

Chapter 4 DEVELOPMENT CONSTRAINTS AND POTENTIAL

4.1 Zoning of the Study Area

4.1.1 *Concept and Approach*

Considering the physical and socio-economic conditions of the Study Area, which have been confirmed through the data/information collection and analysis during the field study period, the Study Area was divided into several zones through the following concept and approaches.

- Seven indexes were selected in relation with the purpose of the Study, i.e. improvement of food sufficiency and enhancement of living standard and/or income level of farmers,
- Zoning was done by index,
- Problems, development potential and constraints were identified by zone of each index, and
- A Gewog was categorized into certain zone of each index

4.1.2 *Development Stage*

Any kind of development is to be conducted in accordance with strategic approaches to meet the needs by development stage. For this study, the following development stages were considered to clarify and highlight the existing problems, needs, potential and constraints of each Gewog so that the optimal and effective development should be promoted strategically:

(1) Stage-1a: Fulfillment of BHN

In order to promote agricultural development, the basic human needs (BHN), such as food, health, safe drinking water, education, etc. should be fulfilled, otherwise farmers can not devote themselves to farming activities.

(2) Stage-1b: Production Increase

Production of food crops should be increased by farmers' own effort to secure sustainable and sufficient food supply in the area. Input supply and infrastructure development will contribute largely at this stage.

(3) Stage-2: Improvement of Productivity

Productivity should be improved; i) by maximizing yield, ii) by reducing production cost, and iii) by reducing losses in harvesting, post-harvesting, and shipping. Extension services will play larger role at this stage.

(4) Stage-3: Value Adding and Market-oriented Production

Once productivity is optimized, value adding and market-oriented production will increase profit for producers. Basic infrastructures for communication and market system development consisting of market facilities, storage, information, research, etc. are required along with institutional capacity building.

4.1.3 *Zoning Criteria*

Taking the above-mentioned development stages into consideration, the seven indexes were selected and zoning was done according to criteria as mentioned in the following.

Zoning of each index is illustrated in Fig. 4.1.1, Fig. 4.1.2 and summarized in Table 4.1.1.

(1) Index-1 ~ Living Standard

Poverty Assessment and Analysis Report (2000, Planning Commission) analyzed “poverty” by Gewog by using of 10 aspects, namely, i) household income, ii) education, iii) health, iv) economic activities, v) non-material needs, vi) physical facilities, vii) environment, viii) transport, ix) communication, and x) position of woman, which consist of 44 benchmark indicators. Composite index was provided by synthesizing these indicators and modifying with priority weights on the above 10 sectors given by Dzongkhags. The Study Area was categorized into three (3) zones according to the index as follows:

Index-1 ~Living Standard Index	
Zones	Index (dimensionless)
1(A)	Fine (index 0.6 - 0.8)
1(B)	In between (index 0.4 - 0.6)
1(C)	Difficult (index 0.2 - 0.4)

(2) Index-2 ~ Agro-ecological Zone

According to the agro-ecological zones identified by MOA, six zones were identified in the country, which were categorized by altitude. In the Study Area, there are three main zones suitable for crop cultivation; they are warm temperate zone (1,800 - 2,600 m), dry sub-tropical zone (1,200 - 1,800 m), and humid sub-tropical zone (600 - 1,200 m).

Index-2 ~ Agro-ecological Zone	
Zones	Altitude (m) / Agro-ecological Zone
2(A)	1,800 - 2,600 / Warm temperate
2(B)	1,200 - 1,800 / Dry sub-tropical
2(C)	600 - 1,200 / Humid sub-tropical

Source: Agro-ecological Zoning, MOA (1992)

(3) Index-3 ~ Food Security

Food security is one of the main targets of the agricultural development. The Study Area is divided into three zones in terms of food security, in other words, food balance, which is included in “Household Food Grain Security” of RNR Statistics 2000 of MOA.

Index-3 ~ Food Security	
Zones	Security Level
3(A)	High or surplus
3(B)	Fair or balanced
3(C)	Low or seasonal shortage

(4) Index-4 ~ Special Crops

Poor access and small production are the biggest difficulties of the Study Area to attain the income generation by increasing of marketable crops with sufficient volume for marketing. In this sense, “formation of production center” should be promoted by strengthening of cultivation and production of special crops which are currently planted. Special crops in connection with the target of the Study, namely, food security, income increase, and enhancement of living standard, paddy rice, horticulture and aromatic and medicinal plant

(APM), and non-paddy cereal crops were selected so that all the area should contribute to attainment of the target by promoting of these special crops.

Index-4 ~ Special Crops	
Zones	Predominant Crops
4(A)	Paddy rice
4(B)	Horticulture and AMP
4(C)	Non-paddy cereal crops

(5) Index-5 ~ Land Resources

Available land resources for agriculture except forest and pasture land were examined to identify development potential and to simulate future food balance. The Study Area was divided into three (3) zones according to the total available or potential agricultural land (wet land, dry land mixed crop land and tseri) per person.

Index-5 ~ Land Resources	
Zones	Agricultural Land (ha/person)
5(A)	Over 0.2
5(B)	0.1 to 0.2
5(C)	Less than 0.1

Source: Population ← Dzongkhags
Land use ← Land Use Planning Project

(6) Index-6 ~ Accessibility to Motor Roads

Road development is considered as the most important project component by either the government staffs or people in the Study Area. Road development will improve marketing circumstances for production area, and living conditions of remote area with better access to living commodities and various social services.

Here accessibility to the existing motor roads was used as an index for identifying potential for market system development.

Index-6 ~ Accessibility to Motor Roads	
Zones	Criteria
6(A)	Over 50 % households can reach motor roads within one hour walk and over 90 % households can reach within three hours walk.
6(B)	Over 75 % households can reach motor roads within three hours walk.
6(C)	Others

Source: RNR Statistics 2000

(7) Index-7 ~ Accessibility to Export Market

As mentioned in Section 3.7 “Marketing and Agro-processing”, local or inter-local market activity is quite small and limited only in/around several market areas such as Mongar, Gyelposing, etc. On the other hand, cash crops are exported through Samdrup Jongkhar. In this sense, the Study Area is divided into three (3) zones according to the following criteria:

Index-7 ~ Accessibility to Export Market	
Zones	Criteria
7(A)	Gewogs with motor roads to the national / district roads and closer to Samdrup Jongkhar than Mongar
7(B)	Gewogs with motor roads to the national / district roads but farther to Samdrup Jongkhar than Mongar
7(C)	Gewogs without motor roads to the national / district roads

According to the zoning results of each index (Table 4.1.1), present development stage of each Gewog was examined. The criteria of determination of the development stage are as follows:

- Stage-1: Living Standard Index or Food Security Index shows “C”
 Stage-2: Both Poverty Index and Food Security Index show “A” or “B”
 Stage-3: Among Gewogs of Stage-2, either “Access to Motor Road Index” or “Access to Export Market Index” shows “A” and the other shows “B”.

A flowchart to identify Gewog-wise development stage is given in Fig. 4.1.1.

4.2 Problems by Zone

According to the zoning of the Study Area, general problems of each zone were discussed and identified. The problems often correlate closely one another and common for several zones. However, background of similar problems is not always similar. The problems are summarized in the following table.

Problems by Zone			
Zoning	A	B	C
1: Living standard and Income	<ul style="list-style-type: none"> • Unstable agricultural cash income • Little value adding or quality control skills 	<ul style="list-style-type: none"> • Unstable job opportunity • Less job skill • Little agricultural cash income • Poor access to public services 	<ul style="list-style-type: none"> • Little capacity to pay • Poor BHN condition
2: Agro-ecology	<ul style="list-style-type: none"> • Poor access to motor roads (mostly higher than main roads) • Not suitable for paddy rice cultivation 	<ul style="list-style-type: none"> • Crop diseases • Prices of sub-tropical cash crops 	<ul style="list-style-type: none"> • Crop diseases • Large fluctuation of prices of sub-tropical cash crops • Less competitive crops for export
3: Food security	<ul style="list-style-type: none"> • Poor access to market for selling surplus 	<ul style="list-style-type: none"> • Seasonal food shortage or low productivity 	<ul style="list-style-type: none"> • Chronic food shortage or low production
4: Special crop	<ul style="list-style-type: none"> • Irrigation water shortage • Small farm plot • Low yield 	<ul style="list-style-type: none"> • Poor cultivation technique • Lack of fund • Price fluctuation • Poor access to market 	<ul style="list-style-type: none"> • Low price (or less incentive for farmers) • Poor access to market

Zoning	A	B	C
5: Land resources	<ul style="list-style-type: none"> • Labor shortage • Unfavorable topographic condition • Fund shortage 	Some of problems of "A" and "C"	<ul style="list-style-type: none"> • Fear of food shortage • Low productivity • Environmental degradation
6: Accessibility to motor roads	<ul style="list-style-type: none"> • Lack of road transport • Poor road condition 	<ul style="list-style-type: none"> • Lack of market function near-by • Poor access to market 	<ul style="list-style-type: none"> • Difficult supply of input, food and other basic commodities
7: Accessibility to export market	<ul style="list-style-type: none"> • Lack of market information • Lack of storage and proper packaging 	<ul style="list-style-type: none"> • High transportation cost 	<ul style="list-style-type: none"> • Small quantity of production • High transportation cost

4.3 Development Potential and Approaches by Zone

4.3.1 General Development Potential of the Study Area

Regardless to predominance of attractiveness of marketing or special crops among Dzongkhags in the eastern region, the Study Area, i.e., Lhuntse and Mongar Dzongkhags have the following potential of agriculture development.

(1) Various Agro-ecological Zones

The Study Area consists of three major agro-ecological zones of; i) warm temperate, ii) dry sub-tropical and iii) humid sub-tropical zones. Large variation in altitude enables;

- various choices of advantageous crops in terms of marketing, and
- prolonging or adjusting of harvesting period.

(2) Land Resources

According to the Land Use Planning Program (LUPP), potential agricultural area in the Study Area is about 32,000 ha, which is equivalent to 0.50 ha per person on average. Even with conservative side of unit yield of cereal crops of 2.0 ton/ha for cereal crops or 1.0 ton/ha of grains, development potential of food grain is estimated at 0.5 ton or 500 kg per person. Taking into account operational agricultural land (8,000 ha in RNR Census 2000¹), land resource potential itself is considered good enough as a whole.

(3) Human Resources

Labor force for agricultural activities does not seem to be sufficient to develop the above-mentioned land resources. As for government officials at local administration level, RNR or agricultural sector is the single line agency that has extension staffs at Gewog level. In this sense, there should be certain potential to improve extension activities rapidly by utilizing of the existing man power, even though absolute number of the staffs may not be sufficient.

¹ This operational land is estimated on the basis of land registration. However, this registered land area seemed to be much smaller than the actual land use. According to the land re-registration that is being implemented by the Department of Survey and Land Records, the re-registered areas often become more than 150 % of the previous ones.

4.3.2 Development Potential and Approaches by Zone

Development potential and approaches of each zone are summarized in the following table.

Development Potential and Approaches by Zone			
Zoning	A	B	C
1: Living standard and Income	Market oriented agriculture <ul style="list-style-type: none"> • Quality improvement • Marketing system development 	Small-scale horticulture for local barter <ul style="list-style-type: none"> • Extension • Credit • Improvement of access to motor roads 	BHN development <ul style="list-style-type: none"> • BHN services • Road access improvement
2: Agro-ecology	Export during rainy season of India <ul style="list-style-type: none"> • Horticulture crop production • Virus free seed crop 	Formation of production area near motor roads <ul style="list-style-type: none"> • Farm road • Market facilities 	Intensification of sub-tropical horticultural crops <ul style="list-style-type: none"> • Paddy rice • Tree crop
3: Food security	Production increase by intensified agriculture <ul style="list-style-type: none"> • Motivation of farmers for more cereal crop production 	Crop diversification <ul style="list-style-type: none"> • Intensification of field crops • Horticulture • Improvement of access to motor roads 	Nutrition improvement <ul style="list-style-type: none"> • Food for work • Kitchen garden
4: Special crops	Paddy rice production <ul style="list-style-type: none"> • Irrigation development • Introduction of high yield variety 	Horticulture and AMP crop production <ul style="list-style-type: none"> • Extension • Credit • Improvement of access to motor roads 	Non-paddy cereal crop production <ul style="list-style-type: none"> • Intensification • Agro-processing • Animal feed
5: Land resources	High labor productivity agriculture <ul style="list-style-type: none"> • Group activity • Agriculture infrastructure 	Cost effective agriculture <ul style="list-style-type: none"> • Multiple farming with cereal, horticulture crops and livestock 	Intensive cash crop cultivation <ul style="list-style-type: none"> • Farm mechanization • Access improvement
6: Accessibility to motor roads	Production increase of high value crops <ul style="list-style-type: none"> • Good cash income opportunity • Easy to obtain good input • Value adding 	Production increase <ul style="list-style-type: none"> • Motor road (farm road construction) • Income generation with better access to market 	Improved living condition <ul style="list-style-type: none"> • Access improvement for simple transport (horse, power-tiller, etc.) • Securing of self-sufficiency at community level
7: Accessibility to export market	Export market oriented agriculture <ul style="list-style-type: none"> • Marketing system development 	Production area formation near motor road <ul style="list-style-type: none"> • Joint operation • Farm road 	AMP production <ul style="list-style-type: none"> • Extension • Agro-processing

4.4 Development Constraints by Zone

4.4.1 General Development Constraints of the Study Area

(1) Development Constraints of Bhutan

(a) Topography

Physical conditions might not be “constraints” if they can not be overcome. However, in order to understand difficulties in developing the country, topographic condition, namely, steep slope, mountainous land form and variation of altitude (from 300 m to 5,000 m even for the inhabitant area), should be firstly considered. Such topographic conditions make transportation cost and development cost considerably high, which eventually restrains economic viability of projects in Bhutan.

(b) Sparse Distribution of Households

People in rural area, mostly farmers, prefer or tend to reside nearby their farm land even access to various services is poor, most probably due to the following reasons:

- Difficult to protect crops from wild animals if they stay away from the farm,
- They get along with their own products in self-consumptive manner,
- Steep topography hampers shipping of products, and
- Less money-based economy

Sparse distribution of households is also one of the reasons of low economic viability because of higher investment cost per beneficiary household.

(c) Religious Sentiment

Bhutanese people are pious Buddhists and they are not allowed to kill any sort of living things even insects or wild animals that spoil their farm products. They basically do not rear animals for meat products but for eggs and dairy products, even meat demand is quite high. They do not kill their livestock animals even when they become unproductive. Such religious sentiment often restrains productivity and cash income of the farmers.

(d) Labor Shortage

Unlike other South-east Asian countries, Bhutan has small population of 700,000. Labor shortage is not only by numeric number of labor force but access to labor for exchanging each other is also poor. As enrollment of primary education is improved, younger labor force has decreased as farmers point out.

(2) Development Constraints of the Study Area

(a) Unfavorable Location on Marketing Aspect

In view of agricultural development, the Study Area is situated in the most unfavorable location among Eastern Region. Main market to forward products and to procure input is Samdrup Jongkhar, from which Lhuntse and Mongar Dzongkhags are located farthest among six Dzongkhags in the eastern region.

(b) Climate Condition

Situated under similar natural conditions to other Dzongkhags in the eastern region, few special crops are cultivated in the Study Area. Major crops in the Study Area, namely maize for cereal crops, orange for tree crops and potato for vegetables are produced less in volume

than in Samdrup Jongkhar, Pemagatsel and Trashigang, which are located closer to the main market.

The Study Area is situated in humid sub-tropical to warm temperate zone in agro-ecological classification. Double cropping of paddy rice or maize can not be done due to climate condition, which restrains economic viability of investment and food security.

(c) Kuri Chhu River

The Kuri Chhu River is one of the largest rivers in Bhutan. However, situated on the bottom of deep valley, water of the Kuri Chhu River can not be utilized for irrigation properly. Moreover, the river running in the middle of the Study Area separates the area into eastern and western parts. This makes accessibility in the Study Area very poor without bridges and roads along the river.

(d) Expectancy or Dependency of Farmers on the Government

In the course of socio-economic survey conducted during the field study, it was observed that farmers are reluctant to devote themselves to get additional values once they were satisfied with certain level of requirements such as food, clothes and other living necessity. They seem to expect any form of services from the government as much as possible.

4.4.2 Development Constraints by Zone

Development constraints by zone are summarized in the following table:

Development Constraints by Zone			
Zoning	A	B	C
1: Living standard and Income	<ul style="list-style-type: none"> • Shortage of fund • Lack of knowledge • Less initiatives 	<ul style="list-style-type: none"> • Unawareness of farmers • Less incentives for farmers 	<ul style="list-style-type: none"> • Little job opportunity • Poor road access • Dependency to the government
2: Agro-ecology	<ul style="list-style-type: none"> • Poor road access • Poor access to qualified seed • Short growing period 	<ul style="list-style-type: none"> • Poor road access • Lack of strategic cultivation (extension of diversified crops) 	<ul style="list-style-type: none"> • Poor road access • Competition with Indian products (low price)
3: Food security	<ul style="list-style-type: none"> • Poor road access • Low price 	<ul style="list-style-type: none"> • Labor shortage 	<ul style="list-style-type: none"> • Traditional farming practices • Shortage of input • Labor shortage
4: Special Crops	<ul style="list-style-type: none"> • Steep topography • Controlled price 	<ul style="list-style-type: none"> • Shortage of qualified seed • High transportation cost 	<ul style="list-style-type: none"> • Low price • Poor road access • Poor transport
5: Land resources	<ul style="list-style-type: none"> • Labor shortage • Poor road access 	<ul style="list-style-type: none"> • Labor shortage 	<ul style="list-style-type: none"> • Small holding size
6: Accessibility to motor roads	<ul style="list-style-type: none"> • Bridge construction • Shortage of machinery and fund 	<ul style="list-style-type: none"> • Poor road condition 	<ul style="list-style-type: none"> • Too remote • Less number of beneficiaries
7: Accessibility to export market	<ul style="list-style-type: none"> • Poor initiative 	<ul style="list-style-type: none"> • Poor road access • Poor diversification of crops 	<ul style="list-style-type: none"> • Poor road access • Small production

Chapter 5 THE MASTER PLAN

5.1 Development Approaches Identified at Problem Analysis Workshop

Problem Analysis Workshops were conducted with Dzongkhag staff and Gewog leaders¹ (one session in Lhuntse Dzongkhag and two sessions in Mongar Dzongkhag) in charge of planning of agriculture and farm road development. Purposes of the workshops are to work out existing problems, objectives of projects, and developing approaches, through Project Cycle Management (PCM) procedure.

Participation Analysis, Problem Analysis, Objective Analysis and Project Selection were conducted with participants at each workshop. Results of the workshops are given in Annex-I.

5.1.1 Dzongkhag Level

The target group and the core problem were similar for both Dzongkhags. The target group was "Farmers in Dzongkhag", and core problem was "Low Income". The direct causes of the core problem were also similar for both Dzongkhags as summarized below.

Results of Problem Analysis (Dzongkhag Staffs)		
	Lhuntse	Mongar
Target Group	Farmers in Lhuntse Dzongkhag	Farmers in Mongar Dzongkhag
Core Problem	Low income	Low income
Direct Causes	<ul style="list-style-type: none"> - Low production of agricultural products - Low market price - Less cash income - No market in the Dzongkhag - High transportation cost - Low livestock production - Less off-farm activities - Low forest production - High production cost 	<ul style="list-style-type: none"> - Low production - Low market price - Less cash income - No market in Gewog - High transportation cost - Limited work opportunities - High production cost - Low yield

The project selection was an analysis to identify project components and feasibility based on the information obtained in the objective analysis process. Some of the selected approaches were common with Dzongkhags as shown in the following page. The "Farm Road Development" is key approach to solve many existing problems.

¹ Village chiefs and agriculture and/or livestock extension agents

Selected Approaches (Dzongkhag Staff)		
	Lhuntse	Mongar
Selected Approaches	- Road development	- Road development
	- Training of farmers	- Farmers training on-farming technology
	- Construction of irrigation facilities	- Irrigation development
	- Water harvesting	
	- Farm mechanization	- Farm mechanization
	- Construction of market	- Market facilities development (Market, storage and auction yard)
	- Farm inputs supply	- Input supply
	- Vocational training	- Vocational training for farmers
	- Strengthening of RNR-RC activities	- Agriculture research / extension
	- Strengthening of EAs' activities	- Plant protection
	- Land use intensification	- Agricultural and animal husbandry land development
	- Druk Seed Corporation's operation strengthening	- Acceleration of seed production (Manpower, technology and facilities)
	- Increase of number of CA	- Small-scale agro-industry
	- Provision of farm equipments and facilities	- Back-yard farming (Livestock)
	- EAs training	- Public transportation services
- BDFC's loan procedure simplification	- Post-harvest technology improvement	
- Strengthening of Dzongkhag officers' activities	- Market information dissemination	
- Increase of production	- Cooperative marketing support	
- Fodder development		
- Improvement of livestock feeding system		
- Strengthening of livestock farm		
- Construction of slaughter house		
- Strengthening of family planning		

5.1.2 Gewog Level

The target group was same at each workshop with Gewog leaders. The target group was "Farmers in the Dzongkhag". One of "Core Problems" was "low income" at each workshop. "Food shortage" was also identified as "core problem" at two workshops. One of the direct causes of food shortage was low income and the other was low food production itself. The direct causes of the core problem were also similar at both Dzongkhags as summarized below.

Results of Problem Analysis (Gewog Leaders)			
	Lhuntse	Mongar Close Gewogs	Mongar Remote Gewogs
Target Group	Farmers in Lhuntse Dzongkhag	Farmers in Mongar Dzongkhag	Farmers in Mongar Dzongkhag
Core Problem	Low income Food Shortage	Low Income Food Shortage	Low income
Direct Causes	- Low agricultural production	- Surplus population	- Low yield of agricultural products
	- High transportation cost	- Low production of dairy products	- Low production of agriculture products
Direct Causes	- No market	- Low agriculture income	- Low production of NTFP
	- Low off-farm income	- Low non-agricultural income	- Low off-farm activities
Direct Causes	- Low productivity of livestock	- Low production of food crop	- No marketing facilities for agricultural products
	- Low income		- Low marketing opportunities
Direct Causes	- Low agricultural production		- Less cash crop
	- Rapid population growth		

Selected approaches in workshop with Gewog leaders are shown in the following page. Some of approaches were commonly identified at each workshop.

Selected Approaches (Gewog Leaders)			
	Lhuntse	Mongar Close Gewogs	Mongar Remote Gewogs
	Selected Approaches	<ul style="list-style-type: none"> - Road construction - Farmers' training - Vocational training - Construction/Repair of irrigation facilities - Training of EAs - Demonstration for farmers - Provision of agricultural machinery - Construction of market - Provision of farm equipment - Provision of communication facilities - Provision of transportation facilities - Provision of EAs' office equipment - Subsidization of farm inputs - Provision of improved seed - Organization of farmers - Strengthening of WUA - Seed grower in each Gewogs - Watershed management - Town planning - Strengthening of livestock breeder/research 	<ul style="list-style-type: none"> - Road construction - Farmers' training - Training of agro-processing - Construction of irrigation facilities - Strengthening of EAs' activities - Agricultural extension services - Livestock extension service - Vaccination service - Biological control for insects - Farm mechanization - Market construction - Agricultural material and inputs supply - Cooperative shipping - Market information service - Strengthening of research - Improvement of seed supply system - Electric solar fencing or wire fencing against wild animal - Quality control of products - Land slide protection - Health education - Farm storehouse construction

5.2 Target and Framework

5.2.1 Vision of the Study Area

(1) Vision of the Nation

As mentioned in Chapter 2, the development philosophy of Bhutan is to realize “*Gross National Happiness*”, which consists of four main pillars of;

- Economic growth and development
- Preservation and promotion of cultural heritage,
- Preservation and sustainable use of the environment, and
- Good governance

According to “Bhutan 2020, A Vision for Peace, Prosperity and Happiness”, several milestones were identified to regional agriculture and road development as follows:

Agriculture

- Increase the value of horticultural exports by 200 % (2007, End 9th Plan),
- Achieve a three-fold increase in real income of farmers (2012, End 10th Plan),
- Increase the value of horticultural exports by 300 % (2012, End 10th Plan),

Road and Marketing

- Upgrade current national trunk roads to take 30-ton trucks (2007, End 9th Plan)
- Construction of third “dry port” at Samdrup Jongkhar (2007, End 9th Plan)
- Ensure that 75 % of rural population live within half-day’s walk from the nearest road (2012, End 10th Plan)

Living Standard

- Provision of potable water supplies to 90 % of rural population (2007, End 9th Plan)
- Provision of electricity to 50 % of rural population (2012, End 10th Plan)
- Provision of electricity to 75 % of rural population (2020, 12th Plan)

Decentralization

- Enhanced capacity of DYT and GYT to prepare own plans (2005, 9th Plan)
- Operationalize Local Development Funds in all Gewogs (2012, End 10th Plan)
- Introduce Gewog development funds in all Dzongkhags (2017, End 11th Plan)

(2) Vision of the Study Area (Refer to Fig. 5.2.1)

According to the strategic development approaches, all the rural population enjoy situation as mentioned in Bhutan 2020. Prospective future image of the Study Area in 20 years on agriculture, living condition, and local administration are as follows:

(a) Agriculture

Food self-sufficiency is secured in each Gewog. Though maize still remains the main staple food in the Study Area, people also purchase rice with their cash income increased through cultivation of cash crops. Diversification of food through kitchen garden development and continuous bulk of supplies at local market, improves nutrition condition of rural population.

Even with certain geographical disadvantage on marketing, marketing system has been established supported by formation of production area and market-oriented production strategy. Quality of agricultural products has been drastically improved through intensive research and dissemination to the rural area. Extension Agents have been trained intensively on cultivation technique for specific cash crops such as orange, potato and others, then sent to Gewog level in order to disseminate the farming technique they acquired through the training program at field level.

Livestock animals have gradually been replaced with improved breed and the production is maintained even the total number decreases. Productions of non-meat products such as dairy products and eggs are increased in accordance with improvement of access to the main road. Livestock products also provide cash income to the farmers.

Farmers organize groups for production and joint shipping, and negotiation is done between the groups and traders. Market information is provided smoothly through radio or telecommunication from the market to the farmers’ groups. Post-harvest loss and transportation loss are reduced with improved road condition and packing of products.

Farmers are aware of demands of the market, and they devote themselves to produce

better-quality products that meet the market demand. Thinning out of the fruits is properly done and the fruit trees are well maintained so that crop management and harvesting should be carried out efficiently without making losses.

Tseri culture is drastically reduced as the productivity increases. Some of Tseri land is converted to forest, and environmentally friendly agriculture system is introduced.

(b) Living Condition

Nearly 80 % of rural population enjoys improved access of three hours or less walk to motor roads. According to the improvement of the access, rural population has equal opportunity or access to various social services such as education, health, commodities, employment opportunities, credit, etc. Basic infrastructures such as water, electricity, primary school and basic health unit are available up to 75 to 90 % of population. Electrification in rural households reduces consumption of fuel woods and destruction of forest.

Improved living condition of the remote area slows down rural-urban migration that may bring about over-population and poverty in the urban area and lose balancing of development.

5.2.2 Development Strategy of the Study Area

(1) General Condition of the Study Area

Prior to the formulation of a master plan on regional agriculture development and farm road development, it is required to consider the target, approach and strategy of the development of the Study Area, then position and roles of the proposed master plan should be identified.

It is obvious at a glance that living standard and difficulty of living depend on accessibility to services, market and information, in other words, communication. Comparing rural households in poor access area with those in good access area, some suggestions for development approach can be obtained. In this case, "access" means not only physical access but also access to the social services, such as electricity, education, training, health care, governance. The following table shows comparison of conditions of the rural households related to services.

Living Condition in Areas of Good Access and Poor Access

Services	Poor Access Area	Good Access Area
Health care	Since BHU or referral hospital is not available in the neighbor, they follow traditional or religious treatment. Some of them prefer consulting astrologer to doctor	They receive free medical services not only for consulting but also for operation, medicine, and hospitalization. Even old generation comes to hospital.
Education	Due to poverty, long distance, poor awareness of parents, shortage of farm labor, failure in examination for promotion, enrollment percentage is very low. Accordingly, literacy rate is also low, particularly for women. School facilities are also poor.	Even with certain percentage of drop-out, enrollment rate and literacy rate are higher as a whole. Parents are aware of importance of education. They believe that educated people can get good job opportunity.
Training	Due to poor physical access, opportunity of training is much less, particularly for women, although awareness building of adults is the very necessity through practical training	They have more opportunity to be involved in training. Granted that they do not participate spontaneously, they can get certain benefit from the activity.

Services	Poor Access Area	Good Access Area
Governance	Located distant from Gup office, village (chiog) is the local community. Local rule, religious mind and custom are predominant in their living. Sense of ownership or participation to the governance is less. People think that the government will do something for them. They are basically satisfied with their life granted that they have less food and commodities	They have chance to see and feel government activities and request their desire to higher administration. Gup election that was newly started awakened the people on participation to the governance. Due to more economic activities, more people are started with convenient life with commodities, then willing to request and participate to development activities.
Electricity	Percentage of electrification is quite low. They use butter lamp and lantern at night. There is a fear of over cutting of trees for firewood.	Even near town area (Mongar, Lhuntse), electrification has not been completed. However, many people have radio and cassette to enjoy listening music, radio, etc. with battery. Rural electrification is being promoted rapidly.
Sanitation	Latrine is put aside of houses as a small hut. Since households are distributed sparsely, little problem occurs even without treatment. Proper location and management of livestock hut should be considered.	Houses are densely distributed and application of sanitary toilet facilities is required. Sanitation or manure management of livestock is required.
Water supply	People use stream or stagnant water without proper treatment. Water borne disease is observed.	Piped water supply system is provided even with primitive facility. They have more access to safe water source.
Road	Only foot path is available.	Either mule track or motorable road is available. Otherwise, round trip to/from motorable road is possible.
Agriculture	Self-consumptive production of food crops. Kitchen garden. Few livestock. Very little cash income. Traditional cultivation of low productivity.	Cash income from sales of vegetables, dairy products. Good access to agricultural input, extension services, and market. NTFP collection and sales.
Employment opportunity	Hired labor for farming (paid in kind). Transport (man power or horse back)	Road construction, household or office work (care taker, baby sitter), transport, cottage industry, etc.

(2) Improvement of Access

It is apparent that poor accessibility to social services in remote areas is definitely caused by poor physical access, namely lack of roads, electricity and telecommunication. In fact, rural electrification is being carried out rapidly, much faster than provision of roads. Telecommunication will be followed by the electrification by utilizing of electric poles at least public phones at Gup office. Farm road construction, which is the most costly communication development, is far behind in progress especially in remote areas. Even in the Master Plan period (2002-2012), a number of villages will not be connected with a motor road. In order to accelerate the improvement, more economical, sustainable and systematic approach, procedure and scheme are required. They should be participatory construction, bottom-up planning approach and a new concept of a road or a bridge with lower but acceptable capacity.

(3) Agriculture

Taking into consideration that most of the people in the Study Area belong to farm households, agriculture development should be definitely the first priority to improve and maintain the food security of each household, which in turn will secure the Study Area. Food security can be attained with food that is produced at the farm and purchased food with cash

income or through barter with other products. However, considering the poor access condition that hampers smooth movement of products from surplus area to deficit area, and also short period of the master plan, i.e. 10 years, production increase at each household or locality level should be the most appropriate approach.

Income source of the people in the Study Area should also be from agriculture-related activities. Cash crop production, dairy products, agro-processing, cottage industry such as lemon grass oil, non-timber forest products, aromatic and medicinal plants should also be considered by location. Special and advantageous crops should be considered.

(4) Capacity Building

In order to realize the achievement of the development plan, capacity building is a prerequisite. Participatory and sustainable development can be performed by beneficiaries themselves only. The capacity building should consist of; i) awareness building, ii) dissemination of knowledge, iii) practice and experience, iv) incentive and v) motivation of target group. All the capacity building programs should include these factors in some form.

(5) Education

In the 9th FYP, about 25 % of the budget outlay is allocated to Dzongkhag and Gewog. In the budget outlay of Dzongkhag / Gewog of Lhuntse and Mongar, more or less half is allocated for education sector. The budget is mainly for school facilities such as school buildings and teachers' quarter. Improvement of quality of teachers is also main concern.

Even for capacity building of stakeholders, particularly for rural population, primary education is quite important. According to the interview survey of households, it is clear that parents and grand parents are aware of importance of education, and they are willing to spend money for the education of children. Thus, it is obvious that education should be given higher priority in the long run.

(6) Health and Sanitation

There are two referral hospitals, 27 BHUs and 75 out reach clinics in the Study Area. In general health condition of rural households is worse in remote area, because of poor awareness on preventive procedures such as boiling of drinking water, treatment of foods, etc. Curative procedure is often improper, which makes the matter worse. The most important input or activity in this sector is education on primary health care through primary school education and mobile guidance at villages. Management of livestock waste and sanitary toilet facilities is another option of preventive method.

(7) Electrification

Having mini-hydropower stations and Kuri Chhu hydropower station, capacity of power generation in the Study Area is quite enough. However, due to lack of distribution system, most of the rural households do without electricity. Some very remote villages will not be electrified with transmission line from the power plant, and they should adopt other resources such as solar power. Rural electrification program is being carried out by the World Bank, and the coverage area is growing rapidly.

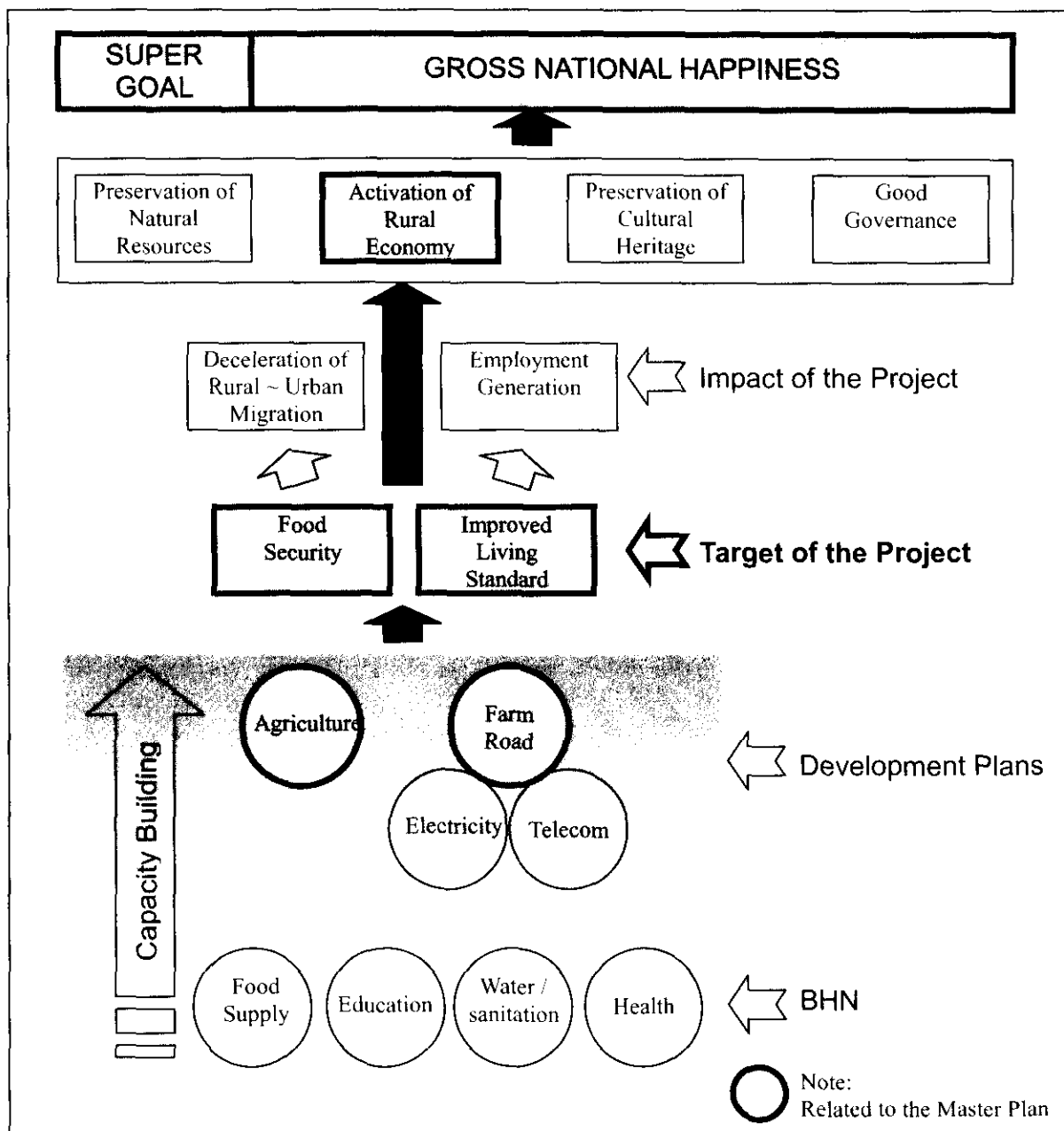
(8) Activation of Rural Economy

In order to improve living standard of rural households, more cash income or income sources should be generated. Since most of rural households are engaged in agriculture, the short-cut

and the only way to increase the household income is to improve agricultural income. Having constraints of limited labor force and land resources, high value crop or special crop in each area should be identified and developed intensively. As the production increases, cash economy and employment opportunity will be increased. Quick and wide impact on rural economy will be encouraged by increase of agricultural production and access improvement followed by market system establishment.

Once living standard of rural households is improved with sufficient food, the rural to urban migration will be decelerated. According to the results of interview survey, most rural people want to remain at their villages and continue farming. Only the households those have urgent need for cash look for income at construction site and town area. If they can get enough food production, certain amount of cash income, and employment opportunity generated by agriculture sector, the rural to urban migration will definitely be decelerated.

Image of the integrated development of the Study Area is illustrated below:



5.2.3 Target of the Master Plan

Overall targets of the Master Plan are;

- To improve self-sufficiency of food at Gewog level in the Study Area, and
- To enhance income and living standard of the people of the Study Area.

Target year of the Master Plan is 2012 as confirmed in the first Steering Committee Meeting held in April 2002.

(1) Self-sufficiency

Prior to improve self-sufficiency, food shortage should be overcome by increasing of food crops production for meeting seasonal food demand. The target is to increase food crop production to meet and fulfill the consumption of 230 kg/person/year in form of edible food grain. Considering the poor road access condition, it will be difficult to transfer the food grain from surplus area to deficit area. Thus the target should be attained at each Gewog. The food shortage should be overcome not only for the present demand but also the increasing demand in accordance with the population growth rate assumed for the 9th FYP period, i.e., 2.5 % per year.

The self-sufficiency rate of Bhutan is calculated as percentage of domestic food grain out of total with imported food grain, which predominantly consists of rice.

Considering these, the target on the self-sufficiency of the Study Area should be;

- To produce 230 kg/person/year of food grain in each Gewog, and
- To increase rice production in the Study Area at a rate of 2.5 % per year, which is equivalent to the assumed population growth rate for 9th FYP period.

(2) Living Standard and Income Level

According to cash income and expenditure confirmed by the household survey of the Study, income level was estimated by zone of Index-1, Living Standard, mentioned in Chapter 4.

Then, target of improvement of the income level by level of living standard was duly examined and set;

- To increase agricultural income² by 150 ~ 200 %.

Beside the income level or monetary fulfillment, living standard should be improved for security or convenience of living. Basic Human Need (BHN) is one of the important factors on the living standard. In the scope of the Study, farm road development is included but other components of BHN such as drinking water supply, health, education, etc. are not included. Thus, as for the living standard improvement, the following target is set for the Master Plan.

- To provide access to the Gewog center and/or other population center of the Gewog with either farm road or access road for a light transport such as horse, donkey, power tiller, motorcycle, etc.

5.2.4 Framework of the Master Plan

(1) Framework by Target and Stage

Concept and approaches by development frame (stage, target) are described in the following page:

² Production for self-consumption is included. Income by livestock products is not included.

(a) Food Security

1) Stage-1

For urgent need for food grains as a part of BHN, quick increase of cereal crop production would be pursued by promoting improved seed, farm input, and organizing labor exchange for extension of cropping area. Non-cereal crop production should also be considered to improve nutrition condition of the people at this stage.

2) Stage-2

Once certain amount of production of food crops is achieved, productivity should be improved by reducing production cost, losses by diseases, harvesting losses, post-harvest losses, etc. Application of irrigation and farm mechanization would also improve land and labor productivity. Seasonal food shortage would be overcome by the improvement of the productivity.

3) Stage-3

Even though food shortage is overcome, the production should be increased to catch up with population growth. In particular, the advanced Gewogs would have more population growth. Certain post-harvest processing and storage should also be considered to reduce loss of surplus food grains.

(b) Living Standard and Income Improvement

1) Stage-1

Component of BHN which can be covered by this Study is rural access improvement by road construction. Prior to promotion of horticulture production at Stage-2, preparatory activities would be carried out at this stage. Farmers at this stage are not familiar with horticulture crop cultivation due to lack of knowledge and technique, initial fund, market, access, etc. They are reluctant to start new effort even for improving their cash income. Motivation of farmers and extension services for horticulture crop production, and access improvement are necessary at this stage. Strengthening of extension services, particularly, research on suitable horticulture crops for local climate, and training of extension agents, are important activities at this stage.

2) Stage-2

Intensive support for horticulture crop cultivation is quite important at this stage. Once farmers fail, they will be definitely discouraged to continue horticulture crop cultivation. At initial stage, while access roads are not fully developed, tree crops plantation would be promoted. Then, vegetables which are not perishable and suitable for transport, such as potato, squash, onion, etc. would be promoted. Improvement of collection and shipping of products will be an approach on marketing aspect at this stage. Aromatic and medicinal plants (AMP) would also be considered at remote Gewogs.

3) Stage-3

Provision and improvement of marketing infrastructures, and system development will be major activities at this stage so that added value and more profit should be generated. As for agro-processing, experimental production of processed commodities will be

promoted.

(2) Plans, Programs and Sub-programs

In order to attain the above-mentioned development targets, the following plans or projects and programs are proposed:

Regional Agricultural Development Plan / Project, Lhuntse and Mongar (RADP-LM)

- ① Program for Food Crop Production Increase (P1)
 - Food Security Sub-program (P1-SP1)
 - Paddy Rice Production Sub-program (P1-SP2)
 - Irrigation Development Sub-program (P1-SP3)
 - Backyard Animal Husbandry Sub-program (P1-SP4)
 - Post-harvest Technology Training Sub-program (P1-SP5)
- ② Program for Cash Crop Production Strengthening (P2)
 - Market Research Sub-program (P2-SP1)
 - Technical Research and Development Sub-program (P2-SP2)
 - Training of Extension Agent Sub-program (P2-SP3)
 - Agro-processing Technology Training Sub-program (P2-SP4)
- ③ Market System Development Program (P3)
 - Collection Depot Construction Sub-program (P3-SP1)
 - Group Assembling Sub-program (P3-SP2)
 - Group Assembling and Marketing Sub-program (P3-SP3)
 - Marketing Support Sub-program by FCB (P3-SP4)
- ④ Extension Strengthening Program (P4)
 - Extension Strengthening for Food Crop Sub-program (P4-SP1)
 - Extension Strengthening for Cash Crop Sub-program (P4-SP2)

Farm Road Development Plan / Project, Lhuntse and Mongar (FRDP-LM)

- ① Farm Road Construction Program
- ② Farm Mule Track Construction Program
- ③ Light-load Bridge Construction Program
- ④ Construction Machinery Center Program

(3) Framework of the Master Plan

The framework of the Master Plan was examined in accordance with the overall target and development stages, which were identified through the zoning of the seven indices. The target-oriented stage-wise development approaches or frameworks are illustrated in the following page. Details on the concept, approaches, and purposes of each plan, program and sub-program will be described in Section 5.3 and Section 5.4.

		Development Target: Food Security	Development Target: Living Standard & Income Improvement
STAGE-1	BHN		<u>FRDP-LM</u> Farm Mule Track Construction Pr Light-load Bridge Construction Pr Construction Machinery Center Pr
	Production Increase	<u>RADP-LM</u> Food Crop Production Increase Pr - Food Security SP - Post-harvest Technology Training SP <u>Extension Strengthening Pr</u> - Extension Strengthening for Food Crop SP	<u>RADP-LM</u> Cash Crop Production Strengthening Pr - Market Research SP - Technology Research & Development SP <u>Market System Development Pr</u> - Collection Depot Construction SP <u>FRDP-LM</u> Farm Road Construction Pr <u>Construction Machinery Center Pr</u>
	Productivity Improvement	<u>RADP-LM</u> Food Crop Production Increase Pr - Food Security SP - Paddy Rice Production SP - Irrigation Development SP - Post-harvest Technology Training SP <u>Extension Strengthening Pr</u> - Extension Strengthening for Food Crop SP	<u>RADP-LM</u> Cash Crop Production Strengthening Pr - Market Research SP - Technology Research & Development SP - Extension Agent Training SP - Agro-processing Technology Training SP <u>Market System Development Pr</u> - Collection Depot Construction SP - Group Assembling SP - Marketing Support SP by SP <u>Extension Strengthening Pr</u> - Extension Strengthening for Cash Crop SP <u>FRDP-LM</u> Farm Road Construction Pr <u>Construction Machinery Center Pr</u>
STAGE-3	Adding Value & Marketing	<u>RADP-LM</u> Food Crop Production Increase Pr - Food Security SP - Paddy Rice Production SP - Irrigation Development SP - Backyard Animal Husbandry SP - Post-harvest Technology Training SP <u>Extension Strengthening Pr</u> - Extension Strengthening for Food Crop SP	<u>RADP-LM</u> Cash Crop Production Strengthening Pr - Market Research SP - Technology Research & Development SP - Extension Agent Training SP - Agro-processing Technology Training SP <u>Market System Development Pr</u> - Collection Depot Development SP - Group Assembling SP - Group Assembling and Shipping SP - Marketing Support SP by FCB <u>Extension Strengthening Pr</u> - Extension Strengthening for Cash Crop SP <u>FRDP-LM</u> Farm Road Construction Pr <u>Construction Machinery Center Pr</u>

Note: Pr; Program SP; Sub-program

Development Framework and Components

5.3 Regional Agriculture Development Plan (RADP)

5.3.1 Development Concept and Approach

(1) Development Needs

The Study Area confronts the following development constraints:

- Most of the farmers in the Study Area have low-income and poor living standard, and they live under self-consumptive conditions isolated from market economy.
- Seasonal food shortage occurs in remote Gewogs, and food grain can be distributed only through barter trading in and around their community. Also, the rapid population growth might burden the people with more food shortage.
- Farmers have a limited cash income sources. Because their knowledge on production and marketing on cash crops is still insufficient, and they do not have access to market for cash crops due to poor infrastructure and undeveloped market system.
- Main market of agricultural products is India because of small scale of domestic market.

(2) Targeted Crops

As aforementioned, the overall targets of the Master Plan are; i) to improve self-sufficiency of food in the Study Area, and ii) to enhance income and living standard of the people in the Study Area.

The former target would be attained by production increase of food crops, mainly maize and rice. Food security, food cereal grain should be produced by 230 kg per capita per year in each Gewog in order to solve seasonal shortage of food and to cope with population growth. Demand of rice will be increased according to improvement of the living standard of rural population. However, suitable land for paddy production and water resource for irrigation are limited in the Study Area, especially in the southern Gewogs of Mongar Dzongkhag. Therefore, the target of paddy production is set to increase with a rate of 2.5 % per annum, which is population growth rate assumed for the period of 9th FYP.

The latter target would be attained through cash crop production and marketing of the products. The cash crops include horticulture crops (fruits, other tree crops and vegetables), pulses such as soybean and Rajma bean, AMP (Aromatic and Medicinal Plants) such as lemongrass oil and *Artemisia annua* (medicinal plant), and Non-Timber Forest Products (NTFP) such as pine resin, lac dye and wild vegetables. A lot of crops and products with marketable potential are grown in the Study Area under various climate conditions and agro-ecological diversity. However, market-oriented production has not been conducted except a few areas with advantages on transportation and marketing. Priority crops of each Gewog, which were presented in Problem Analysis Workshop, are shown in Table 5.3.1.

(3) Development Approach of Food and Cash Crop Production

Agricultural production has to be practiced with integrated production system consisting of agriculture, livestock and forestry. Tseri (shifting cultivation land) occupies around 30 % of the total farmland area. Some of them will be converted to dry land, orchard land, pasture or forest. Even for the cash crop development, Tseri will be a target area of fruits development. Farm Yard Manure (FYM) is the main source of fertilizer for crop production. The materials are mainly leaf litters collected from neighboring forest of the household. Backyard animals will provide good materials for preparation of FYM. Feed of backyard animals will be

supplied by surplus cereal of food crop production.

The target crops for the RADP-LM are categorized into two groups, food crops and cash crops. Production increase of food crops would be achieved in each Gewog through dissemination of improved farming techniques including proper input utilization, and capacity building of Extension Agent (EA) by Dzongkhag and MOA. The both Dzongkhags have capacity and system for promotion of food crop production with support and coordination by MOA. Strengthening of production system and capacity building of EAs on the food crops would be achieved by Dzongkhags' own effort.

It is essential that the target crops should be lightweight and high value considering the transportation cost. However, the crop that will satisfy such requirements cannot be identified among existing cash crops except some special crops such as wild lemongrass for distillation of essential oil, medicinal plants, and dye materials. At the first stage of the development, potato and orange will be priority crops, which are currently exported to India through Samdrup Jongkhar with agro-ecological advantages of tropical highland. In the future, gradually and strategically, the priority crops should be diversified and the major producing area of the priority crops should be formed in the Study Area.

As for cash crop, technical capacity, experience and knowledge of Dzongkhag staffs are not sufficient. Therefore, for cash crop development, it is necessary to implement a program for research of cash crops and intensive training of field extension staffs by introducing external experts. The program will include Research and Development (R&D) and capacity building of EAs on the cash crops which are suitable for the Study Area. RNR Research Center of Eastern Region (RNR-RC-East) will be able to play the role by strengthening the function and activities in cooperation with experienced specialists in the fields of horticulture and marketing.

Production support at field level on both food and cash crops would be mainly provided through EAs' activities in close coordination with input supply / distribution and rural micro-financial supports.

The extension services shall be strengthened in a manner of OJT with beneficiaries at field level. The activities of demonstration plot and farmers study tour will be carried out more intensively. Farmers' field school aiming at training of leader farmers and dissemination of improved farming system will be undertaken by EAs. Working group aiming at participation of beneficiaries to extension activities and strengthening of administrative functions of Gewog will be organized under the GYT.

The development approaches of crop production and production support consist of the following sub-programs which belong to three (3) programs, namely, i) Program for Food Crop Production Increase, ii) Program for Cash Crop Production Strengthening, and iii) Extension Strengthening Program.

Proposed Sub-programs and Allocation to Programs	
Sub-programs	Programs
Food Crop	
1 Food security	Program for Food Crop Production Increase
2 Paddy rice production	-do-
3 Irrigation development	-do-
4 Backyard animal husbandry	-do-
5 Extension Strengthening	Extension Strengthening Program
Cash Crop	
6 Technical research and development	Program for Cash Crop Production Strengthening
7 Training of extension agents	-do-
8 Extension strengthening	Extension Strengthening Program

(4) Development Approach of Marketing and Agro-processing

(a) Development Concept

1) Precondition

- Expandable market is external markets for increased cash crops.
- Marketing infrastructure such as road network, communication network and financial services are improved.

2) Official support

Technical extension services shall be improved and strengthened in the following fields:

- Post-harvest processing
- Agro-processing
- Business management including marketing

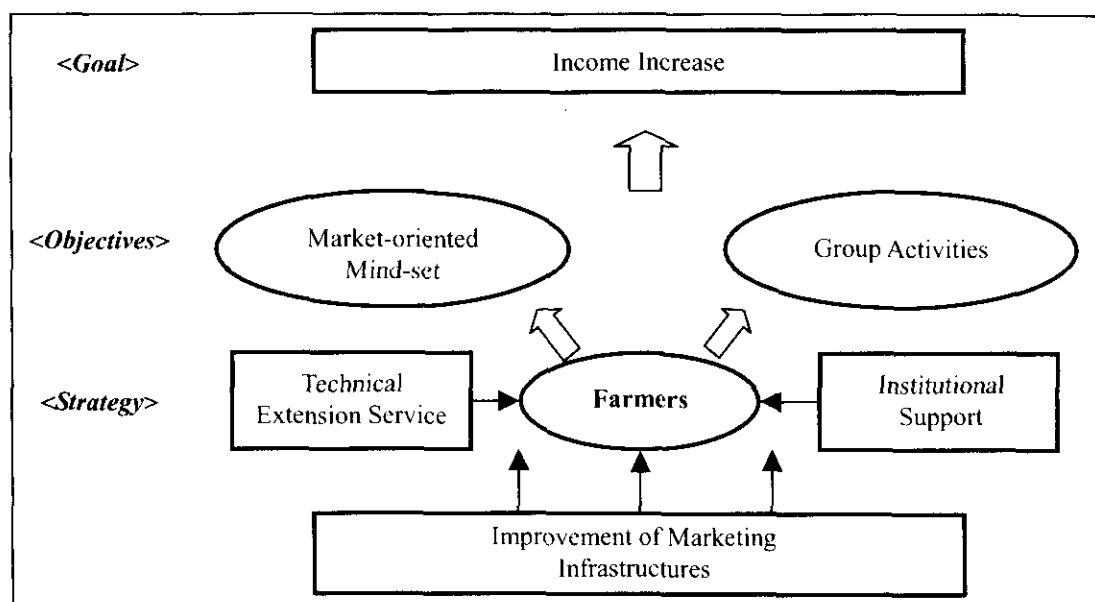
Institutional supports for promotion and maintenance of the sound commercial circumstance shall be strengthened in the following fields:

- Standards and quality control of commodities
- Market information system

3) Farmers

Receiving the official supports and services as mentioned above, the farmers will be aware of the following conditions:

- Market-oriented activities derived from the changed mind-set and/or the entrepreneurial mind.
- Group activities for expanding and improving of the business capacity in view of efficiency and economic benefits.



Development Concept

(b) Development Activity

Necessary activities for development of marketing and agro-processing fields in the Study Area are considered and compiled in the table below. It also contains various external conditions concerning each activity such as another field and the administration in charge who may be beyond the scope of the Study and the Study Area.

Necessary Activities for Development and External Conditions

Category	Activities	Imple- menting Agency	Other Fields	Admin. Level in Charge		
				Gewog	Dzongkhag	Nation
Technical Extension	1) D&R activities shall be strengthened to establish improvement measures to the traditional P/H practice.	PHU/ MOA				○
	2) Strengthening extension services of post-harvest processing technology including marketing.	RNR- RC EO	○	○	○	○
	3) Strengthening extension services of agro-processing technology including business management.	RNR- RC EO			○	○
Institutional Support	4) Improvement and strengthening collection of more regional information and dissemination of useful information to farmers.	AMS/ MOA DAO			○	○
	5) Strengthening marketing support to farmers.	AMS/ MOA RNR- RC			○	○
	6) Establishment and promotion of grading and packing standards	AMS- QCS /MOA				○
	7) Establishment of a scale inspection authority and promotion of scale use.		○			○

Category	Activities	Imple- menting Agency	Other Fields	Admin. Level in Charge		
				Gewog	Dzongkhag	Nation
Infrastructure	8) Improvement and expansion of the road network.		○	○	○	○
	9) Improvement and expansion of the information infrastructure.		○		○	○
	10) Improvement of financial services	BDFC	○			○
	11) Construction of collection depots for products			○	○	
Farmers Group	a) Group assembling			○	○	
	b) Group assembling and marketing			○	○	
	c) Support activity by the FCB	FCB			○	○

Note: * implementation

(c) Proposed Development Sub-program / Component

After screening and consideration of necessary activities for development in view of various external requirements and the bureaucratic demarcation, the following development sub-programs and components for the development programs are prepared and proposed in the field of marketing and agro-processing. Those sub-programs and components are arranged and treated as the components for the three development programs under the RADP-LM, mainly for the Program named "Market System Development Program".

Proposed Sub-programs and Allocation Programs

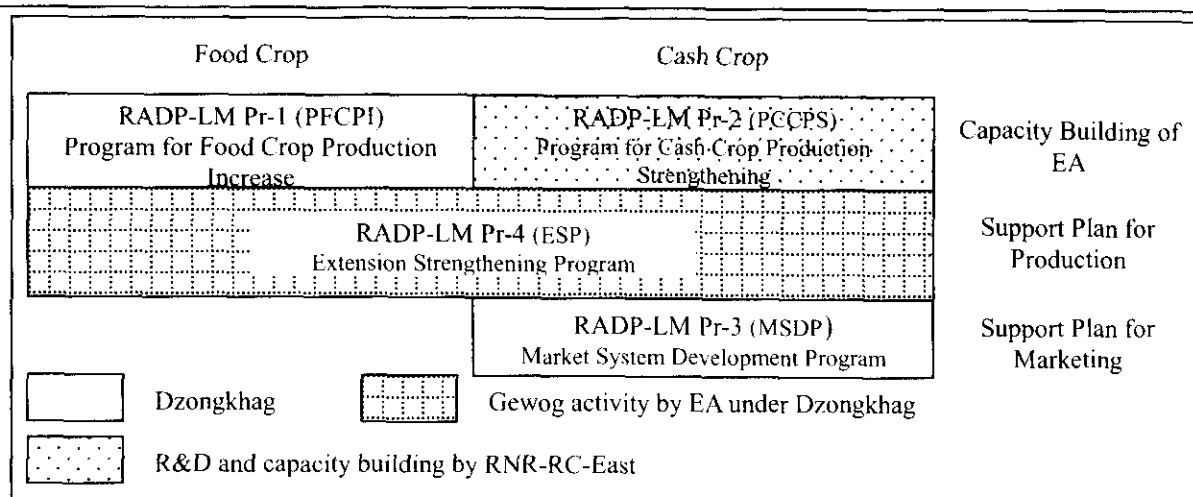
No.	Sub-program	Program
1	Collection Depot Construction	Market System Development Program
2	Group Assembling	
3	Group Assembling and Marketing	
4	Marketing Support by FCB	
5	Post-harvest Technology Training for Food Crop	Program for Food Crop Production Increase
6	Market Research	Program for Cash Crop Production Strengthening
7	Post-harvest Technology Training for Cash Crop *	
8	Agro-processing Technology Training	

* A component of "Training of Extension Agent for Cash Crop Sub-program"

5.3.2 Programs and Sub-programs of RADP-LM

(1) Concept of Programs

Framework of the development plan of RADP-LM is illustrated in the following page.



Framework of Sub-program on Regional Agricultural Development Plan

Programs and Sub-programs for RADP

Program	Sub-program	Major Components
1) Program for Food Crop Production Increase	a) Food security	Production plan of food crops; Land use plan;
	b) Paddy rice production	EA training on farming
	c) Irrigation development	Rehabilitation/expansion of irrigation facility; Strengthening of WUA
	d) Backyard animal husbandry	Utilization of surplus maize to livestock; Training of EAs on animal husbandry
	e) Post-harvest technology training	EA training on post-harvest losses reduction
2) Program for Cash Crop Production Strengthening	a) Market research	Study and selection of suitable cash crops
	b) Technical research and development	Varietal improvement; Research on production system and technology
	c) Training of extension agents	Capacity building of EAs
	d) Agro-processing technology training	Training on small size agro-processing
3) Market System Development Program	a) Collection depot construction	Collection shed construction for buyers
	b) Group assembling	Assembling by farmers group
	c) Group assemble and marketing	Assembling and shipping by farmers group
	d) Marketing support by FCB	Shipping to auction yard by FCB
4) Extension Strengthening Program	a) Extension strengthening for food crop	Dissemination of improved technology; Input supply including HYVs
	b) Extension strengthening for cash crop	Awareness on cash crops; Dissemination of improved technology

(2) Prospective Agricultural Production

Prospective production of food and cash crops was estimated based on land resources, available labor force for on-farm activities and shipping of products, and anticipated yield increase through production support strengthened by the programs.

Production increase will be achieved by improvement of cropping intensity through efficient land use and yield increase within present farmland. The planted area in the future plan will be increased according to the population growth in the following manner:

- ① Utilization of fallow land: According to the RNR Statistics 2000, fallow land in Lhuntse Dzongkhag was 8.1 % for wet land and 17.3 % for dry land, while those in Mongar Dzongkhag were 5.9 % and 13.8 %, respectively. The fallow lands, which could not be planted mainly due to the shortage of labor force, will be a potential land for improvement of cropping intensity with the increase of labor force according to population growth. The population in the target year will be increased to 128 % of the population at present.

- ② Similarly, Tseri will be converted to dry land for permanent cultivation. The maximum potential area is roughly estimated at around 20 to 30 % of the Tseri area,
- ③ Double cropping by planting of the second crops such as wheat, barley, buckwheat, maize and mustard after harvesting of maize will be practiced. The harvest season of maize at the altitude below 2,000 m is in July and August. The second crop sown before middle of September will grow utilizing residual soil moisture of late wet season.

The planted area of food crops will be increased to 130 % of that at present by irrigation development. The planted area of maize will be 110 % of the present area.

The anticipated yield of food crops in the target year was estimated that paddy rice would be increased to 2,600 kg/ha (118 % of present yield) by irrigation development, dissemination of improved farming technology and utilization of improved / high yielding varieties. The yield of maize would be increased to 2,300 kg (115 % of present) by dissemination of improved crop management and improved varieties. According to the crop cut survey in improved farming areas conducted in 2001 and 2002, the average yields of paddy and maize were 3.3 ton/ha and 3.0 ton/ha, respectively. Consequently, the production of paddy, maize and total cereals will be increased to 155 %, 125 %, and 130 % of present yield, respectively.

The production of cash crops was estimated assuming typical crops: orange for fruits, and potato for vegetables. As for cash crops production in the target year, planted area of vegetables and number of trees were estimated at around 0.1 ha, and 10 to 20 trees per household, considering carrying capacity for the marketing. Prospective production of the food crops (cereals) and cash crops (fruits and vegetables) at the target year are shown in the following table:

Yield and Planted Area of Cereal Crops						
Year	Lhuntse		Mongar		Total	
	2012	2002	2012	2002	2012	2002
Paddy						
Planted area (ha)	1,538	1,326	1,056	657	2,594	1,983
Yield (kg/ha)	2,600	2,200	2,600	2,200	2,600	2,200
Maize						
Planted area (ha)	1,944	1,700	5,951	5,574	7,895	7,274
Yield (kg/ha)	2,300	2,000	2,300	2,000	2,300	2,000

Prospective Production of Food and Cash crops in 2012					Unit: ton
	Food crops		Cash crops		
	Total cereals	Paddy	Fruits	Vegetables	
Target Year (2012)					
Lhuntse Dzongkhag	8,471	4,000	1,989	3,490	
Mongar Dzongkhag	16,432	2,745	4,519	9,140	
Total	24,903	6,745	6,508	12,630	
Present (2002)					
Lhuntse Dzongkhag	6,318	2,918	197	667	
Mongar Dzongkhag	12,593	1,445	1,206	3,218	
Total	18,911	4,363	1,403	3,885	

(7) Prospective Income Increase of Households

Income increase per household was calculated based on the production increase of food crops and fruits and vegetables. The cash income was estimated on the basis of the marketed value of cash crops. The results are shown in the table below.

Prospective Income Increase per Household

Unit: Nu.

	Agricultural Income			Cash Income		
	Stage 3	Stage 2	Stage 1	Stage 3	Stage 2	Stage 1
Income level at 2002 ^{*1}	29,900	20,000	19,400	14,700	4,800	4,200
Increase of income	18,900	17,900	9,100	13,300	12,300	3,500
Income level at 2012	48,800	37,900	28,500	28,000	17,100	7,700

Note: Incomes from food crops, fruits and vegetable production

*1: Farm household interview survey conducted by the Study Team

Besides, agricultural development and marketing will make active concerning economic activities such as agro-processing, transportation. Off-farm income, which consists of non-timber forest products (NTFP), labor wage, handicraft, business and others, is important for the farm households occupying around 50 % of the total cash income presently. Above income sources will be available continuously in the future. NTFP such as extraction of lemongrass oil, and collection of lac (dyestuff from insect secretion), wild vegetables / mushroom, and other medicinal and aromatic plants will be increased as a major income source using various agro-ecological natural resources under the policy of maintaining environmental conservation. Handicraft such as weaving and bamboo craft is potential for household income increase through commercialization of these products.

5.3.3 Outline of Programs

(1) Program for Food Crop Production Increase

(a) Objectives

The aims of this program are; i) increase food crop production by proper land use and input supply, ii) improve extension system, and iii) improve capacity of extension agents; so that food security in the Study Area be ensured.

(b) Implementation Organization

Dzongkhags will be the implementing organization supported by MOA.

(c) Sub-programs

This program consists of five (5) sub-programs of; i) food security, ii) paddy rice production, iii) irrigation development (refer to Table 5.3.6: Proposed Irrigation Scheme by Gewog), iv) post-harvest improvement for losses reduction and v) backyard animal husbandry for using surplus cereals. The outline of each sub-program is given in Table 5.3.2.

(2) Program for Cash Crop Production Strengthening

(a) Objectives

This program aims at; i) research on export market and selection of potential cash crops, ii) technical research, development, and establishment of farming technology on cash crops, iii) training and capacity building of extension agents for specific cash crops including extension procedure, farming technology, marketing and post-harvest, iv) training of farmers groups and women's groups.

(b) Implementation Organization

This program will be implemented by RNR-RC-East, which is located at Wengkhar in Mongar Dzongkhag, together with the sub-research centers, at Lingmethang (Mongar

Dzongkhag) and Khangma (Trashigang Dzongkhag). The program will be carried out incorporated with experienced senior specialists on targeted crops in a form of task force or project. The project period will be five (5) years from 2004. After the completion of the project period, the project will be handled by Bhutanese staff trained by the project, and the target area will be expanded to other Dzongkhags in the Eastern Region.

(c) Experienced Senior Specialist

Senior specialists will consists of long-term and short-term expatriates

Long-term Experts

- Cash crop development (1)
- Fruit (1)
- Vegetable (1)
- Training and Extension (1)
- Marketing (1)

Short-term Experts

- Plant protection
- Plant genetic resources/Aromatic and medicinal plant
- Agricultural engineering
- Post-harvest
- Agro-processing
- Market research
- Rice (for research and extension of paddy production increase)

(d) Facility Improvement of RNR-RC-East

Wengkhar Center of RNR-RC-East has not been facilitated with equipment and facilities for research and training. The following facilities and equipment should be provided for the above activities:

- Laboratory and laboratory equipment
- Greenhouse and research farm equipment
- Training hall and training equipment
- Boarding facility for trainees

(e) Sub-programs

This program will be composed of four (4) sub-programs, namely: i) market research, ii) technical research and development, iii) training of EAs, and iv) training on agro-processing. The outline of each sub-program is shown in Table 5.3.3.

(3) Market System Development Program

(a) Objectives

The objectives of the Marketing System Development Program are to support the farmers for marketing of the increased production of cash crop that will be promoted and strengthened by the integrated support program of the “Cash Crop Production Strengthening Program” and to ensure the increase of cash income of farmers.

(b) Implementing Agency

Dzongkhags will be responsible for implementing this Program. Each Dzongkhag will coordinate execution of sub-programs and support staff and groups concerned during

implementation of the Program.

(c) Sub-programs

The Program consists of four sub-programs whose details are given in Table 5.3.4.

(d) Roles of Gewog

Each sub-program will be implemented Gewog-wise and the application plan will be prepared according to the development stages of Gewogs mentioned in the development framework.

Application Plan of Sub-program to Gewogs					
No.	Sub-program	Stage of Gewog			Application Plan
		1	2	3	
1	Collection Depot Construction Sub-program	△	○	○	According to farm road construction Sub-program, it will be applied in Gewogs of Stage - 2 & 3 including some of Stage-1. 4 Gewogs introduced markets already are excluded.
2	Group Assembling Sub-program		○	⊙	After construction of collection depots, it will be started in Stage - 2 & 3 Gewogs.
3	Group Assembling and Marketing Sub-program			○	It will be developed from the activities of "Group Assembling Sub-program" above in Stage - 3 Gewogs.
4	Marketing Support Sub-program by FCB		○	⊙	The program will support the group assembling activities for marketing the assembled products especially before starting group marketing by farmers.

Note: ⊙:primarily implemented, ○:implemented △:partially implemented

(4) Extension Strengthening Program

(a) Objectives

This program aims to accelerate production of both food and cash crops through strengthening of extension capacity of EAs in cooperation with; i) input distribution by Commission Agent (CA), ii) input supply by Druk Seed Corporation (DSC), and iii) rural micro finance by Bhutan Development Finance Corporation (BDFC).

(b) Implementation Agency

Each Dzongkhag will be responsible for implementation of this program. The Dzongkhags would play a role of coordination among related agents and corporations mentioned above. EAs will perform extension activities in the field of their responsible Gewog getting support of this program.

(c) Sub-programs

The program consists of two sub-programs according to the target crops, namely, food crops and cash crops. The outline of each sub-program is given in Table 5.3.5.

5.3.4 Implementation Setup

(1) Coordination Committee

The implementation of RADP, coordination body should be established in order to carry out the plan smoothly, and to coordinate sectors and organizations related to the plan. Coordination Committee would be organized consisting of the following members:

Member of Coordination Committee	
Chairperson	Program Director of RNR RC - East
Vice Chairperson	DAOs of Lhuntse and Mongar Dzongkhags
Member	DPO, DAHO, DFO and DE of both Dzongkhags

The Committee will play roles and take the following responsibilities.

- Overall coordination on implementation of programs
- Coordination among sectors including non-agricultural sectors and Dzongkhags
- Review of results of Monitoring and Evaluation (M&E) on the project implementation
- Modification of the Plan, programs and sub-programs

(2) Assignment of Cash Crop Specialist in Dzongkhag

Qualified cash crop specialist should be assigned at each Dzongkhag in order to promote the production and marketing under the DAO. Also, DAO plays the role of technical backstop for extension agents. The cash crop specialist will be assigned among the staff of ADAO and AEO of Dzongkhag administration.

5.4 Farm Road Development Plan (FRDP)

5.4.1 Development Concept and Approach

(1) Development Concept

(a) Guidelines for Farm Roads Development and Participatory Approach

RGOB has transferred the mandate of farm road construction to MOA from DOR, MOC, after MOA formulated the Guidelines for Farm Roads Development (hereinafter referred to as the "Farm Roads Guideline") in 2000 based on the guidelines formulated by the NEC. The Farm Roads Guideline has specified parameters on engineering technicalities, environment standards, economic viability, and management entirely for the farm road development. Therefore, the concept of development of farm road should also be conformed to the Farm Roads Guideline.

(b) Definition of Farm Road

A basic definition of a farm road is; "a road that links agricultural production areas with the national highways and/or feeder roads to enable transportation of inputs to the farm and products to the market". It is to be constructed by active participation of beneficiaries with government assistance of technical guidance and provisions of equipment and machinery services. Once a farm road is constructed and handed over to a community, the responsibility of repair and maintenance is placed to the community.

Taking into consideration of project economy and environmental aspect, the following points are clearly described in the Farm Roads Guideline.

- a minimum of ten households of 70 people per km should be benefited,
- total cultivated area per season should not be less than 30 acres per km,
- drainage structure and/or bridges should be multi-cell culvert or wooden bridge,
- unskilled labor should be provided by the beneficiaries as labor contribution, and
- construction machinery, tools, and materials would be provided by the government (MOA).

Conformed to the definitions and stipulations as described above, the farm road plan was formulated.

(c) Basic Policy of Farm Road Development

There are 8 Gewogs in Lhuntse and 16 Gewogs in Mongar respectively and all the Gewog centers are deemed to be a distributing and trading center. They should be at least planned to be connected either to District Road, National Highway or Feeder Road taking into consideration of the road plan, promised by the Government. Equity in development activities and marketability of the products in the entire Study Area in accordance with the Farm Roads Guidelines will be carried out. The principal of the farm road development in the Study Area is to connect all the Gewog centers with certain farmland and proper motorable roads to promote more agricultural activities benefited by the proposed roads.

(2) Proposed Farm Roads and Identification

Farm road construction plans were requested by the farmers of the Gewogs in the Problem Analysis Workshop. However, some of them were overlapped or were not feasible from technical point of view. Then, simultaneously, the farm road development plan readjusted on the requests from the Gewogs was submitted from Dzongkhag Administration in the Study. The plan submitted by Dzongkhag Administration with respect to the above mentioned development concept and approaches was finalized through due discussion and screening taking into consideration of 9th FYP and technical consideration mentioned in the table below: (Refer to Fig. 5.4.1 and Fig. 5.4.2).

Identified Farm Roads in Lhuntse				
S/N	Name of Gewog	Farm Road	Approx. Length	Remarks
1	Menbi & Metsho	Takila to Ongar	42.8 km	Extension from Takila of S/N 2.
2	Menbi	Thinleypang to Takila	9.8 km	Improvement of existing road and facilities. This is passing through Tangmachu irrigation area, but undertaken by DOR.
3	Tsenkhar	Phawan to Domkhar	10.6 km	Through Domkhar up to Phawan Khoy.
4	Tsenkhar	Autsho to Tsenkhar	23.0 km	Since it is difficult to connect between S/N 3 Domkhar and S/N 4 Tsenkhar, due to steep rocky cliff, Tsenkhar is connected from Autsho.
5	Tsenkhar	Budur to Wambur	7.3 km	To be connected from forest road, Rongmanchu.
6	Khoma	Suspension bridge at Khoma	6.3 km	Gentle gradient on alignment up to Khoma school, starting from the Kuri Chhu River (bridge)
7	Gangzur	Thimiyul to Jangcholing	5.2 km	To be activated Gewog center, Gangzur.
8	Gangzur	Lingabee to Ney	9.5 km	From center Gangzur to Lingabee, feeder road is already constructed and planned to connect Naleng, Kurtoe
9	Jaray	Autsho to Ladrong	22.4 km	Since it is difficult to connect between Ongar, Metsho and Ladrong, due to steep rocky cliff, an alternative is planned from Autsho, to be started at the Kuri Chhu River.
	Total		98.4 km	Starting from the existing roads
			28.7 km	Starting from the Kuri Chhu River (bridge)
			9.8 km	To be executed by DOR
			136.9 km	

A feeder road plan will cover the road system up to Naleng, Kurtoe Gewog and the on-going farm road plan at Minjay, which is currently under construction, will cover the road system up to Legapachu, Minjay Gewog. Accordingly proposed farm roads and farm mule tracks will be able to connect almost all of Gewog centers and major villages to District Road or Feeder Road in Lhuntse.

Identified Farm Road in Mongar

S/N	Name of Gewog	Farm Road	Approx. Length	Remarks
1	Serimuhung, Balam & Drametse	Serizong to Narang through Balam	62.8 km	Runs through the advanced agricultural areas.
2	Serimuhung	Kafu to Sonakhar	20.5 km	Feeder road extension is committed by DOR from Kafu, not include in the plan.
3	Mongar, Chali and Tsakaling	Themnangbi to Rewan through Chali	40.0 km	Run parallel to District road toward Lhuntse on the hilly farmland area.
4	Tsamang	Yongkala to Banjar	26.5 km	The valley of Kuri Chhu is very deep and rocky for road construction. The farm road will be connected from Yongkala, Highway.
5	Drepong	Gyelposhing to Laptsa	23.5 km	To be connected with the road developed for the Study of Kuri Chhu Hydropower generation.
6	Thangrong	Chaskhar to Thangrong	12.3 km	Farm road under construction at Chaskhar will be extended up to Thangrong.
7	Jurme & Kengkhar	Jurme (opposite side of S/N8) to Kengkhar	34.6 km	Starting from planned feeder road to Nganglam
8	Gongdue & Silambi	Kuri Chhu (nearby Gorthongla) to Nagor	50.8 km	Light-load bridge is required to cross Kuri Chhu. Starting from the Kuri Chhu River.
9	Saleng	Kalapang to Resa	16.8 km	To be connected from forest road constructed.
Total			181.9 km	Starting from the existing roads
			85.4 km	Starting from the Kuri Chhu River (bridge) or planned road,
			20.5 km	To be executed by DOR
			287.8 km	

The proposed farm roads would connect almost all the Gewog centers and major villages in Mongar after the construction of feeder road from Gyelposhing to Nganglam.

5.4.2 Road Development Programs

(1) Identification of Road Development Programs

In accordance with the development policy, the above listed roads were identified for the road development in the Study Area. However, some of them do not satisfy the farm road definition. Moreover, for some roads, construction machinery cannot be used due to lack of bridges to bring machinery. Therefore, the following four programs were proposed to meet the demand and development policy.

(a) Farm Road Construction Program

Farm road is earthen motorable road to connect each other or to connect to National Highway or Feeder Road to enhance the agricultural activities as is planned in accordance with the Farm Roads Guidelines' design standards.

(b) Farm Mule Track Construction Program

Farm mule track is an access road for transportation of light-load transport, especially farming machinery like power tiller with cart truck. The farm mule track is considered as a temporary farm road to be upgraded to the farm road itself by widening and improving it.

The definition and engineering parameters of the farm mule track are same as those of the farm road except road width and sub-base structure. The engineering parameters are given

below:

Engineering Parameters of Farm Road and Farm Mule Track		
Parameters	Farm Road	Farm Mule Track
Ruling gradient	6 % (1 in 16.7)	Same as Farm Road
Limiting gradient	7 % (1 in 14.3)	Ditto
Exceptional gradient	10 % (1 in 10)	Ditto
Type of pavement	- Road with ordinary earth surface - Water bound Macadam (WBM)	Ditto Compaction and soling
Retaining Wall	- Hammer dressed dry wall for < 3m in height - Rubble masonry for wall > 3 m	Same as Farm Road Not applicable
Road width	4.0 m	2.2 m
Carriageway width	3.0 m	1.7 m
Shoulder	0.5 m	0.25 m
Side drain width	0.6 m	Same as Farm Road
Side slope	1:2 in loose soil and 1:4 in stiff clay	Ditto
Design speed	20 – 40 km per hour	10-15 km per hour
Pavement cross fall	4 % in straight sections of road	2 % in straight sections of road
Radius of curvature	- Minimum – 25.0 m - Exceptional – 10.0 m	- Minimum – 25.0 m - Exceptional – 10.0 m

This road development concept was introduced where the farm road cannot be connected directly to National Highway or Feeder Road by the interruption of wider river, or the site is physically isolated and depends on another proposed road construction plan. The construction should be undertaken by the beneficiaries themselves manually getting support of Dzongkhag on construction materials and engineering service.

(c) Light-load Bridge Construction Program

As clearly mentioned in the Farm Roads Guideline, heavy-load motor bridge such as concrete or bailey bridge may not be constructed for the farm road. However, in the Study Area, several proposed farm roads should start at big rivers such as the Kuri Chhu River. In such case, it is impossible to construct a farm road, and even a feeder road will not be constructed for a single Gewog. In the course of the participatory planning approaches of the Study, strong requests and needs were expressed by farmers, Gewog official, and Dzongkhag officials that even a pedestrian bridge will drastically improve the convenience of life in the remote Gewogs. Thus, Light-load Bridge Construction Program was proposed as one of the programs of FRDP. The proposed bridge would be either suspension or suspended bridge with live load capacity for light-load transport such as power tiller with wider carriage way.

Engineering Parameters of Light-load Bridge

		Suspension Bridge (SSB)	Suspended Bridge (SDB)	Light-load Bridge (LB) (Suspension/Suspended)	Remarks
Design condition	Width	1.2m	1.0m	1.7m	
	Live load -Uniform - Point	30 kN/m 2persons x 150kg/0.6m	25 kN/m Same as SSB	25 kN/m 1,000kg (Power tiller)	
	Impact coefficient	i=0.0	i=0.0	i=0.0	
Structure	Tower	Steel/ Concrete	None	Suspension: Same as SSB Suspended: Same as SDB	Considering increase dead load of floor in LB
	Main cable	20,26,32,36,40mm used	Same as SSB	Same as SSB	Depending on load
	Anchor	Gravity type	Gravity type	Gravity type	Considering increase dead load of floor in LB
	Cross beam	Angle or Channel steel	Same as SSB	Same as SSB	Member up in LB
	Deck plate	Plank or Steel	Same as left	Steel	Steel deck rank up in LB
	Hanger system	By rod (Φ12)	Cross beam on main cable	Suspension: Same as SSB Suspended: Same as SDB	Depending on load
	Curb	None	None	Steel curb	

Note: Power tiller with cart dimension: Length (4.57m) x width (1.40m), Total weight (with load)=1,000kg
Wheel load: Max. 400kg/Wheel

As mentioned above, the light-load bridge is a new concept of suspension bridge that has wider carriage way and more rigid floor structure. In proposing the program, the Study Team found that even DOR does not have much experience in design and construction of such suspension bridges. Therefore, the Study Team prepared a technical guideline titled “Light-load Bridge Guideline” which is given in Annex-XI of the Final Report. Preliminary design of the proposed light-load bridges was conducted by engineers of DOR and MOA in the course of the Study.

(d) Construction Machinery Center Program

MOA is planning to set up CMU including the establishment of workshop for repairing and maintaining construction machinery in Bumthang to facilitate the farm road development of the whole Bhutan. Accordingly the program was proposed since the farm road development including farm mule track in the Study Area should be developed in collaboration with CMU.

5.4.3 Outline of the Programs

(1) Farm Road Construction Program (FRCP)

(a) Construction of Farm Roads

In the course of the Study, 18 routes of road were identified totaling 424.7 km in length. However, it is not possible to include all the routes in the Master Plan because of the following reasons:

- Consistency with 9th FYP,
- Capacity of implementation of MOA, Dzongkhags and beneficiaries,
- Conformability to the Farm Roads Guideline, and
- Government intention

Consistency with 9th FYP

In the 9th FYP, farm road construction was proposed for about 60 km in the Study Area. Total length of the Farm Road Construction Program should be duly determined for 9th and 10th FYPs.

Capacity of Implementation

The farm road development will be implemented with construction machinery of MOA

(CMU), farmers' participation, and engineering support by Dzongkhags and MOA. Physical progress of the farm road construction with a fleet of construction machinery is estimated at about 12.5 km per year. Accordingly, it is considered possible for a fleet to construct 100 km for the Master Plan period³.

Conformability to the Farm Roads Guideline

Some of the identified farm roads run through several Gewogs. Such routes might be taken up as "feeder road". Thus, the routes penetrating several Gewogs should be given lower priority.

According to the above-mentioned consideration, screening of the identified roads was carried out. The results of the screening are given in the following table.

Proposed Farm Roads in Lhuntse

S/N	Name of Gewog	Farm Road	Approx. Length	Remarks
R1	Menbi & Metsho	Takila to Ongar	42.8 km	14.0 households (HH) per km*
R2	Menbi	Thinleypang to Takila	9.8 km	Dropped (Feeder road to be constructed by DOR)
R3	Tsenkhar	Phawan to Domkhar	10.6 km	24.4 HH per km
R4	Tsenkhar	Autsho to Tsenkhar	23.0 km	7.4 HH per km
R5	Tsenkhar	Budur to Wambur	7.3 km	11.8 HH per km
R6	Gangzur	Thimyul to Jangcholing	5.2 km	11.3 HH per km
R7	Gangzur	Lingabee to Ney	9.5 km	12.4 HH per km
Total			98.4 km	

Note: *; Anticipated household (HH) number in 10 years with a population growth rate of 2.5 % per year.

Location of proposed farm roads in Lhuntse Dzongkhag are shown in Fig. 5.4.1, while general layout plan of each road is given in Annex-V "Road and Other Infrastructure".

Proposed Farm Roads in Mongar

S/N	Name of Gewog	Farm Road	Approx. Length	Remarks
R8	Serimuhung, Balam & Drametse	Serizong to Narang through Balam	62.8 km 20.0 km	From Bagengla to Narang (Dramtse, 22.0 HH per km)
R9	Serimuhung	Kafu to Sonakhar	20.5 km	Dropped (Feeder road to be constructed by DOR)
R10	Mongar, Chali and Tsakaling	Themnangbi to Rewan through Chali	40.0 km 12.0 km	From Themnangbi to Chali (23.8 HH per km)
R11	Tsamang	Yongkala to Banjar	26.5 km	Proposed for the 11 th FYP (10.6 HH per km)
R12	Drepong	Gyelposhing to Laptsa	23.5 km	11.3 HH per km
R13	Thangrong	Chaskhar to Thangrong	12.3 km	27.6 HH per km
R14	Saleng	Kalapang to Resa	16.8 km	Selected for FRCP (11.3 HH per km)
Total			84.6 km	

Note: *; Anticipated household number in 10 years with a population growth rate of 2.5 % per year.

Location of proposed farm roads in Lhuntse Dzongkhag are shown in Fig. 5.4.2, while general layout plan of each road is given in Annex-V "Road and Other Infrastructure".

(b) Capacity Building of Engineers

Communication between the site engineer and the site in-charge will be very important after strengthening of the existing implementation system. The capacity building for the site engineer and the site in-charge is proposed as follows;

³ Implementation period will be eight years from 2005 to 2012.

Title:	Technical Training for Site Engineer and Site In-charge
Period:	Six (6) months from the establishment of the cooperative
Implementing Organization:	Dzongkhag
Objectives:	To train to know the method of route selection using Total Station (survey equipment), and maintenance of subgrade and slope for farm road development
Input:	Dispatch of road engineer
Activities:	Technical training in the workshop
Expected effects / profits:	Smooth repairing and maintenance of machinery facilitating construction.

(2) Farm Mule Track Construction Program (FMTCP)

Out of the identified road routes, several routes could not be proposed as the “Farm Road” because they start at the Kuri Chhu River which should have permanent bridges for vehicles. Thus those routes were proposed as the “Farm Mule Track” where a power tiller can run. Two routes were proposed in Lhuntse and Mongar respectively as shown in the following tables:

Proposed Farm Mule Tracks in Lhuntse

S/N	Name of Gewog	Farm Road	Approx. Length	Remarks
M1	Khoma	District road to Khoma	6.3 km	52.5 HH per km*
M2	Jaray	Autsho to Ladrang	22.4 km	11.5HH per km
			28.7 km	

Note: *; Anticipated household number in 10 years with a population growth rate of 2.5 % per year.

Proposed Farm Mule Tracks in Mongar

S/N	Name of Gewog	Farm Road	Approx. Length	Remarks
M3	Jurme & Kengkhar	Jurme (opposite side of S/N8) to Kengkhar	34.6 km	Starting from planned feeder road to Nganglam. 19.1 HH per km*
M4	Gongdue & Silambi	Kuri Chhu (nearby Gorthongla) to Nagor	50.8 km	Light-load bridge is required to cross Kuri Chhu. Starting from the Kuri Chhu River. 11.3 HH per km
			85.4 km	

Note: *; Anticipated household number in 10 years with a population growth rate of 2.5 % per year.

Consequently, the farm mule track construction (FMTCP) is proposed for 28.7 km in Lhuntse and 85.4 km in Mongar. Location of proposed farm roads in Lhuntse and Mongar Dzongkhag are shown in Fig. 5.4.1 and Fig. 5.4.2, while general layout plan of each farm mule track is given in Annex-V “Road and Other Infrastructure”.

(3) Light-load Bridge Construction Program

In accordance with the location of the farm mule tracks, three light-load bridges were proposed as follows:

Proposed Light-load Bridges

S/N	Gewog connected	Bridge Location	Approx. Length including Approach Facilities	Remarks
B1	Khoma	Khoma (Kuri Chhu)	90 m	Suspended bridge (replacement)
B2	Jaray	Autsho (Kuri Chhu)	100 m	Suspension bride (replacement)
B3	Gongdue	Gorthongla (Kuri Chhu)	120 m	Suspension bride (new construction)
			310 m	

General plans of the light-load bridges are shown in Table 5.6.4, Fig. 5.4.3, 5.4.4 and 5.4.5.

(4) Construction Machinery Center Program (CMCP)

(a) Introduction of Construction Machinery

Introduction of construction machinery is absolutely necessary for constructing road in terms of coping with the physical conditions of the Study Area. Unit progress of the construction work of the farm road can be estimated in accordance with the physical condition of the site and the type of excavation materials and machinery.

The working day is expected to reduce to about 24 days per 1.0 km of farm road construction in consideration of the actual progress data of the on-going farm road construction in the Study Area. Accordingly, the annual progress of farm road construction is estimated about 12.5 km by one fleet as follows;

- Annual working day: 300 days (assumed)
- Annual expected construction length/ fleet: $300/24 = 12.5$ km

(b) Required Construction Machinery

Lhuntse and Mongar Dzongkhags are situated in the eastern Himalayas between Tibet to the north and the Indian territories of Assam and West Bengal to the south and east, and there is a lot of hard rock and steep slopes in the Study Area. Furthermore, regarding operation of the construction machinery, environmental aspect must be considered.

Besides, in consideration of the construction site observation as mentioned in Sub-section 3.4.3 "*Machinery for Road Construction*", the farm road construction is proposed to be implemented by the fleet machinery method to utilize various types of equipment and its supporting machinery. Number of the fleet of machinery is two (2) according to the total construction length of the farm road in the Study Area (183 km for 10 years). Details of the fleet machinery and supporting machinery and equipment are given in Table 5.4.1, 5.4.2, and 5.4.3. Besides, equipment to convey the construction machinery should also be provided at Bumthang Workshop for smooth and quick transportation of machinery between sites and the Workshop (Table 5.4.4).

(c) Capacity Building of CMU Staff

In the Construction Machinery Center Program, the procurement of construction machinery including equipment for repairing and maintenance is planned. Since the workshop is to be constructed in Jakar, training of the mechanics working in the workshop is proposed as follows;

Title:	Technical Training for Mechanic
Period:	One year from the completion of the workshop
Implementing Organization:	CMU
Objectives:	To improve the repairing techniques of the mechanics for construction machinery and their maintenance
Input:	Dispatch of expert
Activities:	Technical training in the workshop
Expected effects / profits:	Smooth repairing and maintenance of machinery facilitating construction

5.4.4 Capacity Building

As mention in Sub-section 5.2.2 "*Development Strategy of the Study Area*", capacity building is prerequisite throughout the development activities targeting each level of stakeholders, such as government officials and beneficiaries. The following table summarizes necessity of the capacity building proposed in the programs / sub-programs of the Master Plan and

activities on the capacity building.

Capacity Building by Program /Sub-program

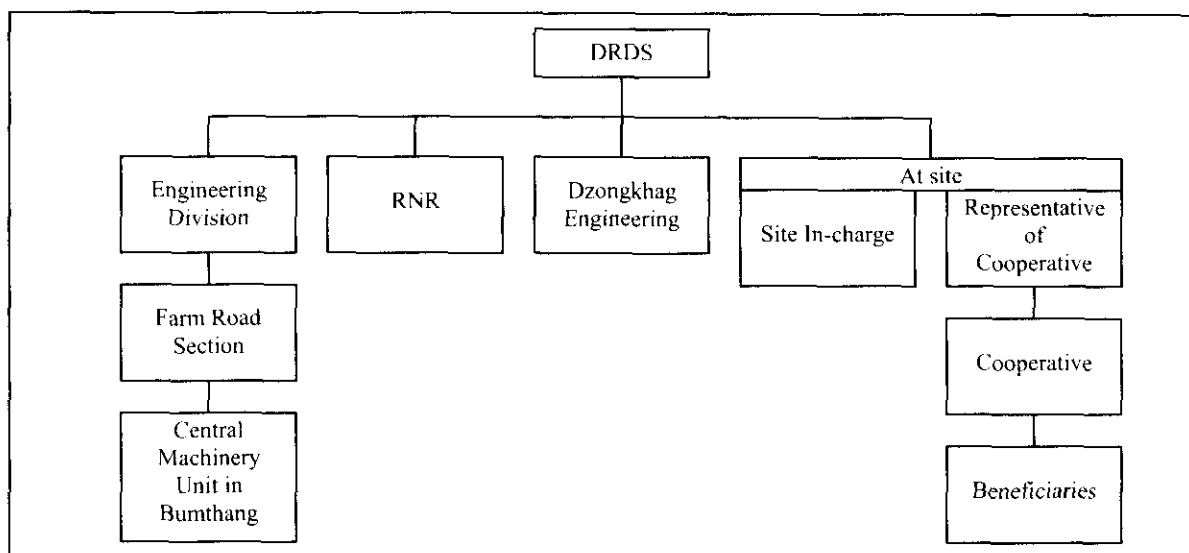
Program / Sub-program	Theme of Capacity Building	Activities of Capacity Building
Program for Food Crop Production Increase		
Food Security SP	Food production planning and technology transfer in each Gewog	<ul style="list-style-type: none"> • Training of EAs on target setting of food crop production in each Gewog • Training of EAs on food crop cultivation technique • Training on extension procedures • Training on data collection of agricultural statistics
Paddy Rice Production	Paddy rice production planning and technology transfer in each Dzongkhag	<ul style="list-style-type: none"> • Training of EAs on target setting of paddy rice production in each Gewog • Training of EAs on paddy rice cultivation technique
Irrigation Development SP	Training of WUA	<ul style="list-style-type: none"> • Organization of WUA • Management of WUA • Maintenance of facilities • Water management
Backyard Animal Husbandry SP	Training of farmers on livestock rearing and utilization of manure.	<ul style="list-style-type: none"> • Livestock rearing practices for farmers • Hygiene treatment and manure production
Post-harvest Technology Training SP	Post-harvest	<ul style="list-style-type: none"> • Training on post-harvest for EAs
Program for Cash Crop Production Strengthening		
Market Research SP	Selection of crop Procedure of market research	<ul style="list-style-type: none"> • OJT for RNR-RC East and AMS/PPD by short-term external expert
Technical Research and Development SP	Research procedure, cash crop farming technique, crop physiology,	<ul style="list-style-type: none"> • Training of RNR-RC East staff by long-term external expert
Training of Extension Agent SP	Training on cash crop for EA	<ul style="list-style-type: none"> • Training of EA by external experts
Agro-processing Technology Training SP	Training on agro-processing of farmers and local entrepreneurs	<ul style="list-style-type: none"> • Training of local entrepreneurs and farmers groups by experts
Market System Development Program		
Collection Depot Construction SP	Construction	<ul style="list-style-type: none"> • OJT for groups on construction
Group Assembling SP	Group formation, management of activities	<ul style="list-style-type: none"> • Training for farmers group
Group Assembling and Marketing SP	Management of shipping, grading, packing, marketing	<ul style="list-style-type: none"> • Training for farmers group
Marketing Support SP by FCB	Operation of collecting of products	
Extension Strengthening Program		
Extension Strengthening for Food Crop SP	Training of farmers	<ul style="list-style-type: none"> • Demonstration farm • Field farmer school • Input supply
Extension Strengthening for Cash Crop SP	Training of farmers	<ul style="list-style-type: none"> • Demonstration farm • Field farmer school • Input supply
Farm Road Construction Program	Training on road construction	<ul style="list-style-type: none"> • OJT for farmers on construction works and skills

Program / Sub-program	Theme of Capacity Building	Activities of Capacity Building
Farm Mule Track Construction Program	Training of beneficiaries on construction works	<ul style="list-style-type: none"> • Training of site engineer • OJT for farmers on construction works and skills
Light-load Bridge Construction Program	Design and construction for DOR, MOA and Dzongkhag engineers	<ul style="list-style-type: none"> • Design of bridge with guideline • OJT for farmers on construction works and skills • OJT for Dzongkhag engineers on construction
Construction Machinery Center Program	Training of operator and mechanic on construction machinery	<ul style="list-style-type: none"> • Training of operator on operation and maintenance • Training of mechanic on maintenance

5.4.5 Operation and Maintenance

(1) Principal of Operation and Maintenance

Construction of the farm road has to be executed with labor contribution of beneficiaries themselves as the principal of the farm road development of MOA. Accordingly, this will be also the principal that operation and maintenance of the farm road, farm mule track and light-load bridge are executed by the beneficiaries. Therefore, it is necessary to strengthen the existing implementation system of MOA, Dzongkhag and Gewog. Introduction of some coordinating system between Dzongkhag, Gewog and beneficiaries is required at the site level as follows;



Note: The site in-charge is selected from the cooperative, and the site engineer is dispatched from Dzongkhag to the site by the request of site in-charge, if necessary.

System of Operation and Maintenance

(2) Roads and Bridges

Prior to the commencement of the program, a Farm Road Users' Cooperative (FRUC) should be established in accordance with the instruction of MOA in cooperation with Dzongkhag Engineering on the basis of conventional local group like Chuu-lam and Tsa-lam. Because, MOA has much experience in establishing Water Users Association conformed to the Irrigation Procedural Manual.

Persistently, DRDS of MOA will administratively control the operation and maintenance and

this will be basically and actually executed through the activities of FRUC. The major activities for the operation and maintenance are:

Farm Road/ Farm Mule Track

- Cleaning and maintenance of side ditch, drainage facilities and others
- Checking and maintenance of cut slope and bank slope
- Checking and maintenance of sub-grade and shoulder
- Checking and maintenance of facilities (drainage, retaining wall, side ditch, culvert and others)
- Repairing of facilities (drainage, retaining wall, side ditch, culvert and others)
- Storage of maintenance materials and equipment (aggregate, sand, cement and tools)
- Others

Light-Load Bridge

- Checking and maintenance of deck plate
- Checking and maintenance of tower and anchor block
- Checking and maintenance of wire cable and stay
- Checking and maintenance of hanger and stiffener
- Repairing the above
- Others

(3) Construction Machinery

Operation and maintenance of the construction machinery would be undertaken by CMU. Plan for maintenance and management of the construction machinery is formulated based on as follows:

Maintenance activities of Central Machinery Unit

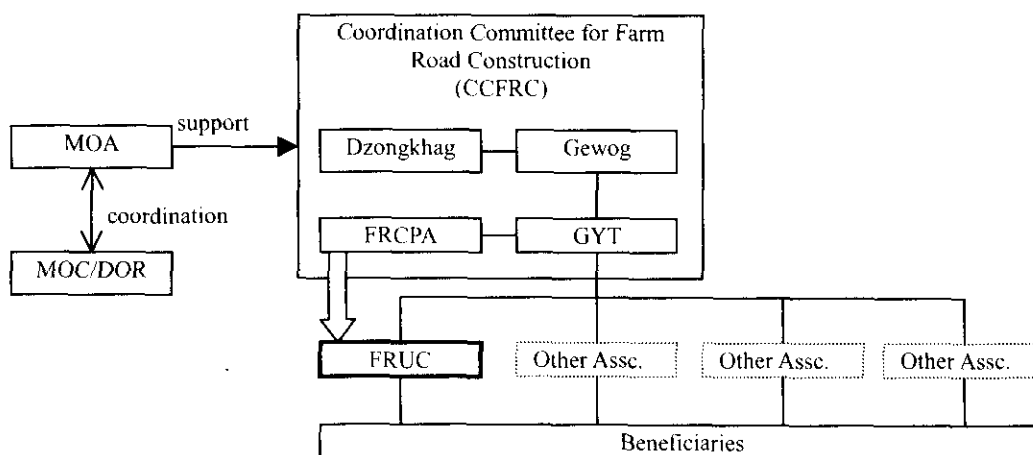
No	Maintenance of equipment		Responsibility	Place of repair	Record
1	Preventive maintenance	Daily check	Operator Mechanics Electrician	Job site (Mobile workshop)	Daily check sheet Machine history book
2		Repair			
3	Repair and Adjustment	Periodical maintenance	Mechanics Electrician	Job site (Mobile workshop) or Workshop in Bumthang	Periodical maintenance check sheet
4		Repair	Mechanics Electrician Welder	Job site (Mobile workshop) or Workshop in Bumthang	Repair record sheet (at the job site)
5		Rebuild of parts	Mechanics Electrician Welder	Workshop in Bumthang or Distributor's shop	Repair process sheet (at the workshop)
6	Inventory of spare parts	Disassemble Assemble Adjustment	Mechanics Electrician		Machine history book
6	Inventory of spare parts	Parts inventory Parts order	Stock house man	Stock house	Parts inventory computer system

Regarding the flow of repair work, all the staffs need to master such work processes to ensure the smooth workshop operation.

5.4.6 Implementation Setup

(1) Overall Establishment

The Farm Road Development Program (FRDP) will be managed in accordance with the institutional setup as shown in the following page:



Note: GYT; Gewog Development Committee
 FRCPA; Association for promoting farm road construction
 FRUC; Farm road construction cooperative
 Assc; Association

Implementation Setup of FRDP

(2) Ministry of Agriculture

MOA would be responsible for; i) arrangement of the construction machinery under the Construction Machinery Center Program, ii) budget arrangement for implementation, iii) coordination with MOC/DOR, and iv) technical support to Dzongkhag. MOA should also undertake capacity building of its staff in terms of road development, light-load bridge construction, operation and maintenance of the construction machinery. In particular, it is recommended to incubate bridge engineer for the light-load bridge in collaboration with DOR/MOC through exchange of personnel.

(3) Dzongkhags

Dzongkhag would be the main body of the implementation of the project. Budget for construction works will be sent to Dzongkhags and they should arrange construction machinery from CMU, construction materials and tools, for the project. Even the operation and maintenance works of the farm roads and farm mule tracks are undertaken with full responsibility of the beneficiaries, major repair works required due to natural disaster would be supported by Dzongkhags. Dzongkhags should also give guidance to Gewogs or groups of beneficiaries to organize, manage and maintain their organization activities and infrastructures.

(4) Gewog / GYT / FRUC

Gewog Development Committee (GYT) should organize target-oriented group within the Committee. At the preparation stage, Farm Road Construction Promotion Association (FRCPA) should be established in order to realize smooth and early implementation. The

committee would organize a request for the implementation from GYT to DYT. Tentative location or routes of the roads or bridges would be discussed in the committee. The chairperson would be a member of the GYT. Once the implementation of the program is assured, the committee would be converted to FRUC according to the instruction of MOA.

If the planned length of some proposed farm road or farm mule track is rather long, the proposed construction length will be divided into certain stretches taking into consideration of the distribution of farmland and the households. Then the cooperative will be established based on the segment length to cope with the concept of participatory approach for the farm road development plan.

(5) Coordination Committee for Farm Road (Farm Mule Track, Light-load Bridge) Construction

In order to realize smooth implementation and coordination, a coordination committee for farm road, farm mule track, or light-load bridge construction would be established consisting of Dzongkhag representative (DE, DAO), Gewog (Gup) and representative of FRCPA / FRUC.

5.5 Implementation Schedule

5.5.1 Development Concept and Approach

The period of implementation is set for 10 years from 2003 to 2012 including pre-stage for preparation of the action plan, and survey / design. Implementation schedule was prepared on the basis of the following concept and approach:

Overall concept and approach

- On the basis of policy of equal development opportunity and benefit to all the farmers, certain program/sub-programs will be implemented in every Gewog from the initial stage,
- Basic Human Needs (BHN) such as food shortage will be targeted at the initial implementation to solve the constraints,
- Step-wise implementation in each Gewog will be applied to bring it up to the higher development stage,

Regional Agricultural Development Program (RADP)

- Food security sub-program will be focused on the food shortage Gewogs at the initial stage of the implementation of BHN,
- Capacity building for cash crop production of the program for cash crop production strengthening (PCCPS), will be implemented from initial stage together with the Extension Strengthening Sub-program for Cash Crop,
- Program on production and marketing on cash crops will be implemented under close relation with schedule of farm road development,

Farm Road Development Program (FRDP)

- For the implementation of farm road construction program (FRCP), construction machinery and equipment will be procured through construction machinery center program,
- FRCP will be implemented taking into consideration of BHN and facilitating agricultural activities in the entire Study Area equally,
- Simultaneously, farm mule track construction program (FMTCP) and light-load bridge construction program (LBCP) will be implemented for isolated Gewogs in the same way.

5.5.2 Regional Agriculture Development Plan (RADP)

Programs of RADP will be implemented from 2004 to 2012 according to the priority of development stage of target Gewogs as summarized below and shown in Table 5.5.1:

Year	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012
1) Program for food crop production increase										
2) Program for cash crop production strengthening										
3) Market system development program										
4) Extension strengthening program										

Preparation stage Implementation stage

Note: Refer to Table 5.5.1

5.5.3 Farm Road Development Plan (FRDP)

Firstly construction machinery and equipment including tools for maintenance and repairing will be procured through Construction Machinery Center Program (CMCP) for Farm Road Construction Program in advance. In consideration of effectiveness of the plan, farm roads of short length, which will be able to be completed within a year will be executed at the early stage of the implementation schedule.

The Farm Mule Track Construction Program and Light-load Bridge Construction Program will be executed from the beginning of the implementation stage.

On the basis of the above considerations, the implementation schedule of the Farm Road Development Plan up to the target year of 2012 is shown in the Table 5.5.2 and 5.5.3.

5.6 Cost Estimate

5.6.1 Condition for Estimate

Cost required for implementation of the Master Plan was estimated on the basis of the following conditions.

- The cost includes initial investment cost for construction works, procurement cost of the construction machinery and improvement cost of facilities in RNR-RC-East, etc.
- Unit prices are estimated on the basis of market prices in June 2002 or standard price of the fiscal year 2002/2003,
- Following exchange rate is applied for the estimate:
USD = Nu. 47.89 = Yen 122.58 as of December 1, 2002
- Construction of FRDP is implemented with participation of the beneficiaries for unskilled labor,
- Construction machinery for FRDP will be provided by CMU of MOA. The cost for the machinery includes costs of operation, maintenance and depreciation of the machinery,

5.6.2 Unit Cost Study

(1) Roads

In Bhutan, the standards indicating the labor requirement/equipment requirement per unit work, and the unit cost of labor, materials and machinery are determined by Quality Control Division of MOC to calculate the cost of construction.

Labor requirement/equipment requirement per unit work is fully reflected on the physical conditions and actual construction practices in Bhutan. Accordingly estimation of the construction cost for the Farm Road Development Plan was done using the standards.

(a) Assumptions of Cost Estimation

In consideration of the physical conditions at the construction site for farm road construction in the Study Area, especially sloping terrain; the unit cost of farm road per km was estimated on the basis of procedures taken by MOA on the following assumptions.

Assumptions of Farm Road Construction (per 1,000 m)

- Clearing: Width 7.0 m x 1,000 m
- Felling Trees: 1 No. per 10m
- Earth Work (Geological Features): Soft Rock 25 %, Hard Rock 25 %, Soft Rock 25 %, Hard Soil 25 %
- Soil Disposal: 80 % of the above earth work (considering the environment friendly road construction method)
- Culvert: 3 Nos. per 1,000 m
- Side Ditch: Length 1,000 m (on the mountain side)
- Basement: Compaction, Subgrade, Soling, Blinding and Wearing (considering in accordance with the farm road cross section standard of MOA)
- Stone Edging: 2,000 m (both sides)
- Shoulder: 2,000 m (both sides)
- Retaining Wall: Length 50 m (10 % of soft soil area)

(b) Work Quantities and Unit Cost

1) Farm Road

The total work quantities divided into labor, material and machinery are calculated to multiply the work volume on the basis of the above assumptions and the labor requirement / equipment requirement per unit work. Consequently, the construction cost for 1.0 km farm road was about Nu. 5.5 million (Refer to Table 5.6.1).

Farm Road Direct Construction Cost per km

Item	Contents	Amount (Nu)	%
Unskilled Labor	Earthwork (beneficiaries' contribution)	696,534	15.8
Skilled Labor	Mason, Carpenter etc.	280,585	6.4
Machinery	Bulldozer, Excavator, Truck etc.	2,179,193	49.5
Materials	Sand, Cement, Detonator etc.	1,244,400	28.3
Sub Total		4,400,712	100.0
Adjustment	Cost index from S/Jongkhar etc.	1,094,281	
Total		5,494,993 (5,500,000)	

The cost for machinery accounts for about 50 % of the total cost excluding adjustment. The cost of labor includes unskilled labor cost of Nu. 697 thousand or 15.8 % of the

total cost (excluding adjustment), which should be deemed as contribution by the beneficiaries.

2) Farm mule track

The unit cost of the farm mule track was also estimated on the basis of the standards and the assumptions on the site conditions and existing mule track construction method. Therefore excavation will be carried out manually by unskilled laborer using shovel and pickaxe together with blasting.

The volume of excavation is about 1,500 m³ per km as the road width for the farm mule track is 2.2 m. However other works like culvert, retaining wall, subgrade and so on are not considered in the cost estimation. The construction cost for 1.0 km of farm mule track is about Nu. 214 thousand (Refer to Table 5.6.2).

Farm Mule Track Direct Construction Cost per km			
Item	Contents	Amount (Nu)	%
Unskilled Labor	Earthwork	116,588	64.9
Skilled labor	Blaster.	491	0.3
Machinery	Compressor, shovel, etc.	26,057	14.5
Materials	Blasting materials	36,330	20.3
Sub Total		179,465	100.0
Adjustment	Cost index from S/Jongkhar	33,955	
Total		213,420	
		(214,000)	

The labor of about Nu. 117 thousand or 65 %of the total cost (excluding adjustment) should be contributed by the beneficiaries.

(2) Light-Load Bridge

There is a big river namely the Kuri Chhu River flowing down southward in the middle of the Study Area. This river will be the physical obstacle for the development of the Study Area, however, it is clearly mentioned in the Farm Road Guidelines that the cross drainage structure for large catchments should be a multi-cell or a wooden bridge in consideration of the participatory approach by the beneficiaries. Accordingly, such large-scale bridge across the Kuri Chhu River will not be applicable in the plan of the farm road construction under MOA officially.

Therefore, in this Study, the light-load bridge was proposed across the Kuri Chhu River. Since the light-load bridge would be connected to the farm mule track, it should have the same function as that of the farm mule track. The unit construction cost of the light-load bridge with specification permissible for the passing of farming machinery per meter was estimated at Nu. 60,000 as follows;

Unit cost of light-load bridge per meter:	Nu. 45,000 (including the cost of fabrication, materials (cement, aggregate), and transportation up to road head, the latest unit cost of suspension bridge, DOR)
Others items beside above:	Nu. 15,000 (unskilled labor, supervision and sand are usually considered)

The cost for the Farm Road Development Plan is shown in Table 5.6.3, 5.6.4 and 5.6.5.

(3) Cost for Irrigation Facilities

In the 9th FYP, the program of irrigation schemes are described at the RNR sector program,

and the outlay for that including the unit cost per 1.0 km length of irrigation canal for renovation and new construction are indicated. It is assumed that the unit cost is properly estimated in consideration of the participatory approach to be assisted by the beneficiaries. The unit cost per 1.0 km length of canal is as follows;

- For renovation: Nu. 0.132 million on average
- For new construction: Nu. 0.300 million on average

5.6.3 Project Cost

The Project costs were estimated for the facilities and equipment required for the project.

Required Cost for the Implementation of the Plans

Plan and Program	Organization of Implementation	(Nu. million)
Regional Agricultural Development		
1) <u>Program for food crop production increase</u>	Gewog/Dzongkhag	<u>73.4</u>
- Irrigation development		72.1
- Training of EAs		1.3
2) <u>Program for cash crop production strengthening</u>	MOA	<u>86.3</u>
- Improvement of facilities and equipment of RNR-RC-East		
# Buildings (laboratory, training hall, trainees' dormitory, working shed)		6.2
# Green house		40.0
# Research farm equipment		20.0
# Laboratory equipment		12.0
# Training/office equipment		4.0
- Training of EAs		4.1
3) <u>Market system development program</u>		<u>4.5</u>
- Construction of collection depots	Gewog/Dzongkhag	1.2
- Construction of storages	Farmers group	1.5
- Procurement of trucks	FCB	1.8
4) <u>Extension strengthening program</u>	Dzongkhag	<u>4.5</u>
Field activities and training of farmers		4.5
Sub-total		168.7
Farm Road Development Plan		
1) <u>Farm road construction</u>	Gewog/Dzongkhag	<u>1,006.5</u>
2) <u>Farm mule track construction</u>	Gewog/Dzongkhag	24.4
3) <u>Light-load bridge construction</u>	Gewog/Dzongkhag	23.0
4) <u>Construction machinery center</u> *	CMU of MOA	<u>181.5</u> *
- Construction machines		109.6 **
- Supporting equipment		18.7
- Equipment / tool and building for workshop		37.1
- Machinery for transportation		16.1
Sub-total		1,053.9 *
Total		1,222.6 *

Note *: Construction Machinery Center Program is a support program of FRDP for establishment of CMU facility and equipment. The cost is excluded in the total cost because the cost of the farm road construction includes maintenance and depreciation cost of the construction machinery.

** : Procurement cost for 2 fleets of construction machines.

5.7 Project Justification

The Master Plan is composed of two Plans, namely RADP and FRDP. These Plans were evaluated in an integrated or combined manner, because FRDP is considered the most influential factor of the benefits brought up by RADP.

The Plans were evaluated on; i) economic and financial aspect, ii) technology and capacity of stakeholders, iii) social aspect, iv) demonstration, model and ripple effect, and v) sustainability.

5.7.1 Economic and Financial Aspect

(1) Economic viability

Economic viability of the plan was evaluated through the following procedures:

Target Benefit

A. Crop production

1) Incremental production value in the target year, 2012:	Nu. mill.	118.0
Cereal crops (6,000 ton x Nu. 8,000/ton)	Nu. mill.	48.0
Cash crops (14,000 ton x Nu. 5,000/ton)	Nu. mill.	70.0
2) Profit ratio to the production value		70%
3) Incremental benefit (118.0 x 0.70)	Nu. mill.	82.6

B. Reduction of transportation cost of living and

 agricultural commodities by farm road development

Nu. mill. 11.1

Total (A + B) Nu. mill. 93.7

Cost (financial cost)

A. Initial Investment Nu. mill. 1,041.0

1) Farm road/Farm mule track/Light-load bridge Nu. mill. 915.9

2) Irrigation facility Nu. mill. 46.9

3) RNR-RC facility and equipment
(The plan shares 1/3 of the total cost) Nu. mill. 27.2

4) Marketing Nu. mill. 4.3

5) Training cost of EAs and farmers Nu. mill. 9.9

B. O&M Nu. mill. 5.5

C. Replacement

(life expectancy of; farm road: 50 years, light-load bridge: 25 years, irrigation and building: 20 years, equipment: 10 years)

The economic cost and benefit flow are shown in Table 5.7.1. The Economic Internal Rate of Return (EIRR) is estimated at 7.7 %. Such low economic viability is supposedly caused by the disadvantageous conditions as mentioned below:

- High construction cost of the farm road due to severe geographical conditions such as steep slopes and difference of altitudes, and
- Low farm road benefit due to the low population density in the rural area.

(2) Farm Households Income Increase

Average income from agricultural products (food and cash crops) per farm household will be increased to Nu. 28,500 for Gewogs categorized in the Stage-1, Nu. 37,900 for the Stage-2 Gewogs, and Nu. 48,800 in the Stage-3 Gewogs in 2012, which range from 147 % to 190 % of the present income. The average increase rate of income is around 5 % per annum.

Prospective Income Increase per Household

(Unit: Nu.)

	Agricultural Income *		
	Stage 3	Stage 2	Stage 1
Income level at 2012	29,900	20,000	19,400
Increase of income	18,900	17,900	9,100
Income level at 2012	48,800	37,900	28,500

Note *: Incomes from food crops, fruits and vegetable production

(3) Capacity to Pay

Beneficiary farmers must bear the operation and maintenance cost of farm road and irrigation facilities by the users association.

As for the maintenance of the farm road, beneficiary farmers can contribute with their labor force. Besides, the mechanical work, which is proposed as periodical repair works for every five year should be done on contract basis by the farm road users association. The average annual cost of mechanical maintenance is estimated at Nu.503 per household. The cost to be paid by the beneficiary is less than 3 % of their increased income for the Stage-2 and 3 Gewogs.

(4) Consistency with the Target of the National Plan

Long-term national development plan, “Bhutan 2020 - A Vision for Peace, Prosperity and Happiness” targets export increase of horticulture products in 2012 would be 300 % of that of year 2000. The value and volume in 2012 were estimated at approximately Nu. 780 million and 14,000 ton, respectively, with assumed export unit price of Nu. 5,000 /ton at current price. On the other hand, the target export volume of the Plan is 14,000 ton in 2012, which would occupy around 9 % of the national target among 20 Dzongkhags in the country. It is considered justifiable that the production and export plan are reasonable in the national plan.

Justification with National Development Plan

	2012 (End of 11th FYP)	Remarks
Target of horticulture export value *1 (mill. Nu.)	300% of year 2000 Nu. 780 million	Nu. 260 million (1999) *2
Volume of horticulture	156,000 ton	Nu. 5,000/ton
Export target of cash crop in the Study Area	14, 000 ton	
Share of Study Area to National Plan	9%	

Source *1: Bhutan 2020 - A Vision for Peace, Prosperity and Happiness

*2: Bhutan Trade Statistics, 1999, MOF

5.7.2 Technology and Capacity of Stakeholders

The Master Plan should be justified from the viewpoint of technology and capacity of stakeholders. The stakeholders for the Plan would consist of;

- Beneficiaries (farmers in the Study Area), who would participate in farm road construction,
- Dzongkhag Administration and its staff including EAs would be the main organization for implementation,
- Gup Office (Gewog Chief Office) and GYT, which are organizations for Gewog level administration and activities,
- RNR-RC-East, which will play a role in research and training of EAs,
- CMU of MOA, which would be the responsible organization for management of construction machinery for the farm road construction,
- MOA, which would be responsible ministry for the Plan,
- Support organizations and agents of production / marketing such as DSC, CAs, BDFC and FCB,
- Middlemen of cash crop products

(1) Beneficiaries

(a) Technical capacity

Beneficiaries, who live under conditions of self-consumptive agriculture, depend on traditional farming system, and they have generally poor knowledge on farming technique and marketing of cash crops. Taking into such situation into account, the Plan includes awareness building of farmers, dissemination of farming technologies, construction of collection depots of products, and support on group activities of group assembling and shipping. Farmers will participate in the farm road construction in their Gewogs during off-season of on-farm activity. Beneficiary farmers will participate in the farm road construction as much as possible within their available labor force, it is intended to maintain the farm road by organizing the user association. This kind of participation has been undertaken for the farm road and irrigation development activities. In the course of the Study, experimental implementation of farm mule track development was carried out so that stakeholders' capability should be confirmed. Both unskilled labor and skilled labor were arranged by Gewog. Site supervisor, blaster and mason worked for the construction period well and beneficiaries of 20 in number on the average participated to the works without getting any payment for 45 days. One kilometer of the farm mule track was completed within proposed period. Environmental examination by NEC was also applied by Dzongkhag and Dzongkhag engineering staff supported the works.

Extension agents of Dzongkhag RNR Sector have basic knowledge and sufficient educational background to get trained in English medium. Even without enough experience their potential is considered high for capacity improvement.

(b) Labor force

One of the major constraints of the agricultural activity is shortage of labor force. Labor requirement in the future plan will be increased by the intensive farming, shipping of products to the proposed collection facilities, marketing activity and participation in the farm road construction. As for labor shortage, improvement of farm roads as well as introduction of agricultural tools and machines will reduce certain amount of required labor force. It is evaluated by labor balance analysis as shown below that labor force would be available for the project.

1) Average labor force per household	2.8person/HH (household)
2) Workable day per year	300 days/person
3) Labor force potential /household	840 man-days/HH
4) Average planted area /household	1.3 ha /HH
5) Labor requirement for on farm work	280 man-days/ha
	370 man-days/HH
6) Other labor requirement (housekeeping, livestock care, off-farm work etc.)	180 man-days/HH
7) Participation with farm road construction *	200 man-days/HH
8) Total requirement	750 man-days/HH
9) Labor balance (3 - 8)	90 man-days/HH

Note *: Participation period for construction is except during 3 months of busy season in farming. Maintenance work of farm road by beneficiaries is around 30 man-days/HH/year.

(c) Financial Situation

Financial situation of the beneficiaries is generally very low to invest for cash crop farming, such as purchase of inputs and marketing activities. For this, group loan by BDFC (mobile

credit) will be available at Gewog level.

(2) Gup Office and GYT

Decentralization policy of the Government focuses on strengthening of Gewog activities in 9th FYP. The government intends to promote self-reliance of Gewogs in planning and implementation of development activities by 11th FYP. The functions of Gup office and GYT will be strengthened through the planning and implementation of the development plan. The first Gup election was held in October and November 2002 in the Study Area. After determination of new governance system of Gewog and Dzongkhag, DYT and GYT will perform the main roles in the regional development. The GYT and DYT Chathrim (Act) 2002 were prepared and implemented. In these documents, detailed responsibilities of DYT, GYT, Gup, Dzongkhag Administrator, etc. are mentioned. Every government official is aware of higher roles and responsibilities.

(3) Dzongkhag

RNR sector of Dzongkhag Administration plays a role of agriculture development and extension activities. EAs are assigned at Gewogs from Dzongkhag for extension activity at the field. Dzongkhag staff and EAs have basic knowledge and extension system for food crops has been established. However, they have not been trained sufficiently on cash crops to disseminate the farming and production techniques and marketing for them. Training of EAs on the cash crops will be provided by project type scheme by RNR-RC-East by the project.

(4) RNR-RC-East

RNR-RC-East is the sole institution in the Eastern Region that would provide above-mentioned training, research and development activities on the cash crops. Research and development on the horticulture crops have been launched by the JICA Expert. Technical cooperation project is considered one of the suitable options for research and training of EAs on the cash crops production in the RNR-RC-East with experienced external experts. Wengkhaz Center of RNR-RC-East was newly established in 2001, and the facilities required for the activities have not been facilitated yet. The required additional facilities for the research and training should be improved by the program of the Plan.

(5) CMU

CMU, which would operate the construction machinery for farm road construction in the Study Area, was shifted from Paro to Bumthang in 2002. Construction of CMU's facilities was started in 2002 getting certain budget allocation. It has enough number of trained operators for construction machinery, but construction machinery required for the Farm Road Development Plan in the Study Area is not sufficient at present. Procurement plan of construction machinery and workshop equipment have been formulated in the Program for Construction of Machinery Center. RGOB requested for grant aid project for the procurement of the construction machinery.

(6) MOA

MOA is the responsible ministry for the development and implementation of the Plan. DRDS of MOA would support research and training activities of the Plan, and coordinate agricultural program of the Dzongkhags.

(7) Support Organizations and Agents

Input supply by DSC and CAs, micro-credit service by BDFC, and auction and marketing services by FCB will be coordinated by Dzongkhag. The organization and agents concerned would function effectively getting such coordination.

(8) Middlemen

At present, activities of middlemen for agricultural products are little. The plan includes production increase and construction of collection depots for cash crop products in order to invite middlemen.

5.7.3 Social Aspect

Following social impacts are expected by the implementation of the Plan.

- The programs will activate the regional economy through production increase and marketing activities by RADP-LM, and improvement of accessibility by FRDP-LM. It will encourage local market activities of agricultural products and small-scale cottage industry. It will contribute to generate job opportunities for the rural population.
- By the farm road development, the inhabitants will enjoy improved accessibility to social and agricultural services such as health, education, food security, agricultural input distribution, and living commodities. It will contribute to realization of the policy of equity in development of living environment for the people.
- Some the farmers will be trained to get skills for construction works through participation in the farm road construction. They will have chance to get more cash income in other construction sites.
- Farmers will be encouraged and motivated through group activity. It is expected that Gewog communities will be stimulated and activated through such group activities.
- Getting integrated benefit from the above, living condition and standard of the rural society will be improved, which decelerate rural-to-urban migration and stabilize the agriculture production of the country.
- As clarified through the farm household survey at villages of good and poor accessibility, enrollment rate of women in social activities such as meeting and training will be increased as access is improved. Women's participation to the social activities will be encouraged by the project.
- The farm road construction works are conducted by labor contribution of beneficiaries. According to the results of experimental construction of farm mule track, women's participation was 30 person-days out of 524 person days in total getting direct instruction of Dzongda at ground-breaking ceremony. The promotion of farm road construction will not be burden to women with certain arrangement or instruction by the implementation agency.

5.7.4 Demonstration, Model and Ripple Effect

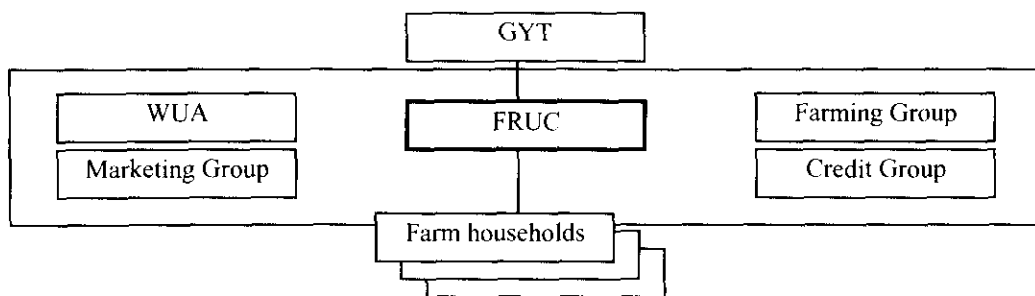
The plan focuses on the regional development of the agriculture and farm roads. The approach of master plan formulation, criteria of categorization and technical standards can be applied to other Dzongkhags and Regions. Similar programs in the surrounding areas will be set up and implemented. It can be said that the Plans would become a model of agriculture and farm road development of RGOB.

5.7.5 Sustainability

The project should be sustainable with good operation and management, financial conditions and natural environmental conservation.

(1) Maintenance of Farm Road

After completion of the farm road construction, maintenance works should be conducted by the Farm Road Users Cooperative (FRUC). FRUC will be organized under GYT. FRUC will be one of the farmers groups under GYT as shown in the figure in the following page. The FRUC would prepare the maintenance schedule, regular work, arranges labor contribution and periodical repair works with machinery as required. The cost of the repair works by the machinery would have to be allocated in the budget of FRUC or GYT. The above operation and management will ensure the sustainable maintenance of farm roads.



GYT: Gewog Development Committee, FRUC: Farm Road Users Cooperative,
WUA: Water Users Association

FRUC and Other Farmers Groups under GYT

(2) Technical Level Applied to the Plan

The target crops were selected from familiar crops with farmers and also suitable for the natural condition of the Study Area. Farming techniques applied in the Plan would be improved on the basis of the present level, seeking for the production increase and quality improvement.

The farm road development was planned in accordance with the concept of farmers' participation in the construction and utilization of local materials as much as possible, for building farmers awareness on their own farm road, reduction of construction cost, and easy maintenance by beneficiaries.

(3) Operation and Management of CMU

CMU would provide construction services for the farm roads with its construction machinery under the contract between the beneficiaries (Gewog) and MOA. MOA or Dzongkhags as implementation agency would allocate necessary budget for operation and maintenance of the machinery of CMU. Workshop of CMU would be operated by the allocated budget from the farm road construction. The sustainable operation of CMU will be ensured through such financial and system backstop.

5.7.6 Confirmation on Beneficiaries' Intention

Farm household survey was conducted during the Action Plan period in order to confirm if concept, approach, and programs of the Master Plan are acceptable for the beneficiaries.

Interview survey was conducted in the priority Gewogs, namely, Gangzur, Drepong and Chaskhar. Sample population was 40 for Drepong and Chaskhar, while 30 for Gangzur.

(1) Drepong

Average labor forces of the households are 2.0 persons. Most of them (70 %) feel “labor shortage” for farming activities. However they are willing to participate in construction works of proposed farm road during a period between October and January, about 15 to 30 days a month. Even for busy months they will participate in construction works getting instruction from Gup or they will just follow what their neighbors do. For the maintenance works, they will attend the work whenever it is required.

They would like to increase their income through sales of vegetables such as cabbage, radish, leaf vegetables and beans. Even without motorable roads, they bring their products to Mongar for selling and purchasing commodities in return. In this sense, there is certain background in Drepong to promote farm road construction and increase cash income through cash crop production. Besides, they also desire to get cash income through selling surplus maize. Almost all the interviewees replied that they will participate in group activities for shipping of products and marketing activities provided that the farm road is constructed. Most (80 %) farmers rely on EA on production technique, thus training of EAs is considered the right approach for strengthening and accelerating of horticulture crop production.

(2) Chaskhar

Average labor forces of the households are 3.2 persons. Many of them (65 %) feel “labor shortage” for farming activities. In Chaskhar, a farm road to Thangrong is being constructed by MOA with labor contribution of both Thangrong Gewog and Chaskhar Gewog. Even non-beneficiary farmers work for the construction of the farm road according to the “labor tax” system of the Gewogs. Thangrong and Chaskhar Gewog provide unskilled labor in turn (15 days) during off-season.

It seemed that Chaskhar village (Gewog center) itself is more densely populated, and the landholding size per household is smaller. The first option to increase cash income is “livestock” (40 %), then vegetables (20 %) and maize (10 %). As for usage of assumed income increased, the first option is repayment of debt (30 %), then house (27.5 %) and purchase of livestock animal (20 %).

It should be noted that most of the households (82.5 %) replied that their sales of agricultural products had increased after completion of the feeder road, but most of them (85 %) are not participating in group activities for shipping and assembling. In this sense, they might not have fully enjoyed advantage of good access for increasing their income. At this moment, potato production of Chaskhar is not high compared to other Gewogs. However, according to the results of participatory planning approaches such as interview survey to farmers, workshops with Gewog and Dzongkhag officials, potato is one of the desired crops, and physical conditions are also suitable for potato cultivation. Taking into account a great deal of production and sales of potato at Drametse Gewog, which is located just opposite side of the National Highway of Chaskhar, potential of potato production in Chaskhar is quite high.

Moreover, taking into account the choice of expected cash income source of the farmers, namely livestock and vegetables, and also high production of maize, backyard animal husbandry along with intensive vegetable cultivation should be a promising approach. In Chaskhar, 35 % of the households are doing cottage industry of lemon grass oil and they are familiar with processing of natural resources with good access. Thus, even with smaller

landholding size, adding value of agricultural products will be highly applicable.

(3) Gangzur

Average labor forces of the households are 2.1 persons. Most of them (75 %) feel “labor shortage” for farming activities. However they are willing to participate in construction works of proposed farm road during a period between December and February, about 15 to 30 days a month. Even for busy months they will participate construction works getting instruction from Gup. As for maintenance works, they will participate in the work whenever it is required.

They would like to increase their income through sales of rice and vegetables such as cabbage, radish, and beans. They prefer to plant plum and pear as fruit crops. Most probably due to poor access, they do not come to Lhuntse town or Gewog center for selling their farm products. In this sense, there is certain potential for Gangzur to increase both rice and cash crop production through farm road construction. Almost all the interviewees replied that they would participate in the group activities for shipping of products and marketing activities provided that the farm road is constructed. Most (90 %) farmers rely on EA on production technique, thus training of EAs is the right approach for strengthening and accelerating of horticulture crop production.

Roles of men and women are a bit different in Gangzur from those of Drepong and Chaskhar. Located very far from the Gewog center or Lhuntse town, shipping, shopping and participation to meeting are mostly undertaken by men. Farm road development will encourage women to be involved in social activities. A feeder road being constructed, living conditions of hinterland in Gangzur and Kurtoe Gewogs will be drastically improved and agriculture development through implementation of the Master Plan.

5.8 Environmental Impact Examination (IEE)

5.8.1 *Lows, Regulation and Institutions on Environment*

The Environmental Assessment Act, 2000 (EA Act 2000) and its subsequent regulations stipulate that Environmental Assessments (EA) shall be carried out for all the activities that have potentially significant environmental impacts. The applicants are required to submit project proposal through relevant competent authorities to NEC. NEC has mandate to review project proposal submitted and decide whether the EA shall be carried out for the project or not. If the EA has to be carried out, TOR shall be prepared by applicant. The TOR must be approved by NEC. The applicants must conduct EA using the approved TOR, and submit EA report to NEC for review and issuance of Environmental Clearance.

Fig. 5.8.1 shows NEC's criteria to judge whether EA is necessary or not. The proposal submitted by the applicant will be categorized based on results of impact scoping and screening activities. Projects with category A, B and C will require environmental clearance by NEC before development consent is provided by the competent authorities. All projects will be classified into four categories;

- Category A (Complex Project); Proposals which require a full environmental assessment to establish the extent and magnitude of potential impacts. Scoped impacts are either known to be significant, or impacts cannot be established from data provided in the project prospectus, requiring either an IEE or an EA report,
- Category B (Impact Significant, Management known); Proposals which have potentially significant impacts, however management and treatment options are

well developed and understood. These projects can be adequately managed through application of detailed impact management and monitoring plans,

- Category C (Impact Moderate, Project repetitive); Proposals that have moderate impacts which tend to be repetitive. These impacts can be managed by attaching environmental code-of best-practice to licenses and permits, and
- Category D (Management known, Management simple); Proposals that have moderate and easily managed impacts. Simple environmental terms are attached to the business permits or licenses.

5.8.2 Main Components and Necessity for IEE

In accordance with JICA Environmental Consideration Guideline, Project Description (PD) and Site Description (SD) were examined as summarized in Table 5.8.1 and Table 5.8.2. Among major components of the Project, the following components were selected as those that require for IEE, in due consideration of characteristics of each component:

- Irrigation
- FRCP (FRDP)
- FMTCP (FRDP)
- LBCP (FRDP)

Main components such as RADP and CMCP (FRDP) were screened out, because it is obvious that no negative and direct impacts will occur.

Besides, construction activities might bring serious negative impacts during FRDP, since i) most of proposed road located in sloping farmland and forest, and ii) construction period will be long. However, irrigation component selected for IEE is expected to have negative impacts, because i) construction period of each scheme will be relatively short, ii) construction work will be within limited area, and iii) construction is mainly manual.

5.8.3 Environmental Elements to be Examined

According to JICA guideline, the following environmental elements were selected for IEE in relation with the four components mentioned above. The detailed items of each environmental element are shown in Table 5.8.3 and Table 5.8.4.

- Social Environment: Socioeconomic, Health and sanitary, and Cultural issues
- Natural Environment: Biological and ecological, Soil and land, and Hydrology and air and water quality issues

5.8.4 Results of IEE

Based on the data and information related to the current environmental conditions and potential impacts of components, the significance and magnitude of the impacts have been preliminary examined using a matrix checklist of IEE and JICA guidelines. The results of IEE are presented in Table 5.8.3 to Table 5.8.4, and likely negative impacts are summarized below:

(1) Social Environment

1) Relocation of Houses and Land Expropriation

Although new construction of farm roads and farm mule tracks seems to cause the house relocation and land expropriation as negative social impacts, the magnitude of impacts will be relatively small, because construction of farm roads and farm mule

tracks are based on request from rural communities.

Although some parts of routes for farm roads and farm mule tracks are supposed to trace present foot path, most of the routes are supposed to stray out of present foot path. House relocation and land expropriation is supposed to be necessary in some parts.

2) Culture issues

Having many religious structures (*Lhakhang, Chorten, Mani Khorlo*, etc.) in the Study Area, construction of farm roads and farm mule tracks might damage such structures.

(2) Natural Environment

1) Degradation of flora and fauna

At present, most of the Study Area is covered with forest. Many kinds of protected species are distributed in the forest. Construction of farm roads and farm mule tracks might bring serious damage on forest resources by landslide not only at construction stage but also after construction. Details of threatened, near-threatened and protected species in/around the Study Area are given in Annex-I.

2) Soil and land resources

Protection for soil erosion and land slide will be required for farm road and farm mule track development. But, any kind of protection might not be effective in steep slope area. Soil erosion and land slide caused by farm road and farm mule track development might be serious problem.

3) Air pollution

Exhaust gas from farm road construction machinery might be of negative effect on air pollution.

According to the results of IEE, the following issues were recognized as major negative impacts by the activities of the projects proposed in the Master Plan.

- Serious impact might be brought by construction of farm road and farm mule track on flora and fauna and social disparity,

Therefore, it is recommended that EIA (Environmental Impact Assessment) would be conducted for new construction of FRCP and MTCP. Environmental conservation program should be developed in order to cope with these issues. Draft TOR for EIA is attached in Annex-I.

5.9 Feedback from Experimental Implementation

5.9.1 General

In implementing the participatory projects, various problems related to technical applicability, social constraints, conflict in communities, land acquisition, etc. may occur. In some cases, the proposed plans are not connected to the expected benefit, or cause some negative impact to the environment.

Technology transfer through seminar or on-the-job training (OJT) was carried out for the Plans in the Master Plan. The technology transfer on the proposed development approaches

such as participatory construction works of the farm road, supporting of pump irrigation, and supporting of horticultural crops cultivation were conducted in the course of the Study. Problems and conditions for applying of the development approaches were examined and confirmed through the process of the OJT. Results of the OJT were also reflected on the formulation of the Action Plan. This approach also contributed to motivating beneficiaries' participation and technical transfer to the counterparts and administrative staffs regarding the project implementation and management. The Seminar / OJT was conducted in the following approaches:

- Seminar on Participatory Farm Mule Track Construction: Farm road improvement with beneficiaries' labor contribution and construction materials and equipment.
- OJT on Support for Small-scale Irrigation: Supporting of small-scale irrigation with portable engine pump sets which do not require major civil works
- OJT on Support for horticulture crops cultivation: Provision of agricultural input (seed), small animals (piglet) for multiple farming, and extension services at field farmer school (FFS) for farmers' groups.

5.9.2 Farm Road Construction Seminar

(1) Objectives

Purpose of this seminar is to transfer procedures on one of the main development approaches of the Master Plan and utilize the results and lessons obtained for formulating of the Action Plan. The following issues were expected to be clarified through the survey:

- Conditions that allow the beneficiaries participate to the development works
- Examination of beneficiaries' skills for civil works such as earthwork, masonry, etc.
- Capacity of Dzongkhag staff and organization
- Time required for the procurement of the machines and construction
- Other problems and constraints against implementation

(2) Location and Works

Proposed farm mule track at Khoma Gewog of Lhuntse Dzongkhag was selected for experimental implementation. The total length proposed for the implementation was one kilometer out of 6.3 km of proposed length. Proposed duration of the work was 1.5 months from mid September 2002 to the end of October, during which farmers are not busy in their farming activities. The proposed road to Khoma village is an existing one as a foot path. The construction works were done with several skilled (paid) laborers (supervisor, blaster, driller, etc.) and unskilled laborers (unpaid) who were from the beneficiaries.

Prior to the implementation, Dzongkhag applied for site inspection by NEC for environmental clearance. NEC suggested making a detour the existing route because of the existence of cremation place. Thus, a new route was shifted to the steep and rocky hill side.

The following road improvement works was conducted for the OJT:

- Construction of new route of 2.2 m width,
- Widening of existing foot path, and
- Construction of dry masonry for track.

(3) Roles by Stakeholder

Roles of the Study Team, Dzongkhag and Gewog were as follows:

Study Team

- Provision of budget for construction equipment and materials,
- Technical advice to the Dzongkhag engineer in charge of the farm road development

Dzongkhag

- Engineering support (design, cost estimate, etc)
- Arrangement of procurement of construction equipment and materials,
- Supervision of the construction

Gewog

- Coordination and arrangement of laborers

Beneficiaries

- Formation of group
- Provision of labor force

(4) Results

The ground-breaking ceremony was held on September 13, 2002, and the targeted length (1 km) was almost completed by the end of October. The participants to the construction works (unskilled or unpaid laborer) totaled to 524 men-days during the construction period of 31 days. In accordance with instruction of the Dzongda (Dzongkhag Administrator), few female and child laborer worked. The construction site is full of hard and weathered rocks, which hampered the progress of construction seriously. The period and cost for this road section is considered higher compared to other sections proposed for the farm mule track construction.

(5) Feedback to the Master Plan

The following lessons and feedback were obtained through the experimental implementation.

(a) Participation of Beneficiaries

Farmers have certain period during which they are mostly free from farming works and can work for other activities either for off-farm business or contribution to public works related to their benefit. They tend to follow their neighbors or leaders such as Dzongda or Gup. If the project makes due consideration on the farmers' convenience related to their farming activities, collaboration with local administrations, and provision of necessary equipment and materials, the participatory implementation of the farm road construction will be highly applicable. According to interview results to the participants, they prefer to be paid, but they would be willing to work even without payment if they have no chance to have farm road without their labor contribution.

(b) Capacity of Skilled Labor

In general, Gewog should take a responsibility to arrange necessary laborers. Skilled laborers such as blaster and mason are available in Gewogs and they can recruit themselves. The skilled labor could instruct the unskilled laborers too. However, it is recommended that periodical training on blasting, particularly on risk management and safety instructions should be carried out by Dzongkhag.

(c) Capacity of Dzongkhag Staff

As far as construction supervision and arrangement for implementation are concerned, the capacity and experience of Dzongkhag engineers and staffs are considered appreciable. However, because of shortage of manpower in number, they might experience some over-load problems in the future having a number of construction sites organized by the beneficiaries themselves. More supervisors at field level (Gewog) should be trained and nurtured in the course of the construction works. Some candidates can be invited to the construction site from other Gewogs for training.

5.9.3 Horticulture Production Support

(1) Objectives

Horticulture development is a main component of the Master Plan for income increase of beneficiaries. Purpose of the OJT is to transfer technology on horticulture cultivation and backyard animal husbandry to counterpart and staff / beneficiaries concerned as well as to utilize the results and lessons obtained for formulation of the Action plan. The following issues were expected to be clarified through the OJT implementation:

- Problems that might arise in the formation process of the farmers' group,
- Problem that might arise in receiving and returning for the supporting services,
- Ability of farmers in farming practices,
- Farm budget, production and yield,
- Confirmation of beneficiaries' attitude to cash crop cultivation and backyard animals,
- Other problems on the horticulture crop cultivation.

(2) Process of OJT

Ten kinds of vegetable seeds and 74 heads of piglet were distributed to the farmers of target area free of charge. The target areas for the OJT were selected by DAO and DAHO of Dzongkhags, conformed to the criteria prepared by the Study Team as follows:

- Potential area of vegetable production and backyard animal husbandry,
- Area in which farmers have high consciousness on potential of horticulture and small animals, and
- In good physical access for the team members,

As the results of discussion with Gewogs, DAO and DAHO selected the areas and participants of 20 farmers, one farmers group (20 members) for vegetable cultivation, and 51 farmers and one farmers group for backyard animal husbandry (74 piglets) as follows:

Participants of Horticulture Crop Cultivation		
	Vegetable seeds	Piglet
Lhuntse Dzongkhag	Farmers group (20 members)* for vegetable production in Jang Village	31 farmers and one vegetable farmers* group in 6 Gewogs; 37 heads in total.
Mongar Dzongkhag	12 farmers in Serimuhang Gewog, and 8 farmers in Tsakaling Gewog	20 heads to 12 farmers in Serimuhang Gewog, and 17 heads to 8 farmers in Tsakaling Gewog; 37 heads to 20 farmers in total
Total	20 farmers and one farmers group (20 members)	74 heads to 51 farmers and one farmers group (20 member)

Note: Same farmers group in Jang Village, Gangzur. It was established in 2001.

Through the discussion with DAO and DAHO, OJT was carried out in the following manner:

- Fertilizer and chemicals were prepared by the participants themselves,
- Timing of distribution of fruit seedling was too late for planting, because watering to seedling in the dry season was difficult,
- Only piglet were distributed, because chicks were not available for distribution in PPBC due to excess of orders in the season, and it would take more than three months from the time of order, and
- Animal sheds were prepared by the participants, because some farmers had pig shed constructed with local materials.

As a result, vegetable seeds and piglet were distributed to the participants through extension agents at the end of August 2002. Dzongkhags provided transportation of piglet from PPBC to the motor road near by the Gewog.

(3) Roles by Stakeholder

Roles of the Study Team, Dzongkhag (DAO and DAHO), Extension Agent in Gewog and beneficiaries (participants) were as follows:

Study Team

- Procurement of vegetable seeds and piglets, and
- Technical advice to EA on crop management, animal husbandry and EA's activities to farmers group

Dzongkhag

- Selection of locations to be implemented,
- Technical support to EAs, and
- Transportation of piglet from PPBC to the distribution point along motor road

Extension Agents

- Explanation to farmers on the trial implementation,
- Collection of applicants and selection of participants,
- Formation of farmers group for extension activities,
- Technical guidance to participants through group and to individual farmers, and
- Submission of monitoring report to the Study Team through DAO/DAHO

Participants

- Provision of required labor force, land and facility for the crop cultivation and animal husbandry, and input such as fertilizer, animal feed, and
- Getting technical guidance and extension service by EA

(4) Results

(a) Vegetable

Vegetables products of the distributed seeds had not been harvested as of middle of November 2002, because the growing period was less than three months. Most of the participants were with experience of vegetable cultivation such as potato, chili, radish, beans, mustard green, and pumpkin. However, some kinds of vegetable (lettuce, carrot) were not familiar to the farmers. EA provided technical guidance to the participants at the time of the distribution, nursery preparation as required. Extension agents submitted monitoring and

activity reports to the Study Team through DAO and DAHO. According to the reports, the following problems and constraints were clarified.

- Low germination rate of some vegetables, especially cabbage; it is supposed to be low quality seeds.
- Farmers tend to grow vegetables with higher density than instructed by EA, especially for transplanting.
- Due to excess rainfall in the planting / sowing season, germination and initial growing were not good.
- Crop damage by wild animal and cattle occurred frequently. However, the crop protection against animal damage is costly and not affordable.
- The vegetable farmers group was established in 2001 in Lhuntse Dzongkhag. The group sells the products to school dormitory and hospital staff. The profit for one year was only Nu. 1,700. The most serious problem is lack of market / consumers in the Gewog. The farmers group activities are well operated and managed.

(b) Pig

Fattening farmers and breeding farmers participated in this OJT. Around 80 % of the participants were with experience of pig rearing. Some (4 farmers and a farmers group) of them were breeder farmers of piglets. Sheds for the distributed piglet were constructed by the farmers using timber or used old pig shed. Piglet was distributed at three months old with 4 - 5 kg of weight. After two months they had grown to 7 - 10 kg. Feeding condition caused difference in growth. Main feeds for pig were maize, rice bran, low-grade cereals, leaves of crops and banana. It was reported that one piglet died in Serimuhang Gewog after one month of the distribution due to disease.

(5) Feedback to the Master Plan

The following lessons and feedback were obtained through the experimental implementation.

(a) Farmers intension to vegetable production and backyard animal husbandry

It was confirmed that farmers have high intension to promote vegetable production and backyard animal husbandry. According to EAs, many farmers requested for the distribution of vegetable seeds and piglet. Generally more than 50 % of farmers have experience of pig rearing. Most of them prefer fattening of pig to breeding because of the difficulty of mating under the condition of scattered houses and steep slopes. Breeder farmers have to rear more than two heads of pigs of both sex. Small farmers cannot provide sufficient feed to the pigs due to lack of feed. It is proposed that group of small farmers should operate pig breeding.

(b) Group activities

One farmers group participated in the OJT. The group with 20 members was established for vegetable production. Dzongkhag and EAs supported the group activity. The group activities were participated by all the members, and managed by the leaders such as the chairman, accountant and clerk.

(c) Capability of farmers in farming practices

Cultivation technology of vegetable was still low, especially for unfamiliar crops to the farmers. Knowledge and technology on nursery management, planting density, and crop management have not been disseminated to the farmers. It is necessary to disseminate improved farming technology intensively.

(d) Farm Budget, Production and Yield

As for farm budget, production and yield could not be clarified because of short-term implementation and low temperature condition in the dry season. Farmers generally use FYM for vegetables, but do not use chemical fertilizer. Backyard animal husbandry provides animal dung for preparation FYM mixing with leaf litter in the forest.

5.9.4 Small-scale Irrigation Support

(1) Objectives

Considering topographic conditions and scattered distribution of small farm lands in the Study Area, gravity irrigation system with fixed intake facilities is not always the best irrigation method. The gravity irrigation system often requires long feeder or headrace canal which should be constructed along the steep slope.

On the other hand, pump irrigation with small engine pump and flexible hose is often useful for the steep and small farm plots distributed on the slope. Therefore, in consideration of the Study Area's topographic conditions and problems derived from such conditions like irrigation canal blockage with debris by land slide, Small-scale Irrigation Support was executed to confirm the effectiveness of introduction of pump irrigation with small engine.

The small-scale irrigation support is an approach to provide farmers' group with portable pump and flexible hose for irrigating their plots in turn, the following issues were expected to be clarified through the OJT:

- Problems that might arise in the formation of the farmers' group,
- Problems that might arise in receiving and returning for the supporting services,
- Ability of farmers in using pumps,
- Actual using hours, required fuel, irrigated area,
- Other problems on the pump irrigation.

(2) Details of Pump and Location

The pump used was priming type, 2 inch each in diameter of suction and distribution with engine and weigh 12 kg. It is a portable pump that was framed in steel pipe to carry. And flexible suction pipe (7 m) and plastic distribution hose (100 m) were procured with the pump taking into account of theoretical suction head and the possibility of various water sources and irrigation coverage for the experimental implementation.

Three pump sets for Lhuentse and Mongar Dzongkhags were distributed in consideration of the water source and access for the experimental implementation as follows:

Pump	Location of Pump		Remarks
	Village, Gewog, Dzongkhag	Water Source	
JICA No.1	Kafu, Serimuhang, Mongar	Seri Chhu (middle scale)	Feeder road is reached nearby the site.
JICA No.2	Autsho, Tsenkhar, Lhuntse	Kuri Chhu (large scale)	Access to the site is not so far from District Road.
JICA No.3	Phawan, Tsenkhar, Lhuntse	Stream (small scale)	The site is nearby RNR Center of Tsenkhar.

(3) Roles of Stakeholder

Roles of the Study Team, Dzongkhag and Gewog were as follows:

Study Team

- Provision of budget and the procurement of pump sets and fittings
- Technical advice to the Dzongkhag engineer, EA and beneficiaries related to the Program for Food Crop Production Increase

Dzongkhag

- Supporting for the Program for Food Crop Production Increase,
- Arrangement of EA deployment,
- Supervision for the introduction of pump,
- Instruction of cropping and cultivation to beneficiaries

Gewog/Beneficiaries

- Coordination and arrangement of beneficiaries
- Formation of group

(4) Results

Since the Study was carried out in the rainy and farming season, the farmers and EAs related to the experimental implementation at the site could not spare enough time. In spite of such actual situation for the experimental implementation, the results were found as follows:

- Though the pump was priming type and fitted with a foot valve at the end of suction pipe, priming water to the pump was required.
- Suction heads must be kept as small as possible (less than 4.0m) in consideration of irrigated area, theoretical reason (air pressure) and the capacity of total heads for pump as the total heads is independent of pump.
- Tentative pump water users association was composed at the site of JICA No.3 by the instruction of Dzongkhag to beneficiaries.
- Sucking water by pump was possible from any scale of water source keeping the certain depth from surface of the water of the source and the suction pipe point.
- Since some of the staff of Dzongkhag and EAs knew how to use engine and pump, *introduction of pump for irrigation was done without difficulty.*

(5) Feedback to the Master Plan

The following lessons, feedback and application were obtained through the experimental implementation.

(a) Formation of Beneficiaries' Group

As aforementioned in (4) *Results*, pump water users association was tentatively composed to irrigate the certain farmer groups' farm land targeting cultivation of rice at the site of JICA No.3. According to the farmers in the group, they prefer to cultivated rice with the engine pump rather than maize.

At the site of JICA No.1, labor exchange was commonly executed to cope with labor shortage for farming. There was a piece of land available for farm land development nearby the Seri Chhu River. If water for irrigation is available for this land, the farmers around the site want to try to plant certain tree crops and vegetables even initially composing farmers' group.

Thus it was thought that composing farmers' group is not so difficult in practice, if water for irrigation can be exactly secured in the Study Area.

(b) Capability of Beneficiaries in Using Pump

Beneficiaries are accustomed to use engine through the experience of using farming machinery like thresher and milling machine. Pump itself is only the machine to suck water to revolve impeller in the pump and not so complicated in its structure. Accordingly, it is considered possible to use a pump with engine even by beneficiaries themselves after instruction of EAs or Dzongkhag engineer.

(c) Pump Application and Pump Selection

This is major problem that irrigation canal blockage is caused by debris of land slide which is very frequent under the topographic and geological conditions in the Study Area. For this, a portable pump with engine would be installed in the canal just before its blockage by land slide, then distribution hose would be connected over the stretch of land slide to the canal to be able to use water. This is also one of the applications of portable pump with engine.

The application of pump using power source delivering from power tiller by means of connecting belt between flywheel of power tiller and pump was also studied in DRDS, MOA. It is very effective to obtain irrigation water directly from various visible source of water. It should be noted that evaluation of capacity of pump's total head should be duly undertaken in consideration of the physical conditions in the Study Area.