CHAPTER 4 ANALYSIS OF PRESENT CONSTRAINTS AND AGRICULTURAL DEVELOPMENT POTENTIAL

4.1. Agricultural Production

4.1.1. Scale of Cultivation Area and Farming System

Mozambican agriculture is characterized by small-scale farming. It is generally considered that the major reason of the small-scale farming in the country is lack of manpower and/or means of cultivation, with understanding that Mozambique is blessed with a vast arable land that is not in use now. This perception is also shared by most farmers in the Study Area. Table 2.3.2, however, implies that population pressure might be a latent reason of the small-scale farming at present. The average farming size of Nampula and Zambezia provinces, where are the most population dense area in the country, is significantly smaller than the national average, while the size of Niassa province, where is less population dense area, is much bigger than the national average.

Because of extensive farming with shifting cultivation, farmers in the Study Area must need a land area bigger than the actual cultivated area in order to continue their farming on sustainable basis. According to the field survey result, many farmers in the area shift their farmland every 3 to 5 years, when they feel that soil fertility of the cultivated land is getting poor. If they save enough time of fallowing for 10 to 15 years in order to recover the soil fertility of the abandoned land, they theoretically need reserved fallow land 2 to 5 times bigger than the actual cultivated area in addition to the existing farmland. It means that there must be vast area of reserved fallow land used for the rotation of shifting cultivation in addition to the actual farmland in use now.

Considering the present population density in the Study Area as shown in Table 3.1.7, substantial number of farmers in the area may face difficulty to continue the extensive farming practice on sustainable basis.

A book reporting slash and burning cum shifting cultivation practices in various Asian countries, that is "*Inasaku Izen*" (Farming Practices in Japan before Rice Farming Came), Sasaki Komei, NHK Books, 1971, estimates that the extensive practices, in any case, can feed only maximum 40 person/km^2 even counting supplementary foods from other activities such as hunting and collection. Table 3.1.7 shows that a population density in many districts, as well as the average in the Study Area, exceeds 40 person/km^2.

It is interesting that fire occurrence in Figure 3.3.1 in high population dense districts in the eastern part of Nampula district is less than the other districts. On the contrary, the fire occurrence is still high in Alto-Molocue and Gurue districts in Zambezia Province even though they have high population density. It is assumed that farmers in the eastern Nampula Province have already shifted to settled-farming because of high population pressure and probably existence of many commercial farms for producing cotton, banana, etc., while farmers in the two districts in Zambezia Province still continue the extensive farming practice by deteriorating their sustainable farming bases.

In some area in the Study Area, population pressure on land has started to appear, and it causes land conflicts between people, especially in the area where is fertile and easy to access from main roads. Farmers in the area are at a crucial point to change their familiar farming practice for surviving. Even though most of the farmers don't recognize the present situation well, their existing farming practice may trigger a serious environmental destruction as we have experienced in the other part of the world. They should understand that there is no remained vast land for farming in the Study Area, if they continue the present extensive farming practice.

Considering the present situation mentioned above and future prospects, the farmers should transform their present extensive farming practice with every possible support of the government. They can expect the following benefit after they shift to settled-farming.

1) To increase crop productivity through intensive farming practices
2) To expand actual farmland area by reclaiming the reserved fallow land
3) To conserve environment condition in order to protect their farming bases

4.1.2. Cropping Technology

Subsistence farmers are dominant in the Study Area. Most of small-scale farmers produce crops only for consumption, and are characterized by low yields and modest returns. Those who manage around 1 to 2 ha or less generally concentrate on their staples, such as maize, cassava, sorghum, groundnut, and several kinds of beans. These crops are usually grown mixed together in the same field. Farmers, who cultivate more than certain acreage, around 5 ha, grow diversified crops in addition to the staples. They are sometimes out growers of cotton and tobacco in the Study Area, and usually grow vegetables and other cash crops in settled farmland where is accessible to a water source for irrigation. However, farmers who cultivate more than 5 ha of farmland are only less than 6 % of the total farm-households in Mozambique (Agriculture Census in 2009-2010, INE).

One of the main problems of agriculture in the Mozambique is low productivity. Table 4.1.1 shows a productivity (ton/ha) of crops, which are popular in the Study Area, in Mozambique and in relatively advanced countries such as, Brazil, South Africa and Kenya. The table implies that Mozambique still has very big room for improvement of the productivity of many crops.

Table 4.1.1 Productivity of Crops in Mozambique and Some Countries in 2010

Crops	Productivity (ton/ha)			
	Mozambique	Brazil	S. Africa	Kenya
Maize	1.2	**4.4**	4.7	1.6
Cassava	6.0	**13.7**	NA	5.3
Sorghum	0.6	**2.3**	**2.3**	0.7
Millet	0.5	NA	0.5	0.5
Paddy, rice	1.0	**4.2**	2.6	4.0
Wheat	1.0	2.8	2.6	**3.2**
Groundnuts, with shell	0.2	**2.7**	1.5	1.0
Beans	NA	0.9	1.2	0.6
Cowpea	NA	NA	0.6	0.4
Pigeon pea	NA	NA	NA	0.7
Soybean	NA	2.9	1.8	0.9
Sweet potato	7.1	**11.2**	3.3	9.1
Potato	13.8	25.3	**33.3**	2.9
Sesame seed	0.7	0.6	NA	0.5
Sunflower seed	0.5	1.1	**1.2**	1.0
Vegetables	4.2	**11.9**	11.6	9.5
Cashew nuts, with shell	0.9	0.1	NA	0.3
Bananas	7.0	14.3	**49.5**	19.0
Sugar cane	13.0	79.2	60.0	**83.1**
Seed cotton	0.5	**3.6**	3.5	0.7
Tobacco	1.5	1.7	**2.8**	0.6

Source: FAOSTAT

This is due to combined factors including the extensive farming practices and the low use of inputs. Majority of farmers in the Study Area except for the eastern part, still much depend their farming on slush and burning cum shifting cultivation. They usually shift their cultivated land every 3 to 5 years in order to find a new fertile land. Fundamental cause of the low use inputs must be the extensive farming practices prevailing in the Study Area. As long as continuing slash and burning cum shifting cultivation, farmers don't need such inputs. They also use only simple hand tools, such as hoe, machete and ax which are typical tools for slash and burning farming. In view of soil and water conservation, scratching the soil surface only with such simple tools is a common land preparation practice in everywhere the farming prevails.

Considering the present uncertain rainfall condition and unclear rights to farmland, it is very reasonable that farmers choose a steady farming strategy of low-inputs and low-return but stable production by shifting cultivation. In the strategy, increased crop production shall be obtained through expanding cultivated land with every available

labor force, with the perception that there is still a vast land for shifting cultivation surrounding them. Therefore, introduction of intensive farming aiming at improving crop productivity will be realistic to farmers, only after transforming their shifting cultivation to settled one, through understanding on-going situation that the land is going to be saturated with increasing population and they are losing a base to continue shifting cultivation on sustainable basis in the Study Area.

4.1.3. Promising Crops

Promising crops in the Study Area were examined from a view point of supply (production) side. In prior to the examination, 24 crops were selected based on the Minutes of Meeting on Triangular Cooperation for Agricultural Development of the Tropical Savannah in Mozambique on September 17, 2009 and familiarity of crops in the Study are. Then, scoring of the corps was made by the 6 criteria as described below.

<Scoring Criteria>

(1) Government's Key Policy

PEDSA stated priority smallholder commodities in the context of the corridor approach and also apply to IIAM and its zonal research centers. The IIAM CZnd in Nampula and the IIAM CZnw) in Lichinga, covering the Study Area respectively, also stated research priority crops in their 5 years (2011 to 2015) activity plans. The priority crops sated by PEDSA and by the IIAM zonal research centers are subtly different each other, while many of the crops are overlapped. The Study team, therefore, classified the 24 crops into 3-grades, i.e. high-priority, priority and non-priority, by integrating the priority crops of PAEDSA and the IIAM zonal research centers.

(2) Value Chain Overview

CEPAGRI is determining the most suitable farm-products value chains for investment under PNISA (the National Agricultural Sector Investment Plan). CEPAGRI's working team will filter the products through 3 sets of criteria to determine which prioritize for future action planning. While the filtering work is still in progress, 9 value chains have selected after 2 steps of filtering at present. The 24 crops were classified into 3 groups by the following criteria.

- High prospect: Included in the second filtered value chains
- Fair prospect: Included in the second filtered value chains
- Low prospect: Not included in above value chains

(3) Popularity in the Study Area

Based on crop production data in the Study Area provided from respective concerned DPAs, an average annual planted area from 2006 to 2011 are calculated for each of 24 crops. The 24 crops were classified into 3 groups by the planted area as follows.

- Very popular: > 50,000 ha
- Popular: 10,000 – 50,000 ha
- Unpopular: < 10,000 ha

(4) Present productivity (in 2010)

Based on the productivity (ton/ha) data in FAOSTAT, the 24 crops were classified into 3 groups as follows. The missing data for several crops were estimated by the Study team in light of the present productivity in the Study Area.

- High: > 5 ton/ha
- Fair: 2 – 5 ton/ha
- Low: < 2 ton/ha

(5) Future productivity (in 2030)

With an assumption of the Study team that the present productivity in relatively advanced countries may represent the productivity of Mozambique in 2030, the FAOSTAT data in 2010 for Brazil, South Africa and Kenya were analyzed. The highest productivity among the 3 countries for each crop was considered as the future productivity in Mozambique. The 24 crops were classified into 3 groups by the same manner of the present productivity (in 2010).

(6) Farmgate price

Based on the collected information as shown in Table 3.3.8, The 24 crops were classified into 3 groups as follows.

- High: > 10 MT/kg
- Fair: 5–10 MT/kg
- Low: < 5 MT/kg

Table 4.1.2 shows the scoring result.

The result in the table shows that nine (9) crops have got more than 9 points (3 points x more than 3 criteria). The nine crops are; Maize, Cassava, Ground nut, Soybean, Potato, Vegetables, Cashew nut, Banana and Cotton. It is considered that these crops would be promising crops in the Study Area from the view point of production (supply) side. The final prioritizing of crops, however, shall be made in the next stage of the Study by a comprehensive examination from every possible aspect including the aspects in terms of market potential, country competitiveness and social impact.

Table 4.1.2 Scoring of Crops

Crops	IIAM/PEDSA Priority in Study Area	PNISA's Focusing	Popularity in the Study Area	Productivity (ton/ha)		Farmgate Price	**Total Score**	Crops in Minutes of Meeting
				Present (in 2010)	Future (in 2030)			
Maize	3	3	3	0	1	0	**10**	**Yes**
Cassava (dry)	3	3	3	1	1	0	**11**	**Yes**
Sorghum	1	0	3	0	1	1	6	No
Millet	1	0	0	0	0	3	4	No
Paddy (Rice)	1	3	1	0	1	0	6	**Yes**
Wheat	3	0	0	0	1	0	4	**Yes**
Ground nut (with shell)	3	1	3	0	1	1	**9**	No
Haricot beans	3	0	1	0	0	3	7	No
Cowpea	3	0	1	0	0	1	5	No
Mungbean	3	0	0	0	0	3	6	No
Pigeon pea	1	0	0	0	0	3	4	No
Soybean	3	3	0	0	1	3	**10**	**Yes**
Sweet potato	1	0	0	3	3	0	7	No
Potato	3	0	0	3	3	1	**10**	No
Vegetables	1	3	0	1	3	3	**11**	**Yes**
Sesame	1	3	1	0	0	3	8	No
Sunflower	0	0	0	0	0	1	1	No
Cashew-nut	3	3	1	0	0	3	**10**	**Yes**
Banana	0	3	1	3	3	1	**11**	**Yes**
Sugarcane	0	1	0	3	3	0	7	**Yes**
Castor oil seed	0	0	0	0	0	3	3	**Yes**
Jatropha	0	0	0	0	1	3	4	**Yes**
Cotton (before ginnig)	3	1	1	0	1	3	**9**	**Yes**
Tobacco	3	0	0	0	1	3	7	**Yes**

Legend: High/Good: 3 points
Fair: 1 point
Low/Bad: 0 point

Source: The JICA study team

4.1.4. Balance Sheets of Crop Production

Cost-benefit calculation was made for 5 (five) of the nine (9) promising crops based on the available data in DPA of Nampula province and collected information by the Study team. Since data collection for some crops are still in progress at present, the calculation was made only for the five crops, i.e. maize, cassava, ground nut, soybean and cotton. The Study team is continuing the calculation for the remained crops.

The calculation was made for 2 cases, namely the present case and the improved case, for comparison. In the present case except for cotton, any inputs application except for seeds was ignored from the costs calculation in accordance with the actual farming practice in the Study Area. For the seeds, only 1/5 of the amount in the improved case was calculated, since farmers should bear a certain cost for seeds even though they are not using improved seeds. For cotton, the Study team referred corrected information from IAM Nampula. And the totals sales were calculated based

on the productivity (ton/ha) of Mozambique in 2010 in FAOSTAT (see Table 4.1.3 and present average market price in Table 3.3.8).

In the improved case, costs were calculated based on a DPA's recommendation except for soybean and cotton. The total sales were calculated as the same way to the present case, though the productivity were calculated based on the highest productivity of corresponding crops in Table 4.1.3. For soybean and cotton, the Study team referred a presentation material of TechnoServe "Soy Balance Campaign 2011/12" and the IAM's data, respectively, for the calculation of costs and sales.

Table 4.1.3 Balance Sheet of Promising Crops

Crop	Farming Practices	Production Costs (MT/ha)							Sales (MT/ha)	Balance (MT/ha)
		Labor	Tractor	Seeds	Fertilizers	Pesticides	Others	S-total		
Maize	Present (1.2 t/ha)	2,360	0	175	0	0	0	2,535	5,040	2,505
	Improved (4.5 t/ha)	2,280	2,000	875	13,100	26	0	18,281	18,900	619
Cassava (dry)	Present (1.8 t/ha)	2,040	0	500	0	0	0	2,540	4,320	1,780
	Improved (4.11 t/ha)	1,520	1,500	2,500	0	249	0	5,769	9,864	4,095
Ground nut (with shell)	Present (0.2 t/ha)	2,120	0	520	0	0	0	2,640	1,180	-1,460
	Improved (2.7 t/ha)	1,760	1,500	2,600	4,800	1,356	0	12,016	15,930	3,914
Soybean	Present (0.75 t/ha)	3,520	0	300	0	0	0	3,820	9,075	5,255
	Improved (1.5 t/ha)	3,000	2,000	1,500	0	250	300	7,050	18,150	11,100
Cotton	Present (0.5 t/ha)	4,660	0	188	0	340	1,775	6,963	7,500	537
	Improved (1.5 t/ha)	3,040	3,500	188	1,000	425	3,857	12,010	22,500	10,490

Source: The JICA study team

Table 4.1.3 implies that farmers in Mozambique cannot expect an increase of net profit for maize, even if they could increase the productivity with improved farming practices. Increased production costs, mainly caused by the fertilizers, offset against the gross profit. While other crops show an increased net profit in accordance with the increased production after transforming to the improved practices, fertilizers costs of those crops are nil or relatively low. It is also interesting that mechanized cultivation (tractor) costs exceed the manual labor costs for all crops according to the table. It is assumed that high inputs costs, especially the fertilizers costs, may impede farmers in the country to enjoy a due profit from the improved farming.

4.1.5. Animal Husbandry and Inland Fisheries

Animal husbandry is not popular in the Study Area in general. Chickens are main and only appealing animal products in the area, while goats and sheep are raised to some extent by small- and medium-scale farm-households. Chicken production has

been growing in the area in accordance with a steady increased demand in the domestic market. The area has a high potential to develop chicken industry, since the production of maize and soybean, which are major materials of chicken feed, is popular and expanding among local farmers. The demand for chicken meat is expected to more than triple, in parallel with urbanization and income growth in the country, according to a CEPAGRI's workshop material "Stimulating Private-Sector Agribusiness Investment in Mozambique" on July 16, 2012.

It is generally understood that the Northern Region, where most Study Area are included in, has relatively few cattle, mainly due to high prevalence of tse-tse and tripanosomiasis (PEDSA 2011-19, MINAG). Though cattle are being introduced through development programs in some areas in Nampula province where are less affected by tse-tse, it is assumed that cattle breeding will not be a major part of animal husbandry in the near future in the Study Area. Pigs are also seriously affected by regular outbreaks of African Swine Fever according to the PEDSA 2011-19.

There is limited information about inland fisheries in the Study Area. According to the DPA of Nampula province, there are 400 households who were participating inland fish cultivation in the province in 2008. While the JICA study team visited several number of ponds developed for inland fish cultivation through PROAGRI in the area, almost all fishery ponds were not used for fish cultivation due to the following reasons. Consequently, some of the ponds are used for irrigation ponds, while the others are abandoned.

1) No continuous supply of juvenile fish
2) Unstable water supply to fishery ponds

Since inland fish cultivation is a new industry in the Study Area, it is difficult to establish the fisheries as a solid income generation source in the area without developing a comprehensive supporting structure, consisted of hatchery, supply of juvenile fish and necessary inputs, technical extension, as well as marketing.

4.1.6. Land Holding System

Land holding system is a highlighted issue for promoting agricultural development in Mozambique. Land issues are not only issues of investors who need to acquire the DUAT (right to use and exploit land) for broad area, but also issues of emerging individual farmers who want to transform their farming to be more intensive one.

As indicated in many concerned materials to land issues in Mozambique, majority of farmers cannot reach a bank loan. Agricultural land is out of the picture of collateral

under the present legal system. The Mozambican Land Law of 1997 confirms that land is state property as stated in the Constitution.

Background of the land issues is complicated, since the Land Law is not harmonized well with actual land managing system prevailing in most rural communities. In fact, land in community areas are managed by traditional leaders according to customary rules. The responsibility for the use, exploitation and distribution of land belongs to the leaders, though they don't have a property right on the land. There is, however, no reference in the Land Law to the traditional leadership system, while the low only mentions that DUAT is something private, an actual right belonging to communities and their members.

The inharmoniousness has sometimes caused serious conflicts between investors and concerned community people when a large-scale agricultural or forest development project is put into operation. Many investors actually get confusion about acquiring the DUAT. The investors usually respect the traditional leaders, with understanding that they represent the target community regarding land management subject, when the investors make negotiation about the DUAT acquisition. According to the principle in the Land Low, investors should deal with local communities in return for using land in respect to the customary occupation. However, an agreement with the leaders to allocate a certain area for a project is not legally valid if the community is in question, because the Land Law doesn't recognize the traditional leadership system. Some of the leaders actually don't enjoy confidence from community members due to their behavior against the interests of the members or power conflicts in and between the communities. Under such situation, suspicion against the investors easily prevails in the community.

Furthermore, customary acquired land rights, which are usually farmers' greatest support to confirm their land rights in public, do not have to be registered by law. The registration is generally far from farmers' reach due to high costs and complicated formalities. Farmers feel that they are in an insecure position on land holding (actually land use), especially for securing fallow land reserved for the rotation under shifting cultivation system. This could be a reason of excessive self-defense reaction of rural people against investors who are looking for the DUAT in or surrounding their community.

In order to address the land issues, the government should have a system that farmers' land shall be registered by law after farmers shift to settled-farming, by paying a respectful attention to the traditional leadership system. This also might be a good incentive for farmers to cease their shifting cultivation.

4.2. Farm Supporting Services

4.2.1. Agricultural Technology Extension

Agricultural extension in Mozambique was historically focused on commercial and export cash crops, such as cotton, tobacco and sugarcane, mainly financed by the corresponding crop sectors before independence. Even after independence, priority was given on such crops, since these crops were mainly produced by government owned state or cooperative farms under socialism policy. In 1987 when the country's economic system was liberalized, the public extension system was established in accordance with a paradigm shift towards enhancement of private sector agriculture dominated by small-scale farmers.

Since 2008, the government has already launched a comprehensive agricultural extension project covering the all country, PRONEA, as a operational program of the Agricultural Extension Master Plan (2007 to 2016). PRONEA aims at attaining increased returns and improved household food security of subsistence farmers through a steady uplift in production efficiency. This will be achieved through the following main three concepts.

1) To provide wider access to effective technical support services focused on districts
2) To organize better producer groups influencing supply of services
3) To enhance delivery of support services in response to requests.

A role of agricultural extension envisaged in PRONEA is not only just assisting subsistence farmers in technology transfer, but also facilitating agricultural innovation through stimulation interactive learning between all actors in agribusiness or in agricultural value chain, such as farmer communities, public and private extension workers, NGOs, service providers, agro-industry, etc.

The PRONEA approach which represents SISNE must be reasonable, considering a weak public extension system in most parts of the country, and the history of the extension service. The extension policy, however, should pay more serious attention to a root cause which impedes farmers to transform their farming practice to be more intensive one as expected in PRONEA.

As mentioned above, farmers in the Study Area cannot only improve their productivity, but also expand their cultivated area, as long as they stick with their familiar farming practice, slash and burning cum shifting cultivation. Unless farmers in the country transform their farming practice, all attempts of PRONEA would not be able to attain their expected goals. Even though it is a big challenge, agriculture extension services should cut into the core issue.

4.2.2. Agricultural Inputs Supply

Less demand from farmers is a critical problem for running agricultural inputs supply business according to all dealers and shop owners interviewed by the Study team. Small sales and high handling costs due to the small market cause high retail price of the inputs. This again causes the low demand from farmers. Another problem is access to a bank loan. Banks in the country take a conservative stance on a credit targeting small- and medium-scale agricultural enterprises, according to the dealers and shop owners. Even if they could access to the credit, high interest rates commonly exceed 25 % is a real difficult challenge for them in many cases.

A structural problem of agricultural inputs business in the country is that a limited number of companies dominate the market as shown in sub-chapter 3.5.4. This might be caused by the small market in the country. Less competition among the companies arose from the structure may lead high-cost characteristics of the value chain. Furthermore, the government still keeps a significant influence on the market, especially on the market of seeds and tractors, through its shareholding of agribusiness companies or development programs. The government intervention should be modest, and much focus on enhancing private sector including small- and medium-scale enterprises rather than increasing a government role in the value chain.

In order to vitalize the agricultural inputs market, the following measures shall be considered by the government.

1) To transform the existing farming practice to be more intensive, so that farmers will start to use more agricultural inputs
2) To establish a favorable financial system targeting farmers, as well as small- and medium-scale agribusiness enterprises
3) To provide subsidies or tax incentives to a strategic inputs, maybe chemical fertilizers, with a definite conditions to prevent a dependency culture among farmers and the enterprises

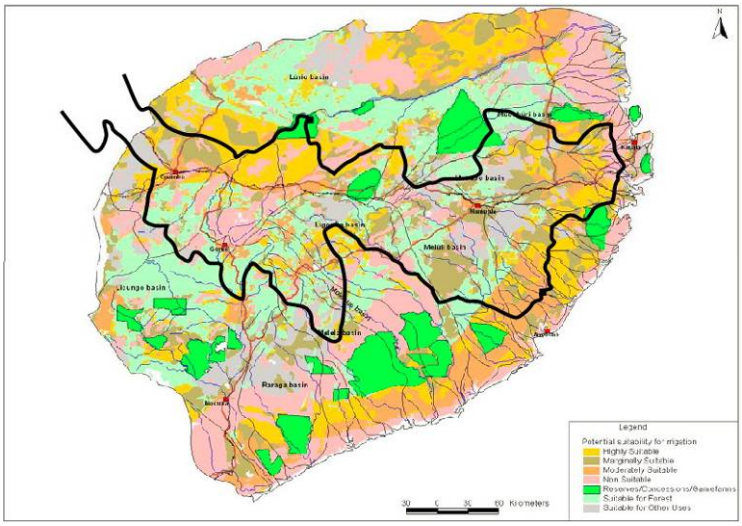
4.2.3. Agricultural Loan and Credit

Financing to individual farmers and agribusiness industries is another critical issue for the development of agriculture in Mozambique, as examined above. However, there is no practical financing system targeting them at present. The existing system cannot deal with the potential demand for finance for the agricultural sector. The government should pay serious attention on this matter. The Study team recommends a hypothetic countermeasure to address the issue in sub-chapter 4.7.

4.3. Irrigation and Drainage

4.3.1. Land Suitability for Irrigation Development

The land suitability for irrigation development is physically evaluated based on the identification of those areas, which are sufficiently productive under irrigation development, considering with the constraints imposed by soils, climate and other land characteristics with the crop eco-physiological requirements. In the study done by ARA-CN[1], the land is classified in the suitability for irrigation development into four classes, i.e., Class 1 refer to high potential for irrigation development, Class 2 to moderate conditions where some limitations are present but areas could be developed with improvement and mitigation of such constraints, Class 3 to low potential, generally not irrigable although some areas could be developed where hazards are not too severe, and Class 4 consider land with no potential, where soil, topographic and drainage deficiencies are too severe to justify development. As for the Study Area within the jurisdiction of ARA-CN, which excludes districts of Niassa except for Cuamba, Class 1 (high potential) and Class 2 (moderate suitable) areas were estimated 824,750 ha and 594,550 ha, which occupy 27% of total land. Those areas are considered the ones possible to develop irrigation area under the condition of land and water resources are available and irrigation farming is economically feasible. The area highly or moderately suitable for irrigation is distributed to overall of the Study Area, while Malema has the largest potential and Monapo is next to that.



Source: Present Status Report of Study for the establishment of ARA-CN (2006)

Figure 4.3.1 Suitable Land for Irrigated Crop Production in the ARA-CN Area

[1] Present Status Report of Study for the establishment of ARA Centro-Norte, 2006, DNA.

Table 4.3.1 Suitability Classification for Irrigated Crop Production

District	Class 1 High (ha)	Class 2 Moderate (ha)	Subtotal of Class 1 & 2 (ha)	Class 3 Low (ha)	Class 4 Not Suitable (ha)	Others (ha)	Total (ha)
Monapo	129,300	107,375	236,675	76,975	3,775	33,825	351,250
Muecate	59,175	20,375	79,550	83,575	26,075	219,950	409,150
Meconta	44,350	35,225	79,575	99,700	12,350	175,800	367,425
Mogovolas	28,700	79,900	108,600	196,975	24,176	140,825	470,576
Nampula	3,675	21,900	25,575	133,425	76,100	160,000	395,100
Murrupula	1,425	8,525	9,950	57,975	58,150	182,025	308,100
Ribaue	93,925	33,825	127,750	113,500	72,475	309,200	509,425
Malema	276,300	85,675	361,975	27,375	135,275	80,250	604,875
Alto Molocue	67,600	76,900	144,500	59,250	68,250	356,125	628,125
Gurue	23,550	55,925	79,475	21,975	212,800	245,575	559,825
Cuamba	96,750	68,925	165,675	135,650	52,625	171,375	525,325
Mandimba	not included in assessment						
Ngauma							
Lichinga							
TOTAL	824,750 15.7%	594,550 11.3%	1,419,300 27.1%	1,006,375 19.2%	742,051 14.1%	2,077,600 39.6%	5,245,326 100.0%

Source: Present Status Report of Study for the establishment of ARA-CN (2006),

4.3.2. Available Water Resources

(1) Potential of Surface Water Resources of the Study Area

Due to malfunctioning and abandon of the hydraulic observation network after 1990's, the river discharge data has a serous limitation to assess hydraulic situation in the Study Area. However, even though it is estimated by the limited available data and it causes inaccuracy of the estimation, it is still worth to estimate the runoff to understand the situation and potential of water resources. In the Study, the mean annual runoff in the each district was estimated as shown in Table 4.3.2 and Figure 4.9.17 by the runoff of major river basins estimated by ARAs. The mean annual runoff in the Study Area is estimated 8,800 million m^3/year for districts of Nampula Province, 5,700 million m^3/year for districts of Zambezia Province and 5,700 million m^3/year for districts of Niassa Province, where that total of the Study Area is approximately 20,000 million m^3/year. By overviewing the runoff of districts, smaller runoff both in specific and amount is observed in the district in the eastern part such as Monapo, Muecate and Meconta, and higher runoff is observed in the eastern part such as Ribaue, Malema and districts of Zambezia and Niassa.

Table 4.3.2 Estimated Mean Annual Runoff of Study Area by District

District	Average Runoff (mm/year)	Area (km^2)	Mean Annual Runoff (million m^3)
1. Nampula Province			
1) Monapo	111	3,514	391
2) Muecate	101	4,103	413
3) Meconta	175	3,675	643
4) Mogovolas	256	4,707	1,205
5) Nampula	215	3,989	859
6) Murrupula	256	3,091	790
7) Ribaue	330	6,245	2,062
8) Malema	395	6,053	2,393
Sub-total	248	35,376	8,757

District	Average Runoff (mm/year)	Area (km^2)	Mean Annual Runoff (million m^3)
2. Zambezia Province			
1) Alto Molocue	322	6,338	2,040
2) Gurue	648	5,646	3,657
Sub-total	475	11,984	5,698
3. Niassa Province			
1) Cuamba	400	5,353	2,143
2) Mandimba	265	4,712	1,246
3) Ngauma	262	3,001	786
4) Lichinga	262	5,657	1,482
Sub-total	302	18,724	5,658
Total of Study Area	304	66,084	20,113

Source: Study Team compiled data of ARA-CN, ARA-N
Note: The runoff data at the station of the lowest reach of each basin shown in Table 3.1.3were applied expect for Lucinga basin (E90 near Gurue city was adapted instead of E91.), Melela basin (E192 near Alto Molocue town was adapted instead of E99.) and Lurio basin (Average of E142 of Malema river, E133 of Mepuipui river and E128 of Lurio river was adapted.) due to the location of the Study Area.

(2) Global Water Balance

The potentials of surface water of the whole jurisdiction areas of ARA-CN and ARAN are estimated to be approximately 25,000 million m^3/year and 24,400 million m^3/year, while the water demands are 405 ~560 million m^3/year and 160 million m^3/year for ARA-CN and ARA-N representatively, as shown in Table 4.3.3. Those regions have a large potential for water developments and the available volume is quite large and farm from estimated water demand, even if 30% of the runoff is reserved for ecological flows and conservation purposes. The situation of the Study Area is same with those analyses.

Table 4.3.3 Estimated Mean Annual Runoff and Water Demand in the Basin

Organization	ARA-CN	ARA-N
Basin	Lurio and other basins	Rovuma basin
Area of basin	188,000 km^2	
Estimated mean annual runoff	25,000 million m^3/year	24,400 million m^3/year
Estimated water demand	405~560 million m^3/year	160 million m^3/year
Urban water supply	23 million m^3/year	9.2 million m^3/year
Small pipes or peri-urban supply	5 million m^3/year	14.2 million m^3/year
Rural water supply	67 million m^3/year	16 million m^3/year
Irrigation	310~465 million m^3/year (assumed 31,000 ha)	120 million m^3/year (assumed 8,000 ha)

Source: Study for the establishment of ARA Centro-Norte, 2006, DNA, Study for the Establishment of ARA- North, 2006, DNA
Note: The runoff is estimated only for major basins and small basins, which occupy approximately 30% of territory, is not considered.

(3) Time Distribution of River Water

Even though, mean annual runoff of the basin is far larger than the expected demand, it is to be considered that there is a time distribution of river flows, both along the year and from year to year. In the Study Area, the river flow is concentrated from January to April, of which period occupies more than 70 % of annual runoff in average. 4 rivers discharge almost 90 % of annual runoff and the remaining discharge almost 80% until April, while the region has an abundant annual runoff, As shown in Table

4.3.4 and Figure 4.3.2. Even though the amount of water will not be a constraint environment, the intake and storage facility, which is necessary to cope with the uneven water distribution in time, would be constraints of development. That is to say the potential of water can be utilized is limited by the capacity of water storage.

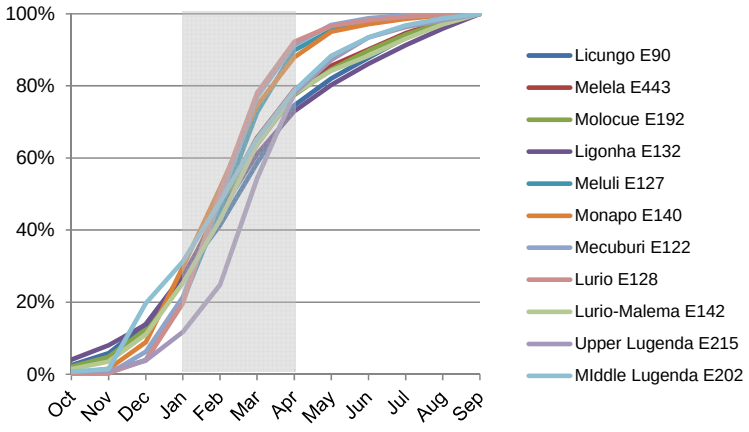


Figure 4.3.2 Accumulate Discharge of Major Rivers in Percentage

Table 4.3.4 Mean Monthly Discharge of Basins

(Unit: million m^3)

Basin	Station	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Annual
Licungo	E90	3.7	4.9	11.9	19.9	20.3	25.3	23.4	10.9	8.6	8.1	5.8	3.9	147
Melela	E443	8.0	11.5	34.2	66.8	92.4	86.1	60.2	30.3	20.5	20.5	15.1	9.7	455
Molocue	E192	3.2	4.3	11.7	22.1	27.7	29.5	21.3	11.0	8.0	6.9	5.2	3.7	155
Ligonha	E132	60.3	59.6	85.4	202.3	261.2	239.5	177.6	107.7	87.8	77.2	68.4	61.3	1,488
Meluli	E127	0.3	6.4	46.5	219.5	336.4	357.2	228.6	73.5	38.5	15.0	6.8	1.5	1,330
Monapo	E140	1.9	9.6	55.7	156.7	165.3	172.9	100.0	53.6	15.7	11.3	7.0	3.5	753
Mecuburi	E122	0.1	0.1	6.9	17.2	30.5	32.7	16.4	6.3	2.1	1.0	0.3	0.1	114
Lurio	E128	13.3	18.0	289.1	1,282	2,493	2,242	1,156	356.2	130.4	78.4	45.6	23.5	8,127
Lurio-Malema	E142	11.4	16.1	57.5	109.3	135.1	161.6	107.4	48.7	32.2	36.3	30.1	23.0	769
Upper Lugenda	E215	27.0	13.6	107.2	307.2	505.1	1,135	916.7	357.8	242.2	111.7	71.7	69.7	3,865

Source: ARA-CN, ARA-N

(4) Potential of Water Storage

Because the usable water potential is mainly limited by the storage capacity instead of runoff of basins as discussed above, the present capacity of water storage was tried to evaluate in the Study. The major water storage facilities in the Study Area expect for irrigation systems are summarized as shown in Table 4.3.5.

Table 4.3.5 Major Storage Dam Structure in the Study Area

Name of dam	River name	District	Height (m)	Capacity (million m^3)	Main use
Nampula	Monapo	Nampula	17.5	4.3	Urban Water Supply
Cuamba	Mepopole	Cuamba	22.0	2.6	Power*
Locomue	Lucheringo	Lichinga	17.5	1.9	Urban Water Supply

*: not in use for power generation

Besides above major dams, the area many hydraulic structures for taking and storing water. Most of structures are small scale ones and the majority are for irrigation systems. At present, it is impossible to accumulate the total amount of storage of those facilities due to lack of information. However, it can be cursorily estimated

based on the equipped irrigation area and the assumption of water demand of irrigation field. With assumption of overall irrigation water demand of 10,000 m^3/ha/year, the storage capacity in the Study Area is estimated 67 million m^3 from the equipped irrigation area of 6,746 ha which is shown in Table 3.4.1 and Figure 4.9.18. Because some of irrigation systems take water by pump or gravity canal without storage facility as well as reduction of capacity by malfunctioning, this estimation is considered as maximum. Among the estimated potential of water storage of existing irrigation systems, only 45 % is in use due the condition of facility.

The total storage capacity in the Study Area is assumed to be 76 million m^3 in maximum. This value is significantly far from the potential water resources of the Study Area, which is estimated 20,000 million m^3. It can be said that the water resources in the Study Area is kept intact at present.

(5) Expected Problem in Water Management

Even though the Study Area has abundant water resources in general, a concentration of development is observed in some river basins such as Monapo River in Nampula Province. The mean annual runoff of the Basin is estimated to be 975 million m^3/year from 7,734 km^2 of catchment area. On the other hand, the water concessions are given to urban water supply by FIPAG-Nampula and large scale irrigation farms in total 57 million m^3/year. FIPAG is planning the increases of the capacity of Nampula Dam, which is the source of urban water supply. As for water demand of rural water supply, it is estimated to be 4.5 million m^3/year with assumption of 407,000 of population[2] and 30 L/day/person. Even it is difficult to estimate accurately the water demand of small scale irrigation due to lack of data, it can be assumed that horticulture crops are cultivated with full irrigation by small irrigation, which occupies 590 ha in the Monapo Basin[3] in 2010/11. With the assumption of overall irrigation water demand as 10,000 m^3/ha/year, the water demand for small scale irrigation is estimated to be 6 million m^3/year. Furthermore, there are approximately 5,400 ha of paddy cultivation using swamp area and they are considered as potential demand of water in the Basin.

Considering the demand increase of urban and rural water supply by population growth, of small horticulture irrigation along the river, of industrial development, there is concern that the balance of water resources and water demand would become seriously tight in future. Thus, it is required to establish the appropriate management of water resources and the water allocation plan in such basins.

[2] The population 2011 of the Basin is estimated by combining the district population shown in Table 3.1.7 and the areal proportion of basins.

[3] The horticulture and paddy area of the Basin is estimated by combining the cultivation area by district shown in Table 3.3.5 and the areal proportion of basins.

4.3.3. Assessment of Rain-fed Crop Cultivation

The condition of rain-fed crop cultivation is assessed from the aspect of water deficit of crop in selected districts, i.e., Lichinga, Cuamba, Malema, Nampula and Meconta. The districts was selected in consideration of the Agro-Eco Zone of IIAM (refer to Section 3.1.1), which is prepared based on the crop environment including climate. The assessment was carried out with the average precipitation of 1998/99 to 2010/11, with some exception. Due to lack of adequate agricultural climate, the data of CLIMWAT/FAO[4] was applied to the climatic data necessary for estimating crop water requirement. Maize, Beans, Soybeans, Potato, Cotton were adapted to the target crops of assessment.

Table 4.3.6 Water Deficit of Rain-fed Cultivation in the Study Area

Crop	Items	Lichinga	Cuamba	Malema	Nampula	Meconta
Maize	Seeding Day	15-Oct	15-Oct	15-Oct	15-Nov	15-Oct
	CWR (mm)	448.6	592.3	662.9	504.9	652.3
	Water Deficit (mm)	8.3	18.8	29.6	28.2	93.9
	in % to CWR	1.9%	3.2%	4.5%	5.6%	14.4%
Beans	Seeding Day	1-Nov	1-Nov	1-Dec	1-Dec	1-Dec
	CWR (mm)	284.3	390.1	400.2	332.0	398.9
	Water Deficit (mm)	0.0	2.9	0.0	0.0	11.6
	in % to CWR	0.0%	0.7%	0.0%	0.0%	2.9%
Soybeans	Seeding Day	15-Dec	15-Dec	15-Dec	15-Dec	15-Dec
	CWR (mm)	301.9	394.5	446.1	363.1	438.1
	Water Deficit (mm)	0.0	20.7	30.4	0.0	30.5
	in % to CWR	0.0%	5.2%	6.8%	0.0%	7.0%
Cotton	Seeding Day	1-Nov	1-Nov	1-Nov	1-Nov	1-Nov
	CWR (mm)	490.4	646.0	725.4	585.7	711.5
	Water Deficit (mm)	36.0	97.3	135.6	45.2	136.1
	in % to CWR	7.3%	15.1%	18.7%	7.7%	19.1%
Potato (1st Season)	Seeding Day	1-Jan	1-Jan	1-Jan	1-Jan	1-Jan
	CWR (mm)	283.1	368.3	415.2	336.7	406.7
	Water Deficit (mm)	15.6	62.4	81.6	12.3	64.2
	in % to CWR	5.5%	16.9%	19.7%	3.7%	15.8%

CWR: Crop Water Requirement (CWR) is represented by Crop Evapotranspiration (ETc) estimated by the FAO methodology based on CRIMWAT data.
Effective rainfall: USDA Method
Rainfall Data applied: Lichinga - INM 2000-2010, Cuamba - INM 1996/97-2006/07, Malema, Nampula and Meconta -DPA 1998/99-2010/2011

The water deficit of crops during vegetation period is estimated from 2% to 14% for maize, where the water deficit occurs in the initial or late stage of growth. This deficit ratio can be reduced to less than 6% by choosing appropriate seeding timing in the districts from Lichinga to Nampula. Beans are observed to be cultivated without water stress except for the eastern area, that is represented by Meconta. The water deficit of soybeans is estimated from 0% to 7%, which is observed in the late stage of vegetation in April. Even though corps of maize and soybean are cultivated with small degree of water stress in the average condition, it is considered that the

[4] Scope of application of climate data in CLIMWAT DATA: In compiling the data, an effort was made to cover the period 1971 - 2000, but when data for this period were not available, any recent series that ends after 1975 and that has at least 15 years of data have been included.

unevenness of rainfall both throughout the year and from year to year affects to the growth of crops in the Study Area, as shown in Figure 4.3.3. Thus, supplemental irrigation is expected to contribute to increase and stabilize the productivity of crops.

Cotton suffers around 19% of water deficit in Malema and Meconta mainly in April, that is in the late stage of vegetation. For the potato of 1st season (rainy season), from 4% to 20% of water deficit is estimated and it is required to apply supplemental irrigation from March to May for expecting adequate productivity.

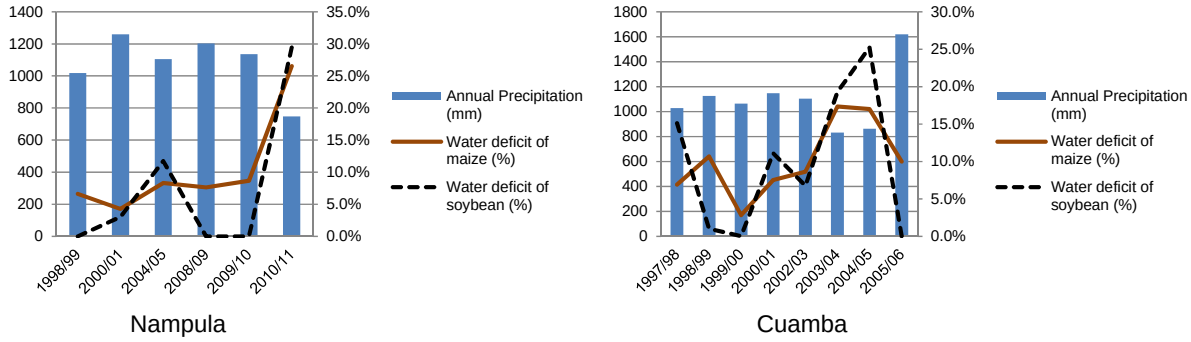


Figure 4.3.3 Annual Precipitation and Water Deficit of Crops in Selected Districts

4.3.4. Expected Direction of Irrigation Development

The future development of irrigation in the Study Area can be discussed from two different main actors of irrigation, i.e., the one small and medium irrigation farmers and another is large scale irrigation user such as farming enterprise or foreign investment.

Regarding the small and medium irrigation farmers, the following direction of the irrigation development can be considered:

- Full use of the potential of irrigation development through rehabilitation existing irrigation systems is considered as an essential for expanding irrigation area. Improving operation and maintenance of facilities, increasing efficiency of water use and improving technology of irrigation farming are required to utilize the expanded irrigation area effectively.
- Due to existence of scattered small family farmers in the ex-beneficiary area of the existing irrigation systems regardless they use irrigation or not, it is considerable rather difficult to invite newly development for large scale users. Those areas are recommended to use for expanding and increasing small and medium irrigation farmers.

- Through land consolidation during the rehabilitation of existing irrigation systems, the systematic irrigation network will be established as well as solving the mixture of irrigation and rain-fed cultivation in the area.
- Bringing up commercial farmers who use irrigation, through expansion and re-arrangement of irrigation area as well as promotion of appropriate irrigation technology.
- Establishing water users association or strengthening the function of farmer's group and association for is required to improve operation and maintenance of facility as well as water management of small irrigation system.
- Promotion of vegetable production by small scale irrigation by promoting mobile pump and small storage equipment in the area easy access to rivers, lake and marsh as well as access to the market.

As for the large scale irrigation development by farming company or foreign investment, the following direction of the irrigation development can be considered:

- There are abundant water resources to be developed for the newly large scale irrigation development. The issues are to secure free land which is close to rivers, lakes and marshes and necessary to develop water storage facility.
- It shall be taken in consideration that the basins in the eastern part represented by Monapo Basin is not suitable for newly large scale development due to its small runoff and concentration of land and water resources development.
- Stabilizing and increase productivity of crops such as maize, soybean and cotton which are cultivated by rain-fed currently, through introducing supplemental irrigation.
- Promoting full irrigation with modern irrigation technology of maize, soybean and other cash crops, that aims high productivity as well as high quality of production.

4.4. Logistics and Processing the Agricultural Products

4.4.1. Logistics

(1) Transportation Cost

High transportation cost causes price competitiveness in domestic market. Lowering transportation cost and produce losses by damage are expected by rehabilitation of national roads in Nacala corridor. Apart from national road, rural roads connecting to national roads are still remained as a constraint for producers and traders.

(2) Storage Facility

According to the result of the trading survey, average annual turnover level of storage facilities is quite low as 462% or 4.62 times. Utilization of storage facility except a peak period of transaction should be considered. Some produces, such as soybean and sesame, both are high value crops, have high loss rate at storage level. Rehabilitation of old facility should be stimulated. And hygiene management should be appropriately applied. At producer's level, in terms of efficient transaction of produce and avoiding quality deterioration in certain aggregated production area, produces are rather assembled and stored at one place near production area than keeping at each house. Appropriate capacity and location of rural storage facility should be considered with cooperation of farmer association.

4.4.2. Value Chain and Market Demand

(1) Soybean

As mentioned above, Mozambique imported 36,000 tons of soybean oil and 7,200 tons of soybean cake in 2009 as well as 12,600 tons of chicken meat. Chicken meat industry is growing adopting domestic chicken meat demand. Chicken farms are seeking domestic soybean as well as import ones. Demand of soybean is increasing as import substitution.

(2) Maize

Maize is one of the food staple in Mozambique, as well as important material for animal feed. As mentioned above, domestic chicken meat production increasing and it suggests increase of feed demand. Furthermore, maize is important produce in Niassa province for export to neighboring countries through Mandimba boarder and Nacala port. More demand of domestic and international market exists adopting increase of production volume inside the Nacala corridor.

(3) Sesame

Farm gate price of sesame is high as about 23 MT/kg. Furthermore, export of sesame increases, and reached about 40,000 tons in 2009. According to the estimation of Agrifuturo, potential volume of international market is estimated 2.8 million tons. Unstable production by insect attack is one of constraints. More capacity of processing facility will be necessary for increase of production and export volume.

(4) Cassava

Cassava has stable demand in domestic market. Apart from food staple, cassava is utilized for materials of brewery. Utilization for a material of biofuel is under

experiment. Demand for cassava will be continued to increase as food staple and materials for brewery and possible biofuel.

(5) Cashew nut

Cashew nut is competitive product in international market. Cashew factories in Nampula can receive more material to fulfill its processing capacity. Increase of number of cashew nut processing factory in 2000's causes shortage of raw cashew nut. The constraint of cashew factories is stable procurement of quality and volume cashew nuts.

(6) Peanut and Beans

Peanut and haricot bean have demand in both domestic and international market. Farm gate prices of these products are very high as 22MT/kg and 19MT/kg respectively. These products have price competitiveness adapting demands in Maputo market, and other central and south region.

(7) Vegetables

Prices of vegetable, such as tomato, onion and potato are high in each step of value chain. Demand of these products is high in population dense areas, Nampula city and eastern part of Nampula province. Malawi will be one possible market in Niassa depending on production cost and market price.

4.5. Farmers Organizations

Farmers' organizations which present in the Study Area can be mainly divided into "farmers' group" and "farmers' association". The farmers' group means what farmers are just assembled, but the farmers' association has its rule (constitution) and management body for its purpose. The size of one organization is usually 10 to 40 farmers, for instance; the extension service of MINAG assembles 10 to 30 farmers into one farmers' group/association, but in the case of NGOs, one group/association consists of 20 to 40 farmers.

Almost all have, at least during part of their formation process, connections to funding entities, either NGOs or donors and MINAG, in the history of organization of Mozambique. Many of farmers' organizations were grouped for the purpose of receiving the support by NGOs, when the support by NGOs is stopped or the support projects terminate, the activities of farmers' organizations would be declined, is real situation. On the other hand, the farmers' associations have been formed for the purpose of saucer of governmental support through DPA, such as agricultural inputs materials of PAPA from the MINAG. In addition, MINAG (DPA and SEDAE) are not able to grasp the whole picture of farmers' organizations.

(1) Results of Inventory Survey

The results of the inventory survey regarding the farmers' organizations are as follows:

Most farmers' associations have no offices and warehouses. They also have no irrigation system. There is lack of input supplier. They are also sold in the informal markets. There are no affordable financial services for the farmers. Farmers and associations do not fulfill bank requirement due to lack of mortgage. Many farmers' associations did not receive appropriate training in terms of organizational development, internal governance, management, and marketing. Many NGOs do not use demand driving approach, but offering extension approach through provision of seeds and other inputs.

The aspects highlighted above together with leadership weaknesses, the majority of the farmers' organizations do not function well. The major aspects encountered in the organizations are less management skills, internal governance, and accountability. The linkage between association and forum and/unions are weak. The problems of weak organizational structure and management skills of the farmers' organizations that opens space to excessive intermediation in the procurement of inputs and marketing of surplus, were also have been pointed out by both the Green Revolution Strategy (MINAG, 2007) and PEDSA (2009-19).

On the other hand, according to the DPA of Nampula, the main problems that may pose as a major factor for the development of the farmers' associations are as follows:

- Lack of information and training on the association;
- Lack of knowledge in financial management;
- Lack of support of agricultural machinery to increase production areas;
- Lack of exchange of experience among the members;
- Lack of training in preparing and implementing of the projects;
- Lack of training in agri-business;
- Lack of coordination in marketing.

(2) Business Challenges of Farmers' Organizations

PRODECER project which is a typical example of development in Brazilian Cerrado region, the cooperatives had carried out various support measures, to settle by mainly the children of members of agricultural cooperatives existing, as well as to provide funds and to donate such as agricultural processing facility, that had been a major factor of success.

Usually, for individual small-scale farmers will be able to have an equal bargaining power with intermediaries and agro-processing companies, to develop a voluntary organization or cooperative by individual farmers is necessary. Unless there is a system in which farmers could respond to distribution or price formation themselves, farmers would always passive attitude. From this perspective, to organize the farmers is important.

However, many NGOs in the Study Area have been working in the organization of farmers long period of more than 20 years, farmer members were trained in improved farming practices as well as governance skills such as literacy, numeracy, conflict resolution, meeting facilitation, agendas, democratic governance practices and business skills. Unfortunately, significant results in the economic perspective would not be expressed/seen. Many international NGOs have often been criticized for being more concerned with production than with marketing, also when supporting the creation of producers associations. In addition, it is clearly from the study results, “for the small-scale farmers, rather than demand markets and market information do not exist, there is no buyer; the buyer cannot come up to the farm gate”, it is a big problem. This is also true with respect to farmers' organizations as well as individual farmers.

The result has been a lack of sustainability as a business view point. The major challenge the current approach used by most NGOs. They simply run to the numbers and easy results through provision of inputs without preparing the farmer to cope with business challenges. However, recent years, some agricultural production companies and part of NGOs, without having to take advantage of an existing farmers’ organization from a business perspective, have started a new business grouping of farmers. They place emphasis for the activities focusing on purchase and marketing. It is notable that such new trial also has been successful.

(3) The new Cooperative Law

The new Cooperative Law provides a well-defined legal framework for organizing farmers’ cooperatives - with a clearly defined purpose. Commercialization of products may at present be the most urgent, and the purpose towards which farmers can create reasonably well-functioning cooperatives. Making new legislation known and available, especially in the districts and rural areas, is still a real challenge in Mozambique.

In the Study Area, there is one (actually the first) farmers’ cooperative to be established under the new Cooperative Law, ALIMI in Cuamba district of Niassa province. ALIMI is a producer cooperative; its goals are to improve producers’ bargaining power in agricultural markets, began trading in the 2009 marketing

season, with sales of 3.16 million MT in the 2010 season. In the 2011 season ALIMI's sales target was 4,300 tons. ALIMI members numbered about 500 in May 2011, with each member paying a 200 MT one-off fee that constitutes the cooperative's capital stock and Cooperative Social Fund. The cooperative is based on local 'unions' at sub-district level, termed 'localidades', each with a purchasing point (posto de compra) and storage depot run by a technician of commercialization and production (TCP: técnico de comercialização e produção) paid by commission on the amount purchased. ALIMI currently has 52 purchasing points. In the 2010 marketing campaign, the cooperative used its social (membership) fund of about 30 000MT to finance its marketing operations (Development of National Producer Organizations and Specialized Business Units in Mozambique, Noragric, 2012.).

The creation of new modern cooperatives within the frameworks given by the new Cooperative Law can be one option towards building a basis for the forging of commercial linkages between farmers'' organizations. The experience of the ALIMI, now in its third year of trading, will be of great interest in this regard. However, these new cooperatives will probably need some years to prove their effectiveness and sustainability.

(4) Support for the Farmers' Organizations

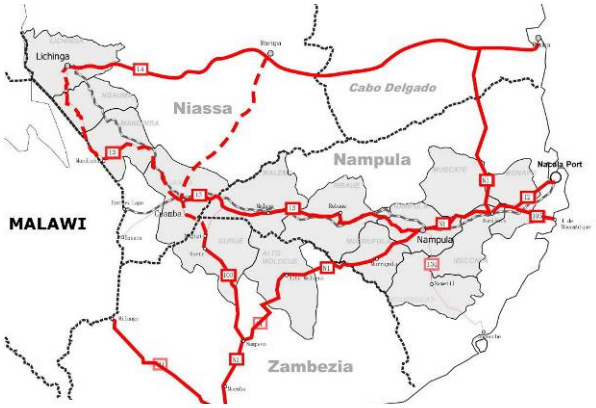
Due to limited capacity of family labor, lack of access to improved input, technology, management skills, and business orientation, to support for the farmers' organizations, it would be considered as follows:

- Establishment of rural credit system by farmers' organizations/cooperatives for agriculture production at small scale farmer level to increase working capital, to hire labor and equipment for agriculture mechanization, including irrigation system, plowing, sowing, weeding, and harvesting;
- Provide qualified technical assistance in agriculture production and management of production chain, including development cooperative business;
- Set up mechanisms to improve farmer access to improved technology through empowerment of farmers' organization at association, forum, union, cooperative, and federations; and
- Provide post-harvest technology at individual farmer, and set up a system to facilitate storage facilities access at farmer's organization level of association, forum, union, cooperative, and federation.

4.6. Road and Social Infrastructure

(1) Road Transportation

At the present, many roads in Nacala Corridor Area are under development. By early 2015, two parallel horizontal lines will be established with paved two lanes roads. One line is called “Nacala Corridor” from Nacala Port to Cuamba and the other is “Pemba Corridor” from Pemba in Cabo Delgado Province to Lichinga.



Source: Study Team

Figure 4.6.1 Future Road Network

Connecting to Cuamba in Nacala Corridor, rehabilitation of N13 road from Cuamba to Lichinga is discussed with African Development Bank and JICA. It might be completed before the target year.

As vertical network, N1 road from Quelimane in Zambezia to Pemba and No.103 road from Mocuma at N1 to Magegi passing Gurue in Zambeiza, are also going to be rehabilitated by 2014.

The rehabilitation/pavement of road from Magegi to Cuamba, and Cuamba to Marrupa at Pemba Corridor in Niassa had been agreed by the Government of Portugal, but it is suspended due to economic crisis. Even though, it might be implemented sooner because its design and tender document had been prepared.

If the aforementioned works are carried out, Cuamba city might be an accumulated point for road transportation in west part of the Study Area.

(2) Railway Transportation

The CDN, a company operating the Nacala Railway, has an improvement plan of the North Railway line (hereinafter called Nacala Railway) in order to connect for Tete Province through the Malawi. The Vale Company, operating Coal Mining in the Tete, main share holder of CDN and JV leader for the rehabilitation works, plan to produce 22 million ton of coals per a year in their short-term plan. They expect to ship 4 million ton of the coal from Beira port and remaining 18 million ton from Nacala Port. Then, in order to transport the 18 million ton of coal, Nacala Railway should be rehabilitated.

The transportation capacity of Nacala Railway will reach to 29 million ton per year after rehabilitation. The CDN expect to handle 22 million ton per year consist of 18

million ton of coal, 2 million ton of national cargo and 2 million ton of transit cargo. Agricultural products will be able to be included in 2 million ton of national cargo.

The discussion regarding rehabilitation of Lichinga line is not opened yet. If CDN improve the Lichinga line, Niassa Province will have good mass transportation.

(3) Nacala Port

The Nacala port has advantage of its natural depth and location closed to the Asia. Due to that, the Port is considered one of the important port in east Africa.

However, The port started its operation in 1951 as international port, and its facilities are getting old and their handling is not efficient. Due to that, rehabilitation plan was prepared by JICA with grant aid and yen loan in order to secure its competitiveness and sustainability for development of Nacala Corridor Area.

The plan says capacity of the port will be increased by stages up to 250,000 T.E.U. in 2030. The expectation of handling amount of cargo per year in the plan is shown in Table 4.6.1.

Table 4.6.1 Expected Amount of Cargo

	Unit	2008	2020	2030
Total	1,000MT	995	4,523	9,972
Container	1,000MT	397	2,073	4,744
	1,000TEU	50	211	491
Bulk	1,000MT	598	2,450	5,228

Source: The Preparatory Survey on Nacala Port Development Project , 2011 June

The Nacala Port is operated by CDN under concession till 2020 and the concession can be extended 15 years more. The Vale has plan to make new special port for coal shipping at Nacala-a-Velha.

(4) Power Supply

By improvement of North Cahora Bassa Hydro Power Plant, HCB will increase its capacity as 3,320 MW from present 2,075 MW. In order to stable power supply from HCB to Nacala Area, it plans to lay new power grid between Caia to Nacala. The new line will operate in 2020, after that, power supply for Nacala, Nampula and other east part of the Study Area until Ribaue district will be stable.

Regarding power supply for rural area, the Government of Mozambique stated that power supply network will be expanded along the existing network. They will connect administration posts at first then cover localities in that area, where the power line laid. It means there is a potential to install agriculture mechanical or irrigation pump in these area.

(5) Water Supply

The city water systems are managed by water supply authority, FIPAG. The FIPAG has plans to upgrade all water supply systems in Nacala Corridor Area.

The all district centers in the Study Area have Small Water Supply System (PSAA - Pequenos Sistemas Abastecimento de Agua), excluded Alto Morocue in Zambezia. The district has PSAA has potential to install small factories related to the agriculture. Moreover, construction of wells is an alternative to secure the water easily in Malema, Cuamba and part of Ribaue.

(6) Education and Health

Number of the facilities for education and health is not sufficient, and securing required number of teacher or medical staff in rural area is big challenge. In case of investment with land development, the rural community may be able to have better health and education facilities with necessary human resource, if the investor agrees to prepare them by CSR.

4.7. Agricultural Investment: Potential for Commercial Farming Involving Small-Scale Farmers

(1) Potential Contract Farming Models Applicable to the Nacala Corridor

As discussed in the Section 3.9.3, contract farming is a potential model for involving small-scale farmers in the commercial agriculture value chain, which would result in increased productivity and better market access for small-scale farmers. As for the current contract farming models applied in the Beira and Nacala Corridors, they are mainly categorized in 3 types, as listed below, according to the conditions for input supply and its repayment. The following table summarizes the detailed arrangement of each model:

- Model 1: Input supply (seed and fertilizer) based on the bank loan contract. Inputs are delivered to farmers from a private sector partner at a price;
- Model 2: Input supply (seed and fertilizer) based on a mutual agreement with farmers on the delivery of the harvest. Input costs are deducted from the payment for the harvest; and
- Model 3: Input supply (only seed) free of charge based on a mutual agreement with farmers on the delivery of the harvest.

Each model has its advantages and disadvantages relating to the points of: i) the input supply system; ii) the provision of technical extension services; iii)

arrangements for the collection of crops; and iv) repayment of input costs as described in Table 4.7.2.

Table 4.7.1 Summary of Arrangements for Contract Farming

	Contract Agreement	Input Supply and Repayment	Remarks
M1	- Farmers make a loan contract with a financial institution. - Purchase guarantee is provided by a company.	- Farmers purchase seed and fertilizer using a loan. - Farmers make the repayment to the bank after the harvest.	- A company provides extensive extension services to farmers to increase productivity. - A local financial institution should be involved in the contract farming arrangement.
M2	- No written contract made. - Oral agreement with a company on the delivery and purchase of crops.	- A company provides seed and fertilizer to farmers. - Input costs are deducted from the payment for the harvests.	- Farmers are expected to sell crops to the company providing the inputs (seed and fertilizer). - Farmers and a company have to mutually agree on the repayment for input costs in advance to avoid conflicts during the harvest.
M3	- No written contract made. - Oral agreement with a company for the delivery and purchase of crops.	- A company provides only seed. - Repayment of the seed cost is not required.	- Farmers are expected to sell crops to the company providing the seed (but not obliged). - The company needs to take measures to ensure the collecting of enough of the harvests from farmers.

As the successful case of ECA in the Beira Corridor, Model 1, which requires a loan contract arrangement with a commercial bank for input financing, seems to be ideal since a private sector partner can establish a reliable partnership with the small-scale farmers. Both parties share equitable responsibility for the provision of inputs and extensive extension services by a private sector partner, and the delivery of crops by farmers. The compensation method for the debt of farmers should a crop failure due to natural phenomenon, such as bad weather or disease/pest outbreak, occur should be considered even though the private sector partner does not provide a loan guarantee.

Model 2 and Model 3 are the commonly applied systems in the Nacala Corridor by service providers (trader) or cotton and tobacco commercial farms. Although the tobacco and cotton farms have a long history in carrying out contract farming with farmers by providing necessary inputs, it is still at the preliminary stage in involving small-scale farmers in commercial agriculture for the production of food/cash crops such as maize, soybeans, sesame, etc. in collaboration with private sector partners in the Nacala Corridor. As a result private sector partners have suffered difficulties in working with small-scale farmers in relation to the effective delivery of inputs and technical extension services as well as the collecting of the expected harvest amounts. However, there is no doubt that the contract farming model has the

potential of involving a large number of small-scale farmers in the product value chain by facilitating a private sector partnerships, which would eventually contribute to improved food security and incomes for the local population.

Table 4.7.2 Advantages and Disadvantages of Contract Farming Models

	Advantage	Disadvantage
M1	-Productivity is improved through the use of appropriate inputs; hence farmer's net income even after the repayment of the bank loan is increased. - Farmers can acquire advanced farming skills through the frequent extension services provided by the private sector partner. - Appears to be a sustainable model for contract farming involving private agribusiness and financial institutions.	- In case of crop failure due to bad weather (drought, etc.), farmers will incur the risk of default. - Farmers might hesitate to acquire a bank loan for the purchase of inputs due to the high interest rate. - The government and donors/NGO have carried out projects in input distribution free of charge, which would dissuade members from contract farming as they are required to pay for the input costs with a bank loan.
M2	- Productivity is improved if farmers use provided inputs (especially fertilizer) in an appropriate manner. - Farmers can acquire advanced farming skills through the extension services provided by the private sector partner.	-There would be the risk of conflict with farmers when deducting input costs at the time of purchasing crops if they are well informed of the repayment arrangement. - Farmers might sell the harvests to other traders once they have compared the offered prices. As a result the private sector partner may not collect enough crops from the farmers to cover input costs (seed and fertilizer).
M3	- Productivity is improved if farmers apply appropriate farm management using the quality seed provided by a private sector partner. - A private sector partner could widely expand this approach to involve thousands of small-scale farmers since the initial investment cost is minimal (only providing seeds to farmers).	- Farmers might sell the harvests to other traders after comparing the offered prices, which in turn would make it so that the private sector partner would not gain the expected profits. - Distribution of free seed might eventually lead to dependency with the small-scale farmers.

(2) A Tentative Idea for the Implementation of Pilot Projects in Collaboration with Private Sector Partners

In the Agriculture Development Master Plan for the Nacala Corridor, Quick Impact Projects (QIPs), which are expected to produce a positive effect in a short period, should be identified from a list of priority agriculture development projects, which will be identified in the Master Plan. Some of the QIPs are also expected to be carried out in collaboration with private sector partners in order to stimulate agriculture/ agribusiness investments in the Nacala Corridor. Concerning this point, it is critical to demonstrate the feasibility of agribusiness from different perspectives, such as technologies, financial schemes, policies and regulations, markets, and the organizational framework of supporting a business, in order to attract private businesses to participate in agribusiness investment. Though it is still premature to select priority agriculture development projects at this stage, it is worthwhile to implement some pilot projects to test the potential arrangements for involving both private sector partners and small-scale farmers in the production of food/cash crops

with the provision of necessary agriculture inputs and extension services. Lessons learned from the pilot projects will be reflected in the Master Plan, which could make the implementation scheme for QIPs more feasible.

1) The basic principles for implementing of pilot projects

The basic principles for implementing pilot projects are:

a) To carry out, on a trial basis, an effective and efficient contract farming model with a private sector partner involving small-scale farmers in order to evaluate the feasibility of the model;

b) To work with the private businesses in the Nacala Corridor introduced in the Section 3.8.1 for the implementation of the pilot projects, taking into account their experiences and networks with local communities, which would contribute to producing results within a limited time period;

c) To establish an accessible financing mechanism to benefit a private sector partner for the developing of an applicable contract farming model; and

d) All experiences and lessons learned from the pilot projects shall be reflected in the designing of the implementation framework of QIPs in the Master plan.

2) The financing mechanism: Introduction of an Investment Fund

As discussed in the Section 3.9.4 with “the experiences of the BAGC initiative”, it is critical to introduce a soft loan scheme to support the efforts of private sector partners in expanding their businesses, which would then be used to acquire necessary machinery or facilities as well as purchase crops from farmers. In consultation with the Ministry of Agriculture, the mobilizing of the Counterpart Fund,[5] of which funds accumulated in the account managed by the Ministry of Agriculture and JICA Mozambique Office, will be proposed in order to create an investment fund for private sector partners to implement pilot projects. A private financial institution that has a specific mandate for supporting small/medium entrepreneurs with business loans, such as GAPI, will be involved in the management of the investment fund, and consignments to GAPI as a trust fund. The criteria for mobilizing the fund should be clearly defined, taking into consideration the social impacts on small-scale farmers and local communities, the commercial viability of the business, and the sustainability of the proposed business model.

[5] A part of the payment from the sale of agriculture machinery or inputs granted by the Government of Japan through Food Assistance and Food Production Grants is accumulated in an account for the recipient country (the Ministry of Agriculture).

3) Selection of private sector partners for the pilot projects

Once the criteria for the awarding of the Investment Fund has been confirmed, the ProSAVANA-PD, in collaboration with the CEPAGRI Nampula office, will hold a public briefing to explain: i) the purpose of implementing the pilot projects; ii) available financial support and the criteria therefor; iii) the expected timeframe of the projects; and iv) other necessary information. It should be emphasized that a proposed project should involve a group of small-scale farmers as a partner with commercial agriculture to establish a model for contract farming. An official call for proposals should be announced after the public briefing. It is expected that 3~4 private businesses will be selected as partners in the implementing of the pilot projects.

4) The proposed implementation scheme and management structure for the pilot projects (the proposed contract farming model)

Figure 4.7.1 below illustrates the proposed implementation scheme for the pilot projects, showing the potential partners for contract farming involving small-scale farmers. A pilot project operation team that includes the Japanese experts of ProSAVANA-PD and local technical staff would be formed to provide support to the private sector partners in the implementing of activities. The team will be specifically tasked with providing the following services:

- Support in the preparing of the project implementation plan;
- Provision of a soft loan from the Investment Fund;
- Training of the extension staff of the private sector partner;
- Technical advice on demo-plot management, including the preparation of a technical extension manual; and
- Monitoring and advisory services during implementation.

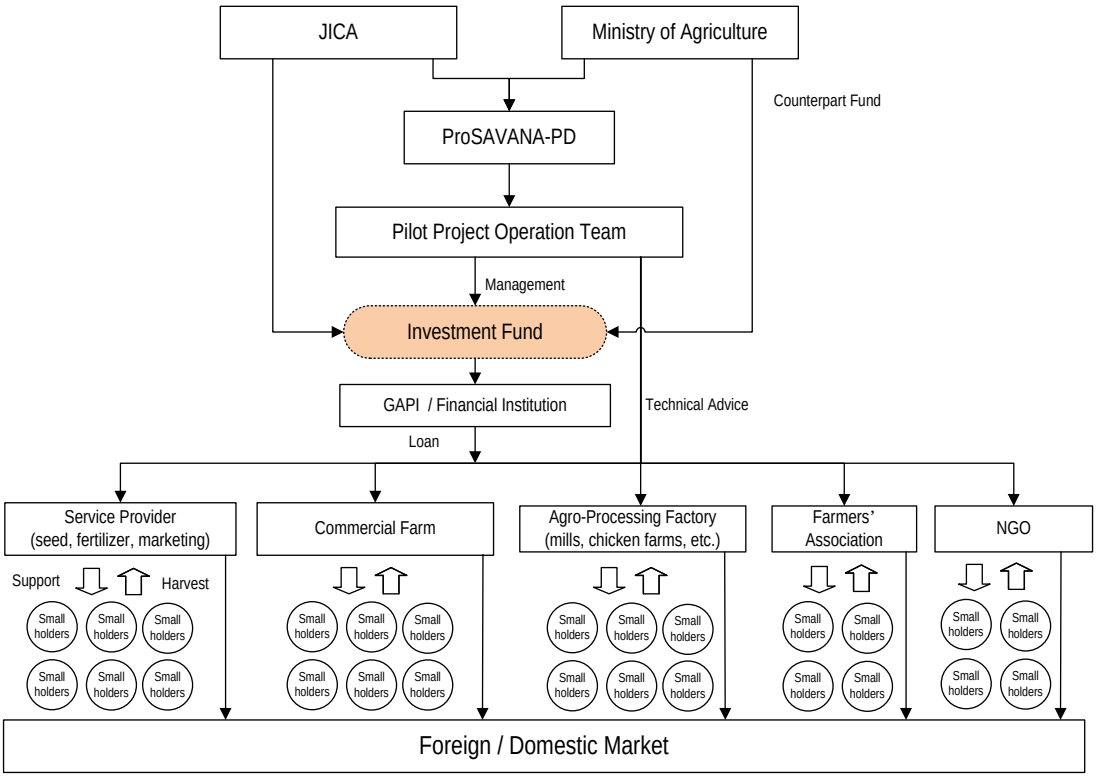


Figure 4.7.1 Implementation Scheme of the Pilot Project

5) Tentative Timeframe for Pilot Projects

The proposed timeframe for the pilot projects is summarized in Table 4.7.3 below. Considering the crop production cycle in the Nacala Corridor, where the rainy season starts in November, the project should commence in October 2012 with the selection process for potential partners, and completed in July 2013 so that the entire production and marketing cycle can be observed in order to learn lessons from the pilot projects.

Table 4.7.3 Tentative Timeframe of the Pilot Projects

	Activities	In-Charge	2012				2013								
			9	10	11	12	1	2	3	4	5	6	7	8	9
	(Preparatory Stage)														
1	Consult with concerned government agencies to establish an Investment Fund	ProSAVANA, Government													
2	Develop criteria for the assessment of an application for the Investment Fund	ProSAVANA, Government													
3	Hold a public briefing and announce a call for a proposal of the Investment Fund	ProSAVANA													
4	Selection of potential private sector partners for the pilot projects	ProSAVANA, Government													
	(Implementation Stage - Production)														
5	Support the finalization of the project implementation plan	ProSAVANA													
6	Conduct a training for extension workers of private sector partners	ProSAVANA													
7	Organize a group of small-scale farmers for contract farming (a series of consultation with farmers)	Private Sector Partners													
8	Conduct a technical training for farmers (establishment of demo-plot, etc.)	Private Sector Partners													
9	Procure and provide agriculture inputs to farmer groups	Private Sector Partners													
10	Conduct a regular technical extension session with farmer groups	Private Sector Partners													
11	Regular farming practice (farm management)	Farmer Group/Private Partner													
12	Regular monitoring and technical support	ProSAVANA													
13	Harvest of crops	Farmer Groups													
	(Implementation Stage - Post harvest)														
14	Consultation between farmer groups and a private partner to arrange the purchase of crops	Farmer Group/Private Partner													
15	Purchase crops from farmer groups and payment	Private Sector Partners													
16	Regular monitoring and technical support	ProSAVANA													
	(Wrap-up Stage)														
17	Repay the loan (a short term loan for crop purchase)	Private Sector Partners													
18	Summarize experiences and lessons learned from the pilot projects	ProSAVANA													

(3) Transition of Investment Fund for the Pilot Projects into a permanent Investment Fund for Agriculture development in the Nacala Corridor

Once the pilot projects have produced positive results with which the effectiveness of the Investment Fund is able to be demonstrated, it is recommended that a permanent funding scheme to support local agribusiness/agro-industry actors be introduced through the morphing of the Investment Fund for the pilot projects into a formal agribusiness support fund (formal Investment Fund) with additional funds added. A formal structure for the managing of this fund, such as a steering committee involving the concerned authorities, should be organized at the central level in order to oversee the fund's operations as well as the investment projects planned in the Nacala Corridor. At the same time an investment fund operations unit should be formed, providing advisory/consultation services to potential investors who are interested in applying to the Investment Fund for new agribusiness investments. Figure 4.7.2 below sets out a tentative concept for the investment fund's management and operational structure during the implementation phase of the Agriculture Master Plan of the Nacala Corridor.

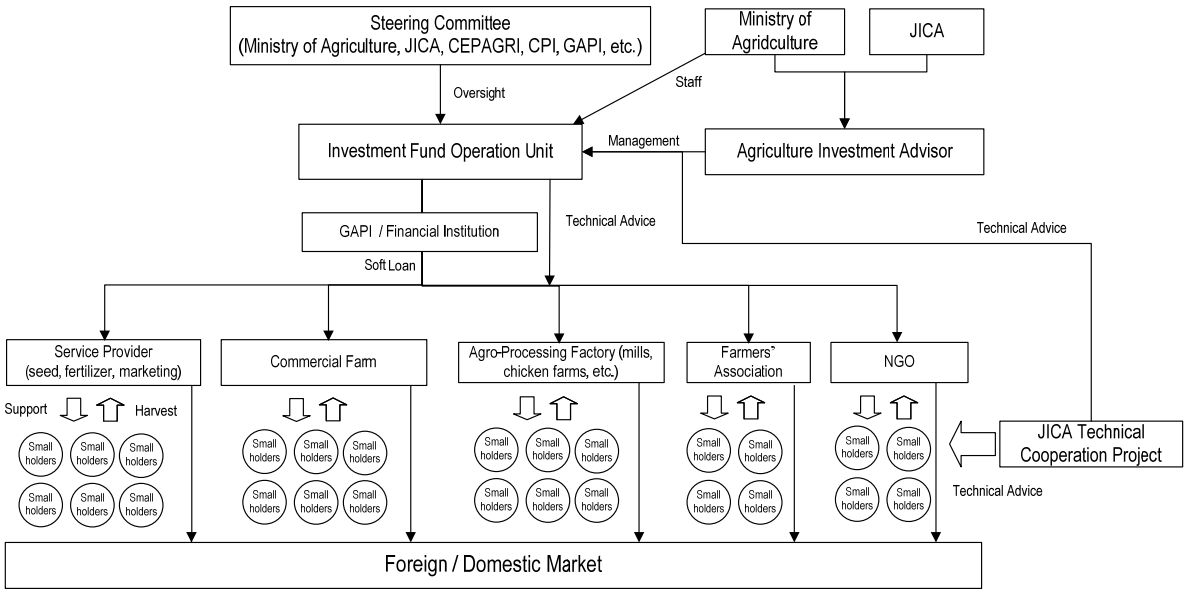


Figure 4.7.2 Future Plan for Investment Fund Management and Operational Structure

4.8. Responsible Agricultural Investment

ProSAVANA is expected to establish a model of Responsible Agricultural Investment (RAI) as a bench-mark under globally changing food security circumstances. A discussion note prepared by FAO, IFAD, UNCTAD Secretariat and World Bank Group "Principles for RAI that Respects Rights, Livelihoods and Resources" has been made public since February 2010. Although the proposed principles are voluntary and subject to consultation and refinement, main international agencies agreed that the following seven key principles are essentially the right ones:

Table 4.8.1 Key Principles of RAI

Principles		Specific Requirements
1	Existing rights to land and associated natural resources are recognized and respected. ***(RESPECTING LAND AND RESOURCE RIGHTS)***	i) Identification of all rights holders; ii) Legal recognition of all rights and uses, together with options for their demarcation and registration or recording; iii) Negotiation with land holders/users, based on informed and free choice, in order to identify the types of rights to be transferred and modalities for doing so; iv) Fair and prompt payment for all acquired rights; v) Independent avenues for resolving disputes or grievances.
2	Investments do not jeopardize food security but rather strengthen it. ***(ENSURING FOOD SECURITY)***	i) Continuing access to food is assured; ii) Opportunities for outgrower involvement and off-farm employment are expanded to protect livelihoods and raise incomes; iii) Dietary preferences are taken into account if the mix of products grown may change; iv) Strategies to reduce potential instability of supply are adopted.
3	Processes relating to investment in agriculture are transparent, monitored, and ensure	i) Ensuring public availability of relevant information, such as land potential and availability, core aspects of prospective investments, and resource flows or tax revenues;

	accountability by all stakeholders, within a proper business, legal, and regulatory environment. ***(ENSURING TRANSPARENCY, GOOD GOVERNANCE, AND A PROPER ENABLING ENVIRONMENT)***	ii) Developing the capacity of institutions that handle investment selection, land transfers and incentives to follow principles of good governance, operate efficiently and transparently; iii) Ensuring that an independent system to monitor progress towards a better investment climate is in place.
4	All those materially affected are consulted, and agreements from consultations are recorded and enforced. ***(CONSULTATION AND PARTICIPATION)***	i) Definitional and procedural requirements in terms of who represents local stakeholders and what is a quorum for local attendance need to be clarified; ii) The content of agreements reached in such consultations should be documented and signed off by all parties; iii) Methods for enforcement and sanctions for non-compliance should be specified.
5	Investors ensure that projects respect the rule of law, reflect industry best practice, are viable economically, and result in durable shared value. ***(RESPONSIBLE AGRO-ENTERPRISE INVESTING)***	i) Comply with laws, regulations, and policies applicable in the host country (and ideally with all relevant international treaties and conventions); ii) Adhere to global best practices for transparency, accountability and corporate responsibility in all sensitive areas; iii) Strive not only to increase shareholder value but also to generate significant and tangible benefits for the project area, affected communities, and the host country.
6	Investments generate desirable social and distributional impacts and do not increase vulnerability. ***(SOCIAL SUSTAINABILITY)***	i) Relevant social issues and risks are identified during project preparation, and strategies devised to adequately address them; ii) The interests of vulnerable groups and women are considered explicitly; iii) The generation of local employment, transfer of technology, and direct or indirect (e.g. via taxes) provision of public goods and services is part of the investment design.
7	Environmental impacts of a project are quantified and measures taken to encourage sustainable resource use, while minimizing the risk/magnitude of negative impacts and mitigating them. ***(ENVIRONMENTAL SUSTAINABILITY)***	i) Independent environmental impact analysis to identify potential loss of public goods, such as biodiversity or forests, is conducted prior to approval; ii) Preference be given to reclaiming or increasing productivity on resources already in use; iii) The most appropriate production system is selected to enhance the efficiency of resource utilization, while preserving the future availability of these resources; iv) Environmental good practices in agriculture, processing and manufacture are adhered to; v) Provision of desirable ecosystem services is encouraged; vi) Negative impacts are addressed through regularly monitored environmental management plans and compensated where appropriate.

Source: Adapted from "Principles for RAI that Respects Rights, Livelihoods and Resources, 2010"

These principles now need to be translated into actions, hopefully as a balanced mixture of voluntary self-regulations and compulsory instruments, for the following different actors:

- Mozambican government at central and decentralized levels;
- Investors including enterprises and financing agencies;
- Local stakeholders including communities;

- Independent neutral players such as NGOs, civil society and academy;
- Bilateral/multilateral donors and, to the extent possible, governments of the countries from which investment initiatives are emanating.

The Government of Mozambique already has a number of laws and regulations which can, in theory, respond to some of the above-mentioned principles and requirements. Most donors also have their own guidelines on environmental and social protection applicable to identification, appraisal and implementation of the projects. Therefore, main challenges of RAI under ProSAVANA will be the following:

(1). Strengthen the law enforcement by the government and include RAI principles into the evaluation processes of different licensing;
(2). Lead the investors to proper application of self-regulations; and,
(3). Involve neutral players in the decision-making and monitoring.

Elaboration of ***"ProSAVANA Guidelines on RAI"*** as an annex to the "Data Book for Private Investors" (the fourth output of the present study) will be a plausible idea to achieve these goals. One chapter of the Guidelines shall be oriented for government agencies such as CEPAGRI and CPI as an operation manual of the procedures related to evaluation, public consultation, authorization, monitoring, assistance, inspection and eventual revocation of agricultural investment projects. In longer term, it is desirable that RAI principles be adopted as public policy of the Government. Table 4.8.2 outlines the expected process to elaborate the Guidelines.

Table 4.8.2 Supposed Outline of "ProSAVANA Guidelines on RAI"

Working Group	Government agencies (CEPAGRI, CPI, MINAG/DPA, MICOA/DPCA, etc.), Producers' organization (such as UNAC), Investors' organization (such as CCIABM), Observers (academic institutes, etc.)
Contents	● Synopsis of RAI principles ● Outline of Mozambican legislation about agricultural investment ● Initial check-list of compliance with RAI principles ● Code of conduct expected for investors (enterprises and financing agencies) ● Criteria for evaluation, authorization and inspection of investment projects ● Key points in public consultation, monitoring and assistance of investment projects ● Good practices in investor-community partnership, farming and agro-industry ● Contact list and useful links (such as "Knowledge Exchange Platform for RAI")

Source: JICA Study Team

As for the Nacala Fund, the consultative council will play a key role in the selection of investment proposals. ProSAVANA Guidelines on RAI is expected to be utilized in this process, too. However, we should also keep in mind that excessively strict rules may repel potential investors from Nacala Corridor.

4.9. Agricultural Zoning of the Study Area

4.9.1. Review of Existing Zoning in Mozambique

Several types of "zoning" are applied in Mozambique for different purposes such as orderly territorial arrangement, protection of forest environment, mapping of agricultural potential, etc. In legal terms, two main systems are giving framework to the zoning as follows:

Territorial Arrangement Law (Law no.19/2007) and its Regulation (Decree no.23/2008)

- "Zoning" is defined as an informative and indicative tool, having its basis on soil quality evaluation, existence of natural resources and human occupation, which serves to evaluate and divide the territory into different areas for preferable land use such as economic, social and environmental activities. The objective of zoning is to safeguard environmental and ecological qualities of diverse regions in the national territory, through definition of the limits among human occupation, economic exploitation and any other forms of land use, in order to prevent degradation of environment and promote its sustainable use.
- Zoning is also one of the seven general instruments for territorial arrangement: 1) Soil quality evaluation; 2) Land classification; 3) National land cadastre; 4) Environmental/ Social/ Economic inventory; 5) Zoning; 6) Geological map; and, 7) Mining cadastre.
- A zoning represents the following elements about the concerned area: 1) Geographic location and environment; 2) Forms of land occupation and established DUATs; 3) Unique natural qualities; 4) Interdependent relations among nature, infrastructure, administration, economy and others; and, 5) History of human occupation.

Forest and Wildlife Law (Law no.10/99) and its Regulation (Decree no.12/2002)

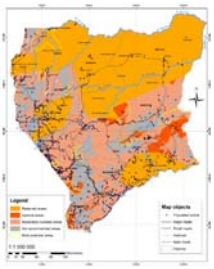
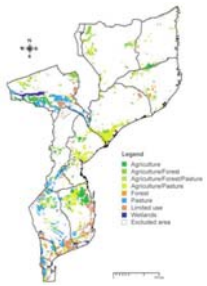
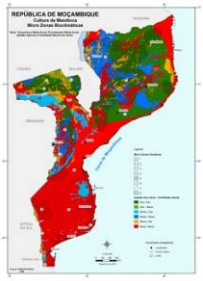
- "Zoning" is defined as division and classification of forests and wildlife according to the type of vegetation and alternative land use, and also considered as one of the fundamental tools for law enforcement.
- Forests are classified into "conservation forest", "buffer zone", "productive forest" and "multiple-use forest" through zoning, in order to identify suitable activities such as protection, conservation or exploitation of forest/animal resources.

Territorial arrangement planning is being undertaken at district level with the help of provincial government. In an example case of Monapo District in Nampula Province, future land use plans are proposed at scale 1: 350 000, dividing the territory into residential area, forest reserve, agricultural concession area and community

development area. Such products shall be collected for all the districts to be incorporated in the process of Nacala Corridor's zoning.

On the other hand, so-called "agro-ecological zoning" is widely practiced mainly by MINAG's initiative. It consists of characterization of climate, topography, soil, vegetation, hydrology and other natural parameters, followed by matching with different crops and mapping of suitability. In recent cases, other factors such as awarded concessions and road accessibility are also taken into consideration. Some well-known examples area listed below:

Table 4.9.1 Examples of Agro-ecological Zoning in Mozambique

	Example 1	Example 2	Example 3	Example 4
Coverage	Nation-wide	Niassa Province	Nation-wide	Nation-wide
Year	1996	2007	2008	2010
Result	Map showing 10 agro-ecological regions. 	Suitability maps for investment in forestry, agriculture, animal husbandry and eco-tourism. 	Map of potentially available lands for agriculture, forestry, pasture, etc. at scale 1:1,000,000. 	Suitability maps for 4 crops (cassava, cotton, Irish potato, and cashew) at different climatic scenarios. 

Source: JICA Study Team

The Example 2 shows the potential area for large scale development in Niassa Province estimated by the view point of vegetative cover, land slope, soil depth, space for large scale development, water source, and accessibility from main roads.

The Example 3 was an epoch-making approach to identify available lands for agricultural purpose. The criteria used for excluding "not available land" from the total land area of Mozambique in its two phases are shown in Table 4.9.2.

Table 4.9.2 Exclusion Criteria and Results of Identification of "Available Lands"

	Exclusion Criteria for "Not Available Land"	"Available Land" in Mozambique (ha)
Phase 1	Productive forests (dense forest, open forest); Conservation areas (national park, national reserve, game reserve, protected forest); Mangroves; Farmlands (annual crop, sugarcane field); Tree farms (cashew, tea, coconut); Forestry plantation (actual reforestation); Areas without vegetation (dune, river-bed, residential area, etc.); Shifting cultivation with forest; Forests with shifting cultivation.	12,016,800
Phase 2	In addition to above, Areas allocated for non-agricultural purpose (ecotourism, fish culture, wetland with limited use); Areas allocated for centers of resettlement of the people affected by recent floods; Areas prospected for mining; DUATs (approved, in process); Concessions (forestry, mining); Wild animal ranch; Community areas; Local and donor-aided initiatives.	6,966,030

Source: National agrarian zoning of lands available for large investments at local level, IIAM 2008

Distribution of "potential available lands" in the Study Area is presented in Figure 4.9.1 and Table 4.9.3. It should be noted that plots smaller than 1,000ha were not considered in this work, so probably there are more "potential available lands" at relatively small scale. On the other hand, it is also reasonable to think that currently in 2012 there may exist less "potential available lands" due to progressing award of DUATs and concessions as well as delimitation of community lands. Now the GOM is carrying out an upgrading of this similar work at scale 1: 250,000 till 2014.

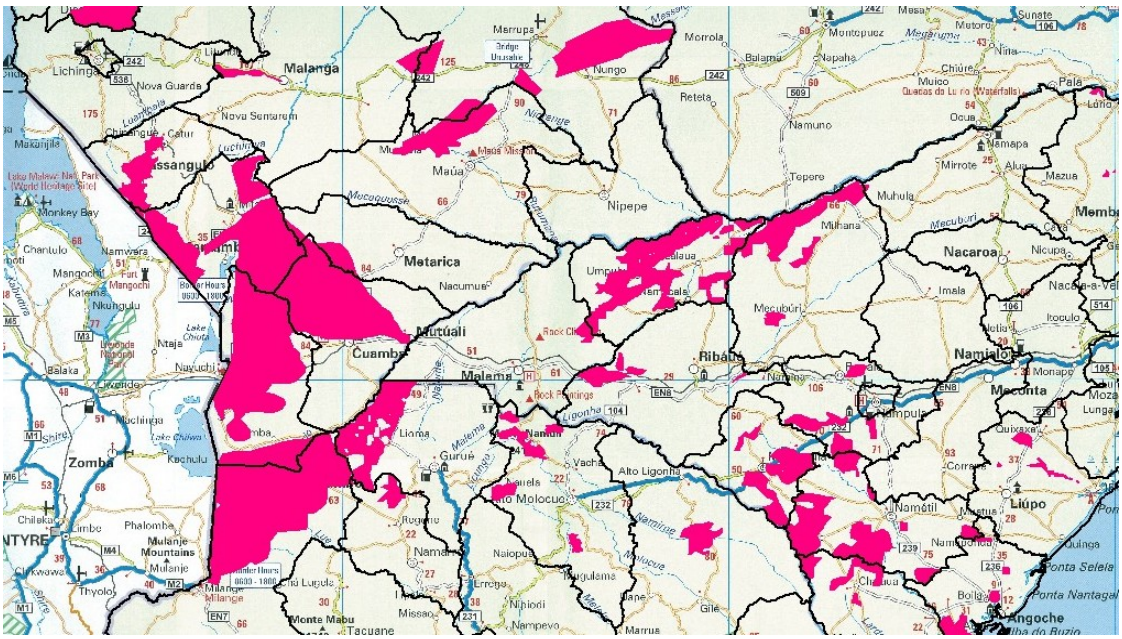


Figure 4.9.1 Distribution of "Available Lands" in Nacala Corridor

Table 4.9.3 Distribution of "Available Lands" in Nacala Corridor

District	Area (ha)	Province	Area (ha)	Total Area (ha)
Monapo	0	Nampula	298,047	968,159
Muecate	0			
Meconta	0			
Mogovolas	143,280			
Nampula	44,371			
Murrupula	74,182			
Ribaue	28,109			
Malema	8,105			
Alto Molocue	44,481	Zambezia	153,512	
Gurue	109,032			
Cuamba	232,800	Niassa	516,600	
Mandinba	243,800			
Nguama	40,000			
Lichinga	0			

Source: JICA Study Team, adapted from "National agrarian zoning of lands available for large investments at local level, IIAM 2008"

Land cover and land use map is also necessary for considering Agro-ecological zoning. CENACARTA provided land cover and land use map covering nationwide based on analysis of the satellite images acquired in 1997. DNTF also provided land cover and land use map covering nationwide based on the satellite image acquired in 2004 and 2005. The category of land cover and land use are basically followed to the guideline of land evaluation by FAO. Those materials were used to estimate the farm area in the Stud y Area.

4.9.2. Agricultural Zoning by ProSAVANA-PD

Agro-ecological zonings mentioned above don't provide sufficient information to meet the requirement of Territorial Arrangement Law, as they are aiming at different objectives.

ProSAVANA-PD will adopt a comprehensive zoning approach for Nacala Corridor, where agro-ecological zoning is considered as the first step to be followed by integration of socio-economic parameters such as demographic trend, land availability, market accessibility and territorial arrangement planning of each district. Final product will include not only maps but also proposal of measures, both promotion and restriction, to achieve the desirable land uses according to the zoning result. The approach is explained as follows.

4.9.3. Principal Methodology for Zoning

The principal methodology of zoning in the Study is shown in the Table 4.9.4. Firstly, natural conditions are considered, because agriculture is highly influenced by natural

conditions. Secondly, socio-economic conditions are considered. The both conditions are considered by the view point of “Supply (available resources)” and “Limitation”. Thirdly, potential for the development is considered, based on analysis of the natural conditions and the socio-economic conditions. Finally, zoning map is composed based on integrated analysis of the current conditions and the potential of the Study Area. The detailed process and maps of zoning will be shown from sub-chapters 4.9.4 to 4.9.7

Table 4.9.4 Matrix of the Idea for Zoning

Stage	Supply	Limitation
1. Natural Conditions	NS-1. Crop suitability NS-2. Distribution of crop production by district	NL-1 Slope (< 8%) NL-2. Land use (excluding bare land, water bodies, swamp area) NL-3 Soil (excluding low productivity soil)
2. Socio-economic Conditions	SS-1 Irrigation & water resource SS-2 Road, railway SS-3 Power supply	SL-1 Occupied area by local farmers SL-2 Conservation & DUAT SL-3 Harmonization between agriculture and forestry
3. Potential for the development	Irrigation development and promoting high-value crops production (combination of SS-1 and 2)	Large scale development (Combination of NL-1, 2, 3 and SL-1, 2, 3)
4. Integrated Zoning	Zoning of the Study Area based on analysis of the above	

Source: JICA Study Team

4.9.4. Classification of Suitability for Agriculture by Natural Conditions

Classification of suitability for agriculture by natural conditions is considered by suitability of major crops for local climate conditions and current distribution of crop production. Availability of reliable agro-climatic data prevents the Study team from making a proper examination on the crop suitability. Further analysis on the crop suitability will be made, by collecting more detailed agro-climatic data from various sources. On the other hand, enough data are available for the distribution of crop production. Local farmers should select and adopt common crops, i.e. cassava, maize, sorghum and beans, to local climatic and socio-economic conditions through long trials.

(1) Crop Suitability by Natural Conditions

1) Crop suitability by climate conditions (NS-1)

Crop suitability to climate conditions is considered by annual mean temperature and annual precipitation only for 4 crops, as summarized in Table 4.9.5. The number of crops in Table 4.9.5 is able to be increased by collecting more information of crop cultivation condition and agro-climatic data from agencies concerned.

Table 4.9.5 Crop Suitability by Climate Condition

Crops	Temperature (^{o}C)	Precipitation (mm)	Reference information
Potato	16-22	300 - 650	SA Guideline, J textbooks
Haricot beans	18-24	Over 600	SA Guideline, J textbooks
Cassava	20 - 36	400 - 1600	IIAM, SA Guideline, J Textbooks
Maize	20 - 33	600 - 1200	IIAM, SA Guideline

Reference information: IIAM = Interviewing to researchers of IIAM, SA Guideline = Production Guideline (Ministry of Agriculture, forestry & fisheries in South Africa),
J Textbooks = Japanese textbooks for food crop cultivation covering all over the world

The suitability maps of potato and haricot beans are shown in Figure 4.9.2 and 4.9.3. The suitable area of both crops covers the western part of the Study Area, and the suitable area is almost synchronized the high production area of haricot beans and potato, as shown in Figure 4.9.7 and 4.9.13, respectively.

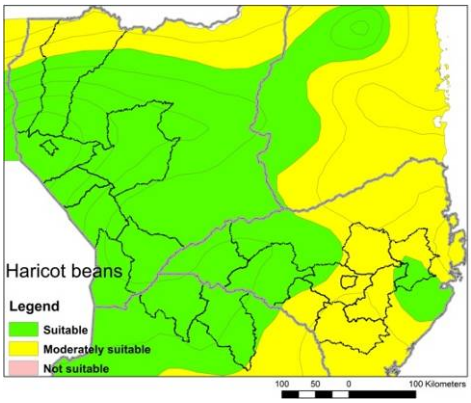


Figure 4.9.2 Suitability of Haricot Beans
Source: JICA Study Team

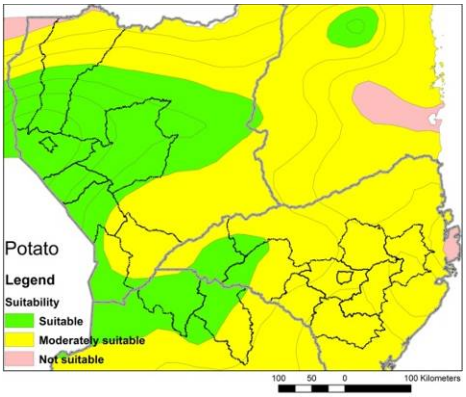


Figure 4.9.3 Suitability of Potato
Source: JICA Study Team

The suitability maps of maize and cassava are shown in Figure 4.9.4 and 4.9.5. The suitable area of both crops covers the almost whole Study Area, except for high altitude area. While the current distribution of maize production is concentrated in the western part of the Study Area, the area of cassava is concentrated in the eastern part of the Study Area, as shown in Figure 4.9.6. This difference may be caused by distribution and stability of annual rain fall. Monthly precipitation data for long years at several locations are needed for making a deep examination in order to make these crop suitability maps to be practical ones.

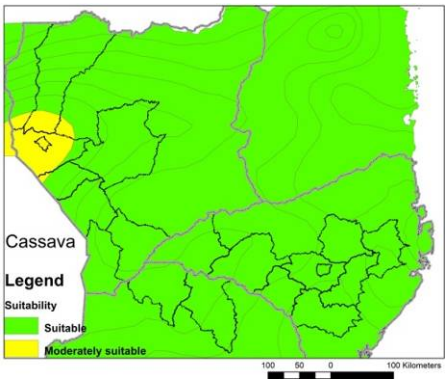


Figure 4.9.4 Suitability of Cassava
Source: JICA Study Team

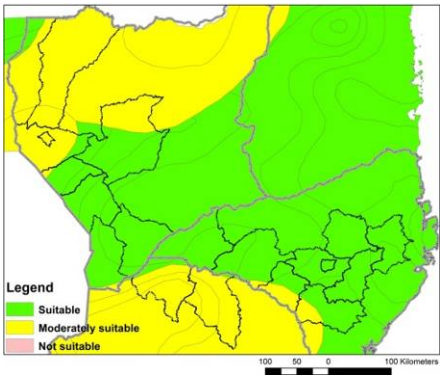


Figure 4.9.5 Suitability of Maize
Source: JICA Study Team

2) Distribution map of crop production (NS-2)

Distribution map of crop production show the crop production situations by district, based on statistical analysis by district collecting from each provincial office, as shown the section of 3.3.5.

a) Staple food crops

The situations of staple food crops are shown on the maps in Figure 4.9.6. The main staple food crops in the Study Area are maize and cassava. Cassava production is distributed over the eastern part of the Study Area, while maize production is distributed over the western part. The central part of the Study Area is the transition area in between the cassava area and the maize area. In the transition area, both of cassava and maize are cultivated. Then, sorghum, millet and paddy are cultivated supplementary to cassava and maize in accordance with local conditions. In Monapo, Meconta, Nampula, and Murrupula, which are high population density areas, various crops are cultivated as supplementary crops to cassava. An isothermal map is overlaid on a distribution map of crop production, as shown in Figure 4.9.6. It shows that maize is the main crop in low temperature condition areas, while cassava is mainly cultivated in high temperature condition areas.

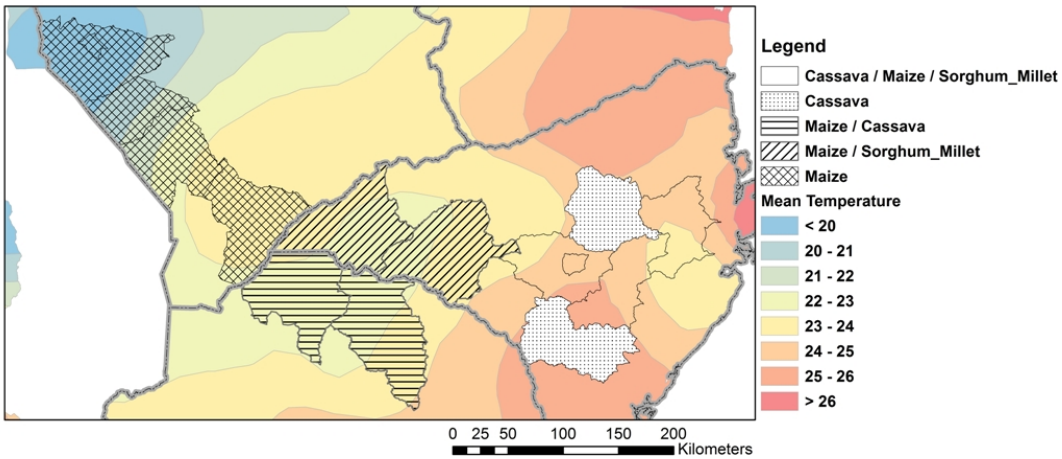


Figure 4.9.6 Crop Production of Cassava, Maize, Sorghum, and Millet
Source: JICA Study Team

Beans and sweet potato has a role of supplemental food to cassava and maize. Haricot beans are distributed over the western part, while mung bean, cowpea, and pigeon pea are distributed over the eastern part. Sweet potato is mainly cultivated in the western part, may be replacing cassava.

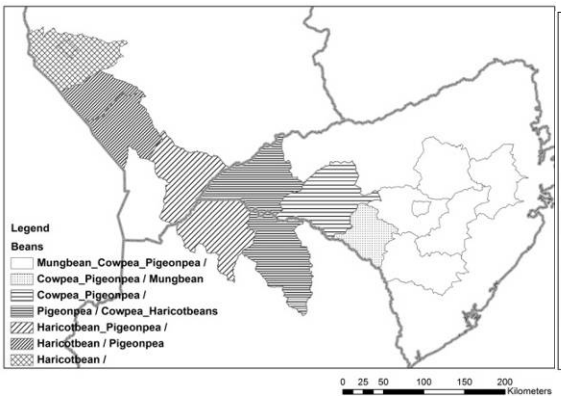


Figure 4.9.7 Beans Production
Source: JICA Study Team

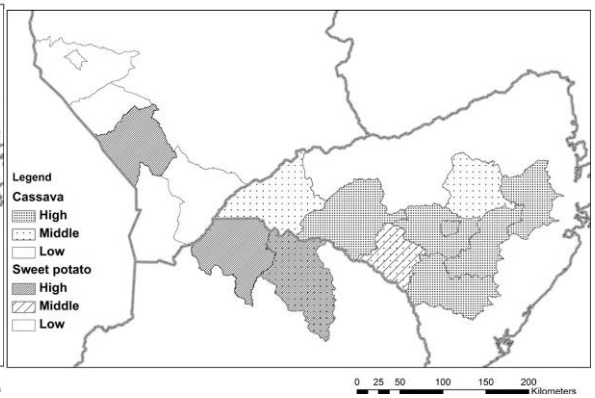


Figure 4.9.8 Sweet Potato Production
Source: JICA Study Team

b) Non staple food crops

The distribution of non staple food crops, such as cashew nuts, ground nuts, sesame, soy bean, are shown in Figure 4.9.9 to 12. Cashew nut is concentrated in the eastern side of the Study are, while ground nuts, sesame, and sunflower are broadly cultivated from eastern to central part. Cotton is concentrated in the eastern and the central areas, while tobacco is concentrated in the central and the western areas.

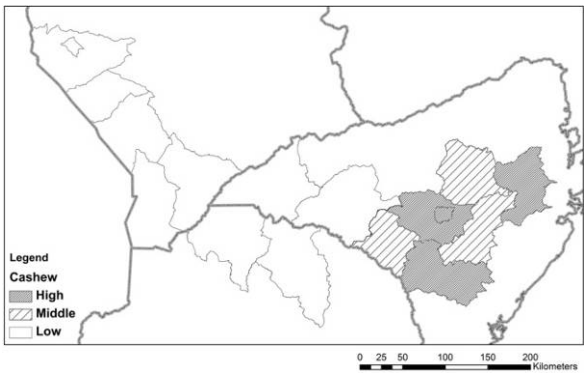


Figure 4.9.9 Cashew Nuts Production
Source: JICA Study Team

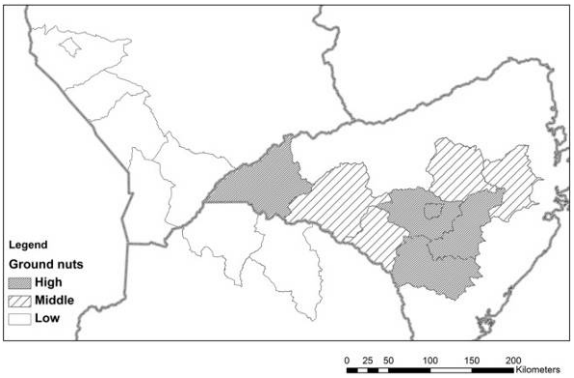


Figure 4.9.10 Ground Nuts Production
Source: JICA Study Team

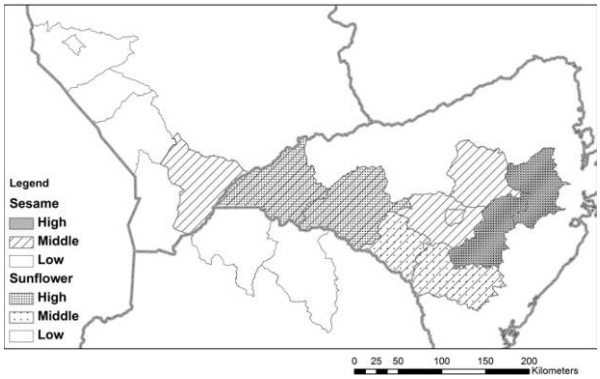


Figure 4.9.11 Sesame and Sunflower Production Source: JICA Study Team

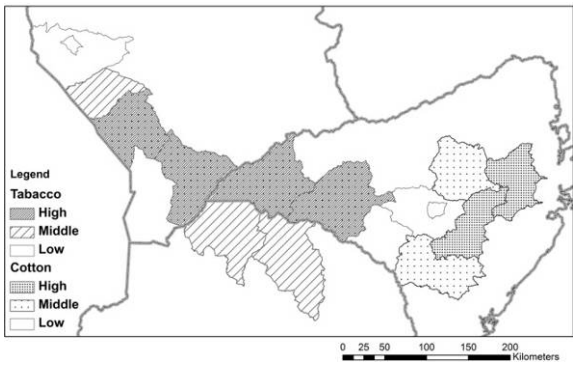


Figure 4.9.12 Cotton and Tobacco Production Source: JICA Study Team

c) Soy bean, Vegetables, and Potato

Soy bean are concentrated in the central part of the Study Area, and the cultivation area is expanding to surroundings, especially to the western part, as shown in Figure 4.9.13. The distribution of vegetable production and potato is shown in Figure 4.9.14. Vegetables and potato production is concentrated in the central part, especially in Gurue district, while Lichinga district also provide much volume of potato.

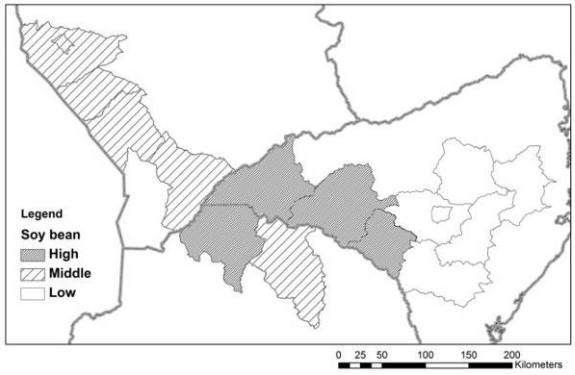


Figure 4.9.13 Soy Bean Production Source: JICA Study Team

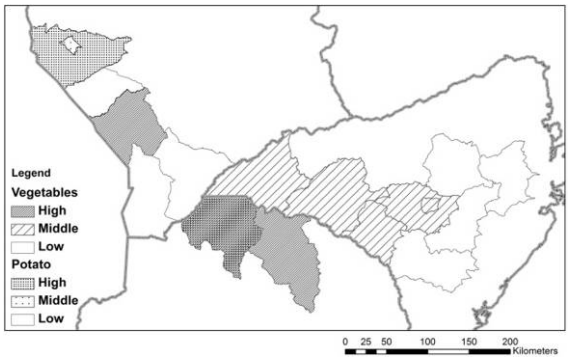


Figure 4.9.14 Vegetable and Potato Production Source: JICA Study Team

(2) Limited Area for Agriculture by Natural Conditions

1) Land Slope (NL-1)

Figure 4.9.15 shows land slope map, based on SRTM data acquired from CGIAR. The limitation slope for using agricultural machine, i.e. tractor, is commonly 8 %. The area beyond 8 % of slope must be excluded from the suitable area for large scale farming using a tractor.

2) Integrated limitation map for farm development

Integrated limitation map in Figure 4.9.16 is made by overlaying a land slope map extracting the area beyond 8 % of slope, a land use map (refer to sub-chapter 3.1.7) extracting water body and swamp area, and soil map (refer to sub-chapter 3.1.7)

extracting unsuitable area for crop cultivation. This integrated limitation map will be used to consider potential area for large scale development.

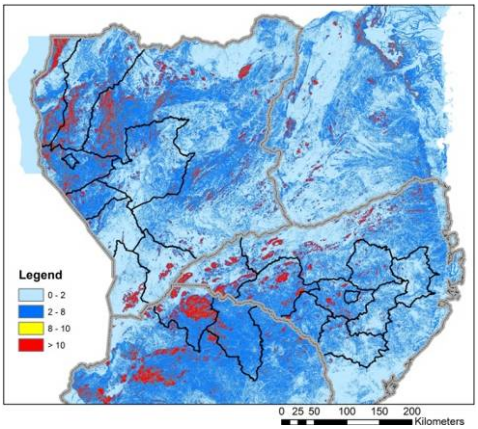


Figure 4.9.15 Land Slope Map
Source: SRTM from CGIAR

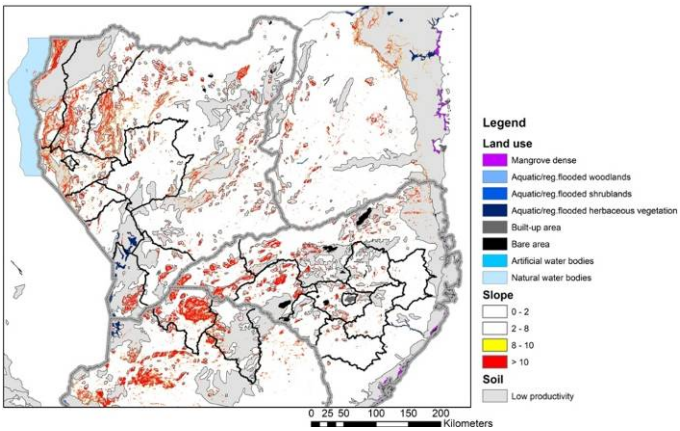
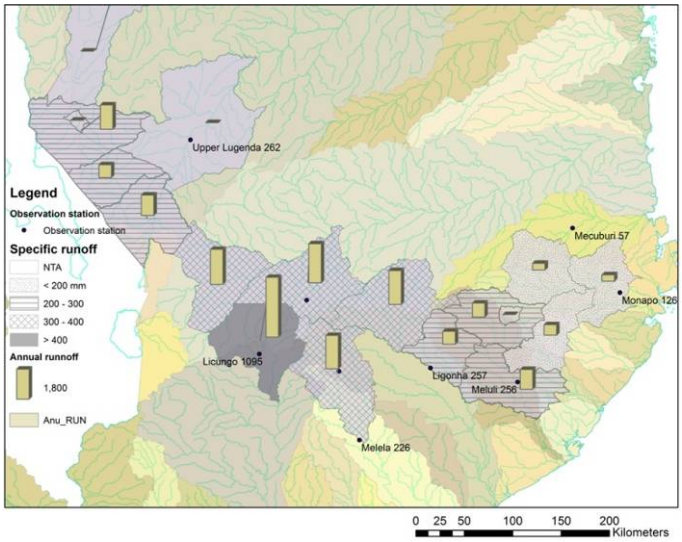


Figure 4.9.16 Integrated Limitation Map
Source: Arranged by JICA Study Team

4.9.5. Socio-economic Conditions

(1) Irrigation and Water Resource (SS-1)

As shown in Figure 4.9.17, the mean annual runoff of the Study Area was estimated based on the specific runoff observed at the stations of the lowest reach of basins, except for some large basins where middle reach stations or average of stations of the basin was applied. The runoff in each district is estimated by the basin runoff of sub-basins. In general, the runoff in the eastern part districts, such as Monapo, Meconta and Muecate, is smaller and the larger runoff is observed in the mountainous area in the middle of the Study Area.



Source: ARAs
Figure 4.9.17 Estimated Mean Annual Runoff by District

Figure 4.9.18 shows the area with equipped and in-use of existing irrigation system based on inventory provided by the concerned provincial offices. Malema has the largest area both with equipped and in-use, and Monao, Murrupula and Nampula are in the second even though the ratio of in-use is extremely low. The area not in-use, that is calculated by the deference between the areas with equipped and in-use, is

considered as a potential area of irrigation development by rehabilitation of the existing irrigation system.

Figure 4.9.19 shows the number of irrigation systems in terms of scale, i.e. small (less than 50 ha), medium (50 – 500 ha) and large (more than 500 ha). In general, small irrigation system is predominant in the Study Area, while Alto Molocue, Gurue and Lichinga have medium scale of irrigation systems. Nampula has a characteristic that there are many smaller sized systems comparing with other districts.

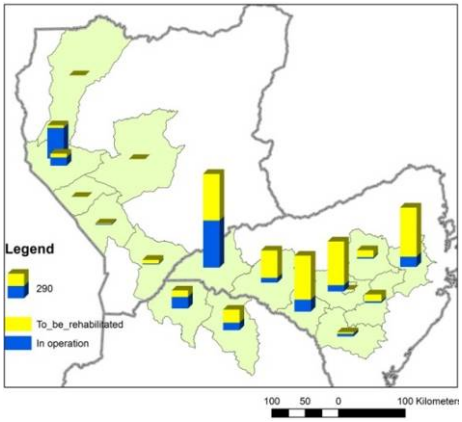


Figure 4.9.18 Area Equipped and in-use of Existing Irrigation System by District Source: DPA of Nampula, Zambezia, Niassa

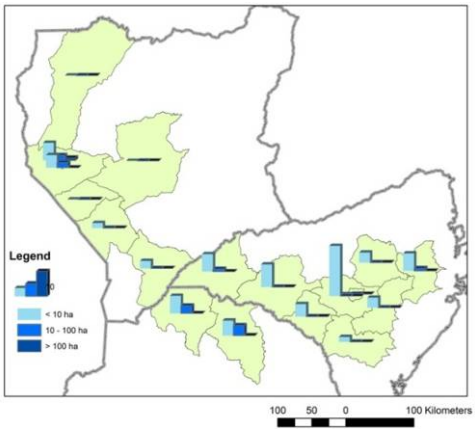


Figure 4.9.19 Size Distribution of Existing Irrigation System by District
Source: DPA of Nampula, Zambezia, Niassa

(2) Road, Railway and Power Supply (SS-2, 3)

The situations of road, railway and power supply were explained in sub-chapter 3.1.8. Those social infrastructures are important to form a value chain of agricultural products and access markets, as well as to be one of key factors to analyze potential of agricultural development.

(3) Occupied Area by Local Farmers, Conservation, and DUAT (SL-1, 2)

The occupied area by reserved area, conservation area and DUAT are overlaid on the map of occupied area by local farmers (refer to sub-chapter 3.1.7), as shown in Figure 4.9.20. The lands not indicated with specific purpose of use in the DUAT map are classified as “Unknown” in the map,

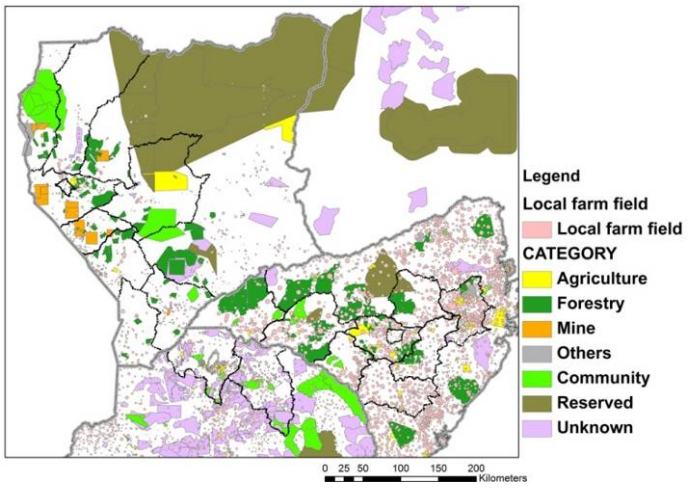


Figure 4.9.20 Occupied Area by Local Farmers, Conservation and DUAT
Source: Arranged by JICA Study Team

while a database of DUAT should contain the information of land use. In Nampula province, almost all of the area is occupied by local farmers and DUAT. In the western part from Malema to Sanga, especially in Mandimba, Majune, and Sanga districts, a substantial space not occupied by local farmers and DUAT is found. However, the potential for large scale development will be considered in sub-chapter 4.9.6 (2) by overlaying all information concerning limitations mentioned in sub-chapters 4.9.4 and 4.9.5.

(4) Harmonization between Agriculture and Forestry (SL-3)

Figure 4.9.21 is a simplified land use map in sub-chapter 3.1.7, which shows the area of agricultural area including field crops, tree crops, grassland etc., and forest area and others. The DNTF of the MINAG defined the productive forest area in their forestry inventory survey (AIFM) in 2007. The productive forest area is almost same as the area classified as forest in Figure 4.9.21. The ellipsoidal areas in Figure 4.9.21 are further processed for analyzing potential areas for large scale development as shown in Figure 4.9.23 and 4.9.24. Majune district is relatively abundant in possible potential areas for large scale development. Most of those areas, however, are included in the productive forest area defined by DNTF. In those areas, the harmonization between agriculture and forestry should be considered from viewpoints of economic efficiency and environmental conservation.

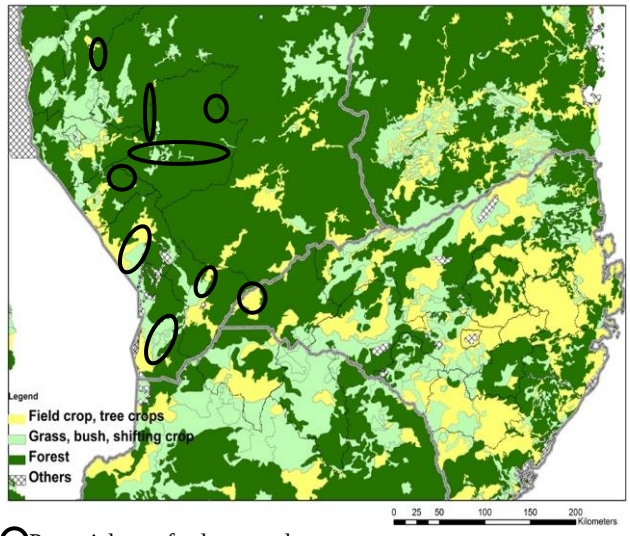


Figure 4.9.21 Land Use Map showing Productive Forest Area
Source: Arranged by JICA Study Team

4.9.6. Potential for the Development

(1) Irrigation Development and Promoting High-valued Crops

Malema district has high potential of water resource and irrigation development in terms of rehabilitation of existing irrigation system, as described in 4.9.5 (1). High-valued crops such as vegetables are cultivated in the very limited area near rivers in dry season. The primary road connecting from Nampula to Cuamba will be paved up to 2017. The access to market in Nampula and Nacara will be improved

significantly by the paved road. Promoting vegetables or other high-value crops production by irrigation development is an effective approach in the middle part of the Study Area, especially in Malema district. As for large scale irrigation development, it is required to consider newly development of water storage facility or ground water usage.

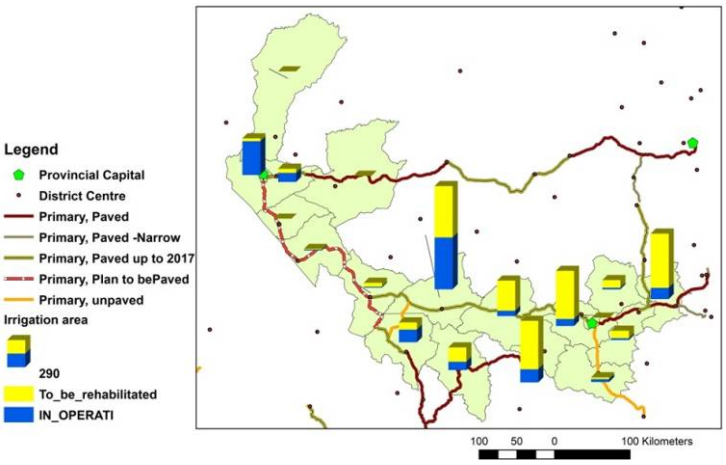


Figure 4.9.22 Irrigation Development and Promoting Vegetable Production
Source: Arranged by JICA Study Team

(2) Potential for Large Scale Development

Figure 4.9.23 contains all of the limiting conditions mentioned in the section of 4.9.4 and 4.9.5, and shows the area from Mandimba district to Sanga district. The ellipsoidal area in Figure 4.9.23 shows the area, which may have favorable conditions for large scale development. However, a serious attention should be paid to harmonize agriculture and forestry development, especially in case of large scale development, as mentioned in the sub-chapter of 4.9.5 (4).

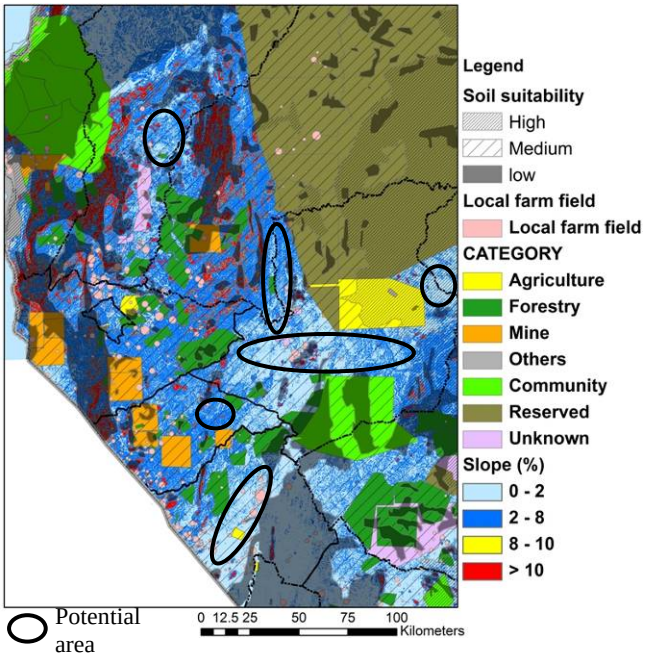


Figure 4.9.23 Potential Area for Large Scale Farm Development in the Western Part of the Study Area
Source: Arranged by JICA Study Team

Figure 4.9.24 shows potential areas for large scale development in the central part of the Study Area. Some potential areas are found in Malema and Cuamba district, while it is difficult to find the space in the eastern part as shown in Figure 4.9.25.

In the eastern part, small to middle scale development less than 1,000 ha may be possible instead of large scale farm development. The area of shifting cultivation

including grass and bush land is estimated to be 1,785 thousand ha in the Study Area, as shown in Table 3.1.15. The real figure of the shifting cultivation area might be larger than the figure, considering the actual farming practices observed in the Study Area. The potential area for small to middle scale farm development shall be reclaimed by transforming the existing shifting cultivation area, including the area for reserved fallow land, to normal farmland area. Simultaneously, encouragement of extension service for promoting intensive farming practices through providing incentives to farmers shall be combined.

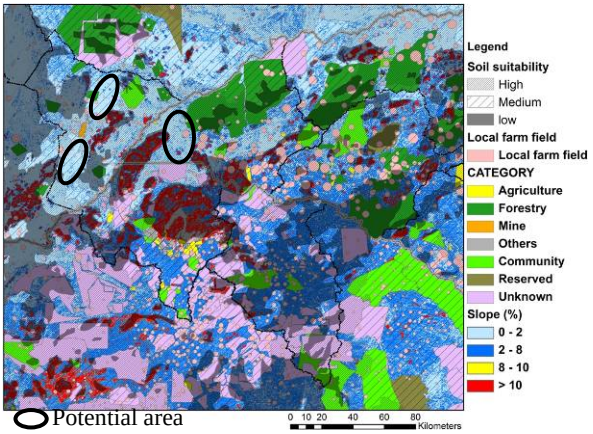


Figure 4.9.24 Potential Area for Large Scale Development in Central Part of the Study Area
Source: Arranged by JICA Study Team

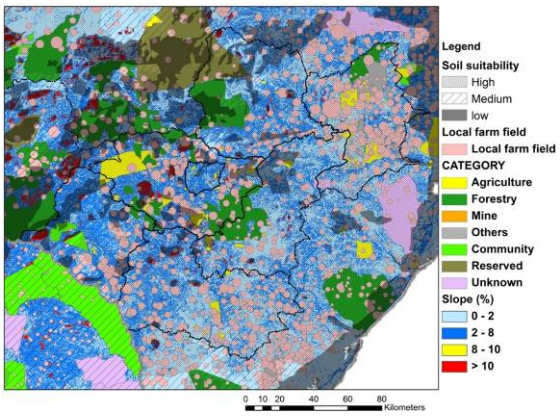


Figure 4.9.25 Potential Area for Large Scale Development in Eastern Part of the Study Area
Source: Arranged by JICA Study Team

4.9.7. Integrated Zoning

(1) Summary of Analysis Process

The above analysis process for zoning is summarized in Table 4.9.6

Table 4.9.6 Summary of Consideration for Zoning

Items	Result of analysis	Limitation of analysis (L), Remarks (R) & Challenge (C)
1) Natural conditions	**a) Supply**	
Crop suitability	Crop suitable map was provided only for a few crops, caused by lack of climatic data	**(C)** Collecting more detailed climatic data, especially, monthly precipitation data at several locations
Distribution of crop production by district	Distribution of main crops, i.e. cassava, maize, fits isothermal map. The finding shows that local farmers have selected suitable crops in order to adapt climate conditions through long trials. Each cash crop also has a similar tendency of its distribution.	Analysis was almost completed (**(L)** Some data collected from DPA s was unreliable. INE did not make its agricultural statistic at district level.) **(L)** Distribution of new crops, i.e. soy bean, doesn't match to the climatic situation. (**(C)** Refer to the results of adaptability trials by IIAM 2010, soy bean can grow in wide locations in the Study Area)
1) Natural conditions	**b) Limitation**	

Slope	Extracting the area where the slope beyond 8%	Almost complete
Land use	Extracting water body, bare land, swamp area (Unsuitable area for upland crops)	**(R)** Another analysis is needed, if paddy cultivation is considered
Soil	Extracting unsuitable soil for crop production (Unsuitable area for upland crops)	**(R)** Another analysis is needed, if paddy cultivation is considered **(C)** More detail soil map is needed, in case of zoning at district level
2) Socio-economic conditions	**a) Supply**	
Irrigation & water resource	Central area in the Study Area has high potential for the development	**(C)** More information is needed, in case of zoning at district level
Road, railway	Many routes around Nacala corridor will be paved by 2017	**(C)** Monitoring the possibility of railway rehabilitation between Cuamba and Lichinga
Power supply	Collecting information	**(L)** Power company does not show outside the plan of electrical line installation
2) Socio-economic conditions	**b) Limitation**	
Occupied area by local farmers	Estimating occupied area by local people by population and average farm size Much area of Nampula province is occupied by local farmers.	Almost complete **(R)** Update the map, in case the latest data is collected
Conservation & DUAT	Showing the occupied area by Conservation and DUAT Much area of Nampula and Zambezia provinces is occupied by DUAT	**(L)** Estimating the figure of occupied area by conservation and DUAT is inadequate, because much DUAT area defined by various sources overlapped and an integrated DUAT database necessary for verification are unable.
Harmonization between agriculture and forestry	Most of potential areas for large scale development are located in the productive forestry area in Majune and Sanga districts. Harmonization with forestry is needed	**(C)** Guideline or standard of judging whether large farm development or environmental conservation
3) Potential		
Irrigation development and promoting high-value crops production	Promoting high-value crops, especially vegetable production by using irrigation in Malema	**(C)** Making an irrigation potential map at district level
Large scale development	Some areas remain where may be possible for large scale development in western area from Malema to Sanga	**(L)** Estimating an accurate figure of the potential area is difficult, due to lack of integrated information of the DUAT area **(R)** Potential area for middle scale development might be found in almost all of the districts, except for high population dense area, such as Monapo and Nampula districts.

Legends: (L): Limitation of consideration, (R): Reference, (C): Challenge
Source: JICA Study Team

Three key factors for zoning are chosen from Table 4.9.6, such as 1) Distribution of crop production, 2) Large scale development, 3) Irrigation development. Sixteen districts in the Study Area are classified by the 3 key factors, as shown in Table 4.9.7

Table 4.9.7 Classification of 16 Districts by 3 Key Factors

Key factors	Zoning of districts
Distribution of crop production	As shown Figure 4.9.6 Non-staple food crops distribution are also almost corresponding to Figure 4.9.6 zoning in spite of small discrepancies.
Large scale development	Few area remains Monapo, Muecate, Meconta, Mogovolas, Nampula, Murrupula, Ribaue, Alto Molocue, Gurue, Lichinga A little area remains: Malema, Cuamba Some area remains: Mandimba, Ngauma, Majune, Sanga
Irrigation development	High: Ribaue, Malema, Alto Molocue, Gurue Middle: Cuamba, Mandimba, Ngauma, Lichinga, Majune, Sanga Low: Monapo, Muecate, Mogovolas, Meconta, Nampula, Murrupula

Source: JICA Study Team

(2) Zoning

The Study Area is divided into 6 zones, as shown in Figure 4.9.26, based on the above considerations. The features of each zone are summarized as follows;

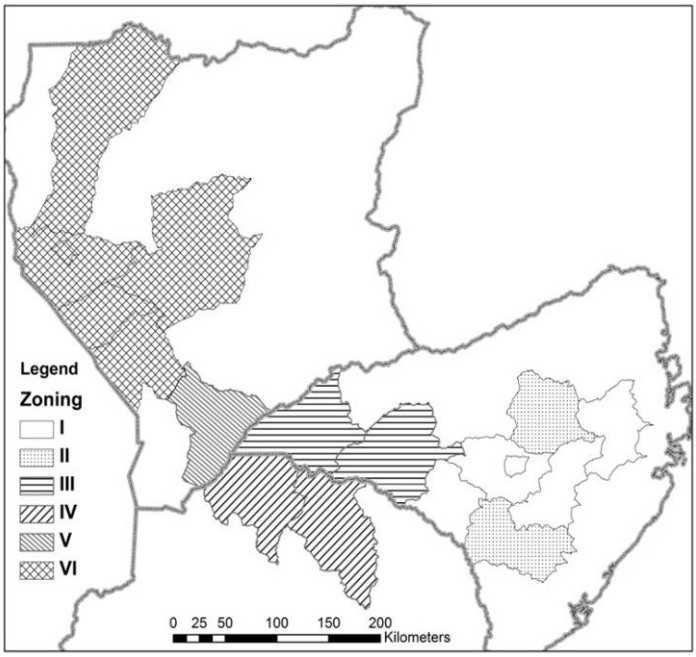


Figure 4.9.26 Zoning of the Study Area
Source: JICA Study Team

Zone I: High population dense area including Monapo, Meconta, Nampula, and Murrupula. Little space remains for new farm development.
Cultivating high-valued crop and value added activity is recommendable by using advantage of high accessibility to markets

Zone II: Cassava and cashew nuts concentration area including Muecate and Mogovolas. Little space remains for new farm developing. Fruits cultivation is also recommendable in addition to high-value crops.

Zone III: High potential zone for irrigation development including Malema and Ribaue. Small space remains for new farm development in the western part of Malema.

Promoting high-valued crops such as vegetable cultivation using irrigation are recommendable in addition to the existing cash crops, i.e. cotton and tobacco when the road between Nampula and Cuamba will be paved by 2015.

Zone IV: Concentration of high-value crops vegetable production including Alto Molocue and Gurue. Little space remains for new farm development due to high population density and hilly land conditions. As the area is relatively blessed with high precipitation and good road access conditions, various crop developments by intensive farming practices are recommended.

Zone V: High potential for developing various crops including industrial crops. Since the zone is located at the intersection point, from the east to the west and from the north to the south by roads or by railroad, the area has potential to be a value-chain center of many agricultural products in the Study Area.

Zone VI: Center of maize production including Mandimba, Ngauma, Lichinga, Majune, and Sanga. Potential space for large scale farming is remaining in Mandimba, Majune, and Sanga. Development of large scale farming in harmonizing with forestry and environmental conservation would be possible, if the space is not occupied by DUAT or local people.

The other features of each zone are shown in Table 4.9.8. It is assumed that a vast free space suitable for large scale development is not remained in the Study Area, as mentioned in 3.1.7 and 4.9.5.

In this report, the zoning is carried out by district unit, because information and data are collected by the district unit by the JICA Study Team. The conditions, however, would vary within district. The situation of high altitude area in Gurue district, for instance, is different from flat area located at lower altitude. Muecate district also has several different conditions by distance from primary road. The zoning of the Study Area will be modified by collected information through the further study.

4.9.8. Further consideration

(1) Crop Suitability Map by Agro-climatic Conditions

In this report, the crop suitability map was made only for 4 crops. The number of crops for suitability map will be able to increase by collecting more information of crop growing conditions and agro-climatic data from agencies concerned.

(2) Zoning at District Level

As mentioned in 4.9.1, Territorial Arrangement Law (Law no 19/2007) requires that each district should make the development plan with zoning and some districts in

Nampula province implemented zoning study in their districts. The zoning map prepared by the Study Team shall be revised in order to harmonize with district zoning maps in the future. In order to keep the balance of development and environment properly, the zoning study at district level is also needed. At the first step, collecting information about the current situation, difficulties, and future plan of zoning study at district level is needed. At the second step, it is proposed that the central government support one or two districts in the Study Area to make zoning plan, in order to accelerate making zoning plan at district level.

(3) Proposal of Zoning and Expected Measures for its Materialization

Expected measures for materialization of proposal in zoning plan will be proposed in the next stage of the Study.

Table 4.9.8 Features of Each Zone

Zone	Districts	Crop		Irrigation development	Farm development	Remark
		Food crops	Cash crops			
I	Monapo, Meconta, Nampula, Murrupula	Composition of cassava, maize, sorghum/millet and paddy Beans (mung bean, Cow pea, and Pigeon pea)	Cashew nuts, Ground nuts, Sesame, Cotton, Sunflower	Low potential for water resource. Small scale irrigation by mobile pump along the river course is recommended.	Few space for new farm development	Good access to market centers because of high population density
II	Muecate, Mogovolas	Cassava and sorghum/millet Beans (mung bean, cow pea, and pigeon pea)	Center of Cashew nuts, Ground nuts, Sesame, Cotton	Low potential for water resource	Making farmland space by reducing shifting cultivation	
III	Ribaue, Malema	Composition of maize and sorghum/millet Beans (cow pea and pigeon pea)	Ground nuts, Sesame, Soybean, Cotton, Tobacco	High potential for water resource. Promoting irrigation investment for growing high-value crops, especially vegetables	Making farmland space by reducing shifting cultivation Some area is found for new farm development	
IV	Alto Molocue, Gurue	Composition of maize and cassava Beans (haricot beans, pigeon pea, cow pea)	Vegetables Potato Soy bean	- ditto -	Making farmland space by reducing shifting cultivation	Gurue has two different condition areas, such as mountainous area and flat area.
V	Cuamba	Maize, sorghum/millet and paddy Beans (haricot beans , pigeon pea)	Tobacco, Cotton Soy bean	Moderate potential for water resource	Making farmland space by reducing shifting cultivation	Good access to wide area, located at the intersection point from the east to the west and the north to the south
IV	Mandimba, Ngauma, Lichinga, Majune, Sanga	Maize and sweet potato Beans (Haricot beans)	Vegetables, potato	Moderate potential for water resource	Making farmland space by reducing shifting cultivation Potential space for large scale development is remaining in Majune and Sanga	Little space for farm development in Lichinga Monitoring the possibility of railway rehabilitation from Cuamba to Lichinga is needed