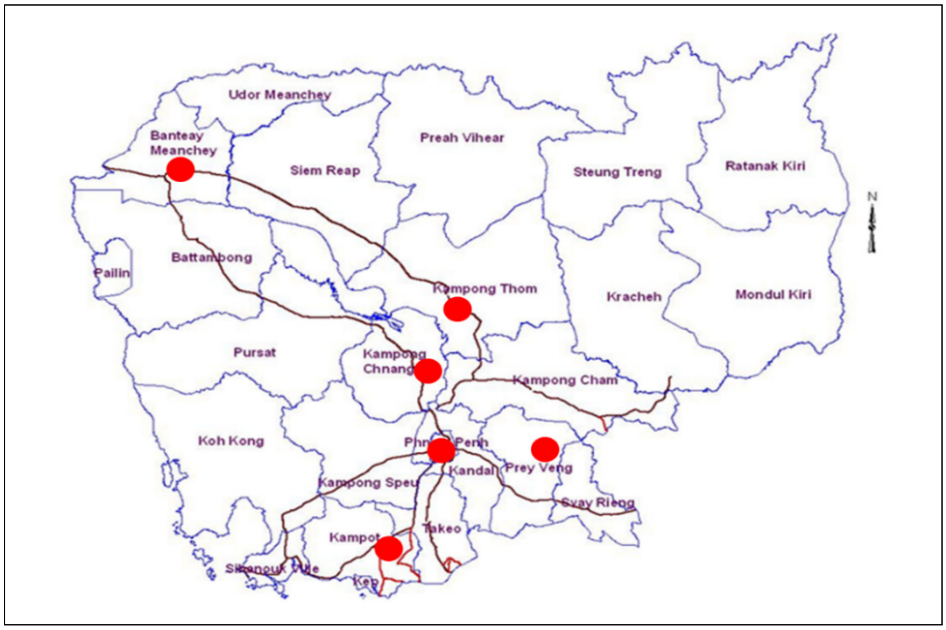
- *Private Sector*. The private sector compagnies will also be engaged in the project implementation to carry out construction of livestock infrastructure activities as well as to supply agriculture materials, breeds, seeds for animal feeds and other related equipment for improving animal production and its livestock value chains. Contractual arrangements will be made with the compagnies by EA/IAs (Project Director, Project Manager and Procurement Officer) in compliance to the government procedure.

- *Monitoring Framework*. Will be based on the theory of change, describes the Project indicators and the component-specific intermediate indicators including unit of measures, respective baselines, cumulative target values, frequency, data source and methodology, and responsibility for data collection. A baseline survey will be undertaken at the start of the first six months of the project implementation to establish and/or update data and information about the socio-economic situation in the project sites provided by the project team with assistance from VAHW and VHV. At the same time, the project management team will monitor progress on additional, linked indicators that provide important information for decision-making and resource allocation.

○ *Project Evaluation Framework*. A mid-term review will be conducted after 3 years of the project start by a consultant team hired by the EA/IA to assess challenges and/or problems during implementation, and identify possible solution to enhance the project implementation performance. The final evaluation would be carried out to assess the project impacts on beneficiaries, and help assess the overall achievement that can be attributed to the project interventions.

The impact evaluation would be conducted by an independent institution at project completion. This project will generate significant benefits to the livestock sector in Cambodia, as a whole and to the livestock producers in the target provinces.

〈Figure 44〉 Map of project site



The project will be implemented at national level and in five provinces including Banteay Meanchey, Kampong Chhnang, Kampong Thom, Kampot, and Prey Veng.

〈Table 48〉 Project Design Matrix (PDM) and Project Outcomes

Narrative Summary	Objectively Verifiable Indicators	Means of Verification	Important Assumption
Goal			
To strengthen animal health and production services that will reduce the impact of animal diseases, increase animal production, improve livestock-based livelihoods and food security and enhance safe trade.	- Increased household income from livestock - Increased share of marketed livestock products through contracts and partnerships - Increased dietary diversity among women in participating households - Reduced disease prevalence of priority animal diseases	- Institutional and laboratory capacities will be strengthened	- The establishment of a trans-boundary animal disease database subsequent to PCR based diagnosis, animal vaccines R&D, and intervention to improve animal health and productivity would be undertaken.
Outcome			
Sustainable livestock production by increasing animal productivity and reducing morbidity and mortality of TADs through application of nuclear-derived and molecular techniques and control program.	- Laboratory capacity (animal vaccines, virology and bacteriology) with standard protocols and SOPs developed by 2025. - Number of livestock increased, and morbidity and mortality rate decreased.	- Project report of GDAHP - National animal health and production statistic by GDAHP	- Existing building, lab facilities and staff - Strong commitment and capacity of the technical staff involved in the project - Smooth facilitation and technical inputs from KREI - Well-organized operational plan between the project teams
Outputs			
1. Strengthened capabilities for early detection of TADs and zoonoses, and build capacity for vaccine research and production	Capacity for TADs diagnosis and vaccine development in placed	Progress report of GDAHP	Strong commitment and capacity of technical staff involved in the project

Narrative Summary	Objectively Verifiable Indicators	Means of Verification	Important Assumption
2. Establishment of the laboratory quality management system for diagnosis and vaccine production	– Laboratory equipment, consumables and reagents for TADs diagnosis and staff capacity strengthened – Five SOPs and lab algorithm for TADs diagnosis developed	Progress report of GDAHP	– Existing building, lab facilities and staff – Strong commitment and capacity of the technical staff involved in the project
3. Built Vaccine Production Center	– Building, equipment, consumables and reagents for vaccine production are in place, and staff capacity developed – GMP and HACCP guidelines developed	Progress report of GDAHP	– Existing building, lab facilities and staff – Strong commitment and capacity of the technical staff involved in the project
Activities	Inputs Cambodian side		Important Assumption
1.1 Invitational training in Korea (High level, master degree); 1.2 Local training (GDAHP and provincial officers); 1.3 International symposium and seminars (one symposium and four seminars); 1.4 Capacity development for diagnosis of TADs and zoonoses; 1.5 Capacity development for livestock vaccine research and production.	1. Number of people trained 2. Number of training organized and participants attended 3. Number of people attended symposium and seminars 4. Capacity for TADs and zoonose diagnosis in placed 5. Capacity for vaccine development and production in placed		– Experiences of local technical staff involved – Involvement of project leader and commitment of technical staff – Level of accomplishment and achievement measured.
2.1 Laboratory algorithm 2.2 Safety management (GMP, GAP and SOP etc.); 2.3 HACCP system; 2.4 Establishment of law	1. Laboratory algorithm developed 2. Laboratory quality management system developed. 3. HACCP system developed 4. Policy on livestock disease control and vaccine development were reviewed		– Competent staff to be trained, – Ensure the communication with project coordinator and scheduling,

Narrative Summary	Objectively Verifiable Indicators	Means of Verification	Important Assumption
and subsidiary regulation for disease control; 2.5 ISO17025:2017 accreditation	and developed. 5. Accreditation received		communication with KREI and couriers - Consultation with project coordinator on the need and commitment of in charged staff - Scientific publication or NAHPRI Bulletin
3.1 Building construction; 3.2 Installing equipment and setting facilities; 3.3 Establishing regulations and training program; 3.4 Strengthening local disease management; 3.5 Producing livestock vaccine and distribution	1. Vaccine production center developed 2. Equipment and consumables in placed 3. Training program developed 4. Local disease situation managed 5. Number of vaccines produced and distributed		- Competent staff to be trained - Ensure the communication with project coordinator and scheduling, communication with KREI and experts - Consultation with project coordinator on the need and commitment of in charged staff - Scientific publication or NAHPRI Bulletin

4.4. Cost Estimation and Time Schedule

The proposed project financing from ODA would be for five years implementation period. The total estimated project cost is US$16,500,000.00, including price and physical contingencies. The government's support would be in form of counterpart financing as in-kind contributions, such as office space, staff costs, and utilities expenses.

〈Table 49〉 Detailed Budget for Investment Project

Components	Activities	ODA Funding Amount Requested (US$)
Component 1: Strengthen capabilities for early detection of TADs and zoonoses, and build capacity for vaccine research and production	1.1 Invitational training in Korea (High level, master degree)	600,000
	1.2 Local training (GDAHP and provincial officers)	800,000
	1.3 International symposium and seminars (one symposium and four seminars)	500,000
	1.4 Capacity development for diagnosis of TADs and zoonoses	800,000
	1.5 Capacity development for livestock vaccine research and production	800,000
Component 2: Establishment of the laboratory quality management system for diagnosis and vaccine production	2.1 Laboratory algorithm	200,000
	2.2 Safety management (GMP, GAP and SOP etc.)	200,000
	2.3 HACCP system	200,000
	2.4 Establishment of law and subsidiary regulation for disease control	300,000
	2.5 ISO17025:2017 accreditation	300,000
Component 3: Construct Vaccine Production Center	3.1 Building construction	2,000,000
	3.2 Installing equipment and setting facilities	1,800,000
	3.3 Establishing regulations and training program	600,000
	3.4 Strengthening local disease management	2,500,000
	3.5 Producing livestock vaccine and distribution	3,100,000
Component 4: Project management	4.1 Performance management, monitoring evaluation	600,000
	4.2 Operation field, local staff, interpretation	800,000
	4.3 Another project support	400,000
TOTAL BUDGET FOR ALL COMPONENTS		16,500,000

〈Table 50〉 project Timeframe

Activities	Year 1				Year 2				Year 3				Year 4				Year 5			
	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4
Output 1																				
1.1 Set up the project team.																				
1.2 Conduct project review and close-out meeting.																				
1.3 KREI field monitoring and evaluation.																				
Output 2																				
2.1 Fellowships and training courses on diagnostic techniques.																				
2.2 Enhance laboratory quality management system																				
2.3 Conduct surveillance on zoonoses, TADs, and monitor AMR.																				
2.4 Scientific visit to reference laboratory in Korea																				
2.5 Develop SOPs and laboratory algorithm for TADs diagnosis.																				
2.6 Enhance laboratory proficiency (proficiency testing and related materials).																				
Output 3																				
3.1 Assess livestock disease control and vaccine development policy.																				
3.2 Conduct livestock vaccine research and development with SOPs and guidelines for vaccine production																				
3.3 Fellowship and training on livestock vaccine production in Korea.																				
3.4 Conduct post-vaccination monitoring.																				
3.5 Assess and train on vaccine storage and cold chain systems.																				
3.6 Develop GMP and HACCP guidelines for vaccine production.																				

4.5. Risk Management

4.5.1. Project Risk Assessment

The overall risk for the proposed project is substantial. Complexity in technical design, institutional gaps in MAFF, environment and social, and fiduciary aspects carry substantial risk. This makes a fit case for ODA grant to support innovative and market-based approaches for making livestock sector remunerative, resilient and competitive. The lessons and robust evidence generated from the project will serve as important basis for engagement with policy makers such as Ministry of Economy and Finance (MEF), MAFF, and others relevant institutions.

〈Table 51〉 Risk Assessment Matrix

Risk	Likelihood	Risk rating	Risk description	Proposed mitigation measures
Technical design Risk that technical design could affect the project from reaching its objectives	Moderate	High	The design is complex but necessary to bring together different actors to address O H challenge. The design incorporates innovative approaches for service delivery using digital platforms and market led models for commercialization.	The design of the project is informed by analytical work and experiences of animal health and OH projects in Cambodia and the region. One way to reduce the complexity is to sequence the activities by priming analytical assessments and technical capacity building ahead of hard investments. At the grassroots, the project will incentivize market players to undertake mobilization and extension services to livestock producers.
Institutional capacity for	Moderate	High	The complexity of the institutional	The project will leverage experience of MAFF, GDAHP

Risk	Likelihood	Risk rating	Risk description	Proposed mitigation measures
implementation Risk that there is insufficient capacity to implement the project			arrangements (at central and local levels) such as number of implementing entities involved; geographical spread of project intervention areas and remoteness of these areas;	implementing similar scaled projects with international organizations such as World Bank, ADB, etc. Technical assistance to the sub-national project implementation entities and training on project management will be planned under the project.
Vaccine research and development Coordination and collaboration failures between different stakeholders in disease control program	Moderate	High	Effective disease surveillance and control measures will require changes to engrained practices among agricultural producers, food traders, community health and sanitation workers as well as government officials tasked with surveillance and oversight.	The Project Operation Manual with clearly defined decision-making structure will be developed to guide the project implementation. Joint training and drills will facilitate interaction and coordination among human health, animal health and wildlife protection sectors. Demand based support will be made available under the project for undertaking multi-sectoral actions under the project and lessons learnt will be shared with national and provincial agencies before scaling-up.
Vaccine research and development Risk that there is insufficient capacity to produce livestock vaccines	Moderate	High	Efficacy of developed vaccines and participation of farmers in vaccination program will lead to successful implementation of disease control program in the country.	echnical support from KREI and Korean institutions will boost the capacity for livestock vaccine production, and awareness raising amongst livestock producers on the benefits of vaccination program will thus help to improve community health and livelihood and achieve the project implementation plan.
ISO17025:2017 accreditation Risk that the diagnostic capacity is not recognized	Moderate	High	Laboratory quality management system is key to get recognition in laboratory result/analysis.	Technical support from KREI and Korean institutions will help to establish the LQMS, and improved diagnostic techniques.

〈Table 52〉 Evaluation of Negative Externalities

Potential Negative Externalities	Likelihood (L, M, H)	Risk rating (L, M, H)	Description of potential negative externalities	Proposed mitigation measures
Environmental	High	High	The main environmental risks associated with the project are the: (i) Occupational Health and Safety (OHS) issues related to testing and handling of supplies and the possibility that they are not adequately implemented by laboratory technicians; (ii) environmental pollution (livestock waste) and community health and safety issues related to the handling, transportation and disposal of dead animals and waste from the slaughter houses, agriculture markets; and (iii) potential downstream environmental implications of technical assistance activities under the project, such as from review, research work or investigations to support needed policy and legislation improvement for prevention and control of priority zoonotic diseases and other health risks.	– The management of these environmental risks have been incorporated into the project design through focused project activities, including targeted training and better equipping of the health workforce, community and animal health workers and wildlife protection workers to manage OHS, community health and safety, biodiversity, and pollution issues. – The World Bank's Environment and Social Safeguards Policy will be applied to all project activities, which will guide the environmental and social screening and subsequent assessment of subprojects activities. – A comprehensive safeguards assessment will be carried out in due diligence to verify institutions' safeguards mechanisms.
Social	Moderate	Moderate	The project is not likely to involve resettlement or land acquisition, the broader social risks are considered moderate. Full societal inclusion is not only fundamental to improved social development outcomes,	– The social assessments to be undertaken during ESMF preparation will identify and define specific requirements of vulnerable groups. – Without being exhaustive, these groups are likely to include

Potential Negative Externalities	Likelihood (L, M, H)	Risk rating (L, M, H)	Description of potential negative externalities	Proposed mitigation measures
			but given the nature of zoonotic diseases, if parts of the society (by geography, ethnicity income, gender, identification or any other measure) are excluded, the overall efficacy of the engagement will be compromised.	ethnic minority communities, the elderly and other groups, the needs of whom require specific project focus. – The ESMFs will document the information required by relevant decision makers and service providers to ensure the needs of these groups are designed into the project.
Gender	Low	Moderate	The key social risk is that disadvantaged, vulnerable and high-risk social groups, particularly women may be excluded from project benefits.	– The project will develop a gender action plan based on the gender assessments to identify strategic and practice gender needs and tailor the project interventions (including targeting, capacity building, preferred benefits flow, etc.) to maximize project impact. – The Bank's Safeguards Framework promotes non-discrimination toward project's direct and indirect beneficiaries; promotes labor standards and acceptable working conditions; and has zero tolerance to sexual harassments.

For Likelihood: L (low probability), M (moderate probability), or H (high probability).
For Risk rating: L (low risk or impact), M (moderate risk or impact), or H (high risk or impact).

4.6. Seeking Opportunities for Linkage and Convergence with Joint Research-Related Projects

The following table shows the ongoing projects of various development partners. The proposal project will leverage and complement the investments in related project in the table below as well as to build synergies with CASDP and LASED III.

〈Table 53〉 Ongoing Projects of Various Development Partners

No	Project Name	Yrs.	When	Target Province	Project Status	Manager	Supported by
1	Technical Support to Develop and Implement Livestock Identification and Registration System	3	2019-2021	Takeo, Battambang, Pursat, Kampong Thom, Tbong Khmum, and Kampong Cham	Ongoing	DAP	FAO
2	Understanding the Risk of zoonotic disease from swine production and exchange systems in Cambodia	5	2018-2022	Takeo, Kandal, Kampong Speu and Phnom Penh	Ongoing (Research Project)	Dr. Sorn San, Project Coordinator	DTRA
3	Climate-Friendly Agri-bussiness Value Chains Sector Project	7	2018-2024	Takeo, Kampot, Kampong Cham & Tbong Khmum	Ongoing	Dr. Soun Sothoeun	ADB
4	Cambodia Agricultural Sector Diversification Project-CASDP	6	2019-2025	Battambang, Siem Reap, Preah Vihear, Stung Treng, Kratie, Tboung	Ongoing	Dr. Sar Chetra	WB

No	Project Name	Yrs.	When	Target Province	Project Status	Manager	Supported by
				Khmum, Kampong Cham, Mondulkiri, Ratanakiri, Kampong Chhnang,Kampong Speu, Kandal, and Phnom Penh			
5	Cambodia Land Allocation for Social and Economic Development Project	6	2020–2026	National wide, except Phnom Penh and Urban/Municipality	Ongoing	Mr. Khy Kosal	WB
6	Food Security of Underprivileged Peoples – Genetic improvement of local chicken breed and enhance its productivity through demonstration trial in the context of climate change in Cambodia	2	2020–2021	Takeo, Kampong Chhnang & Tbong Khmum	Ongoing	Dr. Soun Sothoeun	JICA
7	AMR MPTF Enhancing Governance and Coordination Mechanisms to reduce AMR in Cambodia	2	2021–2022	At national level	Just started	Dr. Tep Bengthay	OIE
8	Greater Mekong Subregion Cross-border Livestock Health and Value Chains Improvement Project	5	2022–2026	Takeo, Prey Veng, Kampong Cham, Siem Reap and Odor Meanchey	Designing	Dr. Soun Sothoeun	ADB
	Establishing National Research Institute for Safety and Sanitation of Livestock Products in Cambodia	5	2023–2027	Phnom Penh, Banteay Meanchey, Svay Rieng and Takeo	Designing	Dr Tum Sothyra	KOICA

〈Table 54〉 Proposal Stage Results Monitoring Matrix

Indicators	Unit of measurement	Baseline	End-of-project target	Data sources (Data collection instruments)
Project level indicators				
1. Increased household income from livestock	Percentage	0	15%	Survey of household income in project and control groups
2. Increased share of marketed livestock products through contracts and partnerships	Percentage	0	15%	Survey of household income in project and control groups
3. Reduced disease prevalence of priority animal diseases	Percentage	0	15%	Serological Survey
4. Increased dietary diversity among women in participating households	Percentage	0	15%	Survey of household income in project and control groups
Component level indicators				
Component 1: Strengthening Animal Health Services				
5. Risk-based animal disease and zoonotic management instruments (policies, guidelines, etc.) developed	Number	0	5	Monitoring of systems using checklist for each instrument developed
6. Veterinarian and veterinary paraprofessionals (included VAHWs) trained (disaggregated by gender)	Number	0	1500	Progress report/Mid-term project review
7. Animal health laboratories upgraded and strengthened	Number	0	2	Progress report/Mid-term project review
Component 2: Livestock Vaccine Production				
8. Livestock vaccine produced and distributed to relevant stakeholders	Yes/No	No	Yes	Progress report/Mid-term project review
9. Approximately 80% of cattle and buffalo are vaccinated against HS	Percentage	40	80	Progress report/Mid-term project review
Component 3: Project Implementation Support				
10. Grievances registered related to delivery of project benefits addressed	Percentage	0	100%	GRM reporting system
11. Share of satisfactory citizen's feedback received on services provided by Project	Percentage	0	80%	Beneficiary survey

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